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NatureServe EXPLORER

An Online Encyclopedia of Life

Ambystoma cingulatum - Cope, 1867 [1868]
Flatwoods Salamander
Unique Identifier: ELEMENT_GLOBAL.2.105681
Element Code: AAAAA01030
Informal Taxonomy: Animals, Vertebrates - Amphibians - Salamanders

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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Amphibia	Caudata	Ambystomatidae	Ambystoma

Genus Size: D - Medium to large genus (21+ species)

Check this box to expand all report sections:

Concept Reference

Concept Reference: Frost, Darrel R., ed. 1985. Amphibian species of the world: a taxonomic and geographical reference. Allen Press, Inc., and The Association of Systematics Collections, Lawrence, Kansas. 732 pp.
Concept Reference Code: B85FRO01HQUS
Name Used in Concept Reference: *Ambystoma cingulatum*
Taxonomic Comments: See Kraus (1988), Shaffer et al. (1991), and Jones et al. (1993) for phylogenetic analyses of North American *Ambystoma*.

Conservation Status

NatureServe Status

Global Status: G2G3
Global Status Last Reviewed: 17Dec2004
Global Status Last Changed: 26Sep1996
Rounded Global Status: G2 - Imperiled
Reasons:
Endemic to southeastern U.S. Coastal Plain; typically collected in low numbers; few recent collections; trend data indicate a loss of nearly 90 percent of historical local breeding populations; adult and larval habitats continue to be threatened by conversion to other uses.
Nation: United States
National Status: N2N3

U.S. & Canada State/Province Status	
United States	Alabama (S1), Florida (S2S3), Georgia (S2), South Carolina (S1)

Other Statuses

U.S. Endangered Species Act: LT: Listed threatened (01Apr1999)
U.S. Fish & Wildlife Service Lead Region: R4 - Southeast

IUCN Red List Category: VU - Vulnerable

NatureServe Conservation Status Factors

Global Abundance: 2500 - 100,000 individuals
Global Abundance Comments: Secretive habits of adults make population estimates difficult. Likely at least several thousand adults, but actual number is unknown.

Estimated Number of Element Occurrences:21 - 80
Estimated Number of Element Occurrences Comments: Surveys completed since 1990 indicate that 51 populations are known from across the historical range (102 inhabited sites, chiefly breeding ponds), with 36 of these in Florida (USFWS 1999).

Global Short Term Trend: Declining (decline of 10-30%)
Global Short Term Trend Comments: Species presumably declining in concert with continued loss of remaining intact pine flatwoods community (particularly degradation of groundcover).

Global Long Term Trend: Large decline (decline of 75-90%)
Global Long Term Trend Comments: During extensive surveys of historical (pre-1990) breeding ponds, researchers recorded the species at only 12 percent of formerly inhabited sites. The salamander may be extirpated from Alabama and has lost much of its former habitat in Georgia and South Carolina.

Global Inventory Needs: Re-sample all known EOs; continue to survey for additional occurrences (particularly within managed areas). Monitor sample of varied occurrences to determine and track trends.

Global Protection: Several (4-12) occurrences appropriately protected and managed
Global Protection Comments: Occurs on several managed areas (see state ranking files and USFWS 1997). About one-half of the known populations occur on public land (USFWS 1997). Sites include Apalachicola and Osceola national forests, St. Marks National Wildlife Refuge, and Eglin Air Force Base in Florida; Fort Stewart in Georgia; and Francis Marion National Forest in South Carolina. Outlook on private lands is poor.
Global Protection Needs: Maintain ecological integrity of managed areas from which species is known. Limit collecting if exploitation is extensive. Protect populations on private lands by conservation agreements or land purchases.

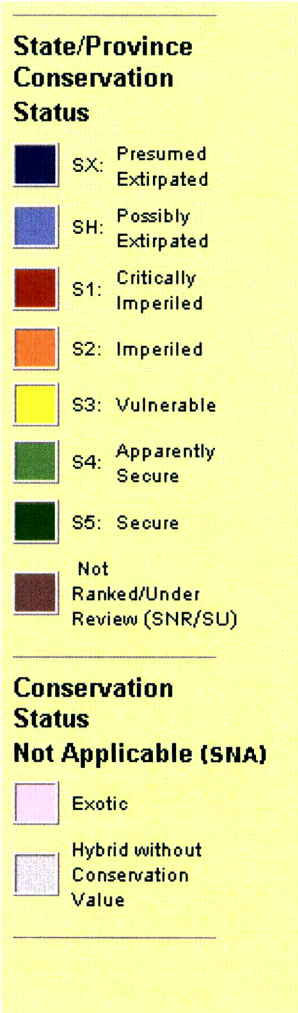
Degree of Threat: Unknown
Threat Scope: Unknown
Threat Severity: High
Threat Immediacy: Unknown
Threats: Potential threats include conversion of pine flatwoods habitat for agriculture, silviculture, or commercial/residential development; drainage or enlargement (with subsequent introduction of predatory fishes) of breeding ponds; habitat alteration resulting from suppression of fire; mortality and collecting losses associated with crayfish harvest; and highway mortality during migration. The principal threat is habitat destruction as a result of agriculture, silviculture, and residential and commercial development. Modern silvicultural methods rely on altering soil hydrology, suppressing fire, shortening timber rotations, and replacing widely-spaced longleaf pine with dense plantations of slash pine. Loss of groundcover vegetation due to mechanical soil preparation, fire suppression, and shading by overstories of slash pine have been implicated in the decline in north Florida (Means et al. 1994, 1996). Larvae are threatened in some wetlands by the harvest of crayfish as bait. Bait harvesters drag large hardware cloth buckets through inundated vegetation, dump the contents of the bucket on the ground, and then sort out the crayfish. Flatwoods salamander larvae taken in this manner are left to die or are collected as bait (J. Palis, pers. obs.). The effect of herbicide or fertilization application on flatwoods salamanders is unknown. However, fertilization of plantations often results in eutrophication of wetlands, promoting algal blooms. Larval flatwoods salamanders have not been observed in algal-choked wetlands (J. Palis, pers. obs.). Ditching or berming of small, isolated pond-cypress wetlands, a common practice when establishing slash pine plantations on mesic sites, results in lowered water levels and shortened hydroperiods (Marois and Ewel 1983). These hydrologic perturbations could prevent successful flatwoods salamander reproduction by preventing egg inundation or stranding larvae before they are capable of metamorphosis. Altered hydrology, in association with fire exclusion, results in a shift in dominance from pond-cypress to broad-leaved hardwoods that reduce herbaceous groundcover vegetation through shading (Marois and Ewel 1983). This may be detrimental since *A. cingulatum* larvae take shelter in herbaceous vegetation during the day. Ephemeral pond-cypress depressions are sometimes converted into permanent water bodies, rendering them unsuitable for flatwoods salamander reproduction (J. Palis, pers. obs.). A constant winter-burn fire plan could be detrimental (Ashton 1992). See USFWS (1999) for additional information.

Fragility: Moderately vulnerable

Environmental Specificity: Narrow. Specialist or community with key requirements common.

Distribution

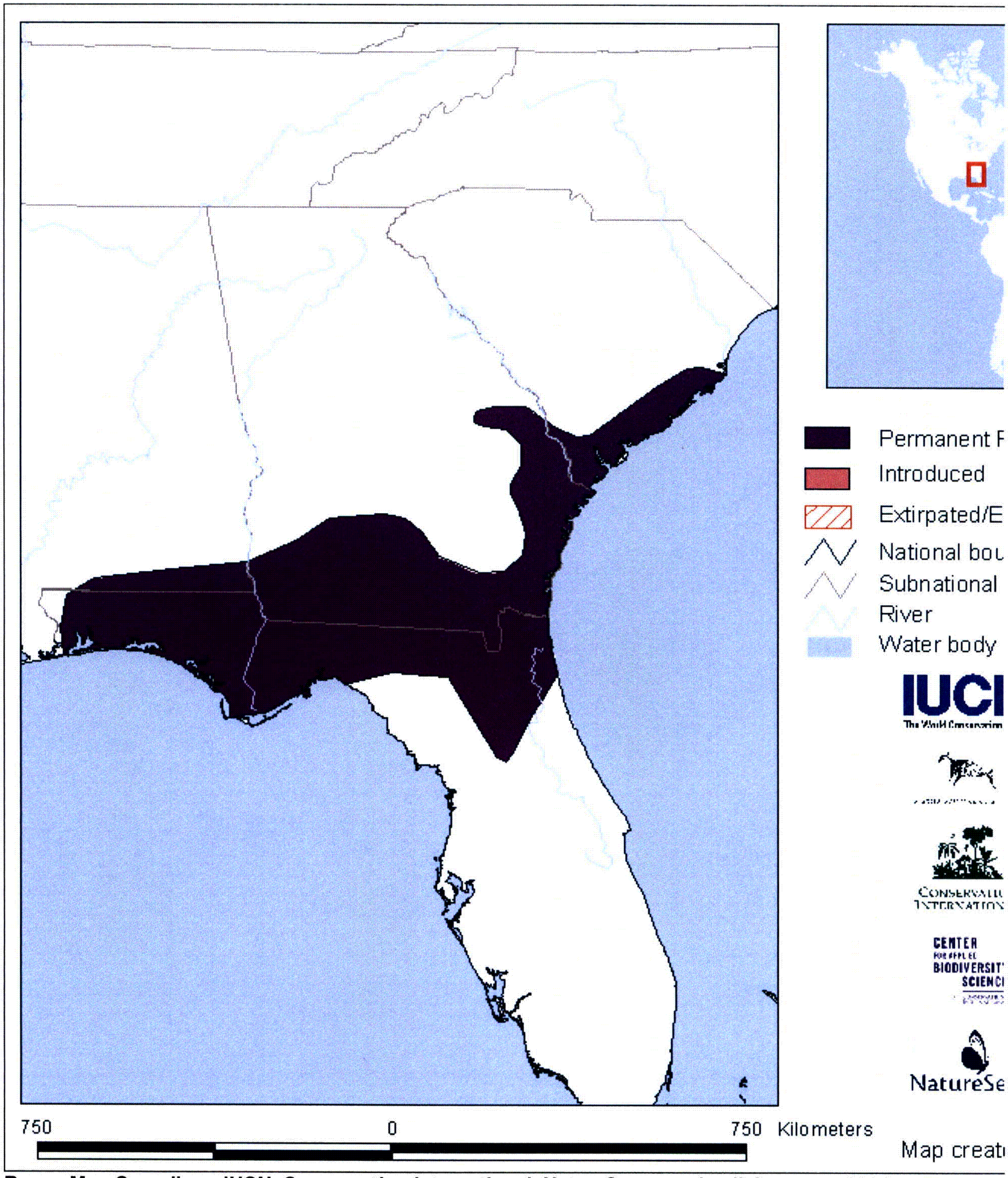
U.S. States and Canadian Provinces



Endemism: endemic to a single nation

U.S. & Canada State/Province Distribution	
United States	AL, FL, GA, SC

Range Map
Note: Range depicted for New World only. The scale of the maps may cause narrow coastal ranges or ranges on small islands not to appear. Not all vagrant or small disjunct occurrences are depicted. For migratory birds, some individuals occur outside of the passage migrant range depicted. A shapefile of this map is available for download at **www.natureserve.org/getData/animalData.jsp.**



Range Map Compilers: IUCN, Conservation International, NatureServe, and collaborators, 2004

Global Range: 20,000-200,000 square km (about 8000-80,000 square miles)

Global Range Comments: Lower southeastern U.S. Coastal Plain from southern South Carolina southward to Marion County, north-central Florida, and westward to extreme southwestern Alabama (Conant and Collins 1991). The inclusion of North Carolina and Mississippi on old range maps is apparently the result of misidentification of larval specimens (Hardy and Olmon 1974, P. Moler, pers. comm.). Stronghold appears to be Florida west of the Suwannee River (the only known extant Florida population east of the Suwannee River occurs in the Osceola National Forest) (Palis, unpubl. data). In Georgia, extant populations occur at opposite ends of the state; presently known from Fort Stewart and the Naval Bombing Range in southeastern Georgia (D. Stevenson, pers. comm.; Seyle, unpubl. data), and Ichauway Plantation in southwestern Georgia (J. Palis, pers. obs.). Not observed in Alabama since 1981 (J. Godwin, pers. comm.) or in South Carolina since 1990 (S. Bennett, pers. comm.). See also USFWS (1997).

State	County Name (FIPS Code)
AL	Covington (01039), Houston (01069)
FL	Alachua (12001), Baker (12003), Calhoun (12013), Duval (12031), Franklin (12037), Holmes (12059), Jackson (12063), Jefferson (12065), Liberty (12077), Okaloosa (12091), Santa Rosa (12113), Wakulla (12129), Walton (12131), Washington (12133)
GA	Baker (13007), Berrien (13019), Brooks (13027), Bryan (13029), Chatham (13051), Effingham (13103), Evans (13109), Jeff Davis (13161), Liberty (13179), Long (13183), Lowndes (13185), Mcintosh (13191), Miller (13201), Ware (13299), Worth (13321)
SC	Berkeley (45015), Charleston (45019), Jasper (45053)

U.S. Distribution by Watershed (based on available natural heritage records)	
Watershed Region	Watershed Name (Watershed Code)
03	Santee (03050112), Cooper (03050201), Broad-St. Helena (03050208), Lower Savannah (03060109), Lower Ogeechee (03060202), Canoochee (03060203), Ogeechee Coastal (03060204), Altamaha (03070106), Satilla (03070201), Little Satilla (03070202), St. Marys (03070204), Oklawaha (03080102), Aucilla (03110103), Upper Suwannee (03110201), Alapaha (03110202), withlacoochee (03110203), Little (03110204), Apalachee Bay-St. Marks (03120001), Middle Flint (03130006), Ichawaynochaway (03130009), Spring (03130010), Apalachicola (03130011), Chipola (03130012), New (03130013), St. Andrew-St. Joseph Bays (03140101), Yellow (03140103), Pensacola Bay (03140105), Lower Choctawhatchee (03140203)

Ecology & Life History

Basic Description: A salamander in which adult total length generally is about 9-13 cm.

General Description: A black salamander with variable gray or grayish dorsal markings that may form a "frosted" or netlike pattern or narrow light rings. Belly is black with scattered or many small gray spots. Total length 9-13 cm (Conant and Collins 1991). Larvae are long and slender, with very slender legs and fragile tail fins; body is black to brown with white to yellow stripes (Ashton 1992).

A moderately-sized (up to 76 mm snout-vent length, 135 mm total length; Palis unpubl. data), slender salamander with a relatively small, pointed head and stout tail, weighing from 4.5 - 10.5 grams (adult male and gravid female, respectively (Palis unpubl. data)). The body is black to chocolate-black with fine, irregular, light gray lines that form a net-like or cross-banded pattern across the back. In some individuals the gray pigment is widely scattered and "lichen-like." Melanistic, uniformly black individuals are occasionally encountered (Carr 1940). The belly is black to chocolate-black with a scattering of gray spots or flecks.

The broad-headed, boldly striped pond-type larva can attain a snout-vent length of 47 mm and total length of 96 mm before metamorphosis (Palis unpubl. data). The striping pattern, from mid-dorsum down the sides, is as follows: pale tan mid-dorsal stripe, grayish-black dorsolateral stripe, pale cream mid-lateral stripe, blue-black lateral stripe, and pale yellow ventrolateral stripe. A black stripe extends from the snout, through the eyes, to the base of the gills. A second dark stripe, extending along the upper jaw, is typically present, as well.

Although sexual dimorphism is not pronounced, males can be distinguished from females during the breeding season by their slightly swollen cloaca (pers. obs.). In addition, mature gravid females are heavier and more robust than males at this time (pers. obs.).

Diagnostic Characteristics: Adults may be confused with the slimy salamander (*Plethodon grobmani*), small-mouthed salamander (*Ambystoma texanum*), or Mabee's salamander (*Ambystoma mabeei*). Slimy salamanders are readily distinguished by the presence of a small groove (nasolabial groove) from the nostril to upper lip (absent in all *Ambystoma*). *Ambystoma texanum* (smallmouth salamander) overlaps the range of *Ambystoma cingulatum* in extreme southwestern Alabama. Small-mouthed salamanders have a very short, rounded snout and, in Alabama, are brown or dark gray with lichen-like light blotches (Mount 1975). In South Carolina, *Ambystoma cingulatum* has been observed breeding in the same wetland as *Ambystoma mabeei* (Anderson and Williamson 1976). The body of Mabee's salamander is dark brown or black with pale specks that are concentrated along the sides.

Although the flatwoods salamander larval pattern is distinctive, two other *Ambystoma* larvae may appear similar to the untrained eye. Like *Ambystoma cingulatum*, *Ambystoma mabeei* larvae have a light mid-lateral stripe between two dark lateral stripes. However, unlike the continuous lateral stripes of *Ambystoma cingulatum*, those of *Ambystoma mabeei* are broken into blotches (Hardy and Olmon 1974). In addition, the stripe extending from the snout to the gills in *Ambystoma mabeei* is diffuse and indistinct, and the upper lip stripe is replaced by a series of spots (Hardy and Olmon 1974). Larval mole salamanders (*Ambystoma talpoideum*) may have an indistinct, light mid-lateral stripe, but are readily distinguished from *Ambystoma cingulatum* larvae by the presence of a dark mid-ventral stripe and dark dorsal crossbands (pers. obs.). The light mid-lateral stripe of larval *Ambystoma cingulatum* is retained by metamorphs through their first year (pers. obs.). It is best observed by shining a bright light through the body.

Reproduction Comments: Movements to breeding ponds occur usually between early October and January during rainy evenings when the barometric pressure is falling (Ashton 1992). In Florida, salamanders that entered and exited the breeding site only once remained in the basin an average of 38 days (range 3-117 days) (Palis 1997). Individual females lay up to 225 eggs (Ashton 1992) singly or in small clusters, with larger individuals producing more eggs than smaller ones (Anderson and Williamson 1976). Eggs are laid terrestrially before depressions fill with water; The eggs develop to hatching size within three weeks, but do not hatch until inundated (Anderson and Williamson 1976). The larval period lasts three to four months (11-18 weeks) (Means 1986, Palis and Jensen 1995). Metamorphs emigrate from their natal ponds during the months of March and April (J. Palis, pers. obs.). In captivity, adult size can be reached within one year (Means 1972). Preliminary field data, however, suggest that full size is not attained until the third or fourth year in the wild (Palis, unpubl. data). Although not much bigger than metamorphs, males attain sexual maturity in their first year (Palis 1997). Females, however, do not sexually mature until at least two years old (Palis and Jensen 1995, Palis 1997).

Ecology Comments
Preliminary data suggests that flatwoods salamanders have a home range of 1500 sq m or more (Ashton 1992).

Non-Migrant: N

Locally Migrant: Y

Long Distance Migrant: N

Mobility and Migration Comments: Migrates up to hundreds of meters between breeding and nonbreeding habitats; Ashton (1992) mentioned movements of over 1700 m. Migrations to breeding sites occur at night in conjunction with rains and passing cold fronts from mid-fall through early winter (Means 1972, Anderson and Williamson 1976; Palis, unpubl. data).

Lacustrine Habitat(s): Shallow water

Palustrine Habitat(s): FORESTED WETLAND, HERBACEOUS WETLAND, SCRUB-SHRUB WETLAND, TEMPORARY POOL

Terrestrial Habitat(s): Forest - Conifer, Savanna, Woodland - Conifer

Special Habitat Factors: Benthic, Burrowing in or using soil, Fallen log/debris

Habitat Comments: Post-larval individuals inhabit mesic longleaf pine (*Pinus palustris*)-wiregrass (*Aristida stricta*) flatwoods and savannas. The terrestrial habitat is best described as a topographically flat or slightly rolling wiregrass-dominated grassland having little to no midstory and an open overstory of widely scattered longleaf pine. Low-growing shrubs, such as saw palmetto (*Serenoa repens*), gallberry (*Ilex glabra*) and blueberries (*Vaccinium* spp.), co-exist with grasses and forbs in the groundcover. Groundcover plant diversity is usually very high. The underlying soil is typically poorly drained sand that becomes seasonally inundated.

Slash pine flatwoods is often cited as the preferred terrestrial habitat of the flatwoods salamander (e.g., Conant and Collins 1991). This may be the result of an error made by Martof (1968) in which he referred to longleaf pine as slash pine (*Pinus elliottii*). In addition, slash pine now dominates or co-occurs with longleaf pine in many pine flatwoods communities as a result of fire suppression and preferential harvest of longleaf pine (Avers and Bracy 1975). Historically, however, fire-tolerant longleaf pine dominated the flatwoods, whereas slash pine was confined principally to wetlands (Harper 1914, Avers and Bracy 1975). Post-larval individuals are fossorial (live underground) and occupy burrows (Goin 1950, Neill 1951, Mount 1975, Ashton 1992). Presumably, they remain underground during the lightning-season (May through September). Adults are rarely encountered under cover objects at or near breeding sites (J. Palis, pers. obs.).

Breeding occurs in acidic (pH 3.6-5.6 (Palis, unpubl. data)), tannin-stained ephemeral wetlands (swamps or graminoid-dominated depressions) that range in size from 0.02 to 9.5 ha, and are usually not more than 0.5 m deep (Palis, unpubl. data). The overstory is typically dominated by pond cypress (*Taxodium ascendens*), blackgum (*Nyssa sylvatica* var. *biflora*) and slash pine, but can also include red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), sweetbay (*Magnolia virginiana*), and loblolly bay (*Gordonia lasianthus*). Canopy coverage ranges from near zero to almost 100% (Palis, unpubl. data). The midstory, which is often very dense, is most often composed of young of the aforementioned species, myrtle-leaved holly (*Ilex myrtifolia*), Chapman's St.

John's-wort (*Hypericum chapmanii*), sandweed (*Hypericum fasciculatum*), titi (*Cyrilla racemiflora*), storax (*Styrax americana*), popash (*Fraxinus caroliniana*), sweet pepperbush (*Clethra alnifolia*), fetterbush (*Lyonia lucida*), vine-wicky (*Pieris phillyreifolia*), and bamboo-vine (*Smilax laurifolia*). Depending on closure of the canopy and midstory, the herbaceous groundcover of breeding sites can range from about 5% to nearly 100% (Palis, unpubl. data). The groundcover is dominated by graminaceous species, including beakrushes (*Rhynchospora* spp.), sedges (*Carex* spp.), panic grasses (*Panicum* spp.), bluestems (*Andropogon* spp.), jointtails (*Manisurus* spp.), three-awned grass (*Aristida affinis*), plumegrass (*Erianthus giganteus*), nutrush (*Sclera baldwinii*) and yellow-eyed grasses (*Xyris* spp.). The floor of breeding sites is riddled with the burrows of crayfish (genus *Procambarus*). Breeding sites are typically encircled by a wiregrass-dominated graminaceous ecotone. Breeding sites can include roadside ditches (Anderson and Williamson 1976; Palis, pers. obs.) and borrow pits (D. Stevenson, pers. comm.). Breeding sites often harbor fishes, the most typical species include pygmy sunfishes (*Elassoma* spp.), mosquitofish (*Gambusia holbrookii*), and banded sunfish (*Enneacanthus obesus*) (Palis, unpubl. data). Favorable breeding habitat lacks large predatory fishes.

Before breeding sites fill with water, eggs are deposited singly or in small groups on the ground beneath leaf litter, under logs and *Sphagnum* mats, at the base of grasses, shrubs or trees, or at the entrance to crayfish burrows (Anderson and Williamson 1976). In wetlands that fill incrementally, eggs are deposited amid graminaceous vegetation at the edge (J. Palis, pers. obs.). Egg deposition in shallow water also has been reported (Ashton 1992). Larvae hide amid inundated graminaceous vegetation by day, but will enter the water column at night (J. Palis, pers. obs.).

Adult Food Habits: Invertivore

Immature Food Habits: Invertivore

Food Comments: Goin (1950) found earthworm remains in the stomachs of adults. Larvae feed primarily on small crustaceans (Whiles et al. 2004).

Adult Phenology: Hibernates/aestivates, Nocturnal

Immature Phenology: Hibernates/aestivates, Nocturnal

Phenology Comments: Seldom seen except during the breeding season. Small numbers of post-larval salamanders continue to be active on the surface during the winter months (Palis, unpubl. data).

Colonial Breeder: Y

Length: 13 centimeters

Economic Attributes **Not yet assessed**

Management Summary

Stewardship Overview: Stewardship activities aimed at restoring/maintaining the ecological integrity of mesic longleaf pine-wiregrass flatwoods and associated ephemeral wetlands will preserve extant populations of flatwoods salamanders.

Restoration Potential: Recovery is directly linked with the ability to preserve existing habitat and restore degraded habitat. Given the drastic decline in the extent of longleaf pine-dominated communities (Ware et al. 1993), elevation of flatwoods salamander populations above present levels is unlikely. Restoration of degraded mesic, seasonally inundated longleaf pine flatwoods and savannas has not been attempted, and may only be feasible in cases where soil disturbance is minimal. The effectiveness of reintroduction into areas where extirpated is unknown.

Preserve Selection & Design Considerations: High quality occurrences include several wetlands within a matrix of pine flatwoods and savanna. Based on the maximum distance adults are known to travel between reproductive and nonreproductive habitat (1.7 km), each breeding site should be surrounded by at least 10 sq km of terrestrial habitat. Longterm perpetuation of a viable population of flatwoods salamanders will presumably require protection of a larger area of terrestrial habitat encompassing a suite of alternative breeding sites (Travis 1994). A suite of wetlands guards against extirpation at any one breeding site, since animals can immigrate from nearby wetlands. The minimum viable population size needed to sustain a population longterm is not known. Preliminary drift fence data at Eglin Air Force Base, Florida, suggests that breeding population sizes are low relative to other AMBYSTOMA (Palis, unpubl. data). However, this may be a site specific observation as larger breeding migrations have been observed elsewhere in the range (R. Moulis, pers. comm.). Presently, there is no method of assessing an occurrence based on the number of animals captured at a drift fence or the number of larvae inhabiting a breeding site.

Management Requirements: Maintenance of intact mesic longleaf pine-wiregrass flatwoods and ephemeral wetlands by mimicking natural forces, such as lightning-season fire, is the most appropriate form of management. On sites where timber extraction is practiced, several precautions should be taken to limit the impact to flatwoods salamanders. Tree harvest should be restricted to dry periods to prevent soil compaction and rutting. Clearcutting should be replaced with selective timber harvest and natural regeneration enhanced by fire, particularly lightning-season fire. If off-site species such as slash pine have been planted, they should be removed and replaced with longleaf pine at densities found in nature. Mechanical preparation of the soil should be avoided. If a site supports mature, closed-canopy pine plantations, they should be thinned with as little disturbance to the soil and remaining groundcover as possible. The natural hydrology and fire regime of terrestrial and aquatic habitats should be restored on sites where altered.

The wetland/upland ecotone appears to be critical to successful flatwoods salamander reproduction. Some areas are in need of periodic burning to clear encroaching shrubby vegetation that shades out herbaceous ground cover (Palis and Jensen 1995). Maintenance of a graminaceous ecotone and breeding site will require burning in the lightning-season when wetlands are dry or nearly dry (Huffman and Blanchard 1990) . Bury et al. (1980) recommended that wiregrass not be burned in winter (destructive to wiregrass [used for egg attachment] and possibly to salamanders directly). Palis and Jensen (1995) stated that winter burns may be needed to avoid catastrophic fires when warm-season burning is initiated.

Mechanical disturbance of the wetland-upland ecotone should be avoided. The practice of "protecting" wetlands by encircling them with plow line should be abandoned. Where present, berms should be removed and drainage ditches filled.

Breeding ponds should not be dredged or stocked with fishes.

Monitoring Requirements: The simplest and most inexpensive means of monitoring flatwoods salamanders is dipnet surveys of larval habitat. A 4-mm mesh nylon dipnet, manufactured by Mid-Lakes Corporation, Knoxville, Tennessee (net no. SH-2), has been successfully utilized for larval sampling in Florida (Palis, unpubl. data). Larval surveys are most successful during the latter half of February and the first half of March (J. Palis, pers. obs.), although sampling in other months may be as productive depending upon rainfall patterns and wetland hydrology. Larvae are most readily captured by sweeping a dipnet through inundated graminaceous vegetation by day or night (J. Palis, pers. obs.). Several dipnetting techniques will capture larvae. The net can be swept back and forth through inundated vegetation in a Z or S pattern. A second method involves submerging the bag of the net adjacent to the vegetation to be sampled, agitating the vegetation by foot or hand toward the net, and then thrusting the net through the vegetation in the opposite direction. In addition, multiple parallel dipnet sweeps can be made in the same direction. Because flatwoods salamander larvae occur in low densities (Sekerak 1994), an average of 50 meter-long dipnet sweeps are required to capture the first larva (Palis, unpubl. data).

Because flatwoods salamander larvae will enter the enter water column at night (J. Palis, pers. obs.), nocturnal transects using a flashlight can provide an estimation of the larval density. However, this technique is only applicable to wetlands having little herbaceous vegetation and relatively clear water. Minnow trapping (Gee 6-mm wire mesh funnel trap) has been used with limited success. Methods of quantifying larval sampling were described by Shaffer et al. (1994).

The population breeding at a particular wetland can be monitored by the use of a drift fence and traps. To obtain an accurate estimate of the population size, the entire breeding site must be encircled with a drift fence. Drift fences with traps have proven to be excellent means of surveying amphibian movement into and out of breeding sites (Gibbons and Semlitsch 1981). Because the water table at flatwoods salamander breeding sites is high, aluminum window screen funnel traps are required. Drift fencing is most productive between October and December when flatwoods salamanders are at the surface moving to and from breeding sites (Palis unpubl. data).

Biological Research Needs:

Population/Occurrence Delineation ⓘ

Group Name: AMBYSTOMATID SALAMANDERS

Use Class: Not applicable

Minimum Criteria for an Occurrence: Occurrences are based on evidence of historical presence, or current and likely recurring presence, at a given location. Such evidence minimally includes collection or reliable observation and documentation of one or more individuals (including larvae or eggs) in or near appropriate habitat where the species is presumed to be established and breeding.

Separation Barriers: Heavily traveled road, especially at night during salamander breeding season, such that salamanders almost never successfully traverse the road; road with a barrier that is impermeable to salamanders; wide, fast rivers; areas of intensive development dominated by buildings and pavement.

Separation Distance for Unsuitable Habitat: 1 km

Separation Distance for Suitable Habitat: 3 km

Separation Justification: BARRIERS/UNSUITABLE HABITAT: Rivers may or may not be effective barriers, depending on stream width and hydrodynamics; identification of streams as barriers is a subjective determination. Bodies of water dominated by predatory fishes have been described as barriers but probably should be regarded as unsuitable habitat. For A. barbouri, a stream-pool breeder, predatory fishes appeared to act as a barrier to larval dispersal and gene flow for populations separated by as little as 500-1000 m (Storfer 1999). Highly disturbed land, such as the cleared and bedded soils of some silvicultural site preparation, may serve as an impediment to movement of A. cingulatum (Means et al. 1996), although Ashton (1998) noted the species' use of pine plantations, pastures, and three-year-old clearcuts. Such areas should be treated as unsuitable habitat rather than barriers.

MOVEMENTS: Palis's (1997b) suggested use of 3.2 km between breeding sites to distinguish breeding populations of A. cingulatum was based on Ashton's (1992) finding that individuals may move as much as 1.6 km from their breeding ponds. Ambystoma californiense sometimes migrates up to 2 km between breeding ponds and terrestrial habitat (see USFWS 2004). Funk and Dunlap (1999) found that A. macrodactylum managed to recolonize lakes after trout extirpation despite evidence of low levels of interpopulation dispersal. Based on a review of several Ambystoma species (e.g., Semlitsch 1981, Douglas and Monroe 1981, Kleeberger and Werner 1983, Madison 1997), Semlitsch (1998) concluded that a radius of less than 200 meters around a breeding pond would likely encompass the terrestrial habitat used by more than 95 percent of adults. Faccio's (2003) study of radio-tagged A. maculatum and A. jeffersonianum in Vermont supports this conclusion. In New York, all movements of A. tigrinum occurred in areas within 300 m of the nearest breeding pond (Madison and Farrand 1998). However, most studies of these salamanders had small sample sizes and/or were not designed to detect long-distance movements, so migration distance may be somewhat underestimated.

In summary, ambystomatid salamanders generally stay within a few hundred meters of their breeding pool. Due to high breeding site fidelity and limitation of breeding to pool basins, populations using different breeding sites exhibit little or no interbreeding among adults. Thus one might argue that each pool constitutes a separate occurrence or that the separation distance for suitable habitat should be the nominal minimum of 1 km. However, little is known about how frequently first-time (or experienced) breeders use non-natal pools (pools from which they did not originate) or how far they may move to such sites. Frequent colonization of new and remote habitats by at least some species suggests that dispersal movements sometimes may be longer than typical adult migration distances. It seems unlikely that locations separated by a gap of less than a few kilometers of suitable habitat would represent independent occurrences over the long term.

Inferred Minimum Extent of Habitat Use (when actual extent is unknown): .3 km
Inferred Minimum Extent Justification: Inferred extent distance pertains to breeding sites (with the center of the circle in the center of the breeding site). Most ambystomatids stay within a few hundred meters of their breeding pool (see separation justification section).
Date: 10Sep2004
Author: Hammerson, G.

Population/Occurrence Viability **Not yet assessed**

U.S. Invasive Species Impact Rank (I-Rank) **Not yet assessed**

Authors/Contributors

NatureServe Conservation Status Factors Edition Date: 17Dec2004
NatureServe Conservation Status Factors Author: Palis, J. G., D. R. Jackson, and G. Hammerson
Management Information Edition Date: 10Jan1995
Management Information Edition Author: Palis, John G.
Element Ecology & Life History Edition Date: 13Apr2005
Element Ecology & Life History Author(s): Hammerson, G.

Zoological data developed by NatureServe and its network of natural heritage programs (see **Local Programs**) and other contributors and cooperators (see **Sources**).

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Note: Ecological systems data presented in NatureServe Explorer at http://www.natureserve.org/explorer were updated to be current with NatureServe's central databases as of **October 6, 2006**. All other data were updated as of **October 6, 2006**.
Note: This report was printed on **February 8, 2007**

Citation for data on website including Watershed and State Distribution maps:
NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: February 8, 2007).

Citation for Bird Range Maps of North America:
Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003. Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

Acknowledgement Statement for Bird Range Maps of North America:
"Data provided by NatureServe in collaboration with Robert Ridgely, James Zook, The Nature Conservancy - Migratory Bird Program, Conservation International - CABS, World Wildlife Fund - US, and Environment Canada - WILDSPACE."

Citation for Mammal Range Maps of North America:
Patterson, B.D., G. Ceballos, W. Sechrest, M.F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B.E. Young. 2003. Digital Distribution Maps of the Mammals of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

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"Data provided by NatureServe in collaboration with Bruce Patterson, Wes Sechrest, Marcelo Tognelli, Gerardo Ceballos, The Nature Conservancy-Migratory Bird Program, Conservation International-CABS, World Wildlife Fund-US, and Environment Canada-WILDSPACE."

NOTE: Full metadata for the Bird Range Maps of North America is available at:
http://www.natureserve.org/library/birdDistributionmapsmetadatav1.pdf.

Full metadata for the Mammal Range Maps of North America is available at:
http://www.natureserve.org/library/mammalsDistributionmetadatav1.pdf.

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NatureServe

Version 6.1 (9 November, 2006)
Ecological systems data last updated: October 6, 2006
All other data last updated: October 6, 2006

Rec 9.3 Ref 12

CCD Build a Table

National Center for Education Statistics
Common Core of Data
http://nces.ed.gov/ccd/bat/

Table by County
School Year 2004-2005

County Name (District)	State Abbr (School)	Total Number of Schools (District)	PK thru 12th Students (District)
ABBEVILLE	SC	11	3,777
AIKEN	SC	40	25,299
ALLENDALE	SC	4	1,747
ANDERSON	SC	48	29,764
BAMBERG	SC	7	2,744
BARNWELL	SC	11	4,721
BEAUFORT	SC	30	19,113
BERKELEY	SC	35	28,387
CALHOUN	SC	4	1,861
CHARLESTON	SC		
CHEROKEE	SC	19	9,364
CHESTER	SC	12	6,110
CHESTERFIELD	SC	16	8,077
CLARENDON	SC	12	5,899
COLLETON	SC	12	6,592
DARLINGTON	SC	22	11,826
DILLON	SC	14	6,207
DORCHESTER	SC	105	65,130
EDGEFIELD	SC	9	4,118
FAIRFIELD	SC	9	3,775
FLORENCE	SC	37	22,867
GEORGETOWN	SC	17	10,479
GREENVILLE	SC	94	65,265
GREENWOOD	SC	22	12,351
HAMPTON	SC	10	4,305
HORRY	SC	45	33,566
JASPER	SC	4	3,192
KERSHAW	SC	19	10,377
LANCASTER	SC	20	11,415
LAURENS	SC	19	9,566
LEE	SC	8	2,721
LEXINGTON	SC	66	51,276
MARION	SC	12	6,287
MARLBORO	SC	9	4,988
MCCORMICK	SC	5	1,001
NEWBERRY	SC	14	5,948
OCONEE	SC	21	10,949
ORANGEBURG	SC	30	15,449
PICKENS	SC	25	16,425
RICHLAND	SC	93	50,159
SALUDA	SC	5	2,149
SPARTANBURG	SC	78	45,123
SUMTER	SC	27	18,451
UNION	SC	9	4,959
WILLIAMSBURG	SC	14	6,019
YORK	SC	49	33,938

Numbers reported represent valid responses.

School 2004-05, District 2004-05, District Finance (F-33)(FY03) and LEA Dropout 2001-02 are preliminary.

Totals From Your Table Above
(totals only for numeric columns)

Total Number of Schools (District)	1,172
Total PK thru 12th Students (District)	703,736

School Year 2004-2005

Rec 9.3 Ref 13

CCD Build a Table

National Center for Education Statistics
Common Core of Data
http://nces.ed.gov/ccd/bat/

Table by County
School Year 2004-2005

County Name (District)	State Abbr (School)	Total Number of Schools (District)	PK thru 12th Students (District)
APPLING	GA	8	3,443
ATKINSON	GA	3	1,696
BACON	GA	4	1,879
BAKER	GA	3	391
BALDWIN	GA	11	6,032
BANKS	GA	5	2,550
BARROW	GA	17	10,156
BARTOW	GA	27	17,962
BEN HILL	GA	6	3,314
BERRIEN	GA	5	3,072
BIBB	GA	47	25,148
BLECKLEY	GA	5	2,481
BRANTLEY	GA	6	3,361
BROOKS	GA	5	2,445
BRYAN	GA	12	6,060
BULLOCH	GA	23	8,792
BURKE	GA	6	4,594
BUTTS	GA	6	3,485
CALHOUN	GA	2	746
CAMDEN	GA	14	9,646
CANDLER	GA	5	1,921
CARROLL	GA	30	17,877
CATOOSA	GA	17	10,230
CHARLTON	GA	5	1,992
CHATHAM	GA	55	34,595
CHATTAHOOCHEE	GA	3	533
CHATTOOGA	GA	14	4,286
CHEROKEE	GA	39	31,065
CLARKE	GA	24	11,637
CLAY	GA	2	377
CLAYTON	GA	62	51,405
CLINCH	GA	7	1,431
COBB	GA	120	111,493
COFFEE	GA	15	7,993
COLQUITT	GA	17	8,494
COLUMBIA	GA	29	20,570
COOK	GA	5	3,252
COWETA	GA	31	19,803
CRAWFORD	GA	5	2,067
CRISP	GA	8	4,341
DADE	GA	5	2,642
DAWSON	GA		
DE KALB	GA	291	153,902
DECATUR	GA	11	5,774
DODGE	GA	7	3,555
DOOLY	GA	3	1,502
DOUGHERTY	GA	33	16,894
DOUGLAS	GA	33	20,997
EARLY	GA	4	2,621
ECHOLS	GA	1	734
EFFINGHAM	GA	17	9,778
ELBERT	GA	8	3,673
EMANUEL	GA	11	4,502
EVANS	GA	4	1,897
FANNIN	GA	5	3,177
FAYETTE	GA	29	21,603
FLOYD	GA	34	15,779
FORSYTH	GA	29	23,612

FRANKLIN	GA	7	3,764
FULTON	GA	98	76,269
GILMER	GA	8	4,088
GLASCOCK	GA	1	598
GLYNN	GA	19	12,037
GORDON	GA	16	9,557
GRADY	GA	8	4,461
GREENE	GA	7	2,242
GWINNETT	GA	126	137,781
HABERSHAM	GA	13	6,272
HALL	GA	41	28,345
HANCOCK	GA	4	1,524
HARALSON	GA	13	5,503
HARRIS	GA	7	4,521
HART	GA	6	3,560
HEARD	GA	6	2,181
HENRY	GA	44	32,416
HOUSTON	GA	36	23,998
IRWIN	GA	4	1,762
JACKSON	GA	30	15,135
JASPER	GA	6	2,036
JEFF DAVIS	GA	5	2,690
JEFFERSON	GA	7	3,327
JENKINS	GA	4	1,728
JOHNSON	GA	4	1,260
JONES	GA	10	5,234
LAMAR	GA	4	2,533
LANIER	GA	4	1,522
LAURENS	GA	17	9,318
LEE	GA	7	5,549
LIBERTY	GA	15	11,424
LINCOLN	GA	3	1,399
LONG	GA	3	2,178
LOWNDES	GA	23	16,581
LUMPKIN	GA	21	9,386
MACON	GA	4	2,135
MADISON	GA	8	4,596
MARION	GA	3	1,700
MCDUFFIE	GA	9	4,223
MCINTOSH	GA	4	1,921
MERIWETHER	GA	11	3,834
MILLER	GA	4	1,127
MITCHELL	GA	10	4,386
MONROE	GA	6	3,806
MONTGOMERY	GA	4	1,265
MORGAN	GA	6	3,223
MURRAY	GA	10	7,581
MUSCOGEE	GA	62	33,069
NEWTON	GA	20	15,773
OCONEE	GA		
OGLETHORPE	GA	6	2,317
PAULDING	GA	28	21,732
PEACH	GA	7	4,055
PICKENS	GA	7	4,195
PIERCE	GA	4	3,407
PIKE	GA	4	3,000
POLK	GA	13	7,112
PULASKI	GA	5	1,686
PUTNAM	GA	4	2,650
QUITMAN	GA	1	310
RABUN	GA	7	2,250
RANDOLPH	GA	4	1,591
RICHMOND	GA	58	34,141
ROCKDALE	GA	20	14,623
SCHLEY	GA	2	1,251
SCREVEN	GA	4	3,030
SEMINOLE	GA	3	1,737
SPALDING	GA	24	10,813
STEPHENS	GA	7	4,324
STEWART	GA	3	697
SUMTER	GA	10	5,631
TALBOT	GA	1	776
TALIAFERRO	GA	1	275
TATTNALL	GA	8	3,366

TAYLOR	GA	4	1,595
TELFAIR	GA	4	1,695
TERRELL	GA	4	1,660
THOMAS	GA	18	8,619
TIFT	GA	13	7,708
TOOMBS	GA	10	5,389
TOWNS	GA	4	1,606
TREUTLEN	GA	2	1,241
TROUP	GA	22	12,099
TURNER	GA	6	1,890
TWIGGS	GA	5	1,383
UNION	GA		
UPSON	GA	6	4,983
WALKER	GA	20	10,291
WALTON	GA	22	12,811
WARE	GA	13	6,393
WARREN	GA	3	864
WASHINGTON	GA	8	3,671
WAYNE	GA	10	5,400
WEBSTER	GA	1	410
WHEELER	GA	3	1,120
WHITE	GA	8	3,836
WHITFIELD	GA	33	18,667
WILCOX	GA	3	1,452
WILKES	GA	7	1,823
WILKINSON	GA	4	1,688
WORTH	GA	6	4,099

Numbers reported represent valid responses.

School 2004-05, District 2004-05, District Finance (F-33)(FY03) and LEA Dropout 2001-02 are preliminary.

Totals From Your Table Above
(totals only for numeric columns)

Total Number of Schools (District)	**2,491**
Total PK thru 12th Students (District)	**1,553,437**

School Year 2004-2005

Sec 9.3 Ref 14

Final Recovery Plan for the

Shortnose Sturgeon

Acipenser brevirostrum

December 1998

U.S. Department of Commerce

National Oceanic and
Atmospheric Administration

National Marine Fisheries Service

Final Recovery Plan for the

Shortnose Sturgeon

(*Acipenser brevirostrum*)

prepared by the

Shortnose Sturgeon Recovery Team

for the

National Marine Fisheries Service
National Oceanic and Atmospheric Administration

December 1998

Approved: ____

Rolland A. Schmitten
Assistant Administrator for Fisheries
National Marine Fisheries Service
National Oceanic and Atmospheric Administration

Disclaimer

This recovery plan for the shortnose sturgeon has been approved by the National Marine Fisheries Service. It does not necessarily represent official positions or approvals of cooperating agencies nor the views of all individuals involved in the plan's formulation. The National Marine Fisheries Service has determined that the information used in the development of this document represents the best scientific and commercial data available at the time it was written. The Recovery Plan was prepared by the Shortnose Sturgeon Recovery Team to delineate reasonable actions that will promote recovery of the shortnose sturgeon. This plan is subject to modification as dictated by new findings, changes in species status, and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon agency appropriations and priorities.

Literature Citations should read as follows:

National Marine Fisheries Service. 1998. Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 104 pages.

Preface

Congress passed the Endangered Species Act of 1973 (16 USC 1531 *et seq*, amended 1978, 1982, 1986, 1988) (ESA) to protect species of plants and animals endangered or threatened with extinction. The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) share responsibility for the administration of the Endangered Species Act. The NMFS is responsible for most marine and anadromous species including the shortnose sturgeon.

Section 4(f) of the ESA directs the responsible federal agency to develop and implement a recovery plan, unless such a plan would not promote the conservation of a species. The NMFS determined that a recovery plan would promote conservation and recovery of shortnose sturgeon. The Shortnose Sturgeon Recovery Team included shortnose sturgeon experts from state and federal government and the private sector.

The NMFS agrees with the Shortnose Sturgeon Recovery Team in that the goals and objectives of this recovery plan can be achieved only if a long-term commitment is made to support the actions recommended here. Achieving these goals and objectives will require the cooperation of state and federal government agencies.

Shortnose Sturgeon Recovery Team:

Jeff Brown, NMFS, Southeast Regional Office, St. Petersburg, Florida

Kevin Friedland, NMFS, Northeast Science Center, Woods Hole, Massachusetts

Nancy Haley, (Team Leader) NMFS, Northeast Region, Milford, Connecticut

Boyd Kynard, BRD/USGS, Conte Anadromous Fish Research Laboratory, Turners Falls, Massachusetts

Margaret Lorenz (Team Advisor), NMFS, Office of Protected Resources, Silver Spring, Maryland

Mary Moser (Team Leader), Center for Marine Science Research, University of North Carolina-Wilmington, Wilmington, North Carolina

Marta Nammack (Team Advisor), NMFS, Office of Protected Resources, Silver Spring, Maryland

Gordon Rogers, Satilla Management Associates/Southern Resources and Environmental Services, Brunswick, Georgia

Tom Squiers, Maine Department of Marine Resources Augusta, Maine

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List of Figures and Tables

List of Abbreviations

ACOE	U.S. Army Corps of Engineers
ASMFC	Atlantic States Marine Fisheries Commission
BL	Body Length
CI	Confidence Interval
DPS	Distinct Population Segment
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FER	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FL	Fork Length
FWS	U.S. Fish and Wildlife Service
NMFS	National Marine Fisheries Service
NRC	Nuclear Regulatory Commission
PIT	Passive Integrated Transponder
SL	Standard Length
SSRT	Shortnose Sturgeon Recovery Team
TL	Total Length
YOY	Young of the Year

Executive Summary

Current Species Status: The shortnose sturgeon (*Acipenser brevirostrum*) was listed as endangered on March 11, 1967 (32 FR 4001). Shortnose sturgeon remained on the endangered species list with enactment of the ESA in 1973. Although originally listed as endangered rangewide, the NMFS recognizes 19 distinct population segments occurring in New Brunswick, Canada (1), Maine (2), Massachusetts (1), Connecticut (1), New York (1), New Jersey/Delaware (1), Maryland/Virginia (1), North Carolina (1), South Carolina (4), Georgia (4) and Florida (2).

Habitat Requirements and Limiting Factors: Shortnose sturgeon inhabit the main stems of their natal rivers, migrating between freshwater and mesohaline river reaches. Spawning occurs in upper, freshwater areas, while feeding and overwintering activities may occur in both fresh and saline habitats. Habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges), and mortality (for example, from impingement on cooling water intake screens, dredging, and incidental capture in other fisheries) are principal threats to the species' survival.

Recovery Goal: To delist shortnose sturgeon populations throughout their range.

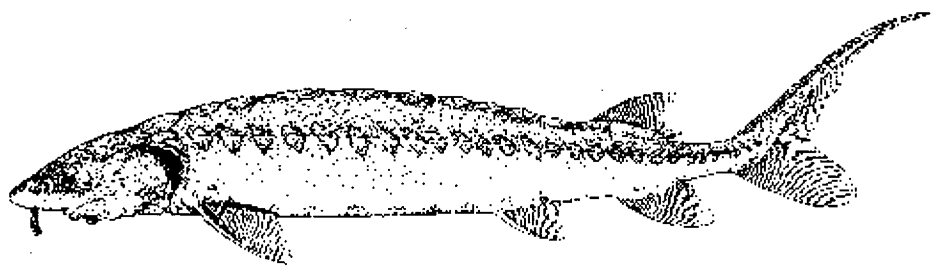
Recovery Objective and Criteria: To recover populations to levels of abundance at which they no longer require protection under the ESA. For each population segment, the minimum population size will be large enough to maintain genetic diversity and avoid extinction.

Actions Needed:

1. Establish Listing Criteria for Shortnose Sturgeon Population Segments
2. Protect Shortnose Sturgeon and their Habitats
3. Rehabilitate Shortnose Sturgeon Populations and Habitats
4. Implement Recovery Tasks

Cost of Recovery Tasks: The costs of recovery are undeterminable at this time. Refer to the Implementation Schedule for cost estimates for individual tasks. Cost estimates were not available for some tasks because the actual actions needed are not known (for example: costs of restoring access to spawning areas located above dams will vary depending on the type of fish passage implemented). In addition, some tasks are a high priority for a large number of population segments. If these tasks are conducted on several rivers concurrently, costs may be significantly reduced. Therefore, accurate cost estimates were impossible to predict.

Date of Recovery: There is evidence that some population segments are already starting to recover. Delisting of all population segments could be initiated by 2024, if all recovery criteria are met.



Shortnose sturgeon *(Acipenser brevirostrum)*

INTRODUCTION

The shortnose sturgeon, *Acipenser brevirostrum*, is an endangered fish species that occurs in large coastal rivers of eastern North America. The NMFS recognizes 19 distinct population segments of shortnose sturgeon inhabiting 25 river systems ranging from the Saint John River in New Brunswick, Canada, to the St. Johns River, Florida (Table 1). The criterion used by the Shortnose Sturgeon Recovery Team (SSRT) to identify these systems was the capture of a shortnose sturgeon in a river/estuarine system within the generation time of the species (30 years). Of the river systems for which population estimates are available, the smallest number of adult fish (< 100 adults) occur in the Merrimack (Massachusetts) and Cape Fear (North Carolina) rivers while the largest number inhabit the Hudson (New York) (>38,000) and Saint John (New Brunswick) rivers (~18,000 adults). Throughout this recovery plan reference is made to "northeast" and "southeast" sturgeon populations. These geographic references follow the respective jurisdictional ranges of the NMFS' Northeast and Southeast regions. All populations from the Chesapeake Bay north are considered "northeast" while those south of the Bay are considered "southeast" population segments.

Legislative Background

Shortnose sturgeon were originally listed as an endangered species by the FWS on March 11, 1967 under the Endangered Species Preservation Act (32 FR 4001, Appendix I). The NMFS later assumed jurisdiction for shortnose sturgeon under a 1974 government reorganization plan (38 FR 41370). Although the original listing notice did not cite reasons for listing the species, a 1973 Resource Publication (Appendix II), issued by the U.S. Department of Interior, stated that shortnose sturgeon were "in peril ... gone in most of the rivers of its former range [but] probably not as yet extinct" (USDOI 1973). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. In the late nineteenth and early twentieth centuries shortnose sturgeon commonly were taken in a commercial fishery for the

Table 1. Shortnose Sturgeon Population Segments

Distinct Population Segments:	Rivers Inhabited by Shortnose Sturgeon
Saint John	Saint John River (New Brunswick, Canada)
Penobscot	Penobscot River (Maine)
Kennebec System	Sheepscot, Kennebec, and Androscoggin Rivers (Maine)
Merrimack	Merrimack River (Massachusetts)
Connecticut	Connecticut River (Massachusetts and Connecticut)
Hudson	Hudson River (New York)
Delaware	Delaware River (New Jersey, Delaware. Pennsylvania)
Chesapeake Bay	Chesapeake Bay, Potomac River (Maryland and Virginia)
Cape Fear	Cape Fear River (North Carolina)
Winyah Bay	Waccamaw, Pee Dee and Black Rivers (South Carolina, North Carolina)
Santee	Santee River (South Carolina)
Cooper	Cooper River (South Carolina)
"ACE" Basin	Ashepoo, Combahee and Edisto Rivers (South Carolina)
Savannah	Savannah River (South Carolina, Georgia), and hatchery stocks
Ogeechee	Ogeechee River (Georgia)
Altamaha	Altamaha (Georgia)
Satilla	Satilla River (Georgia)
St. Marys	St. Marys River (Florida)
St. Johns	St. Johns River (Florida)

closely related, and commercially valuable, Atlantic sturgeon (*Acipenser oxyrinchus*). Catch statistics did not differentiate the two species. Some mis-identifications occurred (Ross et al. 1988) because, at smaller sizes, Atlantic sturgeon are easily confused with shortnose sturgeon unless diagnostic features are recognized. Since there are few confirmed historical reports of shortnose sturgeon captures and because fishermen and scientists did not distinguish between the two species in scientific reports and landing records, there are no reliable estimates of historical population sizes.

More than a century of extensive fishing for sturgeon contributed to the decline of Atlantic and shortnose sturgeon populations along the east coast. Heavy industrial development during the twentieth century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery; possibly resulting in substantially reduced abundance of shortnose sturgeon populations within portions of the species' ranges (e.g., southernmost rivers of the species range: Satilla, St. Marys, and St. Johns Rivers).

Congress passed the ESA to provide protection for species threatened with extinction. Pursuant to Section 4(f)(1) of the ESA, the NMFS and the FWS are required to develop and implement recovery plans "for the conservation and survival of endangered species and threatened species" unless a recovery plan would not help to promote species conservation. Highest priority is given to those species that are or may be in conflict with development projects or other commercial activities. Shortnose sturgeon spend their entire life in waters that are heavily impacted by various construction and industrial activities. Hence, there is a definite need for a recovery plan that comprehensively addresses these factors and describes ways to mitigate or minimize harm to shortnose sturgeon populations rangewide. Moreover, many federal agencies authorize, fund, or carry out actions in rivers where sturgeon occur and, left unchecked, these activities could be detrimental to population survival. This Recovery Plan provides a framework for addressing a multitude of biological concerns, and outlines federal agency responsibilities under the ESA, with the sole purpose of insuring long-term survival of the shortnose sturgeon.

Chronology of Shortnose Sturgeon Recovery Activities

The first step of more than 30 years of shortnose sturgeon recovery began when the FWS placed the species on the original Endangered Species List in 1967. Citing pollution and overfishing as reasons for the shortnose sturgeon's alleged decline, the species continued to meet the criteria of "endangered" under subsequent definitions specified in the 1969 Endangered Species Conservation Act, and in the Endangered Species Act passed in 1973. In 1977, the NMFS established the first SSRT to complete a recovery plan for the species. Although a draft Shortnose Sturgeon Recovery Plan was prepared by this team in 1981, the draft was never forwarded for approval to the Assistant Administrator for Fisheries. Instead, the NMFS elected to complete a Status Review for shortnose sturgeon prior to publishing a final recovery plan.

A Shortnose Sturgeon Status Review was drafted in 1987 and stands as the most recent assessment of the species' status. The most significant conclusions of the 1987 Status Review were recommendations to change the status of the Connecticut, Delaware, and Hudson River populations to "threatened," to delist the Kennebec River system population, and to consider each shortnose sturgeon population as a distinct unit under the ESA definition of "species." The 1987 Status Review states that: "the differences reported in longevity, growth rates, and age at sexual maturity between shortnose sturgeon from the northern and southern extremes of its range are expected in any species with a wide latitudinal distribution. The best available information also indicates differences in life history and habitat preferences between northern and southern river systems (Dadswell et al. 1984), although there are no genetic or morphometric data available to support any taxonomic splitting of the species. However, given the species' anadromous breeding habits, it is unlikely that populations in adjacent river systems interbreed with any regularity. Therefore, until interbreeding is confirmed, we will consider each population within a river system to be a distinct unit under the ESA definition of "species"."

The NMFS received comments on the 1987 Status Review and convened a second SSRT in 1988 to critically review the document and report its findings to the NMFS. This team disbanded before a report was completed. After 5 years of no activity beyond mandated management under Section 7 of the ESA, the NMFS gathered a third SSRT in 1993 to complete the long-awaited Shortnose Sturgeon Recovery Plan.

Recovery Plan

This Recovery Plan was drafted by a seven-member recovery team comprising staff from federal, state and private institutions with both fishery research and management backgrounds (see Preface). In addition, the SSRT solicited the assistance of a group of "Technical Advisors" (see Acknowledgments) with diverse expertise in sturgeon research and management and species recovery planning. The Recovery Plan contains four main sections: 1) an updated synopsis of the biology and distribution of shortnose sturgeon; 2) a description of factors affecting species recovery; 3) an outline of actions needed to recover shortnose sturgeon; and 4) a detailed implementation schedule for completing specific recovery tasks. This Recovery Plan will be periodically revised by the NMFS or a NMFS-appointed plan implementation team to reflect new scientific findings, reclassification and recovery of individual population segments, and improved understanding of factors affecting population survival.

Recovery Approach

Defining what it means to "recover" shortnose sturgeon is complicated by the lack of information on historical population levels and rangewide genetic variation. Shortnose sturgeon are known to have existed in a number of rivers where they no longer occur, particularly in the middle, and at the southern end of their range. This plan primarily addresses recovery of extant shortnose sturgeon population segments. While, recovery actions to restore shortnose sturgeon in rivers where they historically occurred are considered a relatively low priority, the NMFS recognizes the importance of restoring the historically continuous range of the species to re-establish minimal gene flow. A sampling protocol will be developed to determine the minimum amount of sampling needed to establish the presence of shortnose sturgeon in a river system. When sampling is sufficient to establish that shortnose sturgeon are unlikely to exist in a river where they historically occurred, then the list of distinct population segments (Table 1) may require revision.

A joint NMFS/FWS policy (61 FR 4722, February 7, 1996) recognizes distinct vertebrate population segments (DPS) of a species on the basis of: 1) discreteness, 2) significance to the rest of the species, and 3) conservation status. The SSRT defined DPSs of shortnose sturgeon without the benefit of genetic information, however, this information is needed to help resolve DPSs with greater accuracy (61 FR 4722, February 7, 1996). For example, genetic information is needed to determine whether interbreeding occurs between rivers that drain into a common estuary (e.g., Kennebec and Androscoggin Rivers, ACE Basin). At this time, such river systems are considered a single population segment comprised of breeding subpopulations. Genetic data may indicate that the individual rivers in such systems support distinct population segments.

Although genetic variation within and among shortnose sturgeon occurring in different river systems is not known, life history studies indicate that shortnose sturgeon populations from different river systems are substantially reproductively isolated (Kynard 1997) and, therefore, should be considered discrete. Shortnose sturgeon are known to occur in 19 different river systems from New Brunswick to Florida. While their biology and movement patterns have been studied to varying degrees in each system, differences in life history and migratory patterns have been confirmed on at least a regional basis. For example, shortnose sturgeon grow faster in the south but attain larger adult sizes at the northern part of their range. Seasonal movement patterns and spawning locations of shortnose sturgeon also appear to vary with latitude. In northern rivers fish move to estuarine locations in summer, presumably to feed on seasonally abundant invertebrate prey. Estuarine residence in southern rivers, which occurs in winter, appears to last longer. Finally, numerous tagging and telemetry studies have been undertaken to better understand shortnose sturgeon habitat use and seasonal distribution patterns throughout their range. Few recaptures of tagged fish in adjacent river systems have ever been documented, and available tagging data suggest that migration between river systems is low compared to other anadromous species.

Based on the above biological and ecological differences and the lack of recaptures of sturgeon from adjacent river systems, the NMFS concurs with the SSRT and considers shortnose sturgeon from different river systems to be substantially reproductively isolated. The loss of a single shortnose sturgeon population segment may risk the permanent loss of unique genetic information that is critical to the survival and recovery of the species. Therefore, each shortnose sturgeon population should be managed as a distinct population segment for the purposes of Section 7 of the ESA. Under this policy, actions that could adversely affect a DPS will be evaluated in terms of their potential to jeopardize the continued existence of an individual population segment (as opposed to the existence of shortnose sturgeon rangewide).

NOMENCLATURE AND TAXONOMY

Nomenclature

The scientific name for the shortnose sturgeon is *Acipenser brevirostrum*. *Acipenser* is latin for sturgeon and *brevirostrum* means short snout. LeSueur originally described the species from a specimen taken from the Delaware River (Dadswell et al. 1984). Vernacular names include shortnosed sturgeon, little sturgeon (Saint John River, N.B.), pinkster and roundnoser (Hudson River), bottlenose or mammose (Delaware River), salmon sturgeon (Carolinas), and soft-shell or lake sturgeon (Altamaha River) (Dadswell et al. 1984).

Taxonomy

Class: Osteichthyes

Order: Acipenseriformes

Family: Acipenseridae

Genus: Acipenser

Species: brevirostrum

Type Specimen

The holotype was collected from the Delaware River and is housed at the Academy of Natural Sciences of Philadelphia, ANSP 16953 (Dadswell et al. 1984).

Current Taxonomic Treatment

The shortnose sturgeon is a member of the family Acipenseridae, which occurs in the Northern Hemisphere. In the United States this family inhabits the Atlantic and Pacific Oceans, the Gulf of Mexico, and certain freshwater systems (Nelson 1984). In North America the family is represented by five members of the genus *Acipenser* and three members of the genus *Scaphirhynchus*.

The other sturgeon likely to be found in the same waters as the shortnose sturgeon is the Atlantic sturgeon, *Acipenser oxyrinchus*. Adult and juvenile shortnose sturgeon may be distinguished from the Atlantic sturgeon on the basis of mouth width versus interorbital width, scute patterns, and snout length (Vladykov and Greeley 1963; Scott and Crossman 1973) (Table 2).

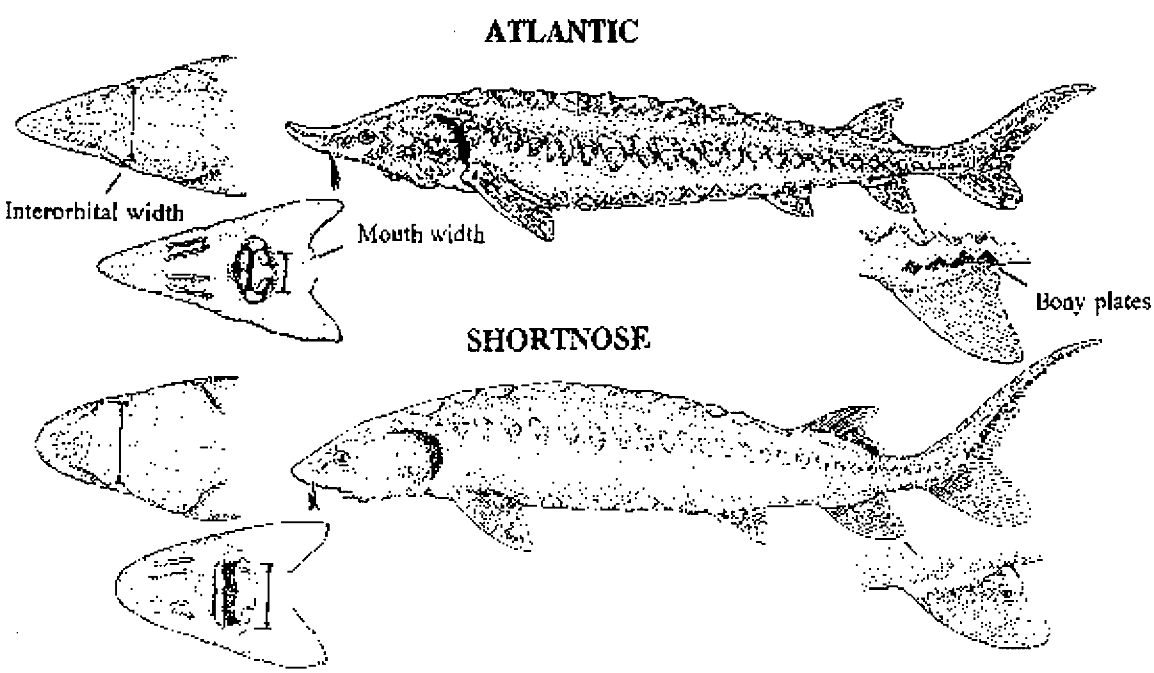
Recently hatched shortnose and Atlantic sturgeon larvae can be differentiated tentatively by size relative to state of development and, depending on the river, by collection date and location. Following yolk depletion, ventral pigmentation and distance between lobes of the lower lips are the most obvious diagnostic characteristics between the two species. The ventrolateral and ventral surfaces of the abdomen are white on shortnose sturgeon but covered with melanophores on Atlantic sturgeon, except on the midventral surface of smaller specimens. The distance between the two lobes of the lower lip is greater than 25% of the mouth width (including lips) for shortnose sturgeon and less than 20% for Atlantic sturgeon. For specimens over 60 mm SL, shortnose sturgeon have 17-22 pelvic and 18-24 anal fin rays while Atlantic sturgeon possess 26-33 pelvic and 22-30 anal fin rays (Snyder 1988).

Shortnose sturgeon are generally larger than Atlantic sturgeon in total length at hatching; about 9-10 mm standard length (SL) versus 7-9 mm SL, respectively. Shortnose sturgeon generally continue to be slightly larger than Atlantic sturgeon at the same developmental stage, at least through 60 mm SL (Snyder 1988). However, Atlantic sturgeon grow more quickly than shortnose sturgeon found in the same geographic region. For example, based on the growth curve for the Altamaha River shortnose sturgeon population (Dadswell et al. 1984), a 2-year old fish should be approximately 51 cm fork length (FL) while an Atlantic sturgeon of the same age from the Altamaha River would be approximately 67 cm FL (Rogers and Weber 1994); a 10-year old shortnose sturgeon would be approximately 83 cm fork length (FL) and a female Atlantic sturgeon would be approximately 175 cm FL. The maximum length for shortnose sturgeon in the Altamaha River is 97 cm FL (von Bertalanffy growth curve in Dadswell et al. 1984) while Rogers and Weber (1994) report female Atlantic sturgeon in excess of 250 cm FL.

Table 2. Distinguishing Characteristics of Atlantic and Shortnose Sturgeon

Characteristic	Atlantic Sturgeon *Acipenser oxyrinchus*	Shortnose Sturgeon *Acipenser brevirostrum*
Maximum length	> 9 feet	4 feet
Snout	Longer and more sharply pointed*	Shorter and blunter
Mouth	Width inside lips < 55% of bony interorbital width	Width inside lips > 62% of bony interorbital width
Bony plates	2-6 bony plates (at least pupil size) along base of anal fin	No row of bony plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Anadromous; spawn at or above head-of-tide in most rivers. Aside from seasonal migrations to estuarine waters, rarely occurs in the marine environment

*Snout length and sharpness is less pronounced in older individuals



In northern rivers shortnose sturgeon attain maximum lengths of as much as 130 cm FL (Saint John River, New Brunswick), but are still well short of maximum lengths attained by Atlantic sturgeon (Dadswell 1979).

POPULATION STATUS

Population Size and Distribution

Shortnose sturgeon occur in estuaries and rivers along the east coast of North America (Vladykov and Greeley 1963) (Figure 1). Their northerly distribution extends to the Saint John River, New Brunswick, Canada, which has the only known population in Canada (Scott and Scott 1988). Their southerly distribution historically extended to the Indian River, Florida (Everman and Bean 1898). Shortnose sturgeon appear to spend most of their life in their natal river systems, only occasionally entering the marine environment. Those fish captured in the ocean are usually taken close to shore, but in full salinity (Schaefer 1967; Holland and Yelverton 1973; Wilk and Silverman 1976). There are no records of shortnose sturgeon in the NMFS' database for the northeast offshore bottom trawl survey.

Occurrences of shortnose sturgeon over the range of the species were chronicled by Dadswell et al. (1984). This chronology will not be repeated here, but rather a summary of the most current data on the presence of the species in river-estuary ecosystems, and the size and status of shortnose sturgeon populations is provided. The summary is organized by river-estuary system or groups of systems. Some small coastal streams are omitted from the summary due to a lack of data or a general suspicion that they contain insufficient habitat to support shortnose sturgeon. This should not be construed as proof that shortnose sturgeon do not occur or never occurred in these systems.

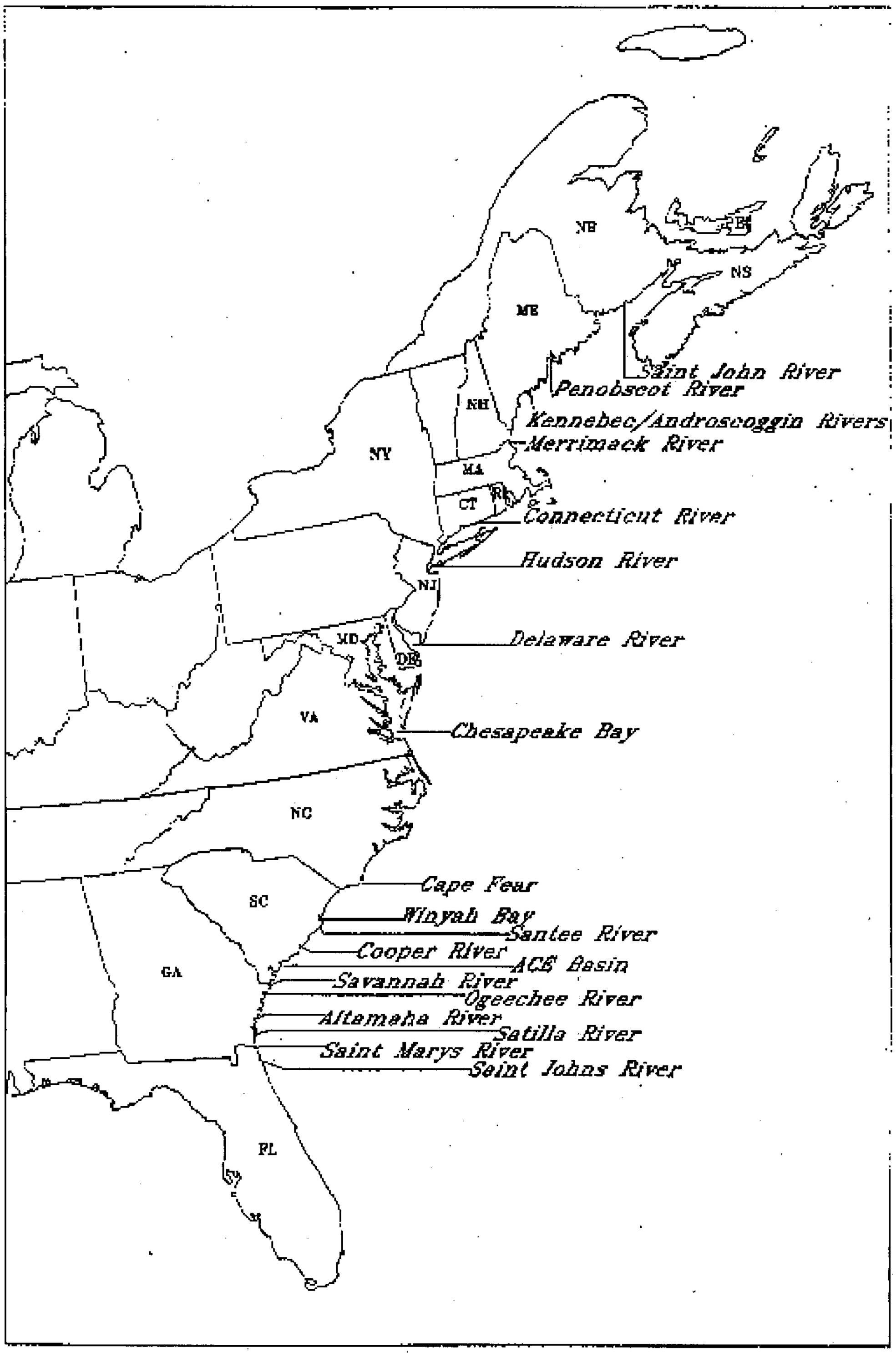


Figure 1. Shortnose Sturgeon Distribution

Table 3. Shortnose Sturgeon Population Estimates*

Locality	Time	Type	Marked (m)	Captured (c)	Re-captured	Estimate Type	Population estimate	Precision 95% CI		Source
Saint John	1973-77	Adult	3,705	4,082	343	S-J	18,000	± 30%		Dadswell 1979
Kennebec	1977-81	Adult	703	272	56	SCH	7,222	5,046	10,765	Squiers et al. 1982
Merrimack	1989	Spawning males				CAP	5	5	20	Kynard unpublished data
	1988-90	Spawning males				CAP	12	10	28	Kynard unpublished data
	1989-90	Total				CAP	33	18	89	Kynard unpublished data
Upper Connecticut	1992	Spawning				CAP	47	33	80	Kynard unpublished data
	1993	Spawning				CAP	98	58	231	Kynard unpublished data
	1976-77	Total	51	162	16	PET	516	317	898	Taubert 1980
	1976-78	Total	51	56	4	PET	714	280	2,856	Taubert 1980
	1977-78	Total	119	56	18	PET	370	235	623	Taubert 1980
	1976-78	Total	170	56	24	PET	297	267	618	Taubert 1980
Lower Connecticut	1988-93	Adult				SHU	895	799	1,018	Savoy and Shake 1993
	1988-93	Adult				SCH	875			
	1988-93	Adult				CHA	856			
Hudson	1979	Spawning	548	899	38	PET	12,669			Dovel 1979
	1980	Spawning	811	698	40	PET	13,844			Dovel 1979
	1980	Total					30,311			Dovel 1979 (extrapolation)
	1995	Adult	1909	2201	29	CAP	38,024	26,427	55,072	Bain et al. 1995
Delaware	1981-84	Partial				PET	14,080	10,079	20,378	Hastings et al. 1987
	1981-84	Partial				SCH	12,796	10,288	16,267	Hastings et al. 1987
	1983	Partial				S-J	6,408			Hastings et al. 1987
Ogeechee	1993	Total	31	36	5	SCH	361	326	400	Rogers and Weber 1994
Altamaha	1988	Total	64	87	1	SCH	2,862	1,069	4,226	
	1990	Total	112	175	24	SCH	798	645	1,045	
	1993	Total	44	83	7	SCH	468	316	903	Rogers unpublished data

Estimate Types: S-J=Seber Jolly, PET=Modified Petersen, SCH=Modified Schnabel, CAP=CAPTURE Method, SHU=Schumacher, CHA=Chapman, SPET=Simple Petersen

* Population estimates should be viewed with caution. In some cases, sampling biases may have violated the assumptions of the procedures used or resulted in inadequate representation of a population segment. Population estimates are not available for the following river systems: Penobscot, Chesapeake Bay, Cape Fear, Winyah Bay, Santee, Cooper, ACE Basin, Savannah, Satilla, St. Marys and St. Johns.

In addition to the wild populations of shortnose sturgeon described below, a captive broodstock from the Savannah River and its cultured progeny are housed at three hatcheries operated by the FWS: Bear's Bluff (South Carolina), Orangeburg (South Carolina), and Warm Springs (Georgia). The University of Florida (Gainesville) recently acquired shortnose sturgeon from these hatcheries for research purposes.

Northeast Region

Saint John River

The Saint John River in New Brunswick, Canada, supports one the largest populations of shortnose sturgeon in North America. Dadswell (1979) conducted a tag-and-recapture study on this population from 1973 to 1977. Due to the size of the study area and the inability to satisfy the assumption of random mixing required for other estimation procedures, Dadswell (1979) used a Seber-Jolly multiple mark-recapture model to generate a population estimate of 18,000 adult sturgeon (Table 3). A 1992 survey indicated that catch-per-unit-effort was unchanged from the previous estimate: approximately 15 sturgeon per net/night.

Eastern Maine Rivers: Dennys, Machias, East Machias, Penobscot, Ducktrap

A shortnose sturgeon was captured in the Penobscot River estuary (Northport, Maine) on June 30, 1978, during a Maine Department of Marine Resources sampling program (Squiers and Smith 1979). This capture indicates that a contemporary shortnose sturgeon population exists in the Penobscot River, as this capture occurred within the generation time of the species. Additionally, archeological data suggesting that sturgeon from the Penobscot River were used by native peoples (Knight 1985; Petersen and Sanger 1986) provides support for the conclusion that shortnose sturgeon occur in this system. Atlantic and shortnose sturgeon co-occur throughout the shortnose sturgeon's range. Thus, evidence confirming even Atlantic sturgeon presence in the Penobscot River strongly suggests that shortnose sturgeon also occurred there.

A directed survey for shortnose sturgeon was conducted during 1994 and 1995 in the Penobscot River at the head of tide. No shortnose sturgeon were captured in 409 net hours of gill net effort; however, this is much less effort than the 11,396 net hours expended by Kieffer and Kynard (1993) to capture 25 shortnose sturgeon in the Merrimack River and far less than the 21,432 net hours of gill net effort expended by Moser and Ross (1995) to capture three shortnose sturgeon in the Cape Fear River. Discharge rates and river depths associated with some of the small coastal rivers between the Kennebec and Saint John rivers may not be sufficient to support shortnose sturgeon populations in this region.

Sheepscot-Kennebec-Androscoggin Rivers

Shortnose sturgeon occur in the estuarine complex formed by the Sheepscot, Kennebec, and Androscoggin rivers. Sturgeon were tagged with Carlin tags from 1977 to 1980, with recoveries in each of the following years. A Schnabel estimate of 7,222 adults was computed and is considered the most reliable estimate of population size for the combined estuarine complex (Table 3). Tracking studies to delineate spawning habitat were performed on the Androscoggin River during 1993. Gill nets were used to capture study animals and catch rates were recorded. Gill net catch-per-unit-effort during this study was the highest recorded in this area, suggesting that the population in the Androscoggin has increased since last surveyed.

On September 19, 1994, the NMFS received a petition from the Edwards Manufacturing Company, Inc., to delist shortnose sturgeon occurring in the Androscoggin and Kennebec rivers. In the ensuing status review, the NMFS found that the petition to delist this population segment was not warranted because: 1) the population estimate used by the petitioners was less reliable than the best estimate accepted by the NMFS; 2) the best population estimate available did not exceed the interim threshold at which the population segment would be a candidate for delisting; 3) no recent information was available to assess population dynamics; and 4) threats to shortnose sturgeon habitat still exist throughout the Androscoggin and Kennebec rivers (NMFS 1996). Recent population dynamics data and genetic information are needed for a further assessment of the status of this population segment.

Western Maine Rivers: Royal, Presumpscot, Saco, Kennebunk, York

There are no known shortnose sturgeon populations in the rivers between the Androscoggin and Merrimack rivers. A 1989 shortnose sturgeon survey in Great Bay, New Hampshire, resulted in zero catch (Nelson 1989). However, the lower salinity reaches of the system may not have been adequately sampled.

Merrimack River

There is a small population of shortnose sturgeon present in the Merrimack River (Kieffer and Kynard 1993). The size of the population has been estimated by tag and release studies using PIT and external Carlin tags. Population estimates, calculated using CAPTURE methodology, of spawning males and all spawners were 5 and 12 sturgeon, respectively (Table 3). The foraging, or total adult population, is estimated to be 33 fish. These estimates are from recently initiated studies and may change over time.

Rhode Island and Eastern Connecticut Rivers: Taunton, Blackstone, Pawcatuck and Thames Rivers

There are no known shortnose sturgeon populations in the rivers between the Merrimack and Connecticut rivers. Shortnose sturgeon previously occurred in area coastal waters and in Narragansett Bay (Dadswell et al. 1984). No shortnose sturgeon were caught in the Taunton River during a gill net survey conducted in 1991 to 1992 (Burkett and Kynard 1993).

Connecticut River

The Holyoke Dam separates shortnose sturgeon in the Connecticut river into an upriver group (above Holyoke Dam) and a lower river group that occurs below the Holyoke Dam to Long Island Sound. The abundance of the upriver group has been estimated by mark-recapture techniques using Carlin tagging (Taubert 1980) and PIT tagging (Kynard unpublished data). The total upriver population estimates ranged from 297 to 714 adult sturgeon, and the size of the spawning population was estimated (using PIT tags) at 47 and 98 for the years 1992 and 1993, respectively (Table 3).

The shortnose sturgeon population estimate for the lower Connecticut is stratified by sturgeon total length. The population estimate for sturgeon >50 cm TL was based on a Carlin and PIT tag study from 1991 to 1993. Schumacher, Schnabel, and Chapman point estimates were all within 39 fish of each other and yielded a mean value of 875 adult sturgeon (Table 3). However, this number may overestimate the abundance of the lower river group because the sampled area is not closed to downstream migration of upriver fish (Kynard 1997).

Western Connecticut: Housatonic River

There are no known shortnose sturgeon populations in the rivers between the Connecticut and Hudson rivers.

Hudson River

The shortnose sturgeon population in the Hudson River was estimated by a mark-and-recapture experiment performed in 1979 and 1980 (Dovel 1979). The adult spawning population was estimated at 13,000 fish (Table 3); this appears to be a robust estimate considering the number of fish tagged and recaptured. Subsequent survey work on shortnose sturgeon indicates that the population may be significantly larger. Researchers at Cornell University and Consolidated Edison have independently detected catch-per-unit-effort increases with their respective gears. Consolidated Edison data show a 3 to 6 fold increase in shortnose sturgeon trawl catch-per-unit-effort for 1992 (M.Bain, Cornell University, personal communication). In a mark-recapture study that replicated Dovel's (1979) methods, Bain et al. (1995) estimated the adult shortnose sturgeon population size to be 38,024. Although an initial estimate, this number suggests a 2 to 4 fold increase in adult shortnose sturgeon abundance in the Hudson River over the past decade. The Bain et al. (1995) study shows that recruitment is occurring despite limited captures of juveniles in recent surveys aimed at collecting juveniles (Haley et al. 1996).

New Jersey Coastal Rivers

There are no known shortnose sturgeon populations in the rivers between the Hudson and Delaware rivers.

Delaware River

Hastings et al. (1987) used Floy T-anchor tags in a tag-and-recapture experiment to estimate the Delaware River shortnose sturgeon population size, in the Trenton to Florence reach, between 1981 to 1984. Population sizes by three estimation procedures ranged from 6,408 to 14,080 adult sturgeon (Table 3). These estimates are useful but, because recruitment and migration rates between the population segment studied and the total population in the river are unknown, model assumptions may have been violated. With the limited scope of the tagging experiment, it is difficult to assess the status of the Delaware River shortnose sturgeon population.

Chesapeake Bay Drainages

The first published account of shortnose sturgeon in the Chesapeake system was an 1876 record from the Potomac River reported in a general list of the fishes of Maryland (Uhler and Lugger 1876). Other historical records of shortnose sturgeon in the Chesapeake include: Potomac River (Smith and Bean 1899), the upper Bay near the mouth of the Susquahanna River in the early 1980's, and the lower Bay near the mouths of the James and Rappahannock rivers in the late 1970's (Dadswell et al. 1984). Recently, in 1996, eight shortnose sturgeon were captured in commercial gear in the upper Bay, between Kent Island and the Chesapeake and Delaware (C&D) canal, and one shortnose sturgeon was captured in a pound net at the mouth of Potomac Creek, off the Potomac River. In 1997, nine shortnose sturgeon were collected in upper Chesapeake Bay between Miller's Island and the mouth of the Susquehanna River. No data on population dynamics exist. Directed sampling for shortnose sturgeon in this area is needed to establish distribution and movement patterns.

Southeast Region

Albemarle Sound/Roanoke and Chowan Rivers

The only published record of a shortnose sturgeon in this area, confirmed by a museum specimen, was from Salmon Creek in the lower Chowan River, April, 1881 (USNM 64330, Vladykov and Greeley 1963). An unconfirmed record from Oregon Inlet (Holland and Yelverton 1973) was also reported in Gruchy and Parker (1980), Dadswell et al. (1984), and Gilbert (1989). No data on population dynamics exist.

Pamlico Sound/ Pamlico and Neuse Rivers

Yarrow (1877) reported that shortnose sturgeon were abundant in the North, New, and Neuse Rivers, but these records are doubtful due to their apparent basis in hearsay (Ross et al. 1988). Shortnose sturgeon were also reported from the Beaufort (Jordan 1886) and Neuse Rivers by Fowler (1945). Nearshore records of shortnose sturgeon in this area (Holland and Yelverton 1973) may be misidentifications (Ross et al. 1988). No data on population dynamics exist.

Cape Fear River

Since the first confirmed capture of shortnose sturgeon in the Cape Fear River (January 1987, Ross et al. 1988), an extensive sampling program has produced eight additional specimens (Moser and Ross 1993). All nine specimens captured were adults; no juveniles were collected. The river is dammed in the coastal plain, a short distance upstream of Wilmington, North Carolina. The river channel near the coast is channelized and heavy industries exist near the port. No information is available on the population dynamics of this population segment, which probably numbers less than 50 fish (Moser and Ross 1995).

Winyah Bay Drainages

Shortnose sturgeon were documented in the Winyah Bay system during the late 1970's and early

1980's (Dadswell et al. 1984). Fed by the Waccamaw, Pee Dee, and Black Rivers, this coastal plain watershed produced over 100 collections of juveniles and adults during the study period. No data on population dynamics exist.

Santee River

Seven shortnose sturgeon were recorded from the Santee River drainage in 1978, and one fish was captured in a gillnet in 1992 (Collins and Smith 1997). In addition, 20 specimens were recovered from a fishkill in the Santee Dam tailrace that occurred during a low dissolved oxygen event below the dam. During the period from 1979 - 1991, shortnose sturgeon were also recorded from Lake Marion, and in the Congaree and Wateree rivers above the dam (Collins and Smith 1997). Some suspect that these fish represent an essentially landlocked population (T.I.J. Smith, South Carolina Department of Natural Resources, personal communication). No population dynamics are available for this population segment.

Cooper River

Shortnose sturgeon were documented in what is now the metro Charleston area during the late 1800's (Jordan and Evermann 1896). Shortnose sturgeon were collected in this heavily altered (dammed and urbanized) drainage in the 1980's during research on the American shad (*Alosa sapidissima*) fishery. Eleven sturgeon were also taken in gillnets at the Pinopolis Dam tailrace in February 1995 (Collins et al. 1996). A functionally landlocked segment may exist in Lake Moultrie (T.I.J. Smith, South Carolina Department of Natural Resources, personal communication), above the dam that blocks the system in the lower coastal plain. Population dynamics are unknown.

Ashepoo, Combahee and Edisto Rivers (The "ACE" Basin)

The Ashepoo, Combahee, and Edisto drainages form one of the most pristine coastal plain watersheds in the southeastern United States. Shortnose sturgeon were incidentally collected during American shad studies in the Ashepoo and Edisto Rivers in the 1970's and early 1980's (Collins and Smith 1997). Population dynamics are unknown.

Savannah River

The Savannah River is a heavily industrialized and channelized drainage that forms the South Carolina/Georgia border. The river is dammed, but not below the fall line. Shortnose sturgeon were first documented in the system in the mid-1970's (Dadswell et al. 1984). During 1984-1992, over 600 adults were collected by shad fishermen and researchers using gillnets and trammel nets (Collins and Smith 1993). The ratio of adults to juveniles in this study was very high, indicating that recruitment is low in this river (Smith et al. 1992). Adult population estimates were calculated using Jolly Seber (96-1075) and Schnabel (1676) techniques, but were deemed unreliable as not all basic assumptions were met (M. Collins, South Carolina Department of Natural Resources, personal communication). During 1984-1992, approximately 97,000 shortnose sturgeon (19% tagged) of various sizes were stocked in the Savannah River to evaluate the potential for shortnose sturgeon stock enhancement (Smith and Jenkins 1991). Subsequent investigation showed that stocked fish were at large for an average of 416 days and comprised 41% of all juvenile sturgeon collected (Smith et al. 1995).

Ogeechee River

The Ogeechee is primarily a coastal plain drainage with 5% of its watershed in the piedmont. The river is undammed, but water quality has changed (eutrophied) during the last 30 years (Weber 1996). Shortnose sturgeon were first documented in the system during the early 1970's (Dadswell et al. 1984). A survey of shortnose sturgeon occurrence, distribution, and abundance, including a 1994-1995 mark/recapture experiment, was conducted from 1993 to 1995 in the tidal portion of the drainage (Rogers and Weber 1994; Weber 1996). The size distribution of shortnose sturgeon sampled indicated that, as in the Cape Fear and Savannah rivers, the Ogeechee population is dominated by adults. Mark/recapture analysis indicated that abundance is low in the Ogeechee system; the highest point estimate yielded less than 400 individuals from all age classes in 1993 (Weber 1996). Size frequency, abundance, and catch rate data indicate that shortnose sturgeon may be experiencing higher juvenile mortality rates in the Ogeechee River system than in the Altamaha (below).

Altamaha River

The Altamaha River system drains the largest watershed east of the Mississippi River and comprises the confluence of the Ocmulgee and Oconee Rivers plus additional, smaller piedmont and coastal plain drainages. The system is moderately industrialized including two kraft process paper mills and a nuclear generating plant. The watershed landscape has been heavily altered by urbanization, suburban development, agriculture, and silviculture. The system is also dammed, but not below the fall line. Shortnose sturgeon were first documented in the Altamaha in the early 1970's (Dadswell et al. 1984), and, later, in a cursory study of spawning movements conducted in the late 1970's (Heidt and Gilbert 1979).

A two-year study of population structure and dynamics was conducted during the early 1990's (Flournoy et al. 1992), building on three additional years of survey data from the late 1980's (B. T-A. Woodward, Georgia Department of Natural Resources, unpublished data). Over 650 individuals were collected during the five years of study, with samples heavily dominated by juveniles (90%). Subsequent analysis of tag/recapture data indicated that, during the two-year study period in the 1990's, abundance did not exceed 6,055 individuals for all size and age classes. However, under the more rigorous constraints imposed by the assumptions of the recapture model and (probably) met under the conditions experienced during the summer of 1990, the point estimate is 798 individuals with a 95% confidence interval (CI) of 645-1,045 fish. The next time that those conditions were met (during the late summer of 1993), a similar 95% CI of 316-903 individuals was generated with a point estimate of 468 fish. An estimate generated from 1988 data, which met the same criteria, yielded 2,862 fish (95% CI 1,069-4,226). Based on these data, the Altamaha population segment is likely the largest and most viable one south of Cape Hatteras, North Carolina.

Satilla and St. Marys

The Satilla and St. Marys Rivers are relatively small coastal plain drainages emptying into the Atlantic Ocean between the Altamaha River, Georgia and St. Johns River, Florida. There are no dams and few human impacts beyond agriculture and timber management along the Satilla system. The St. Marys system (draining the eastern portion of the Okefenokee Swamp and forming a portion of the Georgia/Florida border) is likewise undammed, but is heavily channelized in its estuary to support a small port and a major military installation. The estuary also receives effluents from three major forest product plants. Collections of shortnose sturgeon were made in the estuaries of both systems during the late 1980's and early 1990's during crustacean monitoring (G. Rogers, Georgia Department of Natural Resources, personal communication). Surveys for sturgeon in the St. Marys (1994 and 1995, 117 net hours) and in the Satilla (1995, 74 net hours) failed to yield any shortnose sturgeon (Rogers and Weber 1995b).

St. Johns River

The St. Johns River in Florida is a heavily altered system flowing northward from the east-central portion of the state and emptying into the Atlantic Ocean near Jacksonville, Florida. The system is dammed in the headwaters, heavily industrialized and channelized near the sea, and affected by urbanization, suburban development, agriculture, and silviculture throughout the basin. Shortnose sturgeon are known from the system since 1949 (Kilby et al. 1959). Five shortnose sturgeon were collected in the St. Johns in the late 1970's (Dadswell et al. 1984) and, in 1981, three sturgeon were collected and released by the Florida Game and Freshwater Fish Commission. Interestingly, none of the collections were recorded from the estuarine portion of the system; all captures occurred far upstream in an area heavily influenced by artesian springs with high mineral content.

BIOLOGICAL CHARACTERISTICS

Habitat and Life History

Shortnose sturgeon are found in rivers, estuaries, and the sea, but populations are confined mostly to natal rivers and estuaries. The species appears to be estuarine anadromous in the southern part of its range, but in some northern rivers it is "freshwater amphidromous", i.e., adults spawn in freshwater but regularly enter saltwater habitats during their life (Kieffer and Kynard 1993). Adults in southern rivers forage at the interface of fresh tidal water and saline estuaries and enter the upper reaches of rivers to spawn in early spring (Savannah River: Hall et al. 1991; Altamaha River: Heidt and Gilbert 1979; Flouronoy et al. 1992, Rogers and Weber 1995a; Ogeechee River: Weber 1996).

The use of saline habitat varies greatly among northern populations. In the Saint John and Hudson rivers, adults occur in both freshwater and upper tidal saline areas all year (Dadswell 1979; Dovel et al. 1992). This situation may also exist in the Kennebec River system where, during summer, some adults forage in the saline estuary while others forage in freshwater reaches (Squiers and Smith 1979; Squiers et al. 1981). In the Delaware, Merrimack, and Connecticut rivers adults remain in freshwater all year, but some adults briefly enter low salinity river reaches in May-June, then return upriver (Buckley and Kynard 1985a; Savoy and Shake 1992; Kieffer and Kynard 1993; O'Herron et al. 1993). Some adults have been captured in nearshore marine habitat (Dadswell et al. 1984), but this is not well documented. Many tagging and telemetry studies in rivers throughout the species' range indicate that these fish remain in their natal river or the river's estuary (Dadswell 1979; Dovel 1981; Dadswell et al. 1984; Buckley and Kynard 1985a; Hall et al. 1991; O'Herron et al. 1993; Savoy and Shake 1992; Kieffer and Kynard 1993; Moser and Ross 1995).

Early Life Stages

At hatching, shortnose sturgeon are blackish-colored, 7-11 mm long, and resemble tadpoles (Buckley and Kynard 1981; Dadswell et al. 1984). Hatchlings have a large yolk-sac, poorly developed eyes, mouth and fins, and are capable of only "swim-up and drift" swimming behavior (Richmond and Kynard 1995). They are ill-equipped to survive as free-swimming fish in the open river. In the laboratory, 1 to 8-day old shortnose sturgeon were photonegative, actively sought cover under any available material, and swam along the bottom until cover was found (Richmond and Kynard 1995). This cover-seeking behavior suggests that sturgeon yolk-sac larvae hide under any available cover at the spawning site. This tendency should enhance survival during final development (Richmond and Kynard 1995).

In 9-12 days shortnose sturgeon absorb the yolk-sac and develop into larvae at about 15 mm TL (Buckley and Kynard 1981). Larvae have well-developed eyes, a mouth with teeth, and fins capable of normal swimming. In the lab, larvae resemble miniature adults by 20 mm TL, begin exogenous feeding, are photopositive, and swim in the water column. In the wild, larvae of this size probably migrate downstream (Richmond and Kynard 1995). In laboratory experiments, larvae were nocturnal, and preferred deep water, grey color, and a silt substrate (Richmond and Kynard 1995). Larvae collected in rivers were found in the deepest water, usually within the channel (Taubert and Dadswell 1980; Bath et al. 1981; Kieffer and Kynard 1993). Laboratory studies indicate that young sturgeon move downstream in a 2-step migration: a 2-day migration by larvae followed by a residency period of YOY, then a resumption of migration by yearlings in the second summer of life. Thus, yearlings are the primary migratory stage (Kynard 1997).

In the Hudson and Saint John rivers YOY are found in freshwater (Dadswell 1979; Dovel et al. 1992). Carlson and Simpson (1987) examined stomach contents of YOY in the Hudson River and concluded that they consumed organisms found in the channel (amphipods), and dipteran larvae in the drift and mud substrate, but not sand. Pottle and Dadswell (1979) reported that, in the Saint John River, YOY use intermediate and deep water habitats. In the Connecticut River, upstream of Holyoke Dam where resident adults spawn, young juveniles have been captured in river reaches used by adults (Dadswell et al. 1984).

Juveniles

Juveniles (3-10 year olds) occur in at the saltwater/freshwater interface in most rivers (Saint John River: Dadswell 1979; Pottle and Dadswell 1979; Hudson River: Dovel et al. 1992; Savannah River: Hall et al. 1991; and Altamaha River: Flournoy et al. 1992, Ogeechee River: Weber 1996). Juveniles move back and forth in the low salinity portion of the salt wedge during summer (Pottle and Dadswell 1979). In the Ogeechee River, fish moved into more saline areas (0 - 16 ppt) and were most active when water temperature dropped below 16°C (Weber 1996). Juveniles in the Savannah River use sand/mud substrate in 10-14 m depths (Hall et al. 1991); Saint John River juveniles use similar substrate in channels 10-20 m deep (Pottle and Dadswell 1979); and Hudson River juveniles have been collected over silt substrates in similar depths (Dovel et al. 1992; Haley et al. 1996). Warm summer temperatures (above 28°C) may severely limit available juvenile rearing habitat in some southern rivers. In summer, juvenile habitat in the Altamaha River was limited mainly to one cool, deep water refuge (Flournoy et al. 1992). A similar distribution was observed in the Ogeechee River (Rogers and Weber 1994; Rogers and Weber 1995b; Weber 1996).

In the Connecticut River, where some juveniles and adults are always in freshwater, there was no macrohabitat segregation by age, i.e., both adults and juveniles used the same river reaches (Savoy 1991; Seibel 1993). Radio-tagged adults and yearlings in the Connecticut River show great individuality in choosing microhabitats, but macrohabitat types selected by adults and yearlings are similar (Seibel 1993).

Adults

Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total river length (Connecticut River: Buckley and Kynard

1985a; Savoy and Shake 1992; Savannah River: Hall et al. 1991; Altamaha River: Flouronoy et al. 1992; Delaware River: O'Herron et al. 1993; and Merrimack River: Kieffer and Kynard 1993). In the Connecticut and Merrimack Rivers, the "concentration areas" used by fish were reaches where natural or artificial features cause a decrease in river flow, possibly creating suitable substrate conditions for freshwater mussels (Kieffer and Kynard 1993), a major prey item for adult sturgeon (Dadswell et al. 1984). Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adults and juveniles congregate (Flouronoy et al. 1992; Rogers and Weber 1994; Rogers and Weber 1995b; Weber 1996).

Riverine summer foraging and overwintering have been studied in detail in northern rivers. In the Connecticut River, adult and juvenile summer home ranges are about 10 km. Winter range is usually less than 2 km, with fish overwintering in deep areas, usually within or near the summer range (Seibel 1993). Fish foraging activity is almost equal during day and night. In the summer, foraging adults in the Connecticut River prefer curved or island reaches, not straight runs. Connecticut River sturgeon appear to prefer gravel and rubble substrate in summer, but sand in winter. Most adult sturgeon occur in slightly deeper water during the day than at night. In daytime, sturgeon seek regions with bottom water velocities of 0.25-0.5 cm/s, and illumination levels < 2,555 lx. Seibel (1993) found some shortnose sturgeon to spend all day in the channel and moveto shoal areas at night, while others bahaved oppositely. Both channel and shoal areas are used for foraging in the Saint John and Delaware rivers (Dadswell 1979; O'Herron et al. 1993). In the Connecticut River, relative use of these two habitats by individuals differs (Seibel 1993).

Adult shortnose sturgeon in the Saint John estuary foraged on sand/mud or mud substrate with emergent macrophyte vegetation in 5-10 m depths in summer and overwintered in deep water with mud substrate. Adults captured in freshwater foraged in backwaters of estuarine lakes with aquatic vegetation or on mud substrate along river banks (Dadswell 1979). Kennebec and Androscoggin River adults foraged during the summer in Montsweag Bay, in tidal mud-flats with 18-25 ppt salinity, while tolerating rapid salinity changes (~ 10 ppt salinity/ 2 hours) (McCleave et al. 1977). Other adult sturgeon in the estuary system used shallow and deep tidal channels (salinity of 0- 21 ppt), some of which were surrounded by aquatic vegetation (Squiers and Smith 1979; Squiers et al. 1981).

Reproduction

Length and age at maturity

Length at maturity (45 - 55 cm FL) is similar throughout the shortnose sturgeon's range, but because fish in southern rivers grow faster than those in northern rivers, southern fish mature at younger ages (Dadswell et al. 1984). Males spawn first at 2-3 years in Georgia, 3-5 years in South Carolina, and 10-11 years in the Saint John River, Canada. Females first spawn at 6 years or less in the Savannah River, 7-10 years in the Hudson River, and 12-18 years in the Saint John River (Dadswell et al. 1984). Most shortnose sturgeon probably survive spawning, although there is some post-spawning mortality (B. Kynard, United States Geological Survey, personal observation).

Spawning Periodicity

Spawning periodicity is poorly understood, but males seem to spawn more frequently than females. Dadswell (1979) estimated that Saint John River males spawned at 2-year intervals; females at 3-5 year intervals. Some males in the Hudson River may spawn in successive years (Dovel et al. 1992). Sonic-tagged males spawned during three successive years in the Merrimack River (Kieffer and Kynard 1993). At least some males and females in the Savannah River may spawn in consecutive years but most apparently do not (Collins and Smith 1993).

Spawning behavior

The shortnose sturgeon spawning period is estimated to last from a few days to several weeks. In the Connecticut River, Buckley and Kynard (1985b) found that spawning lasted 2-5 days in 1980-1982, and Kynard (1997) noted that spawning lasted 7-13 days in 1989-1993. Spawning in the Delaware

River lasted 5-17 days (O'Herron et al. 1993). Sturgeon in the Savannah River remained on the spawning grounds for 2-3 weeks (Hall et al. 1991). Altamaha River fish remained on suspected spawning grounds for as long as nine weeks (Rogers and Weber 1995a). Groups of sturgeon in the Connecticut and Merrimack Rivers that were suspected to be spawning consisted of one female and 3-5 males (Buckley and Kynard 1985b; Kieffer and Kynard unpublished data). Males fertilize the female's eggs as the eggs are released close to the substrate. In captivity, males nuzzle the anal and head areas of females, suggesting that females attract males with a chemical attractant (B. Kynard, personal observation).

Spawning Habitat

Information on the location and type of river reach used for spawning is available for many rivers. Microhabitat data is available for spawning sites in the Connecticut and Merrimack Rivers. In populations that have free access to the total length of a river, (e.g., no dam within the species' range in the river), spawning areas are located at the most upstream reach of the river used by sturgeon (Saint John, Kennebec, and Altamaha rivers: Dadswell et al. 1984, Rogers and Weber 1995a; Savannah River: Hall et al. 1991; Delaware River: O'Herron et al. 1993; Merrimack River: Kieffer and Kynard 1993).

Channels are important for spawning in many rivers. Characteristic channel spawning habitats vary slightly among rivers: gravel substrate in the Saint John River (Dadswell 1979); gravel, rubble, and ledge bottom in moderate flow (0.8 m/sec) in the Androscoggin River (Squiers et al. 1993); rubble/boulder substrate in the Merrimack and Connecticut rivers (Kynard 1997); riffles in the Delaware River (O'Herron et al. 1993); in curves with gravel/sand/log substrate in the Savannah River (Hall et al. 1991); and areas near limestone bluffs with gravel to boulder substrate in the Altamaha River (Rogers and Weber 1995a). In the Merrimack River, telemetry studies revealed that spawning males occurred in water 2.3-5.8 m deep and in bottom water velocities ranging from 0.2-0.7 m/sec (mean = 0.4 m/sec; Kieffer and Kynard 1996). In the Connecticut River, radio-tagged females used spawning depths of 1.2-10.4 m deep and bottom water velocities of 0.4-1.8 m/sec (mean = 0.7 m/sec; Buckley and Kynard 1985b; Kynard 1997).

Spawning timing and river conditions

Spawning begins in freshwater from late winter/early spring (southern rivers) to mid to late-spring (northern rivers) when water temperatures increase to 8-9°C. Spawning usually ceases when water temperatures reach 12-15°C (Dadswell et al. 1984; Buckley and Kynard 1985b; Hall et al. 1991; O'Herron et al. 1993; Squiers et al. 1993; Kynard 1997). However, shortnose sturgeon may spawn at higher temperatures. For example, when high river flow conditions delayed spawning in the Connecticut River, shortnose sturgeon had the physiological flexibility to spawn successfully at 18°C (Kynard 1997).

Dadswell (1979) documented spawning from mid-May to mid-June, at the end of the spring freshet, in the Saint John River. Spawning in the Connecticut and Merrimack rivers occurs from the last week of April to mid-May; well after peak spring flows but in moderate, decreasing river discharge (Taubert 1980; Buckley and Kynard 1985b; Kynard 1997). The pattern in the Hudson River appears similar (Dovel et al. 1992). In general, spawning occurs earlier in the year in southern rivers and at moderate river discharge levels (relative to northern rivers). For example, spawning occurs in early-February to mid-March in the Savannah River (Hall et al. 1991)

Physical factors affecting spawning success

High river flows during the normal spawning period can cause unacceptably fast bottom water velocities and prevent females from spawning. This situation was observed in the Connecticut River in early May of 1983 and 1992 when flow was higher than normal and temperature was lower than normal, but still adequate for spawning. (Buckley and Kynard 1985b; Kynard 1997). Buckley and Kynard (1985b) speculated that the reproductive rhythm of females may be under endogenous control and suitable river conditions must be available or endogenous factors prevent females from spawning. Thus, reproductive success depends on suitable river conditions during the spawning season.

Growth

Growth of juvenile shortnose sturgeon is fast throughout the species' range (Dadswell et al. 1984). YOY are 14 - 30 cm TL after the first year. Fish reach 50 cm after only 2-4 years in the southern part of the range. In the Saint John River, juvenile growth is in two stages: slower growth during 1- 9 years and more rapid growth for 10 - 11 year olds — the age when stugeon begin to use more productive estuarine areas.

Dadswell et al. (1984) reviewed growth throughout the shortnose sturgeon's latitudinal range. Fish grow faster in the South, but do not attain the large sizes of northern fish. Adults upstream of the Holyoke Dam in the Connecticut River had the slowest growth rate of any group examined, perhaps because they are unable to use estuarine foraging areas.

Survival and Recruitment

There is no information on survival of eggs or early life stages in the wild. Many eggs reared in captivity die of fungus infections (Dadswell et al. 1984). Richmond and Kynard (1995) maintain that the availability of spawning substrate with crevices is critical to survival of eggs and embryos. Year class strength of shortnose sturgeon populations is probably established early in life, perhaps in the initial few weeks. Although there is no commercial fishery for shortnose sturgeon (and thus, no fisheries recruitment information), some fisheries incidentally catch adult sturgeon and poaching impacts all populations to an unknown degree. Savoy and Shake (1992) estimated 2 - 25 adults were taken annually by the Connecticut River fishery for American shad (*Alosa sapidissima*). At least this many sturgeon may be taken illegally each year by sport fishermen in the Connecticut River (B. Kynard personal observation). The length frequency curve for Connecticut River adults is normal, not truncated, so adult mortalities due to fishing may not be a major factor limiting numbers.

Incidental capture of shortnose sturgeon also occurs in gill net fisheries in the southern portion of the shortnose sturgeon's range. Gill net fisheries for American shad and trawl fisheries for shrimp (*Penaeus* spp.) in Georgia and South Carolina captured about 2% of a tagged sample of shortnose sturgeon (Collins et al. 1996). The gill net fishery was responsible for 83% of the total shortnose sturgeon captures. Moser and Ross (1993) reported that 4 of 7 telemetered adult sturgeon in the Cape Fear River were captured in the gill net fishery for American shad or striped bass (*Morone saxatalis*). In addition, recent apprehension of poachers operating in South Carolina indicates that illegal directed take of shortnose sturgeon in southern rivers may be a significant source of mortality (D. Cooke, personal communication).

Natural mortality

Estimates of total instantaneous mortality rates (Z) are available for several river systems. Dadswell (1979) estimated Z to be between 0.12 and 0.15 for shortnose sturgeon (ages 14 through 55) in the Saint John River, New Brunswick, Canada. The fishing mortality rate (F) for the Saint John River was estimated to be 0.012, which would result in a natural mortality rate (M) of 0.11 to 0.14. Taubert (1980) estimated Z to be 0.12 for adult shortnose sturgeon in the Holyoke Pool portion of the Connecticut River. It is likely that F is very low in this population, so the natural mortality rate is probably very close to Z. Total mortality for the Pee Dee-Winyah River in South Carolina was estimated at 0.08 to 0.12 (Dadswell et al. 1984). All of the above estimates were based on catch curves which were adjusted for gill net selectivity and effort. Using catch curves and Hoenig's technique, total instantaneous natural mortality (M) for shortnose sturgeon in the Connecticut River estuary was estimated to be 0.13 (T. Savoy, Connecticut Department of Environmental Protection, personal communication).

Annual egg production

Annual egg production is determined by the fecundity of females and the number of spawning females. Estimates of egg production from the Saint John River indicated that approximately one-third of the females matured annually (4,000) and mean fecundity per female was 94,000 eggs (Dadswell 1979). More detailed analysis indicates that this situation is more complicated. Monitoring of spawner abundance in the Connecticut River indicated that abundance varies greatly from year to year: in 1992 there were 47 spawners, while in 1993, 98 spawners were detected (Kieffer and Kynard unpublished data). Further, it appears that not every mature female spawns successfully. In the Connecticut River, one of four female shortnose sturgeon removed for egg culture in 1988 could not spawn due to a tumor (B. Kynard, personal observation). Smith et al. (1992) also suggested that spawner abundance in the Savannah River can fluctuate greatly from year to year. This information indicates that the number of eggs spawned annually varies greatly (possibly by several magnitudes) over the species' range and complicates estimation of annual egg production.

Fecundity and sex ratio

Gonadal maturity and fecundity of females were characterized by Dadswell (1979) for the Saint John River, Canada. Just prior to spawning, egg diameter was 3.1 mm and the ovaries composed 25 percent of the body weight. The number of eggs released ranged from 27,000 to 208,000 (11,568 eggs/kg body weight).

In the Connecticut River females are much less mobile and less subject to capture in nets than males, making estimation of sex ratios difficult (Buckley and Kynard 1985b; Kieffer and Kynard unpublished data). Males were most abundant in the available estimates for the Hudson River (2.5:1, Pekovitch 1979), Connecticut River (3.5:1, Taubert 1980; and 3 to 7:1, Buckley and Kynard 1985b), and

Savannah River (3.5:1, Collins and Smith 1997).

Migration and Movements

Movement patterns in shortnose sturgeon vary with fish size and home river location (Figures 2 and 3). Juvenile shortnose sturgeon generally move upstream in spring and summer and move back downstream in fall and winter; however, these movements usually occur in the region above the saltwater/freshwater interface (Dadswell et al. 1984; Hall et al. 1991). Adult shortnose sturgeon exhibit freshwater amphidromy (i.e., adults spawn in freshwater but regularly enter saltwater habitats during their life) in some rivers in the northern part of their range but are generally estuarine anadromous in southern rivers (Kieffer and Kynard 1993). While this species is occasionally collected near the mouths of rivers, shortnose sturgeon are not known to participate in coastal migrations (Dadswell et al. 1984).

Spawning migrations are apparently triggered when water temperatures warm above 8°C (Dadswell et al. 1984). Consequently, spring spawning migrations occur earlier in southern systems than in northern ones (Figures 2 and 3): January-March (Altamaha River: Gilbert and Heidt 1979, Rogers and Weber 1995a; Savannah River: Hall et al. 1991; Pee-Dee/Waccamaw Rivers: Dadswell et al. 1984; Cape Fear River: Moser and Ross 1993), late March (Delaware River: O'Herron et al. 1993), and April-May (Hudson River: Dovel 1979; Holyoke Pool: Taubert 1980; Androscoggin/Kennebec Rivers: Squiers et al. 1982; Merrimack River: Kieffer and Kynard 1993). In the lower Connecticut and Saint John rivers, most of the ripening shortnose sturgeon migrate to their spawning grounds in August-October and remain near the spawning areas (i.e., overwinter) until spring (Dadswell 1979; Buckley and Kynard 1985a). Kieffer and Kynard (1993) hypothesized that these pre-spawning adults migrate in fall to avoid long upstream migrations during high discharge periods in spring. In the Altamaha River, Rogers and Weber (1995a) also documented upstream movement of most adults to suspected spawning grounds in autumn (late November - early December). A second spawning migration occurred in that system during mid-winter (late January - early February).

A shortnose sturgeon spawning migration is characterized by rapid, directed and often extensive upstream movement. Hall et al. (1991) tracked adults during pre-spawning upstream migrations of up to 200 km in the Savannah River and Dadswell et al. (1984) noted that migrations of 160 and 193 km occur in the Saint John and Altamaha rivers, respectively. Telemetry studies have documented maximum ground speeds of 20-33 km d^{-1}, although mean ground speeds during riverine spawning migrations were around 16 km d^{-1} (Buckley and Kynard 1985a; Hall et al. 1991; Moser and Ross 1993). Both Hall et al. (1991) and Moser and Ross (1993) observed that spawning migrations are easily interrupted by capture and handling or by dams. Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in spring and localized, wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985a; O'Herron et al. 1993). Shortnose sturgeon usually leave the spawning grounds soon after spawning. Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Post-spawning migration rates range from 3.5-36 km d^{-1} (Buckley and Kynard 1985a; Hall et al. 1991; Kieffer and Kynard 1993). During these movements shortnose sturgeon apparently move singly and "home" to very specific sites (Dadswell et al. 1984; Kieffer and Kynard 1993; Savoy and Shake 1992).

Continuous tracking of shortnose sturgeon provides detailed information on their migratory behavior. Moser and Ross (1994) demonstrated that, in the Cape Fear River estuary, upstream spawning migration in saltwater was slower (10 km d^{-1}) than migration in freshwater (15 km d^{-1}). This was due to the saltatory nature of movement in the estuary and faster swimming (0.8 body lengths (BL) s^{-1}) in freshwater than in the estuary (0.6 BL s^{-1}). Estimated swimming speed during summer, 0.07-0.37 BL s^{-1}, is considerably slower than during spawning migrations (McCleave et al. 1977), while shortnose sturgeon are even less active in winter (Seibel 1993). Moser and Ross (1994) and McCleave et al. (1977) estimated swimming speed to be greatest when sturgeon oriented against rapid ebbing currents. Moser and Ross (1994) and McCleave et al. (1977) reported that shortnose sturgeon do not display any diel activity pattern, traveled in the upper part of the water column (within 2 m of the surface), and that their movement was apparently unaffected by temperature and salinity.

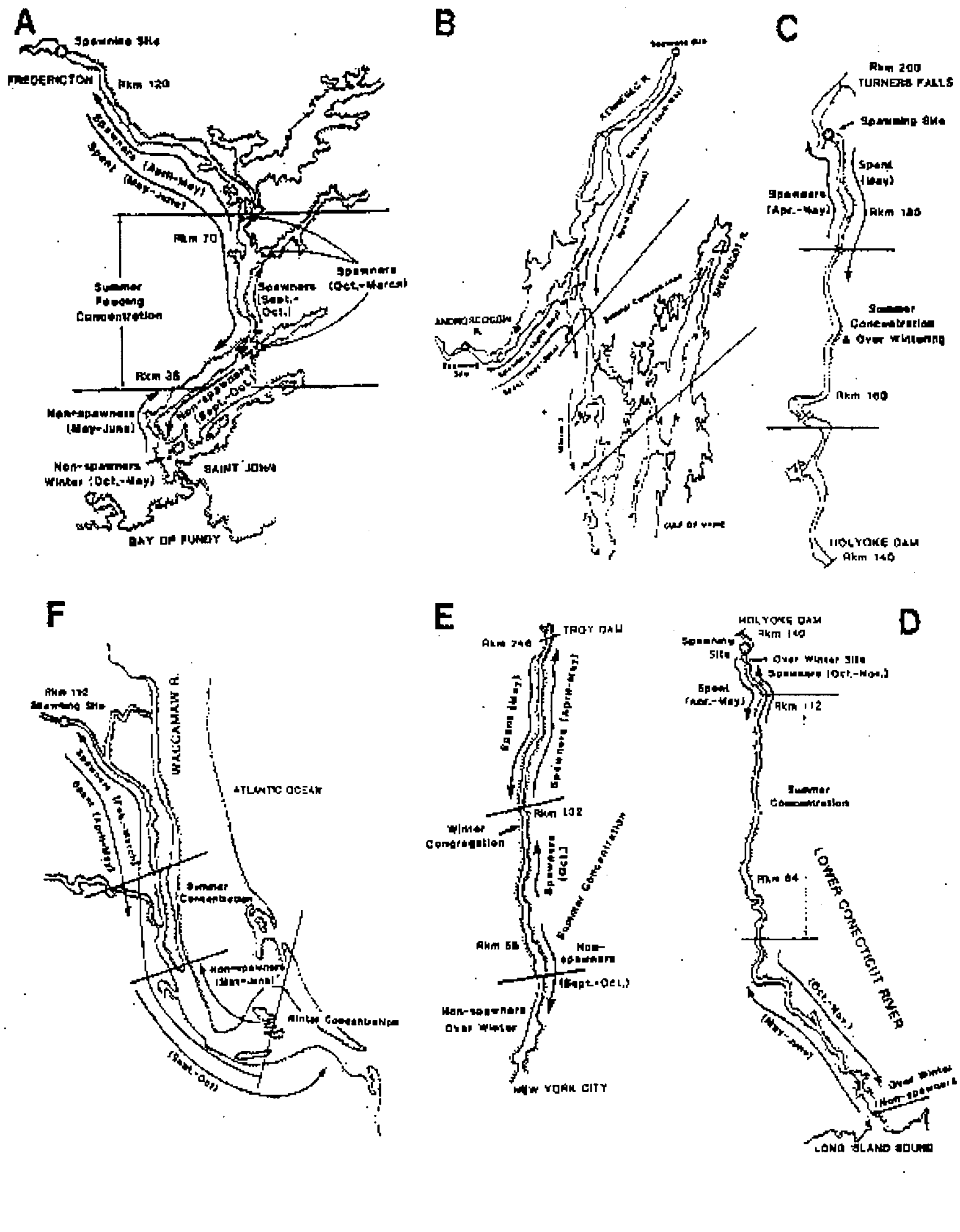


Figure 2. Migration patterns of shortnose sturgeon in the following rivers: A) Saint John (Canada), B) Kennebec, C) Holyoke Pool, Connecticut D) Lower Connecticut, E) Hudson, and F) Pee Dee. (from Dadswell et al. 1984).

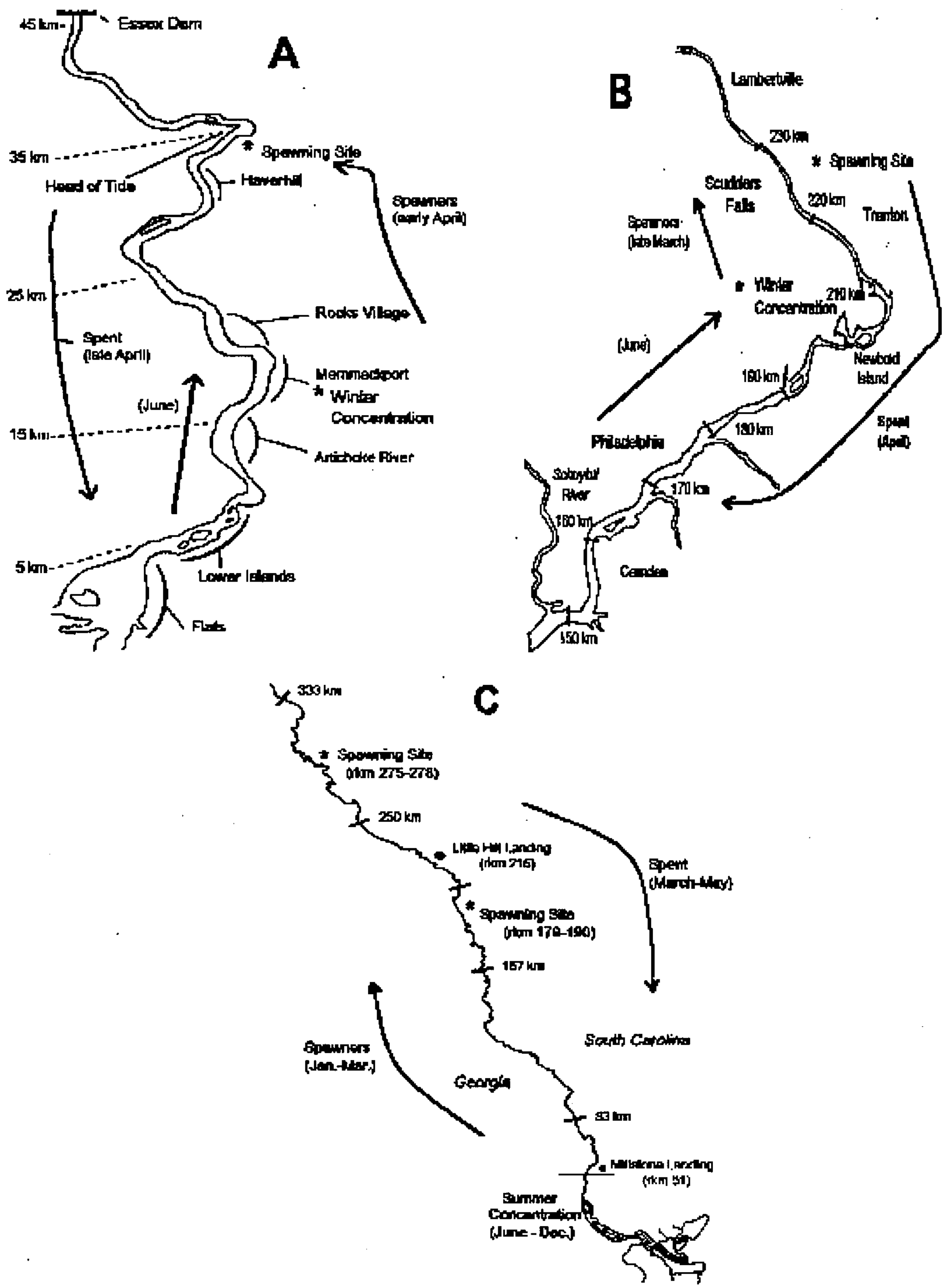


Figure 3. Recently documented migration patterns of shortnose sturgeon in the following rivers: A) Merrimack (Kieffer and Kynard 1993), B) Delaware (O'Herron et al. 1993), and C) Savannah (Hall et

al. 1991).

Feeding

Shortnose sturgeon are benthic omnivores but have also been observed feeding off plant surfaces (Dadswell et al. 1984). Based on the high incidence of non-food items in juvenile shortnose sturgeon, Dadswell et al. (1984) concluded that juveniles randomly vacuum the bottom while adults are more selective feeders. Dadswell (1979) determined that adult shortnose sturgeon in the Saint John River are not opportunists and only switch to other prey when preferred foods are unavailable. The presence of food in the gut during all times of day indicated that shortnose sturgeon are continuous feeders (Dadswell 1979).

Shortnose sturgeon feed on crustaceans, insect larvae, worms, and molluscs; however, they apparently undergo ontogenetic shifts in preferred foods. Insect larvae (*Hexagenia* sp., *Chaoborus* sp., *Chironomus* sp.) and small crustaceans (*Gammarus* sp., *Asellus* sp., *Cyathura polita*) predominate in the diet of juveniles (Dadswell et al. 1984; Carlson and Simpson 1987) while adults feed primarily on small molluscs (Dadswell 1984; Hastings 1983). Molluscs ingested by adults captured in freshwater include *Physa* sp., *Heliosoma* sp., *Corbicula manilensis*, *Amnicola limnosa*, *Valvata* sp., *Pisidium* sp., and small *Elliptio complanata* (Dadswell et al. 1984). In saline areas molluscan prey include small *Mya arenaria*, and *Maçoma balthica* (Dadswell 1979). A recent sturgeon food habits study in the Hudson River revealed that adult shortnose sturgeon prey include gammarid amphipods and zebra mussels (*Dreissena polymorpha*) (Haley, in press).

Shortnose sturgeon feeding patterns vary seasonally between northern and southern river systems. In the Connecticut River, foraging occurs in the summer in freshwater and saline reaches of the river (Buckley and Kynard 1985a; Savoy and Shake 1992). In the Saint John River estuary, summer foraging grounds consist of highly-vegetated, shallow freshwater regions while feeding occurs over sand-mud bottoms in the lower estuary during fall, winter and spring (Dadswell 1979). Females in this system fast during the eight months before spawning but ripening males continue to feed. In contrast, probable foraging activity in southern rivers have been described at the saltwater/freshwater interface during fall and winter in the Pee Dee and Savannah rivers (Dadswell et al. 1984; Hall et al. 1991) and just downstream of the saltwater/freshwater interface in the Altamaha and Ogeechee rivers (Rogers and Weber 1995a; Weber 1996). During summer, shortnose sturgeon in these southern systems appear to reduce activity, fast, and lose weight (Dadswell et al. 1984; Rogers et al. 1994).

Predators, Parasites, and Diseases

There is very little documentation of predation on any life stage of shortnose sturgeon. Young-of-the-year shortnose sturgeon (approximately 5 cm FL) were found in the stomachs of yellow perch (*Perca flavescens*) in the Androscoggin River, Maine (Dadswell et al. 1984). It is likely that sharks and seals may occasionally prey on shortnose sturgeon based on the occasional specimen lacking a tail (Dadswell et al. 1984).

A list of known parasites can be found in Table 4. The degree of infestation has been reported as being quite low with the exception of *Capillospirura* sp. (Dadswell et al. 1984). Sturgeon do not appear to be harmed by these parasites.

There have been no reported incidences of disease for shortnose sturgeon in the wild although an epizootic of *Columnaris* sp. occurred at the FWS' Orangeburg Hatchery in South Carolina (Willie Booker, FWS, South Carolina, personal communication).

Table 4. Parasites recorded from shortnose sturgeon

Group and species	Parasite location	Capture locality	Source
Coelenterata			
Polypodium sp.	Eggs	Saint John River[1]	Hoffman et al (1974)
Platyhelminthes	Gills	Saint John River	Appy and Dadswell (1978)
Diclybothrium armatum			
Spirochis sp.	Mesenteric blood vessels	Saint John River	Appy and Dadswell (1978)
Nitzschia sturionis	Gills	NY Aquarium (may be unnatural infection)	MacCallum (1921)
Nematoda			
Capillospirura pseudoargumentosus	Gizzard	Saint John River	Appy and Dadswell (1978)
Acanthocephala			
Fessesentis friedi	Spiral valve	Saint John River	Appy and Dadswell (1978)
Echinorhynchus attenuatus	?	Woods Hole	Sumner et al. (1911)
Hirudinea			
Calliobdella vivida	External	Connecticut River	Smith and Taubert (1980)
Piscicola milneri	External	Connecticut River	Smith and Taubert (1980)
Piscicola punctata	External	Connecticut River	Smith and Taubert (1980)
Arthropoda			
Argulus alosa	External	Saint John River	Appy and Dadwell (1978)
Pisces			
Petromyzon marinus	External	Saint John River	Dadswell (pers. obs.)

[1]Saint John River, N.B., Canada (Dadswell et al, 1984)

FACTORS AFFECTING RECOVERY

The FWS identified pollution and overharvesting in commercial fisheries as reasons for initially listing shortnose sturgeon as endangered under listing criteria set forth in the Endangered Species Conservation Act of 1969 (USDOI 1973). Many aspects of shortnose sturgeon biology and environmental tolerances are poorly understood, presumably because the sturgeon's endangered status limits access to study animals. As a result, there is much speculation about the factors that affect recovery of shortnose sturgeon populations yet not much conclusive evidence. However, as discussed below, we can identify various activities that, left unchecked, may contribute to the further decline and impede recovery of shortnose sturgeon. Several features of the species' natural history including delayed maturation, non-annual spawning (Dadswell et al. 1984; Boreman 1997), and long lifespan affect the rate at which recovery can proceed. Observable differences in population sizes, whether increases or decreases, will be difficult to quantify due to these characteristics.

Through Section 7 consultations, mandated by the Endangered Species Act, federal agencies are required to assess the impact(s) of federal projects on shortnose sturgeon. Projects that may adversely affect sturgeon include dredging, pollutant or thermal discharges, bridge construction/removal, dam construction, removal and relicensing, and power plant construction and operation. As a result of Section 7 consultations, the NMFS has obtained some valuable information regarding the extent to which these projects may affect shortnose sturgeon. In many cases, however, data are inconclusive in establishing any direct relationships between project activities and biological impacts to sturgeon populations. The following is a summary of the best available information regarding influences on sturgeon recovery throughout the species' range.

Commercial and Recreational Fishing

Directed harvest of shortnose sturgeon is prohibited by the ESA. However, shortnose sturgeon are taken incidentally in other anadromous fisheries along the east coast and are probably targeted by poachers throughout their range (Dadswell 1979; Dovel et al. 1992; Collins et al. 1996). Commercial and recreational shad fisheries operating in the Merrimack, Connecticut, Hudson, Delaware, Cape Fear, and various rivers in South Carolina and Georgia are known to incidentally capture shortnose sturgeon. Collins et al. (1996) reported that the shad gillnet fishery acccounted for 83% of shortnose sturgeon takes (n=10) in Georgia coastal fisheries. In northern rivers, state biologists estimate the number of lethal takes to approximate 20 fish per year (T. Savoy, CT Department of Environmental Protection, personal communication; A. Kahnle, New York State Department of Environmental Conservation, personal communication; T. Squiers, Maine Department of Marine Resources, personal communication). In the Saint John River estuary, shortnose sturgeon are taken incidentally in shad, salmon, striped bass, and alewife fisheries. In most cases fish are returned to the river, presumably unharmed. Moser and Ross (1993) found that captures of shortnose sturgeon in commercial shad nets disrupted spawning migrations in the Cape Fear River, and Weber (1996) reported that these incidental captures caused abandonment of spawning migrations in the Ogeechee River, Georgia.

Sturgeon may be most prone to capture during their spring spawning migration which coincides with the shad fishing season. In fall and winter, sturgeon congregate in deep depressions of river where there is little commercial fishing activity, although poaching probably occurs all year. While the impacts of poaching to individual population segments is unknown, this threat may be significant in some rivers. In 1995, two South Carolina fishermen were apprehended with five pounds of shortnose sturgeon roe and two live gravid fish (D. Cooke, S.C. Dept. of Natural Resources, Bonneau, S.C., personal communication). Poaching may be more prevalent where legal markets for sturgeon exist from importations, commercial harvest, or commercial culture.

Bridge Construction/Demolition

Bridge construction and demolition projects may interfere with normal shortnose sturgeon migratory movements and disturb sturgeon concentration areas. During construction of a new bridge upstream of sturgeon spawning habitat in the Connecticut River, concerns were raised that fine sediments emanating from the construction site might build up in the downstream spawning site and impair egg survival. In that instance, concerns were abated after it was demonstrated that fine sediments are cleanly dislodged from the spawning site during the high spring flood (N. Haley, NMFS, personal communication).

Bridge demolition projects may include plans for blasting piers with powerful explosives. Unless appropriate precautions are made to mitigate the potentially harmful effects of shock wave transmission to physostomous (i.e., air-bladder connected to the gut) fish like shortnose sturgeon, internal damage and/or death may result. There are no data available on the effects of blasting on sturgeon. In 1993-1994 the NMFS consulted with the Federal Highway Administration (FHWA) to assess the potential impacts to shortnose sturgeon of demolishing bridge piers in the lower Connecticut River with explosives. The NMFS advised the FHWA to employ several conservation measures designed to minimize the transmission of harmful shock waves. These measures included restricting the work to seasonal "work windows," installing double-walled cofferdams around each pier to be blasted, and dewatering the outer cofferdams. The use of an air gap (e.g., double-wall cofferdam, bubble screen) to attenuate shock waves is likely to reduce adverse effects to shortnose sturgeon and other swimbladder fish (Sonolysts 1994). Blast pressures below which negative impacts to shortnose sturgeon are unlikely to occur are not known. Wright (1982) determined that detonations producing instantaneous pressure changes greater than 100kPa (14.5 psi) in the swimbladder of a fish will cause serious injury or death.

Contaminants

Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) can have substantial deleterious effects on aquatic life including production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989; Sindermann 1994). Ultimately, toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms (Varanasi 1992) like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known (Ruelle and Henry 1992; Ruelle and Keenlyne 1993). Available data suggest that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976).

Although there have not been any studies to assess the impact of contaminants on shortnose sturgeon, elevated levels of environmental contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron et al. 1992; Longwell et al. 1992), reduced egg viability (Von Westernhagen et al. 1981; Hansen 1985; Mac and Edsall 1991), and reduced survival of larval fish (Berlin et al. 1981; Giesy et al. 1986). Some researchers have speculated that PCBs may reduce the shortnose sturgeon's resistance to fin rot (Dovel et al. 1992). Under a statewide toxics monitoring program, the New York State Department of Environmental Conservation analyzed tissues (i.e., fillet, liver, and gonad) from one shortnose sturgeon to determine PCB concentrations. In gonadal tissues, where lipid percentages are highest, the average PCB concentration was 29.55 ppm (Sloan 1981).

Several characteristics of shortnose sturgeon (i.e., long lifespan, extended residence in estuarine habitats, benthic predator) predispose the species to long-term and repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell 1979). In the Connecticut River, coal tar leachate was suspected of impairing sturgeon reproductive success. Kocan et al. (1993) conducted a laboratory study to investigate the survival of sturgeon eggs and larvae exposed to polyaromatic hydrocarbons (PAH's), a by-product of coal distillation. Approximately 5% of sturgeon embryos and larvae survived after 18 days of exposure to Connecticut River coal-tar contaminated sand in a flow-through laboratory system. This study demonstrated that coal-tar contaminated sediment is toxic to shortnose sturgeon embryos and larvae under laboratory exposure conditions (Kocan et al. 1993).

Although there is scant information available on levels of contaminants in shortnose sturgeon tissues, some research on other, related species indicates that concern about effects of contaminants on the health of sturgeon populations is warranted. Detectable levels of chlordane, DDE, DDT,

and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (U.S. Fish and Wildlife Service 1993). These compounds may affect physiological processes and impede a fish's ability to withstand stress. PCBs are believed to adversely affect reproduction in pallid sturgeon (Ruelle and Keenlyne 1993). Ruelle and Henry (1992) found a strong correlation between fish weight
($r = 0.91$, $p < 0.01$), fish fork length ($r = 0.91$, $p < 0.01$), and DDE concentration in pallid sturgeon livers, indicating that DDE concentration increases proportionally with fish size.

Point-source discharges (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) may also contribute to impacts stemming from poor water quality. Compounds associated with discharges, including metals, dioxin, dissolved solids, phenols, and hydrocarbons, can alter the pH of receiving waters, which may lead to mortality, alterations in fish behavior, deformations, and reduced egg production and survival (Heath 1987). Dioxins and furans were detected in ovarian tissues of shortnose sturgeon collected in the Sampit River/Winyah Bay ecosystem (South Carolina). Results showed that 4 out of 7 fish tissues analyzed contained tetrachlorodibenzo-p-dioxin (TCDD) concentrations > 50 ppt, a level which can adversely affect the development of sturgeon fry (J. Iliff, National Oceanic and Atmospheric Administration, Damage Assessment Center, Silver Spring, Maryland, unpublished data). In addition, this study indicated that TCDD concentrations were much more variable in wild shortnose sturgeon than in the hatchery-reared shortnose sturgeon used for reference.

Dams

Hydroelectric dams may affect shortnose sturgeon by restricting habitat, altering river flows or temperatures necessary for successful spawning and/or migration, and causing mortalities to fish that become entrained in turbines. In all but one of the northeast rivers supporting sturgeon populations (the exception being the "damlocked" population above the Holyoke Dam in the Connecticut River), the first dam on the river marks the upstream limit of the shortnose sturgeon population's range (Kynard 1997). In all of these rivers, shortnose sturgeon spawning sites occur just below the dams, leaving all life stages vulnerable to perturbations of natural river conditions (e.g., volume, flow velocity) caused by the dam's operation. Sturgeon appear unable to use some fishways (e.g., ladders) but have been lifted in fish lifts. For example, the Holyoke Dam fish lift in the Connecticut River passed 81 shortnose sturgeon in 20 years (Kynard in press).

An inability to move above dams and use potentially beneficial habitats may restrict population growth. Recent evidence from the Connecticut River (Kynard 1997), and the Cape Fear River (Moser and Ross 1995) suggests that pre-spawning adults may move upstream at a time when fish lifts or locks are not operating. Since sturgeon require adequate river flows and water temperatures for spawning, any alterations that dam operations pose on a river's natural flow pattern, including increased or reduced discharges, can be detrimental to sturgeon reproductive success. Additionally, dam maintenance activities, such as minor excavations along the shore, release silt and other fine river sediments that could be deposited in nearby spawning sites and degrade critical spawning habitat. Based on the cumulative impacts of the Edwards Dam (located below head-of-tide on the Kennebec River), the Maine Department of Marine Resources estimated that removal of this dam would increase production potential of the Kennebec River shortnose sturgeon population segment by 11% (NMFS 1996). Under the recent Lower Kennebec River Comprehensive Hydropower Settlement Accord, the Edwards Dam is scheduled to be dismantled in 1999.

Buckley and Kynard (1985a) suspected that the low-head Enfield Dam (Connecticut) was an incomplete barrier to sturgeon movements. Similarly, low elevation dams in the Southeast may also restrict or limit sturgeon access to natural spawning areas. In the Savannah River shortnose sturgeon are known to spawn downstream of the Augusta City lock and dam. A low elevation Lock and Dam on the Cape Fear River apparently blocks upstream migration of that river's shortnose sturgeon population (Moser and Ross 1995).

Dissolved Oxygen

Pulp mill, silvicultural, agricultural, and sewer discharges, which contain elevated temperatures or high biological demand, can reduce dissolved oxygen levels. In addition, reduced water flows resulting from power plant shut downs can produce anoxic conditions downstream (see Cooling Water Intakes/ Power Plant section below). Low oxygen levels (below 5 ppm) are known to be stressful to aquatic life, and presumably, sturgeon would be adversely affected by levels below this limit. Jenkins et al. (1993) found that juvenile shortnose sturgeon experienced relatively high mortality (86%) when exposed to dissolved oxygen concentrations of 2.5 mg/l. Older sturgeon (> 100 days) could tolerate dissolved oxygen concentrations of 2.5 mg/l with < 20% mortality, indicating an increased tolerance for lowered oxygen levels by older fish.

Shortnose sturgeon may be less tolerant of low dissolved oxygen levels in high ambient water temperatures and show signs of stress in water temperatures higher than 28°C (Flournoy et al. 1992). At these temperatures, concomitant low levels of dissolved oxygen may be lethal. In Georgia, several rivers exhibit low oxygen levels (<2.5 mg/l) at the saltwater/freshwater interface, an area that normally aggregates both juveniles and adults (Rogers and Weber 1995b). Extremely low dissolved oxygen levels in the St. Marys and Satilla Rivers may explain the failure to capture shortnose sturgeon during recent sturgeon surveys in these systems (Rogers and Weber 1995b).

Dredging

Maintenance dredging of federal navigation channels can adversely affect or jeopardize shortnose sturgeon populations. In particular, hydraulic dredges (e.g., hopper) can lethally harm sturgeon by entraining sturgeon in dredge dragarms and impeller pumps. NMFS observers documented the take of one Atlantic sturgeon in a hopper dredge operating in King's Bay, Georgia (C. Slay, New England Aquarium, personal communication). In addition to direct effects, dredging operations may also impact shortnose sturgeon by destroying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments. Potential impacts from hydraulic dredge operations may be avoided by imposing work restrictions during sensitive time periods (i.e., spawning, migration, feeding) when sturgeon are most vulnerable to mortalities from dredging activity. In 1991, the National Marine Fisheries Service concluded that an Army Corps of Engineers' (ACOE) maintenance dredging operation in the lower Connecticut River was likely to jeopardize the continued existence of the Connecticut River shortnose sturgeon population. This conclusion was based on the season in which the project was scheduled (early summer), the proposed use of a hydraulic hopper dredge, and in-river disposal within high use feeding areas. To avoid jeopardy, the NMFS recommended that the ACOE use alternative dredge types (i.e., clamshell, hydraulic pipeline) and/or reschedule the project when sturgeon were unlikely to be in the project area.

Several recent events demonstrate that, in addition to hydraulic hopper dredging, other dredging methods may also adversely affect sturgeon. Atlantic sturgeon were killed in both hydraulic pipeline (n=1) and bucket-and-barge operations (n=1) in the Cape Fear River (M.Moser, University of North Carolina-Wilmington, personal communication). Two shortnose sturgeon carcasses were discovered in a dredge spoil near Tullytown, Pennsylvania and apparently killed by a hydraulic pipeline dredge operating in the Delaware River in March, 1996 (B. McDowell, New Jersey Division of Fish and Wildlife, personal communication). Necropsy reports indicated that the skins of both fish were infused with silt — a pattern consistent with fish passing through a hydraulic pipeline dredge (J. Ziskowski, NMFS, personal communication). In early 1998, three shortnose sturgeon were killed by a hydraulic pipeline dredge operating in the Florence to Trenton section of the upper Delaware River (N. Haley, NMFS, personal communication).

Cooling Water Intakes/Power Plants

Shortnose sturgeon are susceptible to impingement on cooling water intake screens. Electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. Power plant construction and operation activities such as excavation, dewatering, and dredging may adversely affect sturgeon habitat by producing excessive levels of turbidity and destroying habitat and prey resources. Without better data on current population sizes, it is not possible to assess the extent to which power plant impacts adversely affect a given sturgeon population.

The operation of power plants in the upper portions of rivers has the greatest potential for directly affecting sturgeon populations because of the increased incidence of entraining younger and more vulnerable life stages. Documented mortalities of sturgeon have occurred in the Delaware, Hudson, Connecticut, Savannah and Santee rivers. Between 1969 and 1979, 39 shortnose sturgeon were impinged at power plants in the Hudson River (Hoff and Klauda 1979). Approximately 160 shortnose sturgeon were estimated to be impinged on intake screens at the Albany Steam Generating Station (Albany, NY) between October 1982 and September 1983 (E. Radle, New York State Department of Environmental Conservation, personal communication). No shortnose sturgeon impingements have been reported at this station since 1985 (LMS 1991).

Eight shortnose sturgeon were discovered on the intake trash bars of the Salem Nuclear Generating (SNG) Station in the Delaware River between June, 1978 and November, 1992 (NMFS 1993). All of these fish were adults ranging from 54 to 99 cm FL. Younger fish can pass through the SNG Station's trash racks and become impinged on travelling screens, although these incidents have not been documented (Nuclear Regulatory Commission (NRC) 1980). Estimated annual losses of shortnose sturgeon due to impingement at the SNG station are between 0 and 11 fish (NRC 1980).

The operation of power plants can have unforeseen and extremely detrimental impacts to water quality. The St. Stephen Power Plant near Lake Moultrie, South Carolina was shut down for several days in June, 1991, when large mats of aquatic plants entered the plant's intake canal and clogged the cooling water intake gates. Decomposing plant material in the tailrace canal coupled with the turbine shut down (allowing no flow of water) triggered a low dissolved oxygen water condition downstream and a subsequent fish kill. The South Carolina Wildlife and Marine Resources Department reported that 20 shortnose sturgeon were killed during this die-off.

Reservoir Operation

The ACOE's operation of reservoirs in major rivers may impact sturgeon by altering natural river flow rate and volume. Unplanned but controlled reservoir releases can diminish or reduce sturgeon spawning success by artificially extending high flow periods during the time when water temperatures reach ideal ranges for spawning. In addition, abrupt termination of high discharge periods during summer can result in lethal anoxic conditions downstream
(P. Kornegay, North Carolina Wildlife Resources Commission, personal communication).

Thermal refuges

During summer months, especially in southern rivers, shortnose sturgeon must cope with the physiological stress of water temperatures that often exceed 28°C. Flournoy et al. (1992) suspected that, during these periods, shortnose sturgeon congregate in river regions which support conditions that relieve physiological stress. In southern rivers where sturgeon movements have been tracked, sturgeon refrain from moving during warm water conditions and are often captured at release locations during these periods (Flournoy et al. 1992; Rogers and Weber 1994; Weber 1996). Gulf sturgeon (*A. o. desotoi*) are reported to fast at high water temperatures and occupy river reaches of the Suwannee River (Florida) near flowing spring heads (Mason and Clugston 1993). Flournoy et al. (1992) suggest that, in the Altamaha River, shortnose sturgeon also seek deep, artesian spring-fed habitats which provide thermal refugia.

Although a relatively new finding, the loss and/or manipulation of these discrete habitats may limit or be limiting population survival, particularly in southern river systems. For instance, Krause and Randolph (1989) report that subterranean aquifers are severly depleted in the Savannah and Ogeechee Rivers (Georgia) and Satilla and St. Marys Rivers (Florida). These systems either exhibit signs of juvenile mortality (Savannah: Collins and Smith 1993; Ogeechee: Rogers and Weber 1994, Rogers and Weber

1995b, Weber 1996) or no longer appear to support shortnose sturgeon populations (Satilla and St. Marys: Rogers and Weber 1995b).

Introductions and Transfers

The effects of introduced species on shortnose sturgeon are unknown. However, the rapid increases in abundance of non-indigenous species (e.g., Asian clams, zebra mussels, blue and flathead catfish) in some rivers is likely to adversely affect sturgeon prey and/or introduce new predators and competitors of shortnose sturgeon. Introductions and transfers of indigenous and nonindigenous sturgeon, intentional or accidental, may threaten wild shortnose sturgeon populations by imposing genetic threats, increasing competition for food or habitat, or spreading diseases. Sturgeon species are susceptible to viruses enzootic to the west coast and fish introductions could further spread these diseases.

RECOVERY

Recovery Strategy

The long-term recovery objective for the shortnose sturgeon is to recover all discrete population segments to levels of abundance at which they no longer require protection under the ESA. Each population segment may become a candidate for downlisting when it reaches a minimum population size that: 1) is large enough to prevent extinction, and 2) will make the loss of genetic diversity unlikely. This minimum population size for each population segment has not yet been determined. Therefore, establishing endangered and threatened population size thresholds is a priority 1 recovery task specified in the succeeding Recovery Narrative section. To achieve and preserve minimum population sizes for each population segment, essential habitats must be identified and maintained, and mortality must be monitored and minimized. Accordingly, other key recovery tasks are to define essential habitat characteristics, assess mortality factors, and protect shortnose sturgeon through applicable federal and state regulations.

Recovery task priorities vary among population segments because not all segments experience the same sets of problems or receive the same level of research. Even though shortnose sturgeon were listed under the ESA over 20 years ago, population dynamics and distribution data are lacking for many population segments. A rangewide genetic assessment and reliable estimates of population size, age structure, and recruitment are needed to review the status of each population segment. In many river systems (e.g., Penobscot, Chesapeake, Satilla, St. Johns) there are relatively recent records of shortnose sturgeon occurrence, but no information on their distribution or abundance levels. Obtaining this information is a high priority for such rivers. In contrast, assessments of growth, reproductive success, and anthropogenic impacts are needed for relatively well-studied population segments (e.g., Delaware, Hudson, Connecticut). Research activities may be important for a single population segment, several population segments, or rangewide. Therefore, the SSRT designed an Implementation Schedule that specifies recovery task priorities for each population segment and suggests recovery tasks which may be conducted most cost-effectively on a rangewide or regional basis.

What follows is a step-down outline for each of the three shortnose sturgeon recovery objectives, a narrative that summarizes the components of each objective, and a summary list of recovery tasks needed to implement objectives. The recovery outline follows a standard format; numbers corresponding to each of the objectives, subobjectives, and recovery tasks denote their place in the outline not their relative priority. Individual recovery tasks are prioritized in the succeeding Implementation Schedule.

Recovery Outline

1. ESTABLISH LISTING CRITERIA

1.1 Determine the size of shortnose sturgeon population segments for listing and evaluate trends in recruitment

- 1.1.1 Genetic considerations
- 1.1.2 Identify variability within shortnose sturgeon population segments
- 1.1.3 Evaluate population segment stability
- 1.1.4 Survey for shortnose sturgeon in rivers where they historically occurred

1.2 Determine minimum habitat for shortnose sturgeon population segments

- 1.2.1 Limiting effects of spawning, rearing, and adult habitats
- 1.2.2 Criteria for essential habitat identification

1.3 Determine maximum allowable mortality for shortnose sturgeon population segments

- 1.3.1 Allowable take authorized by the ESA
- 1.3.2 Guidance for mortality in the case of de-listing

2. PROTECT SHORTNOSE STURGEON POPULATIONS AND HABITATS

2.1 Ensure agency compliance with the ESA

2.2 Reduce bycatch of shortnose sturgeon

- 2.2.1 Minimize the effects of incidental capture of shortnose sturgeon
- 2.2.2 Increase enforcement of the ESA and state fisheries restrictions

2.3 Determine if critical habitat designations are prudent for shortnose sturgeon population segments

2.4 Mitigate/eliminate impact of adverse anthropogenic actions on shortnose sturgeon population segments

2.4.1 Mitigate impacts of modifications to important habitat and other destructive activities

2.4.2 Study the effects of point and nonpoint source pollution on shortnose sturgeon and reduce harmful levels

2.4.3 Identify introduced species and stock transfers that may affect shortnose sturgeon or their habitat and take actions to control or eliminate these threats

2.5 Formulate a public education program to increase awareness of shortnose sturgeon and their status

2.6 Coordinate federal, state, and private efforts to implement recovery tasks

3. REHABILITATE HABITATS AND POPULATION SEGMENTS

3.1 Restore habitats and their functions in the life histories of each population segment

3.1.1 Restore access to habitats

3.1.2 Restore spawning habitat and conditions

3.1.3 Restore foraging habitat

3.1.4 Reduce deleterious contaminant concentrations

3.1.5 Resolve project conflicts that potentially impact shortnose sturgeon or their habitat

3.2 Develop a breeding and stocking protocol for shortnose sturgeon

3.3 Reintroduce shortnose sturgeon into river ecosystems where they have been extirpated

3.4 Assess the need for augmentation

Recovery Narrative

1. ESTABLISH LISTING CRITERIA

Criteria are needed to assess the appropriate listing status of each shortnose sturgeon population segment. Currently, all shortnose sturgeon population segments are listed as endangered. Changes to the listing status of these segments may be warranted based on population characteristics or degree of threats facing individual populations. A shortnose sturgeon population segment will remain listed as long as there is: 1) present or threatened destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific or educational purposes; 3) disease or predation; 4) inadequate existing regulatory mechanisms; or 5) other natural or anthropogenic factors affecting their continued existence (ESA, 1973). The Recovery Team also envisions a three-tier evaluation process to determine a population segment's listing status based on the following biological factors: evaluation of population segment size and dynamics, assessment of essential habitat, and identification of sources of mortality.

1.1 Determine the size of shortnose sturgeon population segments for listing and evaluate trends in recruitment

A minimum population size below which a shortnose sturgeon population segment is in danger of going extinct should be determined (i.e., an endangered threshold). This population size should reflect the reproductive and genetic characteristics of a population segment. Therefore, the threshold should be sufficiently large enough to maintain genetic diversity and avoid extinction. The loss of population heterogeneity may not pose an immediate threat to a population segment, but may limit its ability to cope with future environmental change. A measure of population size, for example, the number of spawning fish, could indicate that a population is below an established threshold and in jeopardy of extinction or genetic damage. Successive estimates of the population segment should be evaluated to determine if the population is above or below the threshold for an endangered population.

A minimum population size below which a shortnose sturgeon population segment is likely to become endangered (i.e., threatened threshold) should also be developed. This threshold should reflect sturgeon reproductive potential and represent a population of sufficient size that levels of natural mortality likely to be experienced by the population segment will not depress the population below the endangered threshold. Consistent with the theoretic grounds for determining this level, the threshold for a threatened population would be suitable for a delisted population with zero harvestable surplus. A formula should be developed to weigh successive estimates of the population to determine if a population is above or below the threshold for a threatened population.

The demographics of a population segment should be examined to determine if the population size is stable or increasing, and if recruitment is sufficient to replace spawners. In the absence of time series fisheries data, it may be necessary to examine successive population estimates and/or single assessments of age structure to judge whether a population segment is stable or increasing.

In summary, the threshold for an endangered population would represent a level below which the population segment is in danger of going extinct, or of sustaining genetic damage that could lead to extinction. The threshold for a threatened population would represent a level where common perturbations would not be expected to send the population below the endangered threshold. Finally, population dynamics data must be considered together with population size estimates to determine whether a population segment is replacing itself or increasing in size.

1.1.1 Genetic considerations

The shortnose sturgeon's genome, reproductive potential, and reproductive success are all considerations in setting thresholds for endangered and threatened population sizes. The endangered threshold should be sufficiently high to avoid catastrophic extinction (Lande 1993; Lynch and Lande 1993), genetic damage due to loss of rare alleles or inbreeding (Nei et al. 1975; Allendorf 1986; Hedrick 1992) or Allee effects (depensation effects at low population density) (Asmussen 1979; Dennis 1989). Thomas (1990) reviewed threatened and endangered population data from several vertebrate species and established general estimates of minimum viable population sizes: abundance levels that "would be likely to permit medium- to long- term persistence." These population sizes may be used in considering thresholds for shortnose sturgeon population segments (NMFS 1996). Determining minimum population sizes for viable populations is an active area of investigation (Thompson 1991; Caughley 1994; National Research Council 1995); the SSRT recommends researching the appropriate thresholds for use with shortnose sturgeon populations.

1.1A* [2] Conduct a rangewide genetic assessment of shortnose sturgeon

1.1B* Determine abundance, age structure, and recruitment of shortnose sturgeon population segments

1.1C* Determine endangered and threatened population size thresholds for shortnose sturgeon population segments

1.1.2 Identify variability within shortnose sturgeon population segments

Shortnose sturgeon productivity varies both spatially and temporally. Thus, population segment size thresholds should be: 1) adjusted according to local population characteristics; and 2) based on models that simulate the variability of shortnose sturgeon populations over time. Although it may be possible to use the same

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[2] a * denotes specific recovery/research tasks associated with recovery objectives

thresholds for several population segments, the best available shortnose sturgeon population model, that incorporates age structure and recruitment data, should be tested on each population segment over a meaningful number of iterations.

1.1.3 Evaluate population segment stability

Techniques should be developed to analyze trends within shortnose sturgeon population segments to determine if population sizes are stable or increasing. These assessments should be based on fisheries independent data and require either successive population estimates and/or analysis of population segment age structure. These data and the population size estimates should be used to conduct a status review for each population segment.

1.1D* Conduct a status review for each population segment

1.1.4 Survey for shortnose sturgeon in rivers where they historically occurred

In some rivers, shortnose sturgeon have been "discovered" in recent years, even though they probably have existed in these systems for some time, but were not captured in routine fish surveys. Sturgeon habitats are difficult to sample and sturgeon are most susceptible to gear types (gillnets, trammel nets) that are seldom used in standardized fish sampling surveys. For these reasons, sampling directed toward the capture of shortnose sturgeon should be conducted in all river systems where they historically occurred but have not been recorded in recent time. This will confirm that the species is extirpated in these systems and not overlooked due to inappropriate sampling.

1.1E* Develop a standardized sampling protocol and determine minimum sampling required to assess presence of shortnose sturgeon

1.1F* Sample for shortnose sturgeon in rivers where they historically occurred

1.2 Determine minimum habitat for shortnose sturgeon population segments

Sizes and recruitment of fish populations are affected by a variety of factors including climate change, variability in annual fecundity, and habitat availability. Given these factors, it is possible that an endangered shortnose sturgeon population segment may regularly exceed the capacity of a habitat area, if the amount of habitat is based on the threshold for an endangered population. In this event, population segment growth would be arrested and there would be little, if any, potential for recovery. Consequently, the recovery team recommends establishing a minimum habitat size that accommodates the life cycle of a de-listed population segment.

1.2.1 Limiting effects of spawning, rearing, and adult habitats

Essential habitat should encompass the habitat requirements of all shortnose sturgeon life stages. For example, habitat and its associated forage base may not limit growth and reproduction of adult fish but the lack of suitable nursery habitat may create a recruitment bottleneck. A complete understanding of shortnose sturgeon habitat requirements and potential habitat limitations is necessary for determining minimum essential habitat for shortnose sturgeon populations.

1.2.2 Criteria for essential habitat identification

Specific criteria must be established for all essential shortnose sturgeon habitats: spawning and rearing sites, feeding locations, and overwintering/summering concentration areas. Recent research indicates that these criteria may differ for southern and northern populations or even for individual drainages. For example, deep thermal refuges may be important habitat for southern population segments but are not necessary for survival of northern populations. Shortnose sturgeon make seasonal movements between spatially separated, but distinct, habitats. Therefore, Geographic Information System (GIS) maps may be important tools for organizing information needed to establish essential habitat characteristics. In particular, the SSRT recommends constructing GIS maps of sturgeon concentration areas based on field observations and physiological requirements (established in the laboratory using cultured fish). Essential habitat zones for each population segment could be identified using these maps.

Shortnose sturgeon inhabit river/estuarine systems that are static in some physical attributes and dynamic in others. For example, units of preferred bottom substrate for spawning are not likely to change rapidly over time, unless dredged or similarly manipulated. Conversely, a required salinity zone that supports preferred foods or provides a physiological refuge may change relative position and extent in response to tidal action and variation in river discharge. Shortnose sturgeon also migrate over great distances in large river systems, occupying some river reaches for a relatively short time. Consequently, essential habitat identification for this species will require careful consideration of many complex variables.

1.2A* Conduct field research (mark-recapture, telemetry, survey sampling, etc.) to document shortnose sturgeon seasonal distribution and map concentration areas to characterize essential habitat

1.2B* Conduct laboratory experiments, using cultured fish, to study behavior patterns, habitat/food preferences, and physiological tolerances

1.2C* Develop criteria to identify essential habitat

1.3 Determine maximum allowable mortality for shortnose sturgeon population segments

The mortality factors for each population segment should be evaluated. If mortality factors are expected to keep a population below the endangered or threatened population threshold, then the population should remain listed. If expected mortality factors are unlikely to reduce a population below a listing status threshold, then the population should be evaluated to determine whether it qualifies for downgrading to threatened or should be delisted. Conversely, de-listed or threatened population segments may require upgrading to endangered status if unforeseen mortality factors push these populations below either the threatened or endangered listing thresholds.

1.3.1 Allowable take authorized by the ESA

Cumulative allowable take, permitted under the ESA, should be reviewed for each listed shortnose sturgeon population segment. The NMFS should insure that allowable take will not significantly affect the recovery of a population segment.

1.3.2 Guidance for mortality in the case of de-listing

Shortnose sturgeon are a long-lived species with limited reproductive potential. The species cannot tolerate the high levels of exploitation associated with sturgeon fisheries at the turn of the century when sturgeon stocks collapsed. Many attributes of shortnose sturgeon life history (e.g., delayed maturation, non-annual spawning, and low fecundity (relative to other fishes)) hinder early detection of population declines and, consequently, limit the effectiveness of retaliative management measures. Therefore, when shortnose sturgeon populations are delisted, fishery managers must acknowledge the potential for sturgeon populations to experience seemingly rapid, precipitous declines in abundance. Further, delisting a shortnose sturgeon population segment should not constitute a mandate for harvest, particularly in cases where opening the fishery in one river could provide a market for fish harvested illegally in other rivers. While healthy sturgeon populations may sustain minimum levels of utilization, directed harvest of shortnose sturgeon should not occur without careful consideration of other sources of sturgeon mortality and characteristics of the species' life history.

1.3A* Assess mortality factors and define take limits for shortnose sturgeon population segments

2. PROTECT SHORTNOSE STURGEON POPULATIONS AND HABITATS

2.1 Insure agency compliance with the ESA

All federal agencies funding, authorizing or conducting activities where shortnose sturgeon occur must fulfill their responsibilities under Section 7(a)(1) and Section 7(a)(2) of the ESA. As a co-administrator of the ESA, the NMFS should insure that the protective actions and regulatory requirements of the ESA safeguard against impacts and mortalities to shortnose sturgeon. The NMFS should inform federal agencies of their responsibilities under the ESA and encourage federal agencies to adopt programs that support shortnose sturgeon recovery. This should include supporting research that identifies potential impacts (to shortnose sturgeon) resulting from specific development projects.

In addition, the NMFS should establish Section 6 cooperative agreements with appropriate states to promote increased state oversight of sturgeon conservation activities and provide a funding resource for state agents to conduct research on shortnose sturgeon. State actions may include identifying shortnose sturgeon habitat within state Coastal Zone Management Plans, promotion of

Best Management Practices to reduce non-point source impacts, and consideration of shortnose sturgeon in State Pollution Discharge Elimination Systems permits to reduce point-source impacts and minimize/eliminate incidental takes.

2.1A* Establish Section 6 Cooperative agreements with states where shortnose sturgeon occur

2.1B* Encourage federal agencies to fulfill their responsibilities under Section 7(a)(1) of the ESA and support conservation programs or research to advance shortnose sturgeon recovery

2.1C* Insure that actions authorized, funded or conducted by federal agencies do not jeopardize the continued existence of shortnose sturgeon, as required by Section 7(a)(2) of the ESA

2.2 Reduce bycatch of shortnose sturgeon

2.2.1. Minimize the effects of incidental capture of shortnose sturgeon

Fisheries that incidentally capture shortnose sturgeon should be identified. Estimates of shortnose sturgeon mortality resulting from incidental capture should be obtained and sub-lethal effects of capture and release should be assessed for each fishery. Based on these results, guidelines should be developed to reduce shortnose sturgeon bycatch mortality and sub-lethal effects. If necessary, the fishery should be regulated to minimize the impacts of capture. For example, impose seasonal or areal limits on problem fisheries (e.g., shad gillnet fishery) to reduce the likelihood of incidental capture, restrict or eliminate certain gear types, and inform fishermen of recommended handling procedures to reduce mortality.

2.2A* Assess shortnose sturgeon mortality from incidental capture and document characteristics of fisheries that impact shortnose sturgeon (gear types, fishing season and location, fishing effort, etc.)

2.2B* Conduct research to determine sub-lethal effects of incidental capture and develop guidelines to minimize bycatch mortality and sub-lethal effects (i.e. reduce soak times, reduce handling time, gear modification, etc.)

2.2.2 Increase enforcement of the ESA and state fisheries restrictions

Section 9 of the ESA prohibits capturing, hunting, injuring, selling or attempting any of the above on shortnose sturgeon, unless covered by one of the ESA's take exemptions. Local enforcement officers should know how to identify shortnose sturgeon, where shortnose sturgeon occur, and in which fisheries or activities they are susceptible to capture or mortality. Genetic analysis of shortnose sturgeon tissue can aid in the identification of sturgeon products that are marketed illegally. Fishery restrictions that protect shortnose sturgeon and the penalties that may result from violations should be widely publicized to discourage the directed take of shortnose sturgeon. Officers of the court should also be alerted to the seriousness of crimes involving endangered species. For example, a U.S. District judge in 1995 sentenced two South Carolina fishermen to home detention and fined each man $500.00 for taking two live shortnose sturgeon and five pounds of roe (D. Cooke, S.C. Dept. of Natural Resources, Bonneau, S.C., personal communication). Such light sentences do not convey the message that Section 9 violations are a serious crime.

2.2C* Increase enforcement of laws protecting shortnose sturgeon

2.2D* Use cultured fish to develop genetic markers to identify illegally-marketed shortnose sturgeon products

2.3 Determine if critical habitat designations are prudent for shortnose sturgeon population segments

For each population segment, critical habitat should be identified and designations promulgated, if prudent, based on generalized criteria and local observations of habitat use (as outlined in 1.2). Periodic surveys of any designated critical habitat should be conducted to confirm shortnose sturgeon use of designated areas. The critical habitat designations should be updated on a 5-year cycle to reflect any changes in sturgeon habitat use (as indicated by field research).

2.3A* Identify and, if prudent, designate critical habitat for shortnose sturgeon population segments

2.3B* Conduct field research to document shortnose sturgeon use of any designated critical habitats and to identify changes in habitat use that would affect critical habitat designations

2.4 Mitigate/eliminate impact of adverse anthropogenic actions on shortnose sturgeon population segments

Human actions that adversely affect shortnose sturgeon include: 1) activities that modify or destroy important habitats and/or kill sturgeon, and 2) introduction of non-native species that disturb ecosystems upon which shortnose sturgeon depend.

2.4.1 Mitigate impacts of modifications to important habitat and other destructive activities

Activities such as dredging, bridge construction, power plant operation, in-river disposal, dam operation and maintenance affect shortnose sturgeon both directly and indirectly (see Factors Affecting Recovery). These activities should be mitigated or eliminated (if possible). For proposed or re-licensed spillways or dams, mitigation may include providing fish passage devices or structure breaches. Blasting should be avoided whenever possible, unless suitable protective measures can be implemented. While dredging and in-river disposal cannot be eliminated in rivers with ACOE Federal Navigation Projects, a number of mitigation alternatives exist: 1) limit dredging windows to non-critical periods, 2) restrict use of in-river disposal sites, and/or 3) use equipment or techniques that minimize impact to sturgeon and their habitat. Effects of entrainment and impingement in river intakes (cooling water, hydroelectric or hydrochemical turbines, dredges, etc.) can be mitigated by requiring adequate screening of intake water or limiting the time period, location, or volume of water withdrawals. Researching all of these impacts will refine and increase the number of mitigation alternatives.

2.4A* Insure that fish passage devices on all proposed and re-licensed structures allow adequate passage of shortnose sturgeon and do not alter migration or spawning behavior

2.4B* Conduct research to assess the direct and indirect effects of blasting, dredging, and in-river disposal on all life stages of shortnose sturgeon

2.4C* Compare impacts of various dredging, blasting and disposal techniques and equipment on shortnose sturgeon and their habitat to minimize the detrimental effects of these activities

2.4D* Conduct research to assess shortnose sturgeon mortality from entrainment and impingement and maximize efforts to obtain scientific information from dead fish

2.4.2 Study the effects of point and nonpoint source pollution on shortnose sturgeon and reduce harmful levels

The degree of organic and inorganic contaminant loads in sturgeon tissue, food, and habitats should be assessed throughout the range of this species. The effects of contaminants (using realistic levels) on shortnose sturgeon growth, survival, and reproduction should be evaluated using cultured shortnose sturgeon. Areas that undergo either acute or chronic hypoxia, which may directly or indirectly impact shortnose sturgeon, should be identified. Point and nonpoint sources of contaminants, nutrient loads, or thermal effluents that significantly lower dissolved oxygen in shortnose sturgeon habitat (i.e., pulp and paper mills, silvicultural and agricultural runoff, power plants, municipal wastewater, etc.) should be reduced or, if possible, removed.

2.4E* Analyze shortnose sturgeon tissue, food items, and sediment/water samples from shortnose sturgeon habitat to assess the degree of contaminant loading

2.4F* Determine the effects of contaminants on shortnose sturgeon growth, survival, and reproduction using cultured fish

2.4G* Collect continuous recordings of dissolved oxygen in shortnose sturgeon habitat to identify the extent and duration of hypoxic events

2.4H* Use cultured shortnose sturgeon to determine the species' tolerance for low dissolved oxygen levels under a variety of temperature and salinity conditions and assess the sublethal effects of hypoxia

2.4.3 Identify introduced species and stock transfers that may affect shortnose sturgeon or their habitat and take actions to control or eliminate these threats

Introduced species and stock transfers that are predators, competitors or parasites of shortnose sturgeon, or that may facilitate the spread of sturgeon diseases, need to be identified. In addition, the incidence of disease in the wild should be assessed for all population segments. If the impacts of non-indigenous species on shortnose sturgeon are significant, efforts should be made to control introductions or transfers of these species and if necessary, eliminate them. In addition, by working with individual states, the risks of proposed introductions of non-native species in the shortnose sturgeon's range can be assessed.

2.4I* Determine the extent of parasitism, disease, competition for resources and direct mortality to shortnose sturgeon resulting from introduced species and stock transfers

2.5 Formulate a public education program to increase awareness of shortnose sturgeon and their status

The NMFS should generate public interest in sturgeon and sturgeon recovery by contacting media outlets, suggesting feature stories, and using existing forums for educating the public (e.g., public aquaria, FWS Partners for Wildlife Program, private foundations). Articles, posters, and pamphlets should be published to increase public knowledge of shortnose sturgeon and their unique and complex life history. This information may include identifiable features of the species, listing status, range, susceptibility to incidental captures, and a number or address to report sightings or captures. Cultured shortnose sturgeon should be placed in aquariums and zoos to increase public awareness of the species and its plight.

2.5A* Educate the public and heighten awareness of shortnose sturgeon issues by printing and distributing articles, posters and pamphlets. Make cultured shortnose sturgeon available to aquariums and zoos

2.5B* Update the public on recovery efforts by working with the media to publish articles featuring shortnose sturgeon research and conservation efforts

2.5C* Work with schools to develop and evaluate educational materials and curricula that introduce students to sturgeons, the river/estuarine environment, and the ESA

2.6 Coordinate federal, state and private efforts to implement recovery tasks

A Recovery Coordinator and a Recovery Implementation Team, or several regional Implementation Teams, should be appointed to stimulate implementation of recovery tasks and focus recovery objectives within specific regions. The Recovery Coordinator should establish a means, or maintain an existing forum (e.g., *Sturgeon Notes*), for communicating shortnose sturgeon research results, management/recovery actions, and availability of recent publications. The Recovery Coordinator will also be responsible for monitoring recovery progress and seeking funds to reach the ultimate goal of de-listing all shortnose sturgeon population segments. The Recovery Coordinator could advance sturgeon conservation by identifying potential funding sources for sturgeon research proposals and investigating long-term strategies to support sturgeon recovery needs. Using the Implementation Schedule, the Recovery Coordinator should bring together researchers seeking funding with agencies responsible for funding proposed research activities.

2.6A* Appoint a Recovery Coordinator and establish regional Recovery Plan Implementation Teams to stimulate implementation of recovery plan objectives among constituents and cooperating agencies

2.6B* Establish a communication network for exchanging research results and highlighting recovery actions

2.6C* Seek funding for shortnose sturgeon recovery activities

2.6D* Complete periodic updates of the Recovery Plan to reflect current status of population segments, factors affecting recovery, and priority recovery objectives

3. REHABILITATE HABITATS AND POPULATION SEGMENTS

3.1 Restore habitats and their functions in the life histories of each population segment

3.1.1 Restore access to habitats

Various barriers (hydroelectric dams, lock-and-dam, etc.) exist on some river mainstems presently inhabited by shortnose sturgeon. These facilities can prevent adult fish from reaching historical upstream spawning habitat and injure adults and juveniles during downstream migration. Providing access to habitats and minimizing delay and injury of migrants at both operating and abandoned facilities should be a priority. Restoring access to habitats may involve removal of abandoned barriers or providing up- and downstream fish passage facilities.

3.1A* In each river, identify natural migration patterns of each life stage and any barriers to movement between habitats. Devise methods to pass shortnose sturgeon above/below existing barriers

3.1.2 Restore spawning habitat and conditions

The amount and timing of river discharge is regulated by facilities on many rivers; that is, flows during spawning may not be natural. As spawning timing and locations are identified in these regulated rivers, flows that create acceptable spawning conditions should be maintained during the spawning period. Thus, the operating plans for hydroelectric generating facilities and flood storage reservoirs should include special conditions to protect shortnose sturgeon.

Mainstem rivers are continually impacted by point and non-point activities that increase sediment levels entering rivers. Spawning substrate should be protected from activities that can degrade substrate composition (e.g., fine sediment level increases and reduction of crevices). When prevention fails and substrate is degraded, natural rehabilitation or artificial rehabilitation should be evaluated using appropriate methods (regulated flows or addition of new material).

3.1B* Examine the relationships between river discharge level (and the correlated bottom water velocity), substrate type, and shortnose sturgeon spawning success

3.1C* Investigate the relationship between spawning substrate characteristics and shortnose sturgeon reproductive success. Conduct field experiments that: (1) evaluate the ability of natural river discharge to remove sediment and debris from spawning substrate; and (2) evaluate the acceptability of artificial substrate to spawning females

3.1D* Restore flows, in regulated rivers, during spawning periods to promote spawning success and rehabilitate degraded spawning substrate

3.1.3 Restore foraging habitat

Activities that can alter substrate type, such as damming, dredging, bridge construction, etc., can degrade foraging habitat. Basic knowledge of diet and feeding for all life stages is needed to assess the importance of feeding stations and movement between them (i.e., downstream movement of northern fish to saline areas in May-June). If foraging habitat is lost, activities should be modified to enable natural rehabilitation. If natural rehabilitation is impossible, suitable habitat restoration manipulations should be implemented.

3.1E* Investigate satisfactory methods for examining diet

3.1F* Determine rangewide diet, foraging ecology and growth, for each shortnose sturgeon life stage. In populations with poor growth, examine foraging habitat characteristics and conduct experimental manipulations, if appropriate, to restore habitat

3.1.4 Reduce deleterious contaminant concentrations

The levels of contaminants in shortnose sturgeon should be evaluated. Additionally, the identification of harmful contaminants and the specific levels at which contaminants are deleterious to sturgeon should be a research focus. Presently, there is insufficient information to develop recovery actions relative to many contaminants. In southern rivers, oxygen-demanding contaminants may limit over-summering habitat. Although there is sufficient information to model loading of oxygen-demanding contaminants in many rivers (e.g., Savannah, Ogeechee, Satilla, St.

Marys), continued research on these substances is necessary. Recovery actions to reduce loading of oxygen-demanding contaminants in the above-listed systems should be a high priority.

3.1G* If contaminants are directly or indirectly responsible for loss of shortnose sturgeon fitness, identify contaminant or oxygen demanding sources and reduce loading.

3.1.5 Resolve project conflicts that potentially impact shortnose sturgeon or their habitat

Management and manipulation of river and estuary ecosystems is the responsibility of several federal agencies whose missions often conflict.

3.1H* Establish consistent operating policies that allow federal agencies to meet mission goals while protecting shortnose sturgeon and their habitats

3.2 Develop a breeding and stocking protocol for shortnose sturgeon

A breeding and stocking protocol is needed to insure that the best possible practices are used in the production of shortnose sturgeon for stocking, when and if NMFS determines that stocking is necessary for recovery purposes. The protocol must be consistent with any NMFS policy on artificial propagation of threatened and endangered species under the ESA. Generally, procedures should follow the "Breeding and Stocking Protocol for Cultured Atlantic Sturgeon" (Atlantic States Marine Fisheries Commission (ASMFC), 1996). Culture practices should duplicate known natural conditions (i.e., mating ratios should involve 3-7 males:1 female, with each male fertilizing a separate portion of the eggs as would occur in the wild). Donor stocks should be carefully selected to best match the life history of fish from the recipient system and minimize impacts of stocked fish that stray into areas where wild shortnose sturgeon occur.

3.2A* Develop a Shortnose Sturgeon Breeding and Stocking Protocol

3.3 Reintroduce shortnose sturgeon into river ecosystems where they have been extirpated

In some river systems shortnose sturgeon may be so rare that a population is functionally extirpated. To guide restoration efforts, the minimum population size below which restoration would be considered needs to be established. If rigorous and appropriate sampling indicate that shortnose sturgeon have been extirpated from a river where they historically occurred, then cultured sturgeon may be re-introduced if sufficient habitat is available for all life stages and if NMFS determines that reintroduction is appropriate. Fish should be cultured using the protocol developed for this species (see 3.2). All stocked fish should be tagged to allow monitoring of survival, movement, and growth. Reintroductions should ONLY be conducted when funds are available to monitor the success of the restoration effort via a carefully designed study that is approved by the NMFS and a Recovery Implementation Team.

3.3A* Use the standardized sampling protocol (1.1E*) to determine whether re-introductions may be needed

3.3B* Determine minimum population size below which restoration may be considered

3.3C* Monitor survival, movement patterns, distribution, foraging, and reproduction of stocked shortnose sturgeon. Use this information to evaluate the success of population restoration

3.4 Assess the need for augmentation

When a population segment has unusually low abundance of spawning adults or juveniles relative to available critical habitat (as judged by the NMFS or a Recovery Implementation Team), causes for the low abundance should be determined. If the problem is related to a correctable habitat condition, the problem should be remedied in a timely manner to save the population segment from extinction. Short-term stocking of cultured fish should only be used to supplement an existing population when this is the <u>only</u> reasonable manipulation that can prevent loss of the population; that is when the population is in imminent danger of extirpation and/or habitat conditions cannot be improved in a timely manner.

The SSRT recommends that cultured shortnose sturgeon be used to augment existing population segments under very specific circumstances. The tremendous potential for damage to the genetic architecture of existing population segments demands that extreme caution be used in augmentation efforts.

The SSRT supports augmentation <u>only</u> under the following set of conditions: 1) a breeding and stocking protocol, approved by the NMFS, is available to guide breeding and stocking programs; 2) an existing population segment is in imminent danger of extirpation; 3) essential habitats are functional but inaccessible to shortnose sturgeon; 4) an obstruction to movement cannot be removed in time to prevent extirpation; 5) cultured fish from the natal population are available; and 6) short-term stocking is the only reasonable measure to prevent loss of the population segment. These conditions may be met, for example, in cases where physical barriers that could be removed cause total recruitment failure year after year. Any stocking effort must be approved by the NMFS and a Recovery Implementation Team. In contrast to the ASMFC Breeding and Stocking Protocol for Atlantic Sturgeon (1996), stocking of shortnose sturgeon should be conducted for only a brief period to minimize potential effects of stocked fish on the wild stock.

During this time, a high priority should be to minimize or eliminate those factors that caused the low abundance of shortnose sturgeon. All stocked fish must be tagged to allow ease of future identification and allow comparisons of the population dynamics and behavior of stocked fish to wild shortnose sturgeon. This information should then be used to guide any future augmentation programs.

3.4A* Assess the need for augmenting shortnose sturgeon population segments with stocked fish

Recovery Task Summary

The following is a summary list of shortnose sturgeon recovery/research tasks. Tasks are listed in the order in which they appear in the "Recovery Narrative" section and not in order of importance. Tasks are prioritized in the "Implementation Schedule" to reflect rangewide and river specific priority recovery and research needs.

1.1A* Conduct a rangewide genetic assessment of shortnose sturgeon

1.1B* Determine abundance, age structure, and recruitment of shortnose sturgeon population segments

1.1C* Determine endangered and threatened population size thresholds for shortnose sturgeon population segments

1.1D* Conduct a status review for each population segment

1.1E* Develop a standardized sampling protocol and determine minimum sampling required to assess presence of shortnose sturgeon

1.1F* Sample for shortnose sturgeon in rivers where they historically occurred

1.2A* Conduct field research (mark-recapture, telemetry, survey sampling, etc.) to document shortnose sturgeon seasonal distribution and map concentration areas to characterize essential habitat

1.2B* Conduct laboratory experiments using cultured fish to study behavior patterns, habitat/food preferences, and physiological tolerances

1.2C* Develop criteria to identify essential habitat

1.3A* Assess mortality factors and define take limits for shortnose sturgeon population segments

2.1A* Establish Section 6 Cooperative agreements with states where shortnose sturgeon occur

2.1B* Encourage federal agencies to fulfill their responsibilities under Section 7(a)(1) of the ESA and support conservation programs or research to advance shortnose sturgeon recovery

2.1C* Insure that actions authorized, funded, or conducted by federal agencies do not jeopardize the continued existence of shortnose sturgeon, as required by Section 7(a)(2) of the ESA

2.2A* Assess shortnose sturgeon mortality from incidental capture and document characteristics of fisheries that impact shortnose sturgeon (gear types, fishing season and location, fishing effort, etc.)

2.2B* Conduct research to determine sub-lethal effects of incidental capture and provide guidelines to minimize bycatch mortality and sub-lethal effects (i.e. reduce soak times, reduce handling time, gear modification, etc.)

2.2C* Increase enforcement of laws protecting shortnose sturgeon

2.2D* Use cultured fish to develop genetic markers to identify illegally-marketed shortnose sturgeon products

2.3A* Identify and, if prudent, designate critical habitat for shortnose sturgeon population segments

2.3B* Conduct field research to document shortnose sturgeon use of any designated critical habitats and to identify changes in habitat use that would affect critical habitat designations

2.4A* Insure that fish passage devices on all proposed and re-licensed structures allow adequate passage of shortnose sturgeon and do not alter migration or spawning behavior

2.4B* Conduct research to assess the direct and indirect effects of blasting, dredging, and in-river disposal on all life stages of shortnose sturgeon

2.4C* Compare impacts of various dredging, blasting, and disposal techniques and equipment on shortnose sturgeon and their habitat to minimize the detrimental effects of these activities

2.4D* Conduct research to assess shortnose sturgeon mortality from entrainment and impingement and maximize efforts to obtain scientific information from dead fish

2.4E* Analyze shortnose sturgeon tissue, food items, and sediment/water samples from shortnose sturgeon habitat to assess the degree of contaminant loading

2.4F* Determine the effects of contaminants on shortnose sturgeon growth, survival, and reproduction using cultured fish

2.4G* Collect continuous recordings of dissolved oxygen in shortnose sturgeon habitat to identify the extent and duration of hypoxic events

2.4H* Use cultured shortnose sturgeon to determine the species' tolerance for low dissolved oxygen levels under a variety of temperature and salinity conditions and assess the sublethal effects of hypoxia

2.4I* Determine the extent of parasitism, disease, competition for resources, and direct mortality to shortnose sturgeon resulting from introduced species and stock transfers

2.5A* Educate the public and heighten awareness of shortnose sturgeon issues by printing and distributing articles, posters and pamphlets. Make cultured shortnose sturgeon available to aquariums and zoos

2.5B* Update the public on recovery efforts by working with the media to publish articles featuring shortnose sturgeon research and conservation efforts

2.5C* Work with schools to develop and evaluate educational materials and curricula that introduce students to sturgeons, the river/estuarine environment, and the ESA

2.6A* Appoint a Recovery Coordinator and establish regional Recovery Plan Implementation Teams to stimulate implementation of recovery plan objectives among constituents and cooperating agencies

2.6B* Establish a communication network for exchanging research results and highlighting recovery actions

2.6C* Seek funding for shortnose sturgeon recovery activities

2.6D* Complete periodic updates of the Recovery Plan to reflect current status of population segments, factors affecting recovery, and priority recovery objectives

3.1A* In each river, identify natural migration patterns of each life stage and any barriers to movement between habitats. Devise methods to pass shortnose sturgeon above/below existing barriers

3.1B* Examine the relationships between river discharge level (and the correlated bottom water velocity), substrate type, and shortnose sturgeon spawning success

3.1C* Investigate the relationship between spawning substrate characteristics and shortnose sturgeon reproductive success. Conduct field experiments that: (1) evaluate the ability of natural river discharge to remove sediment and debris from spawning substrate; and (2) evaluate the acceptability of artificial substrate to spawning females

3.1D* Restore flows, in regulated rivers, during spawning periods to promote spawning success and rehabilitate degraded spawning substrate

3.1E* Investigate satisfactory methods for examining diet

3.1F* Determine rangewide diet, foraging ecology and growth, for each shortnose sturgeon life stage. In populations with poor growth, examine foraging habitat characteristics and conduct experimental manipulations, if appropriate, to restore habitat

3.1G* If contaminants are directly or indirectly responsible for loss of shortnose sturgeon fitness, identify contaminant or oxygen demanding sources and reduce loading

3.1H* Establish consistent operating policies that allow federal agencies to meet their goals while protecting shortnose sturgeon and their habitats

3.2A* Develop a Shortnose Sturgeon Breeding and Stocking Protocol

3.3A* Use the standardized sampling protocol (1.1E*) to determine whether re-introductions may be needed

3.3B* Determine minimum population size below which restoration may be considered

3.3C* Monitor survival, movement patterns, distribution, foraging, and reproduction of stocked shortnose sturgeon. Use this information to evaluate the success of population restoration

3.4A* Assess the need for augmenting shortnose sturgeon population segments with stocked fish

IMPLEMENTATION SCHEDULE

The Implementation Schedule for the Shortnose Sturgeon Recovery Plan is summarized in the following two relational tables (Table 5 and 6). The first matrix (Table 5) lists all recovery tasks described in the Recovery Objectives section and identifies the agencies with primary responsibility for conducting each task. Cost estimates and probable duration are provided for each task, even though these figures may vary widely depending on where tasks are conducted and if tasks can be combined. Recovery tasks that must be conducted for each population segment or group of population segments are listed in Table 6 and referenced in the "priority" column of Table 5. The priority ranking assigned to each recovery task was based on NMFS Recovery Planning Guidelines, which defines the established priority system (55 FR 24296). Priority 1 tasks are actions "that must be taken to prevent extinction or to identify those actions necessary to prevent extinction." Priority 2 tasks are actions "that must be taken to prevent a significant decline in population numbers, habitat quality, or other significant negative impacts short of extinction." Priority 3 tasks are "all other actions necessary to provide for full recovery of the species."

Many recovery tasks for the Penobscot, Chesapeake, Satillla, St. Marys, and St. Johns population segments are missing priority rankings because very little is known about the status of these population segments. More research on these populations is needed to make an informed assessment of any major threats affecting them and other critical information needs.

Table 5. IMPLEMENTATION SCHEDULE FOR SHORTNOSE STURGEON RECOVERY TASKS

Priority	Task Description	Duration	Responsible	Cost: FY1	FY2	FY3	FY4	FY5	Comments
1	1.1 A Conduct a rangewide genetic assessment	ongoing	NMFS, ASMFC, NBS, States, FWS	100 K	100 K	100K	80 K	80 K	Costs/duration may be less if tissue from all populations is available
1	1.1 C Determine endangered & threatened size thresholds	ongoing	NMFS	30 K					May be determined regionally or by river system
1	1.1 E Develop standardized sampling protocol	ongoing	NMFS	15 K					
1	1.1 F Survey where shortnose sturgeon historically occurred	ongoing in some systems	NBS, NMFS, States, ACOE, FERC, FHWA	?	?	?	?	?	Costs will depend on the number of systems surveyed
1	2.1 C Insure that federal actions do not jeopardize sturgeon	ongoing	NMFS						ESA section 7 consultation, costs depend on proposed actions
Table 6	1.1 B Determine abundance, age structure & recruitment	ongoing	EPA, FERC FHWA, NBS, ACOE, NMFS	?	?	?	?	?	Cost/duration depend on river system, and work already done.
Table 6	1.1 D Conduct status reviews	ongoing	NMFS						No cost. In house NMFS review
Table 6	1.2 A Document distribution & map concentration areas	2 years each	EPA, FWHA, NBS, ACOE, FERC, NMFS	50 K each	50 K each				Conduct with tasks 1.2B, 1.2C, 2.3A
2	1.2 B Use cultured fish to study sturgeon biology	3 years	NBS, NMFS, FWS, States	80 K	80 K	80 K			
2	1.2 C Develop criteria to identify essential habitat	2 years	NMFS						To be conducted in house based on 1.2A and 1.2B
Table 6	1.3 A Assess mortality factors & define take limits	5 years each	NMFS, NBS, States	20 K each	20 K each	20 K each	20 K each	20 K each	Costs primarily associated with assessing mortality factors
2	2.1 B Encourage federal agencies to support conservation programs	ongoing	NMFS						Recovery Coordinator Task
Table 6	2.2 A Assess mortality from incidental capture	ongoing	ASMFC, FWS, States, NMFS	20K each	20 K each	20 K each	20 K each	20 K each	May be conducted regionally
2	2.2 B Research & reduce sub-lethal impacts of incidental take	3 years	NMFS, ASMFC, States, NBS, FWS	50 K	50 K	50 K			May be combined with 2.2A to reduce costs

Priority	Task Description	Duration	Responsible	Cost: FY1	FY2	FY3	FY4	FY5	Comments
2	2.2 C Increase enforcement of laws	ongoing	ASMFC, FWS, States, NMFS						No cost estimate.
2	2.2 D Develop genetic markers	2 years	FWS, NMFS, States	60 K	60 K				
Table 6	2.3 A Identify critical habitat for population segments	2 years each	NMFS, FWS, NBS, States	50 K each	50 K each	50 K each			Cost is for mapping
Table 6	2.4 A Insure that proposed structures provide passage	ongoing	ACOE, FHWA, FERC, NMFS, FWS	?	?	?	?	?	Costs will depend on modifications needed
2	2.4 B Assess impacts of blasting, dredging,& disposal	3 years	ACOE, FHWA, DOT, NMFS, FWS	100 K	100 K	100 K			may cost more depending on methods tested
Table 6	2.4 D Assess mortality from entrainment & impingement	2 years each	FERC, NRC, NMFS, FWS	80 K each	80 K each				
Table 6	2.4 E Analyze contaminant loads in sturgeon tissue & habitat	3 years each	EPA, States, NMFS, FWS	100 K each	100 K each	100 K each			Costs may be reduced if samples are collected from more than one river
2	2.4 F Determine effects of contaminants on sturgeon fitness	5 years +	EPA, States, NMFS, FWS	100 K	100 K	100 K	100 K	100 K	Long term fitness may be difficult to determine, use doses from 2.4E
Table 6	2.4 G Collect continuous dissolved oxygen data	ongoing	States, FERC, NMFS, EPA, ACOE,	30 K each	30 K each	30 K each			May be combined with other studies to reduce costs
2	2.4 H Assess sturgeon tolerance of low dissolved oxygen	ongoing	EPA, NMFS, FWS, ACOE, States	60 K each	60K each	60 K each			Use biologically relevant doses as determined in 2.4G
2	2.6 C Seek funding for recovery activities	ongoing	NMFS						Recovery Coordinator Task
Table 6	3.1 A Identify movement patterns & devise methods for passage	3 years each	NMFS, ACOE, FERC, FWHA, FWS	60 K each	60 K each	60 K each			Costs may be much greater if barriers must be removed
2	3.1 B Assess effects of river discharge on spawning success	3 years	FERC, ACOE, NBS, NMFS, FWS	60 K	60 K	60 K			Costs may be reduced by combining with 3.1C
2	3.1 C Assess effects of substrate on spawning success	3 years	FERC, ACOE, NBS, NMFS, FWS	60 K	60 K	60 K			Costs may be reduced by combining with 3.1B
2	3.1E Investigate methods for examining sturgeon diet	ongoing	NBS, NMFS, States	20 K	20 K				Can be conducted on a regional basis with 3.1F

Priority	Task Description	Duration	Responsible	Cost: FY1	FY2	FY3	FY4	FY5	Comments
2	3.1 F Document diet, foraging ecology, and growth	5 years	NBS, NMFS, States	50 K	50 K	50 K	50 K	50 K	Conduct regionally with 3.1E
3	2.1 A Establish Cooperative Agreements with states	ongoing	NMFS, States						50 K + may be passed yearly to states
Table 6	2.3 B Assess shortnose sturgeon use of any designated critical habitat	3 years each	All state & federal agencies	50 K each	50 K each	50 K each			
Table 6	2.4 C Minimize impacts of dredging, blasting & disposal	ongoing	EPA, ACOE, NMFS, FWHA, FERC, DOT	100 K each	100 K each	100 K each	100 K each	100 K each	Average yearly cost to federal agencies of altering projects
Table 6	2.4 I Determine effects of introduced species and stock transfers	3 years each	FWS, NMFS, NBS, States	60 K each	60 K each	60 K each			Coordinating with other studies of exotic species may reduce costs
3	2.5 A Educate the public & raise awareness of sturgeon issues	ongoing	all state & federal agencies	10 K	10 K	10 K	10 K	10 K	Recovery Coordinator Task
3	2.5 B Update the public on recovery efforts & status	ongoing	All state & federal agencies	10 K	10 K	10 K	10 K	10 K	Recovery Coordinator Task
3	2.5 C Develop sturgeon-related educational materials for schools	1 year	NMFS	20 K					Recovery Coordinator Task
3	2.6 A Appoint Implementation Team/s & Recovery Coordinator	5 years	NMFS	60 K	60 K	60 K	60 K	60 K	GS13 level & 5 K / year for travel
3	2.6 B Communicate research results & recovery actions	ongoing	All state & federal agencies						Recovery Coordinator Task
3	2.6 D Periodically update plan to reflect changes in recovery	ongoing	NMFS						To be conducted in house by NMFS
Table 6	3.1 D Restore flows & rehabilitate spawning substrate	ongoing	FERC, NMFS, ACOE, States	?	?	?	?	?	Depends on results of 3.1B & 3.1C
Table 6	3.1 G Identify contaminant sources & reduce loading	ongoing	EPA, NMFS, FWS, States	?	?	?	?	?	Cost, duration & priority depend on results of 2.4E & 2.4F

Priority	Task Description	Duration	Responsible	Cost: FY1	FY2	FY3	FY4	FY5	Comments
3	3.1 H Allow federal agencies to meet mission goals & protect sturgeon	ongoing	EPA, ACOE, FERC, NMFS						To be conducted in house by NMFS
3	3.2 A Develop a breeding and stocking protocol	ongoing	NMFS						To be conducted in house by NMFS
3	3.3A Assess whether re-introductions should be made	ongoing	NMFS						To be conducted in house by NMFS
3	3.3B Determine minimum population size for restoration	ongoing	NMFS						To be conducted in house by NMFS
3	3.3C Monitor & evaluate success of restoration efforts	5 years each	NMFS, ASMFC, FWS, States	50 K each	50 K each	50 K each	50 K each	50 K each	Culture costs not included
3	3.4 A Assess need for augmentation	ongoing	NMFS						To be conducted in house by NMFS

Table 6. IMPLEMENTATION SCHEDULE: TASK PRIORITIES FOR DISTINCT POPULATION SEGMENTS

Task Description	Saint John	Penobscot	Kennebec	Merrimack	Connecticut	Hudson	Delaware	Chesapeake
1.1 B Determine abundance, age structure & recruitment	done	1	ongoing	1	1	ongoing	ongoing	1
1.1 D Conduct status review			3	3	3	3	3	
1.2 A Document distribution & map sturgeon concentration areas	done	1	ongoing	done	done	ongoing	done	ongoing
1.3 A Assess mortality factors & define take limits	2		2	2	2	2	2	2
2.2 A Assess mortality from incidental capture	2		2	2	2	2	2	2
2.3 A Identify critical habitat for population segments	2		2	2	2	2	2	
2.3 B Assess shortnose sturgeon use of any designated critical habitat	3		3	3	3	3	3	
2.4 A Insure that proposed structures provide passage	2			2	1	3	2	
2.4 C Minimize impacts of dredging, blasting & disposal	2		2	2	2	2	2	
2.4 D Assess mortality from impingement			2	2	2	ongoing	2	
2.4 E Analyze contaminant loads in sturgeon tissue & habitat	2		2	2	2	2	2	
2.4 G Collect continuous dissolved oxygen data			2	2	2	ongoing	2	
2.4 I Determine effects of introduced species	3		3	2	2	2	2	
3.1 A Identify movement patterns & eliminate barriers to movement	done		3	2	1	3	3	
3.1 D Restore flows & spawning substrate			2	1	1	2	2	
3.1 G Identify contaminant sources & reduce loading	2		2	2	2	2	2	

Task Description	Cape Fear	Winyah	Santee	Cooper	ACE	Savannah	Ogeechee	Altamah	Satilla	St. Marys	St. Johns
1.1 B Determine abundance, age structure & recruitment	1	1	1	1	1	1	1	1	1	1	1
1.1 D Conduct status review	3	3	3	3	3	3	3	3			
1.2 A Document distribution & map sturgeon concentration areas	1	1	1	1	1	1	1	1	1	1	1
1.3 A Assess mortality factors & define take limits	2	2	2	2	2	2	2	2			
2.2 A Assess mortality from incidental capture	1	1	1	1	1	1	1	1			
2.3 A Identify critical habitat for population segments	2	2	2	2	2	2	2	2			
2.3 B Assess shortnose sturgeon use of any designated critical habitat	3	3	3	3	3	3	3	3			
2.4 A Insure that proposed structures provide passage	2	2	2	2	2	2	2	2			
2.4 C Minimize impacts of dredging, blasting & disposal	ongoing	2	2	2	2	1	2	2			
2.4 D Assess mortality from impingement	2	2	2	2	2	2	3	2			
2.4 E Analyze contaminant loads in sturgeon tissue & habitat	2	2	2	2	2	2	2	2			
2.4 G Collect continuous dissolved oxygen data	ongoing	1	1	1	1	1	1	1			
2.4 I Determine effects of introduced species	1	2	2	2	2	1	2	2			
3.1A Identify movement patterns & eliminate barriers to movement	1	1	1	1	1	1	3	3			
3.1D Restore flows & spawning substrate	1	2	2	2	2	2	2	2			

Task Description	Cape Fear	Winyah	Santee	Cooper	ACE	Savannah	Ogeechee	Altamaha	Satilla
3.1G Identify contaminant sources & reduce loading	2	2	2	2	2	2	2	2	

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APPENDIX I.

Original Listing Notice for Shortnose Sturgeon
Federal Register 32(48): 4001

APPENDIX II.

Resource Publication 114: Threatened Wildlife of the United States
U.S. Department of Interior, March 1973

Rec 9.3 Ref 15

A Protocol for Use of Shortnose and Atlantic Sturgeons

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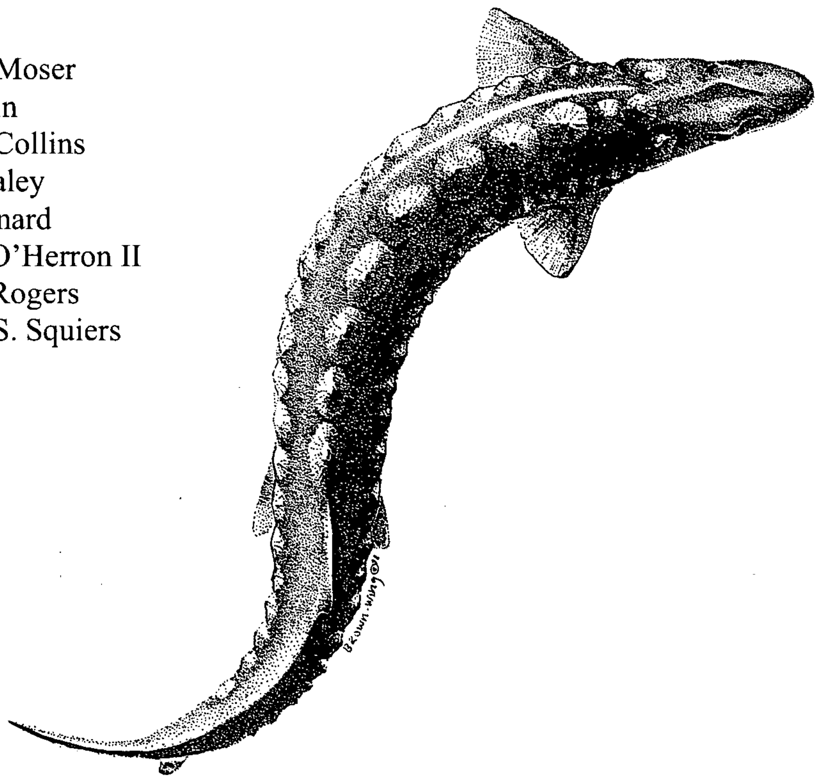

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-OPR-18
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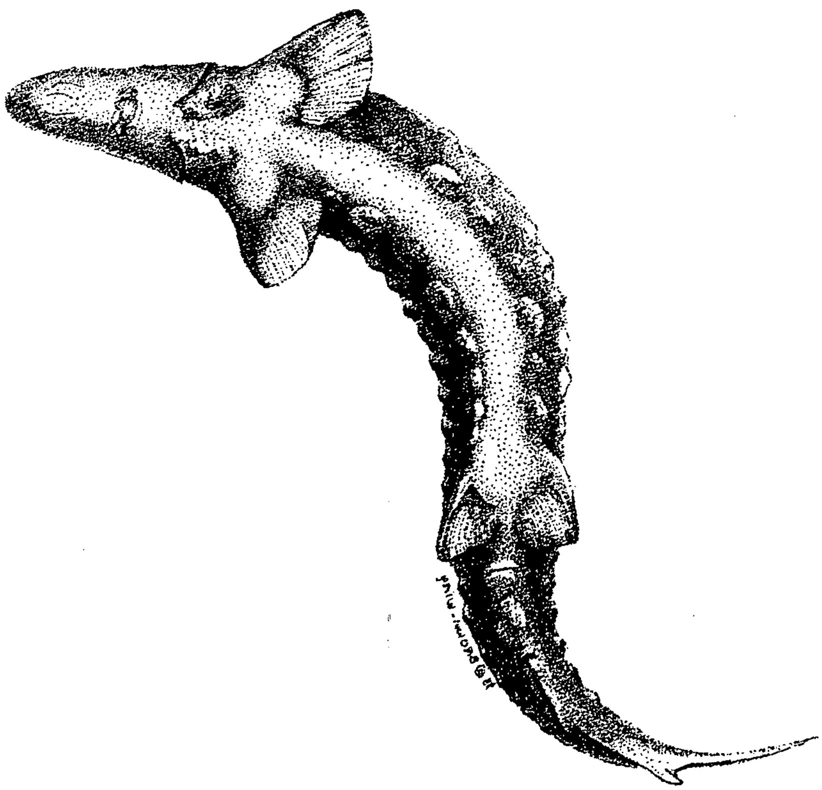

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Abstract

Guidelines for handling and sampling of Atlantic coast sturgeons are needed to protect these fishes and to facilitate standardization of methodologies used by sturgeon researchers. The shortnose sturgeon, *Acipenser brevirostrum*, is a federally listed endangered species and the Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*, is considered a species of special concern. Consequently, special techniques have been developed to reduce stress and mortality resulting from sampling and handling these species. In this document we review the most acceptable methods for short-term holding, identification and measurement, tagging, tissue sampling, gastric lavage, and collection using a variety of gear types. In addition, we provide a protocol for sampling to establish whether shortnose sturgeon are present in systems where their status is unknown.

Introduction

In recent years, a need has developed for standardization of sampling and handling methods for Atlantic coast sturgeons: shortnose (*Acipenser brevirostrum*) and Atlantic (*A. oxyrinchus oxyrinchus*). The shortnose sturgeon has been federally-listed as an endangered species since the Endangered Species Act of 1973. In the past few years the Atlantic sturgeon has been petitioned for listing and has been designated as a candidate species. Because the shortnose sturgeon has been listed for so long, it has been the subject of a relatively large number of research projects; however, this research has been conducted by only a handful of individuals. The Shortnose Sturgeon Recovery Plan (National Marine Fisheries Service 1998) specified the need for a sampling and handling protocol because of: 1) the likely increases in research on sturgeon in future years by a larger number of scientists and the concomitant need for standardization of methods, 2) the need for guidance in permitting research activities that may harm sturgeon, and 3) the need for minimum sampling requirements to determine that sturgeon are extant in a given system.

Sturgeon present some unique challenges for development of standardized methods. Both shortnose and Atlantic sturgeon may occur in a variety of habitats in Atlantic drainages from southern Canada (Saint John River) to northern Florida (St. Johns River). The differences in habitat both within and among river systems, and latitudinal differences in temperature and sturgeon life history, have resulted in sampling methods that are often specific to a given region or time of year. To make this document as comprehensive as possible, we have incorporated methodologies from research conducted across the entire range of habitats where these sturgeons occur and for the all sturgeon life stages that have been studied in the wild. We make no attempt here to suggest methodology for culture or long-term maintenance of sturgeon. In reviewing the literature and incorporating our own experiences in this protocol, we noted that innovations in research occur rapidly. Consequently, we emphasize that this protocol should be a living document that incorporates new techniques as they are developed and perfected. This protocol represents many years of collective experience in sampling and handling sturgeons and should provide useful guidelines for future research. Our intent is not to discourage development of new techniques or to limit or restrict sturgeon research.

Handling Methodologies

Both shortnose and Atlantic sturgeons are very hardy species. The ability of sturgeon to survive under extremely stressful conditions is well established and was exploited during early fisheries for their flesh and roe. The sturgeon's hardy nature also permits the use of research practices that stress these fish, potentially resulting in negative, but sub-lethal, impacts. For example, excessive handling of pre-spawning adults during their migration can result in interruption or even abandonment of upstream migration (Moser and Ross 1995). Moreover, sturgeon are very sensitive to handling during periods of high water temperature or low dissolved oxygen, and sturgeon can be lethally stressed in a short time if handled improperly during these conditions. The following handling protocol therefore includes guidelines for a variety of conditions.

Short-term holding

It is frequently necessary to hold sturgeon for short periods while fishing nets, tagging or collecting tissue samples. If possible, sturgeon should be held in floating net pens or live cars during processing. When fish are held on board the research vessel, they should be placed in flow-through tanks that allow total replacement of the water volume every 15 - 20 min. While total water volume in the tanks is not critical, adequate control of temperature and oxygen levels is absolutely essential. Fish should not be held on board for longer than 2 h when water temperatures are equal to or less than 27°C. If water temperature exceeds 27°C, sturgeon should never be held on board for longer than 30 min. Dissolved oxygen levels below 3 ppm are also stressful to sturgeon (Jenkins et al. 1993). Therefore, oxygenation of the water in holding tanks may be necessary during periods of high temperature or low dissolved oxygen and handling should be minimized. The use of an electrolyte bath (such as Stress Coat, marketed by aquaculture suppliers) can also help to reduce stress and restore the slime coat when fish are collected in fresh water. Sturgeon are very sensitive to chlorine; so, very thorough flushing is required if holding tanks are sterilized with bleach between sampling periods.

Sturgeon are physostomous and tend to inflate their swim bladder when stressed and in air. If this occurs, efforts should be made to return the fish to neutral buoyancy prior to or during release. This can often be achieved by propelling the fish rapidly downward during release. If the fish still has air in its bladder it will float and be susceptible to sunburn or bird attacks. Often the remaining air can be released by gently applying ventral pressure in a posterior to anterior direction.

Identification and measurement

Identification of sturgeon to species, sex and reproductive condition may involve use of both external and internal morphology. Juvenile Atlantic sturgeon and juvenile or adult shortnose sturgeon are easily confused and care should be taken in use of morphological characters for identification. The most consistently accurate external character is the ratio of bony inter-orbital width to mouth width (Moser et al. 1998). Use of other characters such as snout length and scute patterns can be misleading. For weight measurements, sturgeon should be supported using a sling or net and handling should be minimized throughout processing. Use of smooth rubber gloves is recommended to reduce abrasion of skin and removal of mucus.

Neither sturgeon species can be sexed on the basis of external morphology. A close magnifier at the end of a light beam (Bioscope) can be used to distinguish sexes and even to stage eggs without surgery. This instrument is gently inserted through the genital opening and rotated to view the gonads internally. This technique is quick, far less intrusive than surgical procedures, and with experience its use will allow differentiation of females that will spawn during the next spawning period from immature and post-spawned females. However, it cannot provide maturity stage data for males, nor differentiate between males and immature females.

Tagging

The life history, morphology, behavior, and physiology of sturgeons present a plethora of challenges for tagging studies. Sturgeon are long-lived; so, for many studies it is essential that tags be retained for extended periods. In addition, they exhibit very rapid juvenile growth rates and, in the case of Atlantic sturgeon, can achieve very large sizes (> 3 m). Therefore, tags must be retained even as the tag placement area changes size and shape. Moreover, sturgeon are adept at rubbing off external tags and can actually extrude internal tags through the body wall to rid themselves of tags placed in the body cavity (Kynard and Kieffer 1994). Our collective experiences with a variety of tagging methods and materials, in addition to laboratory studies of tag retention, were drawn upon to provide the following recommendations for tagging.

External tags generally have lower retention rates than internal tags, but are often needed in studies that require participation of people other than the researcher (such as tag-recapture studies that rely on tag returns from fishermen). A variety of external tag designs and placement sites have been used on both Atlantic and shortnose sturgeon. The first laboratory studies of tag retention by shortnose sturgeon indicated that Carlin tags placed just below the dorsal fin and internal anchor tags inserted laterally into the abdomen had the highest retention rates of the tags tested (Smith et al. 1990). More than 50 shortnose sturgeon marked with Carlin tags in the Hudson River from 1979-80 were recovered in recent research, indicating that these tags can have long retention times. About half of the tag disks were clearly legible and provided valuable data on fish at large for over 15 years. However, Carlin tag retention in both the Connecticut River and Delaware River has been poor when compared to passive integrated transponding (PIT) and anchor tags, respectively. Anchor tags placed at the base of the dorsal fin in 1981-87 are now being recovered in the Delaware River over a decade later. Collins et al. (1994) tested a variety of external tag designs in the laboratory and found that a T-anchor tag inserted into the lateral abdominal wall provided the greatest retention. However, it was noted that healing of the insertion wound was slow (or did not occur) for all tags that protruded through the skin. While external tags clearly have lower retention than internal tags, anchor tags in the dorsal musculature show the most promise for greatest longevity with least impact to the fish.

A number of sturgeon studies use PIT tags in addition to an external tag. These tags are injected just below the skin along the dorsal mid-line anywhere from the posterior edge of the fourth dorsal scute to the posterior edge of the dorsal fin. Due to the lack of standardization in placement of PIT tags, we recommend that the entire dorsal surface of each fish be scanned with a waterproof PIT tag reader to insure detection of fish tagged in other studies. We note that juvenile Atlantic sturgeon may grow around the PIT tag, making it difficult to get close enough to read the tag in later years. For this reason, the largest (highest power) PIT tags should be used for both sturgeon species, and tags should be placed posterior to the dorsal fin, where tissue growth is least. PIT tags far out perform external tags. However, laboratory studies indicate that sturgeon smaller than 200 mm TL shed PIT tags at a rate of over 50%, due to the lack of musculature at this size. The likelihood of high PIT tag loss should therefore be considered when marking sub-yearling sturgeon.

A variety of methods have been used to outfit sturgeon with sonic or radio transmitters. Due to their large body size, sturgeon can carry large transmitters having extended battery life. Consequently, it is important that these tags be retained for as long as possible. External attachment of the transmitters is the least intrusive method; however, a number of field studies have indicated that both sonic and radio tags are shed at rates of 15 - 60% within the first 4 – 6 mo. of external attachment (Smith 1988, Moser and Ross 1993, Kieffer and Kynard 1993, Rogers and Weber 1995). In a tank study using cultured shortnose sturgeon, externally-attached transmitter loss began on day 2, and 100% were lost by day 60. It was obvious that the sturgeon actively rubbed the transmitters on any available surface.

In spite of the problems with tag loss, only external attachment of transmitters should be used for pre-spawning fish in spring or those on the spawning ground. In addition, surgical implants should not be attempted when water temperature exceeds 27°C (to reduce handling stress) or is less than 7°C (incisions do not heal rapidly in low temperatures). External transmitters are retained longest when they are as small as possible and are attached through the dorsal fin using monofilament line or stainless steel leader and a PVC backing plate (Rogers and Weber 1995). The addition of a neoprene pad between the fish's body and the transmitter or backing plate helps to protect the fish.

Internal implantation of radio or sonic transmitters provides greater retention than external attachment. Radio range is maximized with a trailing antenna, however, there is less chance of infection if the antenna is also implanted internally. In a recent tank study, radio transmitters were surgically implanted in cultured shortnose sturgeon, but the antennas were externally trailing. After 90 days, all of the fish had openings around the antenna exit area and were still bleeding or obviously infected. In some cases the antenna had cut large wounds through the abdominal wall and the transmitter and internal organs were visible. Field trials using this method of attachment indicated less significant impacts to wild shortnose sturgeon in the upper Connecticut River. Eight fish tagged internally with transmitters having a trailing radio antenna were recaptured after 12 months at large. While the tissue at the antenna exit area was darkened, there was no sign of infection or of abrasion to the fins on any of these fish (Kynard et al. 1999). We conclude that radio transmitter antennas should be internally implanted whenever possible to minimize injury to the fish. However, when it is absolutely necessary to obtain maximal signal range (aerial surveys, passage studies around dams, etc.), trailing antennas may be used with caution. This method should not be used when tagging a significant percentage of a given population.

Surgery to implant transmitters should only be attempted when fish are in excellent condition. Methods of Summerfelt and Smith (1990) should be used as general guidelines for sturgeon anesthesia using tricaine methane sulfonate (MS-222); however, the dose should be reduced to only that needed to immobilize the fish during surgery, if at all. Placing fish upside down in a cradle or trough during surgery is often sufficient to immobilize them. Also, sturgeon may be safely immobilized using galvanonarcosis (low voltage DC). The transmitters and internally implanted coiled antennas can be coated with an inert elastomer (Silastic MDX4.4210) to reduce tissue irritation and subsequent tag rejection. However, some transmitter coatings are quite inert and do not need this treatment, and some transmitter models coated with Silastic have been expelled by cultured shortnose sturgeon in tank studies. Also, transmitters with externally trailing antennas should not be coated to allow sturgeon tissue to adhere to the tag and hold it in place in the body cavity (Kynard et al. 1999).

The transmitter and all surgical instruments should be sterilized immediately prior to use. A lateral incision approximately 30 mm long should be made 40 - 60 mm anterior to the pelvic fin and about 10 - 20 mm above the ventral row of scutes (although the specific location will vary with fish size). This location reduces abrasion of the transmitter on the incision. However, lateral muscle tissue in large adults may be quite thick, so a ventral incision is recommended for them. The incision should be closed with either absorbable or non-absorbable suture material (absorbable material is superior for tying knots but there has been no documented differences in healing of wounds with either suture type) and a large cutting needle. Individual sutures should be closed with separate, double, square knots so that the muscle tissue firmly touches but is not drawn tightly. After surgery the fish should be released as soon as it recovers from the anesthesia.

Tissue sampling

Tissue sampling is required for genetic evaluation, studies of contaminant loading, assays of physiological condition, and ageing. A 1 cm^2 pelvic fin clip is recommended for genetic analysis. Muscle samples for contaminant analysis or energetic evaluation should be taken from the thickest dorsal musculature using a mammalian tissue punch. First, a v-shaped flap of skin should be peeled back using a sterilized scalpel. The punch is then used to cut a small core of tissue, which may be removed with cutting pliers. The flap of skin should then be replaced and two sutures used to close the wound. Blood samples may be taken from the ventral caudal peduncle. Egg samples may also be removed using a large gauge hypodermic needle (as used for PIT tag insertion). The needle is inserted through a small ventral incision in the abdomen and a small number of eggs drawn out, if the female has ovulated (i.e., eggs are loose in the abdomen). A gonad biopsy for histological analysis can be obtained from either sex at any point in the reproductive cycle by making a small incision and inserting an Eppendorfer biopsy punch. These techniques should not be used in systems having small populations and should be limited to only a few individuals.

The removal of pectoral fin rays for ageing studies is controversial. Concerns raised include potential impacts to fish swimming performance in high current velocity areas and the equivocal data that may be obtained from these structures. In tank tests, ray regeneration was rapid and sturgeon swimming performance was unaffected (Collins and Smith 1996). Continued study of the impacts of ray removal on sturgeon performance, validation of annuli, and investigations into alternative methods of ageing are sorely needed.

Gastric lavage

A safe and effective technique for flushing food items from the stomach of live sturgeons has recently been developed (Haley 1998). Due to the morphology of the gut tract and the physostomous swim bladder, gastric lavage of sturgeons was previously considered a risky procedure. Consequently, diet information was only available from fish that had been killed. The new lavage method requires the careful use of a flexible, small diameter tubing (intramedic polyethylene, 1.57-mm inner diameter and 2.08 mm outer diameter). The fish is lightly anesthetized using MS-222 and the tube is directed past the pneumatic duct and into the alimentary canal until it can be felt on the ventral surface of the fish. Water is slowly injected into the tubing to flush the stomach. After lavage the fish are allowed to recover and are immediately released. This method is not recommended when water temperature exceeds 27°C and extreme caution should be taken to avoid damage to the swim bladder, which can result in mortality.

Sampling Methodologies

Preferred sampling methods for sturgeon are dictated by the habitat where they occur, season of capture, and life stage. In general, large juvenile and adult sturgeon are efficiently captured in stationary or drifting gillnets or trammel nets (Buckley and Kynard 1985, Hoff et al. 1988, Dovel et al. 1992, Geoghegan 1992, Kieffer and Kynard 1993, Moser and Ross 1995, Collins et al. 1996). Trawl sampling is also an effective means of capturing sturgeon, but much of the time this gear is not feasible for use, due to the rapid current conditions and excessive amount of bottom structure in riverine or estuarine sturgeon habitat. Sturgeon are also susceptible to pound nets, but this gear has not been used for research purposes, other than to assess commercial capture rates. Similarly, sturgeon are occasionally captured on hook and line (usually baited trotlines or via snagging); however, this gear has not been employed for research sampling. Baited trotlines are a safe and effective method for capturing white sturgeon (*A. transmontanus*), and this method probably has potential for shortnose and Atlantic sturgeon research as well (Elliott and Beamesderfer 1990).

Very small juveniles (larvae and young-of-the-year) are rarely captured in traditional survey sampling. Young sturgeon seek cover in gravel crevices and amongst structure for about 9 d after hatching and then the larvae move downstream. Sturgeon eggs and/or larvae have successfully been collected in some rivers using D-shaped drift nets (Kynard et al. 1999), epibenthic sleds, and textured pads to which the eggs adhere. Recent studies have been conducted to confirm that light traps are not effective for capture of sturgeon larvae.

Electrofishing has not proven to be an effective method for capture of sturgeon in most systems because the fish tend to sink immediately upon being stunned. This is unfortunate, because many resource agencies conduct regular survey sampling with this gear. In very shallow areas with clear water it may be possible to retrieve stunned sturgeon from the bottom with a long handled dipnet. The more widespread use of sophisticated electrofishing equipment that allows control of amperage, voltage, and waveform may result in development of electrofishing methods that are specific to sturgeon (such as those for specific collection of catfish). Moreover, Aadland and Cook (1992) have developed an electric trawl for use in sampling benthic river fishes that may be very useful for collecting sturgeon. Studies to examine the efficacy of electrofishing gear should be undertaken using hatchery fish.

Gillnets and trammel nets

Both shortnose and Atlantic sturgeon are very susceptible to gillnets and trammel nets as adults or large juveniles. These gears (especially gillnets) are size selective and therefore should be used with caution when determining sturgeon size or age distributions. However, length frequencies from studies using gillnets having different mesh sizes indicate that there is considerable overlap between size distributions of sturgeon collected with different mesh sizes (Figure 1). Sub-yearling sturgeon (200 –300 mm FL) have been captured using 5 cm (2") stretched mesh nets in the Hudson, Cape Fear, Edisto and Savannah rivers but in all cases the catch rates were low. This was probably due to low abundance of

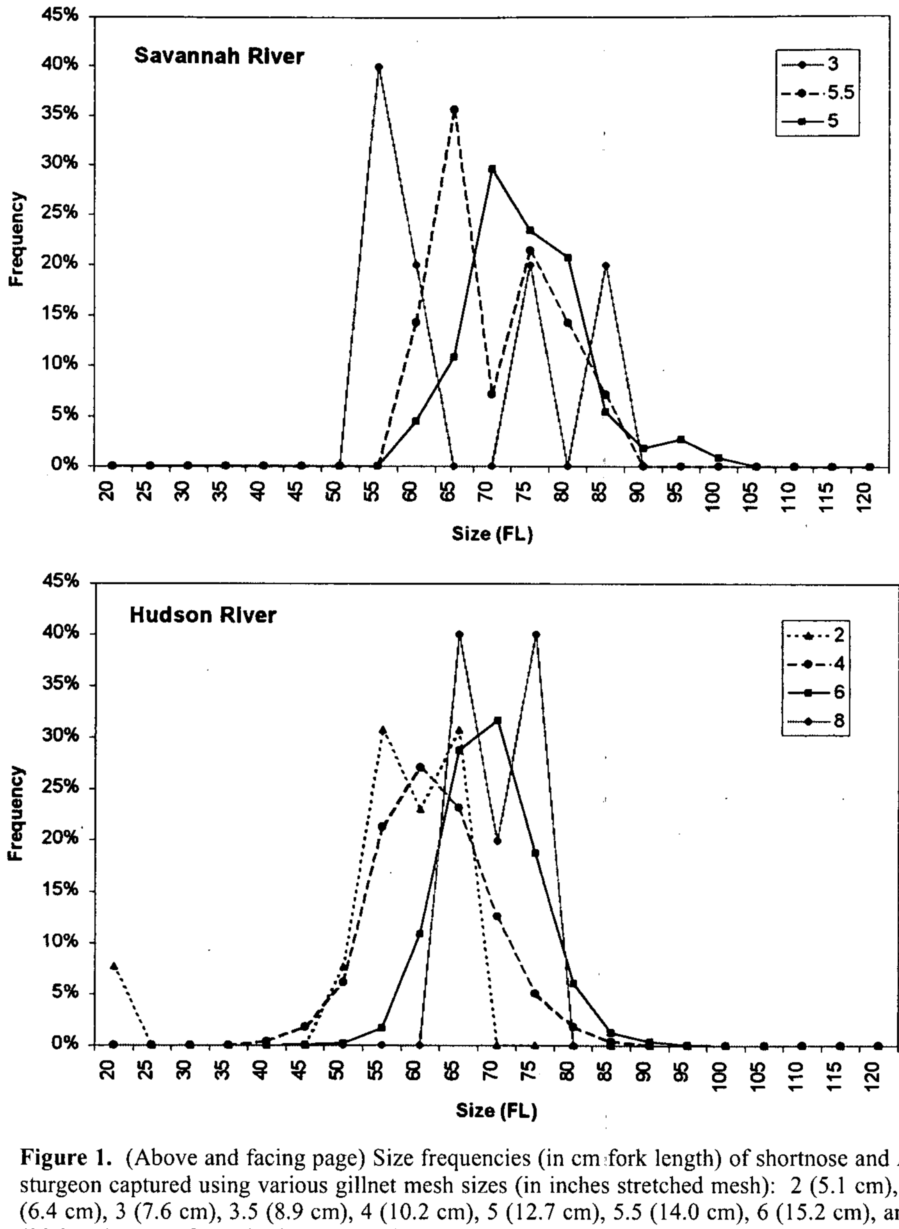
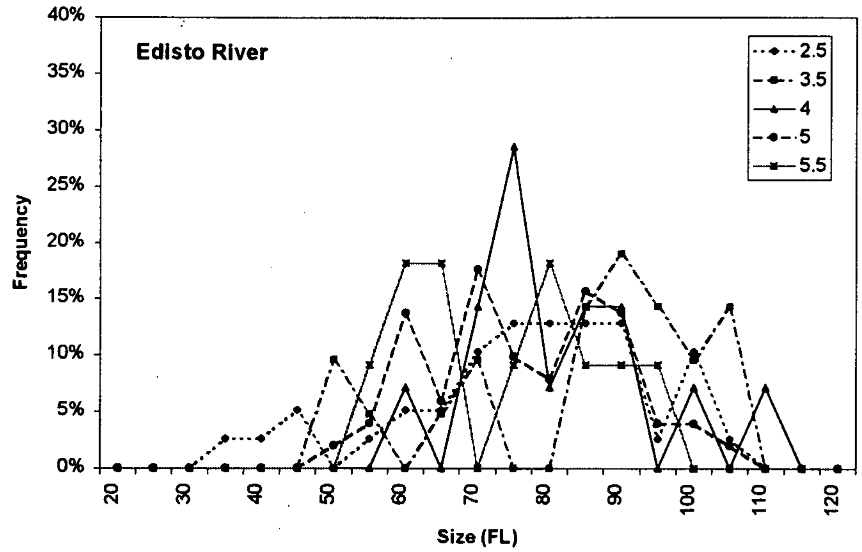
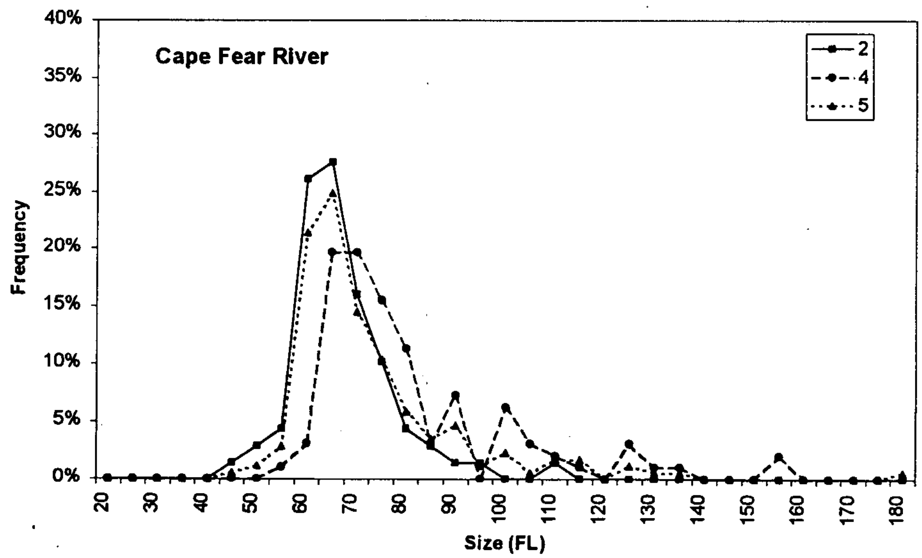


Figure 1. (Above and facing page) Size frequencies (in cm fork length) of shortnose and Atlantic sturgeon captured using various gillnet mesh sizes (in inches stretched mesh): 2 (5.1 cm), 2.5 (6.4 cm), 3 (7.6 cm), 3.5 (8.9 cm), 4 (10.2 cm), 5 (12.7 cm), 5.5 (14.0 cm), 6 (15.2 cm), and 8 (20.3 cm). Data from the Savannah River, S.C. and the Hudson River, N.Y. are for shortnose sturgeon captured in stationary gillnets. Data from the Edisto River, S.C. (J. McCord, S.C. Department of Natural Resources, unpubl. data) are for shortnose sturgeon caught in drifting gillnets. Data from the Cape Fear River, N.C. are for Atlantic sturgeon caught in stationary gillnets.

small size classes in these rivers, rather than gear selectivity. For post-yearlings, all mesh sizes greater than 6.4 cm (2.5") stretched mesh result in similar length frequencies (Figure 1). Trammel nets collect a wider size distribution than gillnets and are often less stressful than gillnets because the fish are frequently entangled rather than gilled.

Both monofilament and braided nylon mesh are effective for capture of sturgeon; however, twine size should be increased if large fish are targeted. Although fish are captured more effectively with light twine, sturgeon can easily break through webbing that is too light. Also, light twine is more likely to cut into the fish and cause injury. When targeting adults, heavy multifilament nylon (size 208 – 233) with 15 cm (6") stretched mesh can be used to reduce sturgeon injury.





Sturgeon are benthivores and generally are captured near the bottom unless they are actively migrating (McCleave et al. 1977, Moser and Ross 1995). Therefore stationary gillnets or trammel nets should be heavily weighted and allowed to contact the bottom. In low velocity areas, nets should be set perpendicular to the current. However, in areas of high velocity or having heavy debris loading, this is not feasible. In this case, nets should be set in back eddies, on the downstream side of islands, or parallel to the current in mid-channel (Buckley and Kynard 1985, Kieffer and Kynard 1993, Moser and Ross 1993, Kynard et al. 1999). In many southern rivers, trammel nets are set during slack tide periods only, to reduce stress on fish and debris loads.

Drifting gillnets can be used very effectively to capture sturgeon by drifting through relatively snag-free areas while dragging near or on the bottom (O'Herron and Able 1990, McCord 1998). Often this method results in lower debris loading because the nets drift along with the debris and do not intercept it. Generally, the short soak times and reduced pressure on driftnets also result in less injury to captured fish. This method can be used through upriver runs and pools without large entanglements by using very light leadline (just enough to take the net to the bottom). The net should be buoyed at the ends with large floats (8-15 L displacement) to facilitate operating the net and to avoid snags. In tidal areas, buoyancy should be reduced and the net dragged along the bottom wherever possible (McCord 1998).

Entanglement in gillnets or trammel nets can result in sturgeon mortalities (Kieffer and Kynard 1993, Moser and Ross 1993, Collins et al. 1996, Kynard et al. 1999). To reduce the risk of mortality, precautions should be taken to reduce stress to fish during netting. Gillnets and trammel net soak times should never exceed 2 hrs in water temperatures > 27°C. During lower water temperatures, soak times up to 24 h are acceptable, but soak times should be reduced as much as possible as temperature rises. Sturgeon should also not be exposed to air temperatures below 0°C for more than a few minutes. In these conditions, fish should be processed while held underwater to reduce the risk of freezing tissue. Every effort should be made to reduce stress during removal of fish from nets and net meshes should be cut to facilitate rapid removal of fish.

Trawls

Where conditions permit the use of trawls, this gear can be effective for the capture of sturgeon. Collins et al. (1996) found that 39% of all juvenile Atlantic sturgeon and 8% of the adult shortnose sturgeon tag returns from fish tagged in the Altamaha River, Georgia were from the commercial trawl fishery. Sampling of shortnose and Atlantic sturgeon was conducted in the tidal portion of the Hudson River from 1975 - 80 using a 6.4 m and 10.7 m semi-balloon otter trawl having mesh sizes of 1.3 – 6.5 cm (Dovel and Berggren 1983, Dovel et al. 1992). Fish >200-mm total length were regularly caught, with most fish around 500 mm. These trawls were fished for variable lengths of time (up to 50 min) at tow speeds of 4-km h^{-1} (2.2 knots). The Hudson River Utilities Monitoring Program has also conducted a standardized trawling survey since 1985 using a 3 m beam trawl with 1.3 - 3.8 cm mesh. This gear is towed for 5 min against the current and adult shortnose sturgeon (500 - 1000 mm fork length) are caught regularly. This sampling indicates that even a small trawl effectively captures sturgeon.

Drift nets

D-shaped or rectangular drift nets have been used effectively to catch shortnose sturgeon eggs and larvae in both northern (Kynard et al. 1999) and southern (Smith et al. 1993) rivers. Mesh sizes of 2 mm^2 trap sturgeon eggs and larvae while letting some debris pass through. The net is attached to a weighted and floated, 1 m diameter steel ring that has been flattened to maximize contact with the substrate (D-shaped, Kynard et al. 1999). A 1m square or 2 m 1m Neuston net can also be used. The net is attached to a Danforth or grapnel-type anchor via a short bridle. This arrangement allows the net to stand upright in currents of up to 1.0 m s^{-1}. Depending on the current velocity and amount of debris accumulation, such gear should be fished for 10 min – 1 h in areas of suspected spawning. A flow meter should be positioned in the mouth of the net to allow calculation of egg or larval densities per volume of water sieved. Such studies are best conducted with the aid of telemetry data from pre-spawning adults to identify likely spawning locations (Collins and Smith 1993, Kynard et al. 1999). Little to no mortality occurs with this gear type if the samples are processed in the field . The D-shaped nets have been used to capture eggs of Chinese sturgeon in the Yangtze River for four years. Tens of thousands of eggs have been captured when the nets have been set in areas occupied by telemetered fish. These eggs are reared to juvenile stages and released into the river (Wei and Kynard 1996). Egg samples can also be collected using artificial substrates to which they adhere (anchored buffer pads, Moser et al. 1998).

Minimum Sampling Required to Confirm Presence of Shortnose Sturgeon

Guidelines for minimum sampling necessary to confirm that shortnose sturgeon still exist in a system are desperately needed for management of this species. Shortnose sturgeon are no longer extant in many rivers where they historically occurred (Dadswell et al. 1984). However, the Shortnose Sturgeon Recovery Plan (NMFS 1998) stipulates that restoration efforts (stocking of cultured fish) should not be undertaken until it is confirmed that wild fish have been extirpated. In addition, sampling for the presence of shortnose sturgeon is often required when activities that jeopardize the existence of this fish are proposed in an area where their status is unknown. Consequently, the National Marine Fisheries Service and other regulatory agencies require guidelines for sampling efforts that are adequate to address such questions.

Unfortunately, it is impossible to absolutely confirm that shortnose sturgeon no longer exist in a given system due to their life history and problems associated with sampling them. Shortnose sturgeon are long-lived (over 30 yrs) and do not spawn every year (Dadswell et al. 1984). Therefore, sampling over multiple years is needed to insure that a strong year class has not been missed. Moreover, sturgeon are rarely captured using traditional survey sampling, so specialized sampling methods in specific habitats are needed, particularly in systems where sturgeon are very rare. Even studies specifically designed to capture sturgeon can only confirm their presence, as negative data does not necessarily indicate that the fish are extirpated. However, given adequate sampling, an acceptable degree of confidence that the fish are extirpated (or functionally extirpated) can be gained. Based on the types and amounts of effort conducted in other systems to date, we developed the following sampling guidelines as the best available approach to assessing shortnose sturgeon presence in areas where they historically occurred.

Research Survey

The first step in any system is to conduct a literature survey and to contact people who currently or historically fished in the area using gear that captures sturgeon. Often museum records, archeological remains (scutes in middens), or patterns in historical collections can provide vital clues to appropriate areas and times to sample for shortnose sturgeon. Personal contact with local fishers is also essential. They can provide detailed information on exact sampling locations that were historically productive, tricks to effective use of gear, and observations on the timing of sturgeon movements. In addition, people currently fishing in the system may have recently captured shortnose sturgeon as bycatch and be willing to provide anecdotal information on these captures or actual specimens (Collins and Smith 1993, Moser and Ross 1993, Collins et al. 1996, Moser et al. 1998). The U.S. Fish and Wildlife Service has successfully obtained shortnose sturgeon specimens by offering monetary rewards for live fish in Chesapeake Bay (J. Skejeveland, Maryland Fisheries Resources, personal communication). While this technique may put more fish at risk or result in targeted fishing for sturgeon, the ability to enlist the help of commercial fishers greatly increases the chances of documenting the presence of fish in areas where they are thought to be extirpated.

Finally, prior to any fieldwork, literature from neighboring systems should be reviewed. Patterns of sturgeon habitat use and movements are similar over small spatial scales (Dadswell et al. 1984). By mapping suspected aggregation areas (spawning grounds, wintering areas, summering sites) from adjoining systems, sites to sample in the study area can be more accurately identified. Any available maps of water quality or bottom substrate in the study area should be collected to help identify likely spawning sites and aggregation areas.

Patterns of habitat use and movements of shortnose sturgeon vary latitudinally. Therefore, our recommendations for minimum sampling are divided into two main groups: 1) northern rivers where < 7°C water temperature regularly occurs in winter and temperatures occasionally reach >27°C in summer (Chesapeake drainages north), and 2) southern rivers where >27°C occurs regularly in summer and temperatures seldom drop below 7°C in winter (south of Chesapeake drainages).

Minimum Sampling Requirements in Northern Rivers

Northern rivers having sturgeon habitat can be subdivided into two groups: northerly (systems in Maine and Canada), and north central (Chesapeake drainages to Massachusetts). It is necessary to subdivide the northern region because sturgeon in the most northerly rivers exhibit a greater degree of anadromy, venturing into high salinity regions. Shortnose sturgeon in north central rivers spend more time in freshwater and make only short forays into relatively low salinity areas to feed (Dadswell et al. 1984, Kynard 1997).

Sampling in northerly rivers (Maine and Canada) should be conducted for a minimum of two years. Attempts should first be made to capture pre-spawning adult shortnose sturgeon at the base of the first dam or falls that they would encounter. This sampling should be conducted weekly for 8 - 10 weeks during early spring when water temperatures range from 8 – 18°C. Four to six, 100 m, 15.2 cm (6") stretched mesh, stationary sinking gillnets should be set as recommended in the sampling protocol for at least two days each week and checked at least every 24 h (minimum sampling effort = 128, 100 m net days). In the event that no fish are captured in the first spring, sampling should be conducted in the estuary (1 – 12 ppt) along marsh edges and in tidal creeks that summer and the following summer. This sampling should occur weekly with four to six, 100 m, 15.2 cm (6") stretched mesh sinking gillnets (2 - 3 day/week) in June – August (8 - 10 weeks) when water temperatures range from 20 – 25°C (minimum sampling effort = 128, 100 m net days). Telemetry studies are recommended so that any fish captured in the estuary can be tracked to their river of origin.

Sampling in north central rivers (Chesapeake drainages to Merrimack River) should initially concentrate on capture of pre-spawning adults with gillnets at the base of the first dam or falls (protocol as described for northerly rivers) for two years (minimum sampling effort = 128, 100 m net days). If no fish are collected in the first spring, sampling efforts should be directed to likely aggregation areas that summer. Areas targeted should be between the saltwater/freshwater interface and the first dam or falls. Habitats sampled should include the deepest part of the water body in every curve and around each island (Kynard et al. in press). Sampling should continue weekly through two summers (June – October) using four to six, 100 m, 15.2 cm (6") stretched mesh sinking gillnets set for at least 3 days each week (soak times should be 24 h unless water temperature exceeds 27°C, see previous section on gillnet methodology).

Minimum Sampling Requirements in Southern Rivers

Adult and juvenile shortnose sturgeon in southern rivers aggregate in deep areas near the saltwater/freshwater interface in summer (Hall et al. 1990, Weber 1996, Moser and Ross 1995, Collins et al. in press). Sampling for shortnose sturgeon should initially be focused in these summer aggregation areas, but extreme caution must be exercised to avoid killing any fish captured during high water temperatures. Sampling should begin in summer when temperature exceeds 27°C (July in most southern rivers) and continue until the temperature drops below 27°C (October in most southern rivers).

Three sinking gillnets of 13 –14 cm stretched mesh (5 – 5.5 in) or trammel nets with 5 – 8 cm (2 – 3 in) stretched mesh inner panels and 35 cm (14 in) stretched mesh outer panels should be set as specified in this sampling protocol. Nets should be 100 m long, or else shorter nets with the equivalent combined length of 300 m should be used (e.g., six, 50 m nets). All nets should be set for 2 h during the slack tide (neap tides are preferred) in the deepest part of the water body near the upper extent of the salt wedge (0 - 3 ppt) or up to 2 km above the saltwater-freshwater interface. In deltaic systems there may be more than one area that fits this definition. In this case all candidate sites should be sampled in random order during the summer. Sampling should be conducted 3 times per week for 8 - 10 weeks (minimum sampling effort = 288 net hours).

If no shortnose sturgeon are collected in the first summer of sampling at the saltwater/freshwater interface, sampling for pre-spawning adults should be initiated at the base of the first dam or falls in January – April. Some rivers on the coastal plain do not present such obstacles to migration and possible aggregation areas are unknown. In such cases, likely spawning habitats based on research in other southern rivers (as identified in Hall et al. 1993) should be identified and sampled. Three, 100 m sinking gillnets of 13 –14 cm stretched mesh (5 – 5.5 cm) or 100 m trammel nets with 5 – 8 cm (2 – 3") stretched mesh inner panels and 35 cm (14") stretched mesh outer panels should be set bi-weekly as specified in the sampling protocol. In many upriver areas it may be necessary to use shorter nets, in which case their total length should equal 100 m. Sampling should be conducted for at least 8 weeks in two years, with three days of effort per week (24 h sets) from January until the water temperature exceeds 18°C (minimum sampling effort = 144, 100 m net days).

Conclusion

Sampling and handling procedures for Atlantic coast sturgeons have evolved over the past 30 years and differ among systems and sampling situations. Minimum sampling requirements also vary across systems. While we have addressed latitudinal differences in developing sampling guidelines, inter-system differences in sturgeon abundance can also affect minimum sampling requirements. The amount of effort required to document sturgeon presence is negatively correlated with sturgeon abundance (Figure 2). Therefore, we have attempted to provide conservative estimates of effort required so that sturgeon presence may be detected in systems where these fish are rare.

The minimum sampling protocols will certainly be affected by the availability of reliable anecdotal/historical information on sturgeon occurrence. With this information, sampling can be directed to specific sites within the protocol framework. We emphasize that obtaining this information is critically important. Sturgeon fishing has become an activity of the past, and sturgeon fishers are aging. When they die, a wealth of information about historical occurrences of sturgeon, movement patterns, and capture methods will be lost.

New sampling and handling methodologies may be developed on the basis of information from fishers or via research innovations and experimentation. We reiterate that this protocol is to serve as a current set of guidelines for use with Atlantic Coast sturgeons, and should in no way restrict testing of new techniques. However, we recommend that cultured sturgeon be used first when testing new and potentially harmful methods.

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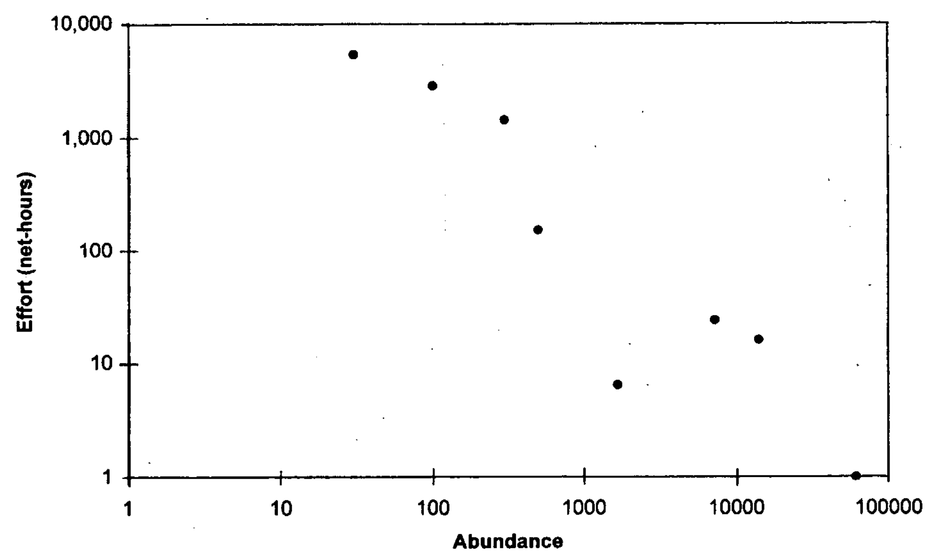

Figure 2. Effort expended (100 m gillnet set for 1 hour) to capture the first shortnose sturgeon in each of eight different systems vs. estimated shortnose sturgeon abundance in each system.

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Loc 9.3 Ref 16

Row	State	County	Resource Name	Address	City	Listed	Multiple
1	GA	Burke	**Burke County Courthouse**	Courthouse Sq.	Waynesboro	9/18/1980	Georgia County Courthouses TR
2	GA	Burke	**Haven Memorial Methodist Episcopal Church**	Barron St., S of Jct. of Barron and 6th Sts.	Waynesboro	4/12/1996	
3	GA	Burke	**Hopeful Baptist Church**	Winter Rd. E of jct. with Blythe Rd.	Keysville	1/11/1993	
4	GA	Burke	**Jones, John James, House**	525 Jones Ave.	Waynesboro	2/15/1980	
5	GA	Burke	**McCanaan Missionary Baptist Church and Cemetery**	McCanaan Church Rd.	Sardis	6/14/2001	
6	GA	Burke	**Sapp Plantation**	NW of Sardis on GA 24	Sardis	2/8/1980	
7	GA	Burke	**Waynesboro Commercial Historic District**	E. 6th, E. 7th, E. 8th, S. Liberty and Myrick Sts.	Waynesboro	6/10/1993	
1	GA	Richmond	**Academy of Richmond County**	540 Telfair St.	Augusta	4/11/1973	
2	GA	Richmond	**Academy of Richmond County--1926 Campus**	910 Russell St.	Augusta	1/28/2004	
3	GA	Richmond	**Augusta Canal Industrial District**	Along the west bank of the Savannah River from the Richmond-Columbia county line to 10th and Fenwick Sts.	Augusta	5/27/1971	
4	GA	Richmond	**Augusta Cotton Exchange Building**	Reynolds St.	Augusta	7/20/1978	
5	GA	Richmond	**Augusta Downtown Historic District**	Roughly bounded by 13th St., Gordon Hwy, Walton Way and the Savannah R.	Augusta	6/11/2004	
6	GA	Richmond	**Bath Presbyterian Church and Cemetery**	Edie Bath Rd., 0.5 mi. W of US 1	Blythe	10/27/2004	

7	GA	Richmond	**Benet, Stephen Vincent, House**	2500 Walton Way	Augusta	11/11/1971	
8	GA	Richmond	**Bethlehem Historic District**	Roughly bounded by Wrightsboro Rd., MLK Jr. Blvd., Railraod , Poplar, and Clay Sts.	Augusta	12/1/1997	
9	GA	Richmond	**Brahe House**	456 Telfair St.	Augusta	4/11/1973	
10	GA	Richmond	**Broad Street Historic District**	Broad St. between 5th and 13th Sts.	Augusta	4/28/1980	
11	GA	Richmond	**Church of the Most Holy Trinity**	720 Telfair St.	Augusta	3/21/1997	
12	GA	Richmond	**College Hill**	2216 Wrightsboro Rd.	Augusta	11/11/1971	
13	GA	Richmond	**Darling, Joseph, House**	3066 Dennis Rd.	Martinez	4/18/1991	
14	GA	Richmond	**Engine Company Number One**	452 Ellis St.	Augusta	5/25/1988	
15	GA	Richmond	**First Baptist Church of Augusta**	Greene and 8th Sts.	Augusta	3/23/1972	
16	GA	Richmond	**First Presbyterian Church of Augusta**	642 Telfair St.	Augusta	2/21/1997	
17	GA	Richmond	**FitzSimons-Hampton House**	GA 28	Augusta	10/29/1976	
18	GA	Richmond	**Fruitlands**	2604 Washington Rd.	Augusta	5/25/1979	
19	GA	Richmond	**Gertrude Herbert Art Institute**	506 Telfair St.	Augusta	3/20/1973	
20	GA	Richmond	**Gould-Weed House**	828 Milledge Rd.	Augusta	7/16/1979	
21	GA	Richmond	**Greene Street Historic District**	Greene St.	Augusta	12/3/1980	
22	GA	Richmond	**Harris-Pearson-Walker House**	1822 Broad St.	Augusta	10/28/1969	

23	GA	Richmond	**Harrisburg--West End Historic District**	Roughly bounded by 15th St., Walton Way, Heard Ave., Milledge Rd., and the Augusta Canal	Augusta	6/7/1990	
24	GA	Richmond	**Lamar Building**	753 Broad St.	Augusta	4/24/1979	
25	GA	Richmond	**Lamar, Joseph Rucker, Boyhood Home**	415 7th St.	Augusta	6/13/1996	
26	GA	Richmond	**Laney-Walker North Historic District**	Bounded by D'Antignac, 7th, Twiggs, Phillips and Harrison Sts., Walton Way and Laney-Walker Blvd.	Augusta	9/5/1985	
27	GA	Richmond	**Liberty Methodist Church**	2040 Liberty Church Rd.	Hephzibah	11/7/1997	
28	GA	Richmond	**Meadow Garden**	1230 Nelson St.	Augusta	7/19/1976	
29	GA	Richmond	**Old Medical College Building**	Telfair and 6th Sts.	Augusta	3/16/1972	
30	GA	Richmond	**Old Richmond County Courthouse**	432 Telfair St.	Augusta	12/22/1978	
31	GA	Richmond	**Pinched Gut Historic District**	Roughly bounded by Gordon Hwy., E. Boundary, Reynolds and Gwinnett Sts.	Augusta	3/6/1980	
32	GA	Richmond	**Reid-Jones-Carpenter House**	2249 Walton Way	Augusta	11/13/1979	
33	GA	Richmond	**Sacred Heart Catholic Church**	Greene and 13th Sts.	Augusta	3/16/1972	

34	GA	Richmond	**Sands Hill Historic District**	Roughly bounded by Monte Sano and North View Aves., Mount Auburn St., Johns Rd., and Augusta Country Club.	Augusta	7/9/1997	
35	GA	Richmond	**Seclusaval and Windsor Spring**	Jct. of Windsor Spring and Tobacco Rds.	Hepzibah	10/11/1988	
36	GA	Richmond	**Shiloh Orphanage**	1635 15th St.	Augusta	12/30/1996	
37	GA	Richmond	**Springfield Baptist Church**	112 12th St.	Augusta	6/17/1982	
38	GA	Richmond	**Springfield Baptist Church (Boundary Increase)**	114 Twelfth St.	Augusta	7/5/1990	
39	GA	Richmond	**St. Paul's Episcopal Church**	6th and Reynolds Sts.	Augusta	4/11/1973	
40	GA	Richmond	**Summerville Historic District**	Roughly bounded by Milledge Lane, Wrightsboro Rd., Highland and Heard Aves., Cumming and Henry Sts.	Augusta	5/22/1980	
41	GA	Richmond	**Tubman High School**	1740 Walton Way	Augusta	3/7/1994	
42	GA	Richmond	**United States Post Office and Courthouse**	500 E. Ford St.	Augusta	1/21/2000	
43	GA	Richmond	**Wilson, Woodrow, Boyhood Home**	419 7th St.	Augusta	2/28/1979	
1	SC	Aiken	**Aiken Mile Track**	Banks Mill Rd.	Aiken	5/9/1985	Aiken Winter Colony TR
2	SC	Aiken	**Aiken Training Track**	Two Notch Rd.	Aiken	5/9/1985	Aiken Winter Colony TR
3	SC	Aiken	**Aiken Winter Colony Historic District I**	Off U.S. 1/78	Aiken	11/27/1984	Aiken Winter Colony TR

4	SC	Aiken	**Aiken Winter Colony Historic District II**	Roughly bounded by RR track, Colleton and 3rd Aves., Laurens, South Boundary, and Marion Sts.	Aiken	11/27/1984	Aiken Winter Colony TR
5	SC	Aiken	**Aiken Winter Colony Historic District III**	Roughly bounded by Edgefield Ave., Highland Park Dr., Fauburg, and Greenville St.	Aiken	11/27/1984	Aiken Winter Colony TR
6	SC	Aiken	**Carroll, Chancellor James P., House**	112 Gregg Ave.	Aiken	11/23/1977	
7	SC	Aiken	**Cedars, The**	US 278, 0.3 mi E of SC 125	Beech Island	6/17/1993	
8	SC	Aiken	**Chinaberry**	441 York St., SE	Aiken	4/29/1982	
9	SC	Aiken	**Coker Spring**	Coker Spring Rd.	Aiken	1/18/1978	
10	SC	Aiken	**Court Tennis Building**	Newberry and Park Sts.	Aiken	11/27/1984	Aiken Winter Colony TR
11	SC	Aiken	**Crossways**	450 E. Boundary St.	Aiken	6/4/1997	Aiken Winter Colony TR
12	SC	Aiken	**Dawson-Vanderhorst House**	NE of Aiken at jct. of Wire and New Bridge Rds.	Aiken	6/29/1976	
13	SC	Aiken	**Fort Moore-Savano Town Site**	Address Restricted	Beech Island	8/14/1973	
14	SC	Aiken	**Georgia Avenue-Butler Avenue Historic District**	Georgia, Butler Aves. and Martintown Rd.	North Augusta	4/5/1984	
15	SC	Aiken	**Graniteville Historic District**	SC 19 and Gregg St.	Graniteville	6/2/1978	
16	SC	Aiken	**Hammond, Charles, House**	908 Martintown Road W.	North Augusta	10/2/1973	
17	SC	Aiken	**Joye Cottage**	463 Whiskey Rd. and 129 1st Ave.	Aiken	9/29/1980	
18	SC	Aiken	**Legare-Morgan House**	241 Lauren St., SW	Aiken	9/22/1977	
19	SC	Aiken	**Lookaway Hall**	103 W. Forest Ave.	North Augusta	8/13/1992	
20	SC	Aiken	**Mims, Britton, Place**	229 Edgefield Rd.	North Augusta	6/4/1997	
21	SC	Aiken	**Phelps House**	Barnwell Ave.	Aiken	6/10/1974	

22	SC	Aiken	**Pickens House**	101 Gregg Ave.	Aiken	5/19/1983	
23	SC	Aiken	**Redcliffe**	1.5 mi. NE of Beech Island on SC 125	Beech Island	5/8/1973	
24	SC	Aiken	**Rosemary Hall**	804 Carolina Ave.	North Augusta	4/28/1975	
25	SC	Aiken	**Salley Historic District**	Bounded by Pine, Ferguson, Poplar, and Aldrich Sts.	Salley	10/27/2000	
26	SC	Aiken	**Silver Bluff**	Address Restricted	Jackson	11/1/1977	
27	SC	Aiken	**St. Mary Help of Christians Church**	York St. and Park Ave.	Aiken	3/25/1982	
28	SC	Aiken	**St. Thaddeus Episcopal Church**	Pendleton and Richland Sts.	Aiken	11/27/1984	Aiken Winter Colony TR
29	SC	Aiken	**US Court House--Aiken, South Carolina**	223 Park Ave., SE	Aiken	12/10/2003	
30	SC	Aiken	**Vaucluse Mill Village Historic District**	SC 191, 3 mi. N of Graniteville and 6 mi. W of Aiken	Vaucluse	5/7/1996	
31	SC	Aiken	**Wall, B. C., House**	1008 West Ave.	North Augusta	11/27/1992	
32	SC	Aiken	**Warrenville Elementary School**	115 Timmerman St.	Warrenville	5/22/2002	
33	SC	Aiken	**Whitehall**	902 Magnolia St.	Aiken	11/27/1984	Aiken Winter Colony TR
34	SC	Aiken	**Willcox's**	Colleton Ave.	Aiken	3/19/1982	
35	SC	Aiken	**Zubly Cemetery**	Forrest Dr.	Beech Island	1/28/2002	
1	SC	Allendale	**Allendale Chert Quarries Archeological District**	Address Restricted	Martin	9/28/1985	
2	SC	Allendale	**Antioch Christian Church**	SW of Allendale on SC 3	Allendale	12/12/1977	
3	SC	Allendale	**Colding--Walker House**	SC 52	Appleton	4/30/1998	
4	SC	Allendale	**Erwin House**	SW of Allendale off U.S. 301	Allendale	5/7/1976	
5	SC	Allendale	**Fennell Hill**	Address Restricted	Peeples	11/19/1974	
6	SC	Allendale	**Gravel Hill Plantation**	SW of Allendale off U.S. 301	Allendale	5/28/1976	
7	SC	Allendale	**Lawton Mounds**	Address Restricted	Johnson's Landing	6/19/1972	
8	SC	Allendale	**Red Bluff Flint Quarries**	Address Restricted	Allendale	6/22/1972	

9	SC	Allendale	**Roselawn**	3 mi. SW of Allendale on SC 47	Allendale	5/28/1976	
10	SC	Allendale	**Smyrna Baptist Church**	S of Allendale on SC 22	Allendale	5/28/1976	
11	SC	Allendale	**Williams House**	US 321, near Ulmer	Ulmer	2/17/1999	
12	SC	Allendale	**Young, Virginia Durant, House**	US 278	Fairfax	8/8/1983	
1	SC	Barnwell	**Ashley--Willis House**	312 W. Main St.	Williston	6/22/2004	
2	SC	Barnwell	**Banksia Hall**	108 Reynolds Rd.	Barnwell	5/31/1974	
3	SC	Barnwell	**Bethlehem Baptist Church**	Wall and Gilmore Sts.	Barnwell	7/10/1979	
4	SC	Barnwell	**Church of the Holy Apostles Rectory**	1700 Hagood Ave.	Barnwell	4/13/1972	
5	SC	Barnwell	**Church of the Holy Apostles, Episcopal**	1706 Hagood Ave.	Barnwell	4/13/1972	
6	SC	Barnwell	**Old Presbyterian Church**	1905 Academy St.	Barnwell	4/13/1972	

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Row	State	County	Resource Name	Address	City	Listed	Multiple
1	SC	Orangeburg	All Star Bowling Lane	559 E. Russell St.	Orangeburg	8/7/1996	Civil Rights Movement in Orangeburg County MPS
2	SC	Orangeburg	Amelia Street Historic District	Amelia St. between Treadwell St. & Summers Ave.	Orangeburg	9/20/1985	Orangeburg MRA
3	SC	Orangeburg	Briggman, F. H. W., House	156 Amelia St.	Orangeburg	9/20/1985	Orangeburg MRA
4	SC	Orangeburg	Bruce, Donald, House	SE of Orangeburg on U.S. 301	Orangeburg	12/1/1978	
5	SC	Orangeburg	Cattle Creek Campground	Off SC 210	Rowesville	5/19/1983	
6	SC	Orangeburg	Claflin College Historic District	On a portion of Claflin College campus	Orangeburg	9/20/1985	Orangeburg MRA
7	SC	Orangeburg	Cope Depot	Cope Rd.	Cope	3/29/2001	
8	SC	Orangeburg	Dixie Library Building	Bull St.	Orangeburg	9/20/1985	Orangeburg MRA
9	SC	Orangeburg	Dukes Gymnasium	South Carolina State College campus	Orangeburg	9/20/1985	Orangeburg MRA
10	SC	Orangeburg	East Russell Street Area Historic District	Along sections of E. Russell St. between Watson & Clarendon Sts. and along portion of Oakland Pl. Dickson & Whitman Sts.	Orangeburg	9/20/1985	Orangeburg MRA
11	SC	Orangeburg	Ellis Avenue Historic District	Along portion of Ellis Ave. between Summers Ave. & Wilson St.	Orangeburg	9/20/1985	Orangeburg MRA
12	SC	Orangeburg	Enterprise Cotton Mills Building	U.S. 21	Orangeburg	9/20/1985	Orangeburg MRA
13	SC	Orangeburg	Eutaw Springs Battleground Park	2 mi. E of Eutawville on SC 6 and 45	Eutawville	6/5/1970	
14	SC	Orangeburg	Fordham, Maj. John Hammond, House	415 Boulevard	Orangeburg	9/20/1985	Orangeburg MRA
15	SC	Orangeburg	Hodge Hall	South Carolina State College campus	Orangeburg	9/20/1985	Orangeburg MRA
16	SC	Orangeburg	Hotel Eutaw	Russell & Centre Sts.	Orangeburg	9/20/1985	Orangeburg MRA
17	SC	Orangeburg	Lowman Hall, South Carolina State College	South Carolina State College campus	Orangeburg	9/20/1985	Orangeburg MRA
18	SC	Orangeburg	Mack, Alan, Site (38OR67)	Address Restricted	Orangeburg	1/6/1986	
19	SC	Orangeburg	Mt. Pisgah Baptist Church	310 Green	Orangeburg	9/20/1985	Orangeburg MRA
20	SC	Orangeburg	Numertia Plantation	E of Eutawville	Eutawville	3/19/1982	
21	SC	Orangeburg	Orangeburg City Cemetery	Jct. of Bull and Windsor Sts.	Orangeburg	9/27/1996	Orangeburg MRA
22	SC	Orangeburg	Orangeburg County Fair Main Exhibit Building	U.S. 21	Orangeburg	9/20/1985	Orangeburg MRA
23	SC	Orangeburg	Orangeburg County Jail	44 Saint John St.	Orangeburg	10/2/1973	
24	SC	Orangeburg	Orangeburg Downtown Historic District	Russell, Broughton, Middleton, Church, Meeting, St. John, Hampton, and Amelia Sts. around public square	Orangeburg	9/20/1985	Orangeburg MRA
25	SC	Orangeburg	South Carolina State College Historic District	300 College St.	Orangeburg	6/19/1997	Civil Rights Movement in Orangeburg County MPS
26	SC	Orangeburg	Southern Railway Passenger Depot	110 N. Main St.	Branchville	4/23/1973	
27	SC	Orangeburg	Springfield High School	Brodie St., bet. SC 4 and Georgia St.	Springfield	3/29/2001	
28	SC	Orangeburg	St. Julien Plantation	SC 6	Eutawville	11/28/1980	
29	SC	Orangeburg	Stroman, William P., House	1017 N. Boulevard	Orangeburg	8/1/1996	Orangeburg MRA
30	SC	Orangeburg	Tingley Memorial Hall, Claflin College	College Ave.	Orangeburg	8/4/1983	Orangeburg MRA
31	SC	Orangeburg	Treadwell Street Historic District	Along portions of Treadwell & Amelia Sts.	Orangeburg	9/20/1985	Orangeburg MRA
32	SC	Orangeburg	Trinity Methodist Episcopal Church	185 Boulevard NE.	Orangeburg	8/26/1994	Orangeburg MRA
33	SC	Orangeburg	White House United Methodist Church	N of Orangeburg on U.S. 301	Orangeburg	5/13/1974	
34	SC	Orangeburg	Whitman Street Area Historic District	Along sections of Whitman, Elliot, and E. Russell Sts.	Orangeburg	9/20/1985	Orangeburg MRA
35	SC	Orangeburg	Williams Chapel A.M.E. Church	1908 Glover St.	Orangeburg	9/20/1985	Orangeburg MRA
36	SC	Orangeburg	Willow Consolidated High School	2750 Cope Rd.	Norway	7/11/2006	
1	SC	Bamberg	American Telephone and Telegraph Company Building	124 N. Palmetto Ave.	Denmark	7/8/1999	
2	SC	Bamberg	Bamberg City Hall	3069 Main Hwy	Bamberg	9/28/2005	
3	SC	Bamberg	Bamberg Historic District	E. Railroad Ave., 2nd, Midway, Elm, Cannon, N. Carlisle, and Church Sts.	Bamberg	5/19/1983	
4	SC	Bamberg	Bamberg, Gen. Francis Marion, House	N. Railroad Ave. and N. Carlisle St.	Bamberg	6/29/1976	
5	SC	Bamberg	Cal Smoak Site	Address Restricted	Bamberg	1/6/1986	
6	SC	Bamberg	Copeland House	SC Secondary Rd. 389, .3 mi. S of jct. with SC 64	Ehrhardt	10/18/1991	
7	SC	Bamberg	Denmark High School	N. Palmetto Ave.	Denmark	3/29/2001	
8	SC	Bamberg	Mizpah Methodist Church	Jct. of US 301 and S-5-31	Olar	12/13/2000	
9	SC	Bamberg	Rivers Bridge State Park	6 mi. SW of Ehrhardt	Ehrhardt	2/23/1972	
10	SC	Bamberg	Voorhees College Historic District	Voorhees College Campus	Denmark	1/21/1982	
11	SC	Bamberg	Woodlands	3 mi. S of Bamberg on SC 78	Bamberg	11/11/1971	

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Row	State	County	Resource Name	Address	City	Multiple	Listed
1	SC	Greenwood	Barratt House	SC 67 & Bryan Dorn Rd.	Greenwood		9/12/1985
2	SC	Greenwood	Brooks, J. Wesley, House	2 mi. S of Greenwood on U.S. 25	Greenwood		3/30/1973
3	SC	Greenwood	Greenville Presbyterian Church	Greenville Church Rd.	Donalds		5/20/1998
4	SC	Greenwood	Lander College Old Main Building	Stanley Ave. and Lander St.	Greenwood		8/2/1984
5	SC	Greenwood	Magnolia Cemetery	416 Magnolia Ave.	Greenwood		6/9/2004
6	SC	Greenwood	Moore-Kinard House	US 178 and S-24-44	Ninety Six		8/4/1983
7	SC	Greenwood	Mt. Pisgah A.M.E. Church	Hackett Ave. and James St.	Greenwood		8/16/1979
8	SC	Greenwood	Ninety Six National Historic Site	2 mi. S of Ninety Six between SC 248 and 27	Ninety Six		12/3/1969
9	SC	Greenwood	Old Cokesbury and Masonic Female College and Conference School	N of Greenwood at jct. of SR 246 and 254	Cokesbury		8/25/1970
10	SC	Greenwood	Old Greenwood Cemetery	503 E. Cambridge Ave.	Greenwood		3/1/2002
11	SC	Greenwood	Old Greenwood High School	857 S. Main St.	Greenwood		10/10/1985
12	SC	Greenwood	Self, James C., House	595 N. Mathis St.	Greenwood		11/20/1987
13	SC	Greenwood	Stony Point	N of Greenwood at jct. of SC 246 and SR 39	Greenwood		6/20/1975
14	SC	Greenwood	Sunnyside	105 Dargan Ave.	Greenwood		11/14/1978
15	SC	Greenwood	Trapp and Chandler Pottery Site (38GN169)	Address Restricted	Kirksey		1/6/1986
16	SC	Greenwood	Vance-Maxwell House	158 E. Cambridge ST.	Greenwood		3/5/1982
17	SC	Newberry	Boundary Street-Newberry Cotton Mills Historic District	Roughly bounded by Drayton, Boundary, Charles, Terrant and Crosson Sts.	Newberry	Newberry MRA	11/26/1980
18	SC	Newberry	Burton House	Address Restricted	Newberry	Newberry MRA	11/26/1980
19	SC	Newberry	Caldwell Street Historic District	Caldwell St.	Newberry	Newberry MRA	11/26/1980
20	SC	Newberry	Coateswood	1700 Boundary St.	Newberry		4/28/1975
21	SC	Newberry	College Street Historic District	College St.	Newberry	Newberry MRA	11/26/1980
22	SC	Newberry	Cousins House	Nance St. Extension	Newberry	Newberry MRA	11/26/1980
23	SC	Newberry	Folk--Holloway House	Jct. of Holloway (Columbia Hwy. or Co. Rt. 107) and Folk Sts.	Pomaria		7/30/1992
24	SC	Newberry	Harrington Street Historic District	Harrington St.	Newberry	Newberry MRA	11/26/1980
25	SC	Newberry	Hatton House	Holloway St. between Folk St. and US 176	Pomaria		10/1/1990
26	SC	Newberry	Higgins, Francis B., House	1520 Boundary St.	Newberry	Newberry MRA	11/26/1980
27	SC	Newberry	Howard Junior High School	431 Shiloh St.	Prosperity		2/3/2006
28	SC	Newberry	Little Mountain Historic District	Along portions of Pomaria, Church, Main and Mountain Sts.	Little Mountain		4/18/2003
29	SC	Newberry	Main Street Historic District	Roughly bounded by Harper, Summer, Douglas, Johnstone, Holman, and McMorris Sts.	Newberry	Newberry MRA	11/26/1980
30	SC	Newberry	Moon-Dominick House	NE of Chappells	Chappells		3/22/1982
31	SC	Newberry	Mower, George, House	1526 Boundary St.	Newberry	Newberry MRA	11/26/1980
32	SC	Newberry	Newberry College Historic District	2100 College St.	Newberry		6/23/1976
33	SC	Newberry	Newberry County Memorial Hospital	1300-1308 Hunt St.	Newberry		4/21/2004
34	SC	Newberry	Newberry Historic District	Bounded roughly by Friend, College, McKibben, and Harrington Sts.	Newberry		12/31/1974
35	SC	Newberry	Newberry Historic District (Boundary Increase)	Roughly bounded by Friend, McKibben, Harrington, Lindsay and Coates Sts.	Newberry	Newberry MRA	11/26/1980
36	SC	Newberry	Newberry Historic District (Boundary Increase)	Along sections of Main, Lindsay and Wilson Sts.	Newberry	Newberry MRA	6/16/2004
37	SC	Newberry	Newberry Opera House	Boyce and Nance Sts.	Newberry		12/3/1969
38	SC	Newberry	Old Courthouse	1207 Caldwell St.	Newberry		8/19/1971
39	SC	Newberry	Pomaria	SE of Pomaria on US 176	Pomaria		4/24/1979
40	SC	Newberry	Reighley, Ike, House	2304 Main St.	Newberry	Newberry MRA	11/26/1980
41	SC	Newberry	St. John's Lutheran Church	SE of Pomaria	Pomaria		12/8/1978
42	SC	Newberry	Summer Brothers Stores	900 Main St.	Newberry	Newberry MRA	11/26/1980
43	SC	Newberry	Timberhouse	1427 Ebenezer Rd.	Newberry	Newberry MRA	11/26/1980
44	SC	Newberry	Vincent Street Historic District	Vincent and Crosson Sts.	Newberry	Newberry MRA	11/26/1980
45	SC	Newberry	Wells Japanese Garden	Lindsay St.	Newberry	Newberry MRA	11/26/1980
46	SC	Newberry	Wells, Osborne, House	1101 Fair St.	Newberry	Newberry MRA	11/26/1980
47	SC	Newberry	West Boundary Street Historic District	Boundary and Jessica Sts.	Newberry	Newberry MRA	11/26/1980
48	SC	Saluda	Bonham House	SE of Saluda off U.S. 178	Saluda		12/30/1974
49	SC	Saluda	Butler Family Cemetery	NE of Saluda off SC 194	Saluda		12/31/1974
50	SC	Saluda	Marsh-Johnson House	Intersection of S-41-21 and S-41-37	Saluda		6/17/1982
51	SC	Saluda	Saluda Old Town Site	Address Restricted	Saluda		6/28/1972
52	SC	Saluda	Saluda Theatre	107 Law Range	Salude		12/13/1993
53	SC	Saluda	Spann Methodist Church and Cemetery	150 Church St.	Ward		10/18/2003
54	SC	Saluda	Stevens--Dorn Farmstead	Co. Rd. 156. 0.5 mi. S of jct. of Co. Rd. 156 and US 178	Saluda		7/25/1997
55	SC	Saluda	Strother Place, Old	E side Fruit Hill Rd., 0.3 mi. N of the jct. with Chappells Ferry Rd.	Saluda		2/25/1994

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Row	State	County	Resource Name	Address	City	Multiple	Listed
56	SC	Saluda	Webb--Coleman House	2 mi. S of Chappells, .3 mi. E of SC 39, at jct. of three dirt rds.	Chappells		4/24/1992
57	SC	Saluda	Whitehall	Etheredge Rd.	Saluda		8/21/1980

Sec. 9.3 Ref 19

POLICIES AND PROCEDURES

of the South Carolina Coastal Management Program

~ An Excerpt of the South Carolina Coastal Management Program Document ~

Office of Ocean and Coastal Resource Management
South Carolina Department of Health and Environmental Control
4130 Faber Place, Suite 300
Charleston, S.C. 29405

Updated July 1995

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PREFACE

This document is an <u>excerpt from South Carolina's Coastal Management Program Document</u> which was approved by the State's General Assembly and the Federal government in 1979. It contains the specific goals, objectives and policies necessary for staff review of development activities taking place in the eight-county coastal zone of South Carolina (Horry, Georgetown, Berkeley, Charleston, Dorchester, Colleton, Beaufort, and Jasper Counties). It also contains the basic procedures involved in the management of specific coastal resources, such as endangered species, archaeological and historical resources, and others, as well as procedures for dock master plans, wetland master plans, mitigation, and appeals. In contrast, the complete Coastal Management Program Document contains findings of fact and summary justification, provides background data on coastal resources, and fully describes the administrative process of the program, in addition to all of the procedures and policies. Any noticeable differences in the language of the full S.C. Coastal Management Program Document and this excerpted version are due to changes in law, reorganization of State government, or minor editorial changes which in no way alter the goals, objectives and policies adopted by the S.C. General Assembly. The sole intent of this excerpt is to provide all users with a more useable, manageable and updated policy document. <u>If any question arises, consult the full program document for clarification.</u>

The Appendix is an excerpt from South Carolina's Beachfront Management Plan dated December 11, 1992. The goals, objectives and policies contained therein were approved in accordance with the State Administrative Procedures Act and provide further guidance and policies for beachfront management and beach access. Please consult the full Beachfront Management Plan for clarification.

INTRODUCTION

The Office of Ocean and Coastal Resource Management, a division of the South Carolina Department of Health and Environmental Control, was originally established in 1977 as the S.C. Coastal Council pursuant to the State's Coastal Zone Management Act (Act 123). The legislation mandated the agency "to protect the quality of the coastal environment and to promote the economic and social improvement of the coastal zone and of all the people of the State" through the implementation of a coastal management program. Culminating a two-year effort, which included wide public involvement, a comprehensive management program for the eight-county coastal zone was approved by the South Carolina General Assembly on February 14, 1979. Eight months later, on September 19, 1979, the program was approved by the Federal government.

The scope of the coastal management program is based on the jurisdiction areas of responsibility and the specific coastal resource which must be managed. And this is further based on the two management tools or authorities defined by the law to implement the program. First, OCRM has direct permitting authority over the "critical areas" of the coast, defined as coastal waters, tidelands, and beach/dune system. Secondly, indirect management authority of coastal resources is granted to OCRM throughout the eight coastal counties (Horry, Georgetown, Berkeley, Charleston, Dorchester, Colleton, Beaufort, and Jasper), defined as the "coastal zone." The coastal zone includes coastal waters and submerged bottom seaward to the State's jurisdictional limits, as well as the lands and waters of the eight coastal counties. Within the coastal zone, the program provides authority to review any project requiring a state permit (certification), a federal permit or license, or federal funding as well as direct federal activities (consistency determination) to determine if the project is consistent with the policies and procedures of the *South Carolina Coastal Management Program*.

GLOSSARY

A-95: Office of Management and Budget Circular A-95; an interagency notification and review process by which state, local and regional levels of government have an opportunity to comment on proposed projects or programs involving federal funding. The goal is to avoid federal or federally-assisted actions which would not be in keeping with state or local efforts, plans, or policies, or would work against other federal efforts.

Beaches: Those lands subject to periodic inundation by tidal and wave action so that no nonlittoral vegetation is established.

Certification: The procedure of OCRM review and approval or disapproval of the permit applications processed by other State agencies (in the coastal zone) based on determination of the project's compliance with policies of the Coastal Management Program.

Coastal Waters: The navigable waters of the U.S. subject to the ebb and flood of the tide and which are saline waters, shoreward to their mean high-water mark.

Coastal Zone: By law, the coastal zone in South Carolina consists of all the lands and waters out to the three-mile limit of State jurisdiction in eight counties: Beaufort, Berkeley, Charleston, Colleton, Dorchester, Horry, Jasper and Georgetown.

Consistency Determination: A decision made with respect to a direct federal activity/development project, a federal permit or license, or a federal funding or assistance program, which ascertains whether such federal-level action is in compliance with policies of the Coastal Management Program ("consistent to the maximum extent practicable"). See Chapter V in the full program document.

Critical Areas: By law, the critical areas of South Carolina are the coastal waters, tidelands, and beach/dune system. In these areas OCRM has direct jurisdiction for permits to perform any alteration.

Feasible (feasibility): As used within the coastal program (for example, "unless no feasible alternative exists"), feasibility is determined by OCRM with respect to individual project proposals. Feasibility in each case is based on the best available information, including technical input from relevant agencies with expertise in the subject area, and considering factors of environmental, economic, social, legal and technological suitability of the proposed activity and its alternatives. Use of this word includes the concept of reasonableness and likelihood of success in achieving the project goal or purpose. "Feasible alternatives" applies both to locations or sites and to methods of design or construction, and includes the no action alternative.

GAPC: Geographic Area of Particular Concern. See Chapter IV.

Networking: Linking together the legal authorities of the various State agencies with jurisdiction in the coastal zone to enable comprehensive management of coastal resources.

This is accomplished through application of the certification process, mandated in *Sections 70(A)* and *80(B)(11)* of the S.C. Coastal Management Act of 1977.

OCRM: Office of Ocean and Coastal Resource Management, a division of SCDHEC.

OCS: Outer Continental Shelf, specifically, used in reference to off-shore oil and gas developments.

Previously undisturbed wetlands: Those having no visible, physical evidence of previous impoundment, that is, separation from adjacent rivers or estuaries by artificial diking.

SCDHEC: South Carolina Department of Health and Environmental Control.

The Department: SCDHEC.

Tidelands: All areas which are at or below mean high tide and coastal wetlands, mudflats, and similar areas that are contiguous or adjacent to coastal waters and are an integral part of the estuarine systems involved. Coastal wetlands include marshes, mudflats, and shallows and means those areas periodically inundated by saline waters whether or not the saline waters reach the area naturally or through artificial water courses and those areas that are normally characterized by the prevalence of saline water vegetation capable of growth and reproduction.

Water-Dependent: A facility which can demonstrate that dependence on, use of, or access to, coastal waters is vital to the functioning of its primary activity.

Water-Related: Significantly enhanced economically by proximity to the shoreline (water).

CHAPTER III

MANAGEMENT OF COASTAL RESOURCES

A. GOALS AND OBJECTIVES

The policy of the State of South Carolina in the Coastal Zone Management Act of 1977 is "to protect the quality of the coastal environment and to promote the economic and social improvement of the coastal zone and of all the people of this State."

In an effort to guide the State's coastal management program in keeping with this policy, the following goals and objectives have been developed by the Office of Ocean and Coastal Resource Management (OCRM):

GOAL:

Development of a management program that will achieve a rational balance between economic development and environmental conservation of natural resources in the coastal zone of South Carolina.

Objectives:

1. To protect and conserve coastal land and water areas of a significant resource value, including those of scientific, geologic, hydrologic and biologic importance.

2. To encourage and assist in research pertaining to coastal natural resource systems and economic and social impacts in order to develop a comprehensive data base to aid in making rational decisions.

3. To protect and sustain the unique character of life on the coast that is reflected in its cultural, historical, archeological, and aesthetic values.

4. To promote increased recreational opportunities in coastal areas and increased public access to tidal waters in a manner which protects the quality of coastal resources and public health and safety.

5. To develop and institute a comprehensive beach erosion policy that identifies critical erosion areas, evaluates the long-term costs and benefits of erosion control techniques, seeks to minimize the effects on natural systems (both biological and physical), and avoid damage to life and property.

6. To encourage new coastal development to locate in existing developed areas, capable of accommodating additional growth, and in areas determined to be more environmentally and economically suitable for development.

7. To resolve existing use conflicts and minimize potential conflicts among activities through improved coastal management reflecting the public's desires, natural resource capacity, and expected costs and benefits.

8. To encourage new water-dependent activities to locate in shoreline areas where adverse social, economic and environmental impacts can be minimized and to encourage the inland siting of facilities which are not water-dependent.

9. To promote employment of thorough assessments of probable energy benefits, positive and negative economic effects and probable social and environmental

impacts as the basis for decisions on development of energy resources; and to ensure that affected local governments obtain sufficient financial and technical assistance to adequately cope with these impacts.

10. To support the wise commercial development of harbors, rivers and waterways for trade and commerce in locations and using methods which maintain the natural environmental integrity of the coastal region.

11. To protect and, where possible, to restore or enhance the resources of the State's coastal zone for this and succeeding generations.

12. To develop a coastal program with flexibility for revision and improvement with the evolution of increased knowledge and experience in managing coastal resources.

GOAL:

To develop a permitting system for activities in critical areas of the coastal zone (beach/dune system, tidelands, and coastal waters) that will serve to implement the goals and objectives of the management program and promote the best interests of all citizens of South Carolina.

Objectives:

1. To develop and implement a streamlined and simplified permitting system for activities in critical areas which maintains the integrity and purpose of the management program.

2. To include conditions and stipulations in permits for activities approved for critical areas in order to minimize negative impacts on water quality, marine productivity, beach and shoreline stability, and other environmental aspects.

3. To give full consideration to the Rules and Regulations for Permitting, as promulgated by OCRM, in thorough and comprehensive reviews of all permit applications.

4. To specify environmentally suitable methods of design, construction and development in critical areas and assist permit applicants to incorporate these environmentally suitable alternatives in their proposals.

GOAL:

To promote intergovernmental coordination and public participation in the development and implementation of the coastal management program for South Carolina.

Objectives:

1. To provide full opportunity for participation by relevant Federal, State, and local government agencies, concerned organizations, and the general public in the development, implementation, and updating of the Coastal Management Program.

2. To increase public awareness and encourage public participation in the development of OCRM's management program and decisions made pursuant to that program.

3. To strengthen the planning and decision-making capabilities of cities and counties in the coastal zone through provision of financial, technical and other assistance, and provide for coordination of local comprehensive plans and ordinances with the policies and rules and regulations of the coastal management program.

4. To promote coordination and use of existing State programs to minimize duplication of efforts, conflicting actions and permit processing delays, and to achieve coastal management objectives and policies.

5. To provide adequate representation of the interests of the State of South Carolina in Federal agency decisions and actions affecting the coastal zone.

B. COASTAL ZONE BOUNDARY

(See pages III-3 - III-4 of the full program document.)

C. USES OF MANAGEMENT CONCERN

1. **CONSIDERATION OF NATIONAL INTEREST**
(See pages III-5 - III-7 of the full program document.)

2. **ACTIVITIES OF REGIONAL BENEFIT**
(See pages III-8 - III-10 of the full program document.)

3. **RESOURCE POLICIES**

GUIDELINES FOR EVALUATION OF ALL PROJECTS

I. In review and certification of permit applications in the coastal zone, OCRM will be guided by the following general considerations (apply to erosion control and energy facility projects, as well as activities covered under Resource Policies):

1) The extent to which the project will further the policies of the South Carolina General Assembly which are mandated for OCRM in implementation of its management program these being:
   a) "To promote the economic and social improvement of the citizens of this State and to encourage development of coastal resources in order to

achieve such improvement with due consideration for the environment and within the framework of a coastal planning program that is designed to protect the sensitive and fragile areas from inappropriate development and provide adequate environmental safeguards with respect to the construction of facilities in the critical areas of the coastal zone;

b) To protect and, where possible, to restore or enhance the resources of the State's coastal zone for this and succeeding generations." *(Sections 48-39-30(B)(1) and (2)*, S. C. Coastal Management Act of 1977).

2) The extent to which the project will have adverse impacts on the "critical areas" (beach/dune system, coastal waters, tidelands).

3) The extent to which the project will protect, maintain or improve water quality, particularly in coastal aquatic areas of special resource value, for example, spawning areas or productive oyster beds.

4) The extent to which the project will meet existing State and Federal requirements for waste discharges, specifically point sources of air and water discharge, and for protection of inland wetlands.

5) The extent to which the project includes consideration for the maintenance or improvement of the economic stability of coastal communities.

6) The extent to which the project is in compliance with local zoning and/or comprehensive plans.

7) The possible long-range, cumulative effects of the project, when reviewed in the context of other possible development and the general character of the area.

8) The extent and significance of negative impacts on Geographic Areas of Particular Concern (GAPCs). The determination of negative impacts will be made by OCRM in each case with reference to the priorities of use for the particular GAPC. Applications which would significantly impact a GAPC will not be approved or certified unless there are no feasible alternatives or an overriding public interest can be demonstrated, and any substantial environmental impact is minimized.

9) The extent and significance of impact on the following aspects of quality or quantity of these valuable coastal resources:

i) unique natural areas -- destruction of endangered wildlife or vegetation or of significant marine species (as identified in the Living Marine Resources segment), degradation of existing water quality standards;

ii) public recreational lands -- conversion of these lands to other uses without adequate replacement or compensation, interruption of existing public access, or degradation of environmental quality in these areas;

iii) historic or archeological resources -- irretrievable loss of sites identified as significant by the S. C. Institute of Archeology and Anthropology or the

S. C. Department of Archives and History without reasonable opportunity for professional examination and/or excavation, or preservation.

10) The extent to which the project is in the national interest.

II. In critical areas of the coastal zone, it is OCRM policy that, in determining whether a permit application is approved or denied, OCRM "shall base its determination on the individual merits of each application, the policies specified in *Sections 48-39-20* and *48-39-30* (of the Act), and be guided by the following general considerations:

1) The extent to which the activity requires a waterfront location or is economically enhanced by its proximity to the water.

2) The extent to which the activity would harmfully obstruct the natural flow of navigable water. If the proposed project is in one or more of the State's harbors or in a waterway used for commercial navigation and shipping or in an area set aside for port development in an approved management plan, then a certificate from the South Carolina State Ports Authority declaring the proposed project or activity would not unreasonably interfere with commercial navigation and shipping must be obtained by OCRM prior to issuing a permit.

3) The extent to which the applicant's completed project would affect the production of fish, shrimp, oysters, crabs or clams or any marine life or wildlife or other natural resources in a particular area including but not limited to water and oxygen supply.

4) The extent to which the activity could cause erosion, shoaling of channels or creation of stagnant water.

5) The extent to which the development could affect existing public access to tidal and submerged lands, navigable waters and beaches or other recreational coastal resources.

6) The extent to which the development could affect the habitats for rare and endangered species of wildlife or irreplaceable historic and archeological sites of South Carolina's coastal zone.

7) The extent of the economic benefits as compared with the benefits from preservation of an area in its unaltered state.

8) The extent of any adverse environmental impact which cannot be avoided by reasonable safeguards.

9) The extent to which all feasible safeguards are taken to void adverse environmental impact resulting from a project.

10) The extent to which the proposed use could affect the value and enjoyment of adjacent owners." (*Section 48-39-150*, S. C. Coastal Management Act of 1977, as amended)

RESOURCE POLICIES

The following pages contain Resource Policies for each of the identified "Activities Subject to Management." These policies are organized into three categories. Category (1) consists of policies which pertain to the entire coastal zone - both the critical areas where the Office of Ocean and Coastal Resource Management (OCRM) has direct permitting authority as well as that portion outside the critical areas in which OCRM has indirect authority (i.e., review and certification authority). Category (2) consists of policies (i.e., rules and regulations - *R.30-1*, et. seq., S. C. Code of Laws of 1976, as amended) which pertain to the critical areas only. Category (3) consists of recommended or enhancement policies which are endorsed by the Office of Ocean and Coastal Resource Management.

The policies contained in *Sections (1)* and *(2)* are those which OCRM is authorized to enforce through the authority of the coastal program and the S. C. Coastal Management Act of 1977. These policies are highlighted in the text with a bold outline along the margins.

I. RESIDENTIAL DEVELOPMENT

Policies

1) In the coastal zone, OCRM review and certification of State and Federal permits and comments on residential projects will be based on the following policies:

   a) Adequate sewage disposal service (septic tanks or treatment systems) which meet the Environmental Protection Agency, South Carolina Department of Health and Environmental Control, and local health department standards must be provided in residential development plans. Septic tanks should be permitted, where feasible, in low density residential developments when they are designed properly and soils are adequate to insure against pollutants leaching into surface or groundwater resources. Septic tanks must be situated a safe distance from the shoreline to ensure proper drainage and filtering of the tank effluents before they reach the water's edge with special attention given in identified erosion areas. Policies for sewage treatment plants and associated facilities appear in IX (A) of this section.

   b) Residential development which would require filling or other permanent alteration of salt, brackish or freshwater wetlands will be prohibited, unless no feasible alternatives exist or an overriding public interest can be demonstrated, and any substantial environmental damage can be minimized. These marshes are valuable habitat for wildlife and plant species and serve as hydrologic buffers, providing for absorption of stormwater runoff and aquifer recharge, and therefore, their destruction for residential purposes must be avoided whenever possible.

   c) Location of new residential development in flood-prone river or other hazard areas is discouraged. When development does occur in flood hazard areas, the inclusion of natural, vegetated buffers between developed areas and the shoreline must be incorporated wherever possible to help absorb flood water surges. Within designated flood zone areas of participating communities residential development must meet existing Federal Flood Insurance

Administration national building standards and insurance requirements. Local governments in the coastal zone are urged to actively participate in the National Flood Insurance program.

d) Where appropriate, particularly adjacent to a critical area, drainage plans and construction measures for residential development shall be designed so as to control erosion and sedimentation, water quality degradation, and other negative impacts on adjacent water and wetlands. Example techniques include buffering and filtering runoff water; use of permeable surfacing materials for roads, parking and other paved areas within a subdivision; and grass ditching, surface drainage contours, or catchment ponds rather than direct stormwater discharge. Best Management practices (and any resultant regulations) designed to control nonpoint source runoff that are developed and implemented as part of the 208 Water Quality Planning process also apply to new housing projects. Developers proposing residential development activities should contact and work closely with local 208 planning agencies and local Soil and Water Conservation Districts.

e) Other activities associated with a residential development or subdivision will be subject to the policies for that activity, for example, dredging, docks and piers, marinas, commercial buildings, parking facilities or transportation access.

f) When local ordinances and plans applying to the critical areas are submitted to OCRM for review, pursuant to *Section 48-39-100(B)* of the Act, such ordinances, plans or subdivision regulations must include provisions for insuring:

   i) adequate non-critical area vehicular access to each subdivision lot,

   ii) adequacy of septic tank or sewage treatment system disposal for each lot.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM **recommends** that the following policies be considered in planning residential development in the coastal zone:

a) Local governments are encouraged to develop local plans and procedures which promote clustering of residential development where growth is most compatible with coastal resources and where necessary public services can be most easily provided with least adverse impacts on these resources. Criteria to judge those areas most capable of accommodating new growth with minimal impact on coastal resources would be included in local plans.

b) Developers are encouraged to incorporate common-use recreational areas in proposals for large-scale residential developments. With regard to water and boat access, "Developers of subdivisions and multiple family dwellings are encouraged to develop joint-use or community docks when their plans are in the development stage" [*R.30-12(A)(2)(h)*], combined with building covenants to limit the proliferation of individual docks and piers.

Management Authority

If located in the critical areas, as defined by the S.C. Coastal Management Act, proposed new residential uses would require a permit from OCRM before beginning construction.

Outside the critical areas, OCRM will review a number of State agency permits required for certain residential developments to determine that issuance of these permits is consistent with the preceding coastal management policies. This review and certification process is mandated in *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the Coastal Management Act.

A S.C. Department of Health and Environmental Control (DHEC) State navigable waters permit is required for the filling of waters or wetlands below mean high water (MHW) in that part of the State outside OCRM permitting jurisdiction.

S.C. Department of Health and Environmental Control (DHEC) water and sewer permits are required for the construction of subdivision water supply and waster disposal systems. Because of the rural and suburban character of much of the coastal zone, there are large areas not served by public water or sewer systems. This DHEC authority will bring a majority of new residential developments under the OCRM certification process.

DHEC is the State agency responsible for administration of the National Pollution Discharge Elimination System (NPDES) permit process. This permit is required not only for effluent discharges, such as from a sewage treatment facility, but in some instances for such point-source discharges as storm drainage pipes. DHEC is also the S.C. agency responsible for "401" water quality certifications (*Section 48-1-50(15)*, S.C. Code of Laws (1976)), which are determinations of allowable water pollution levels required for any activity involving another Federal permit.

In addition to State management authority, major residential developments receiving some form of Federal financial assistance will be subject to the A-95 review process for which OCRM is a commenting agency. Some projects will also require the submittal of Environmental Impact Statements, thereby having further OCRM review. Federal permits will be required for any proposed housing construction in the wetland or water areas under jurisdiction of *Section 404* (*33CFR Section 323*) of the Federal Water Pollution Control Act, as amended in 1976.

II. TRANSPORTATION FACILITIES

A. PORTS

Policies

In the coastal zone, OCRM evaluation of critical area permits or review and certification of permit applications for port development will be based on the approved ports plan and the following policies:

1) New port development should take place in existing industrialized areas where sufficient support facilities are available including public utilities, rail and highway transportation access, and navigational channels which are already maintained, unless there are no feasible alternatives or an overriding public interest can be demonstrated, and any substantial environment damage can be minimized.

2) Port development should occur in areas that have adequate high ground (non-wetland) acreage for proposed current development and near-term expansion plans, and related facilities. Port development should be located in areas where the filling of productive salt, brackish or freshwater wetlands will not be required or can be minimized. If site preparation does require filling in these wetlands, it must be clearly demonstrated that no other feasible alternatives exist or an overriding public interest can be demonstrated, and any substantial environment damage can be minimized.

3) To the extent feasible, port development and expansion should locate on existing channels so that the need for initial and maintenance dredging can be minimized.

4) New port development that will require maintenance dredging must identify adequate upland (non-wetland) spoil areas, ocean disposal, or other environmentally-acceptable alternative disposal techniques to meet the long-term demands for spoil disposal.

5) Port areas must provide for the handling of dangerous and volatile cargoes and materials in relatively isolated or restricted areas, so that in the event of accident, measures can be implemented to contain any spills or other contamination with minimal environmental damage and limited threat to the health, safety and welfare of the public.

6) Wharves, piers, mooring dolphins and other port-related structures should not restrict or block navigation or alter the natural pattern of water currents.

7) Proposed port development or expansion and operation must meet existing air and water quality standards, as regulated by the Federal Environmental Protection Agency and the South Carolina Department of Health and Environmental Control.

8) Port facilities developed by the State Ports Authority (SPA), as well as by private developers, must be sited, constructed and operated in a manner that is consistent with local and State development objectives as set forth in public documents such as comprehensive plans, zoning ordinances and performance standards.

9) Potential negative impacts on navigation which might restrict port and harbor activities in the area will be considered in evaluation of permits for marinas, docks and piers, transportation facilities (especially bridges), cables and pipelines and other relevant activities.

10) Port development or expansion plans must include provision for necessary breakwater or other wake protection measures along major navigable ship channels where appropriate in order to reduce erosion damage. These structures must be in compliance with other applicable policies and Rules and Regulations.

11) All bulkheads associated with a port area must meet the policies as stated in the Erosion Control Program [Chapter IV(C)].

12) All dredging and dredge spoil disposal policies, as stated in VIII (A) and (B) of the Resource Policies will be applied to port activities.

13) All piers and dockage must meet the policy requirements as stated in VI (C) of the Resource Policies.

14) Transportation projects associated with port development must follow the transportation policies stated in II (B)-(E) of the Resource Policies.

15) The policies for manufacturing will apply to port development and related industrial development (III (D) of the Resource Policies).

Recommended Policies

OCRM also recommends that the following policies be considered for port and harbor development projects in the coastal zone:

1) Encouraging comprehensive study of potential secondary impacts of port and harbor development projects.

2) Maximizing the use of existing developed port areas, when feasible, before establishing new facilities in relatively undeveloped areas.

3) Encouraging the State Ports Authority (SPA) to diversify their activities and areas of concern to include the promotion of sports and commercial fisheries and other marine activities.

Management Authority

In the critical areas, all new port facilities are under the direct permitting authority of the OCRM and subject to the Rules and Regulations thereunder. Both within and outside of the critical area, in instances where the permit of another State agency is required, the review and certification of OCRM will apply.

While not a permit agency, the South Carolina State Ports Authority (SPA) has the responsibility for the planning, construction, maintenance, and operation of the State's port system. Cooperative efforts between OCRM and the Ports Authority, not only on project proposals, but also on long-range planning and policy development, are the best means to implement sound coastal management policies. The Legislature recognized the need for this cooperation when it mandated in *Section 48-39-110* of the Coastal Management Act of 1977 (the Act) that the Ports Authority prepare and submit to OCRM a management plan for port and harbor facilities and navigation channels. The port plan, upon approval of OCRM, became a part of the comprehensive management program.

Section 48-39-150(A)(2) of the Coastal Management Act states that:

> If the proposed project is in one or more of the State's harbors or in a waterway used for commercial navigation and shipping or in an area set aside for port development in an approved management plan, then a certificate from the South Carolina State Ports Authority declaring the proposed project or activity would not unreasonably interfere with commercial navigation and shipping must be obtained by the Department prior to issuing a permit.

In addition, the Memorandum of Agreement (MOA) between the two agencies is written so as to provide for cooperative efforts. Port projects and plans are subject to review and comment, and direct OCRM permitting in the critical areas, where applicable, based on the preceding policies. A further legal mandate for cooperative and consistent implementation of the two agencies' programs is found in the Act in *Section 48-39-70(A)* and is further explained in the Legal Authorities and Networking section, Chapter V(A).

A majority of port and navigation projects also require Federal permits, and these permit reviews are subject to the Federal consistency provisions of the coastal program. Those projects involving Federal Funding are subject to the Federal Office of Management and Budget (OMB) Circular A-95 review, and frequently to EIS review, under the National Environmental Policy Act.

B. ROADS AND HIGHWAYS (including bridges and transit facilities)

Policies

1) In the coastal zone, OCRM review and certification of relevant State and Federal permit applications and comments on road or highway proposals will be based on the following policies:

a) Road and highway routes shall be aligned to avoid salt, brackish and freshwater wetlands wherever feasible. Where they cannot be avoided, bridging of these wetlands and all navigable waterways, rather than filling to create roadbeds, will be required wherever feasible. The use of existing fill areas or embankments for widening or improvement projects will be required wherever feasible. Whenever feasible, median and right-of-way widths shall be limited where they will impact salt, brackish, and freshwater wetlands.

b) Road structures through salt, brackish or freshwater wetlands or water bodies must be designed so as not to cause substantial changes in natural waterflow and circulation.

c) Bridges over navigable water bodies must provide adequate clearance for commercial or pleasure craft, where appropriate.

d) Care should be taken in design of roads to minimize direct drainage of roadway runoff into adjacent water bodies. Inclusion of techniques for filtering runoff water, such as grass ditching or vegetative buffers, must be considered. During construction and in later maintenance, roadway embankments should be stabilized to minimize erosion and water quality degradation due to sedimentation problems.

e) Road, highway and bridging projects in wetland or water areas are strongly encouraged to include provision for placement of other utilities, such as cables or transmission lines, in their design to reduce the need for future disruption of adjacent wetlands or waterways.

f) Construction of private roadways for private access shall be aligned to avoid salt, brackish and freshwater wetlands wherever feasible , and, where applicable, must provide bridges, culverts or other means to maintain circulation and water flow. When practicable, permeable surfaces such as gravel or shell should be used rather than pavement.

g) When applicable to highway projects that require spoil disposal areas, the policies for dredge material disposal (Resource Policies VIII (B)) shall apply to that portion of the project proposal.

h) Road or bridge projects involving the expenditure of public funds to provide access to previously undeveloped barrier islands will not be approved unless an overwhelming public interest can be demonstrated, for example, provision of access to a public recreation area or other public facility.

i) Where feasible, new roads and bridges in the coastal zone should be designed to accommodate bicycle and foot paths and fishing catwalks and platforms.

j) OCRM will cooperate and coordinate with the S.C. Department of Transportation in development and implementation of State policy and long-term planning for transportation in the coastal zone, through such mechanisms as the State Highway Action Plan.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM **recommends** that the following policies be considered for road and highway projects in the coastal zone:

a) Encouraging comprehensive study of the potential for secondary growth inducement from new road and highway construction.

b) Study of mass transit alternatives to road or highway construction in urban areas.

c) Encouraging project designs and route alignments which consider the impacts on locally-designated "Scenic Highways" and on other aesthetic considerations, for example, enhancement and protection of scenic vistas and preservation of unique tree canopies and other natural areas.

Management Authority

In the critical areas, roads and highways, both public and private, are under the direct permitting authority of OCRM and subject to the Rules and Regulations thereunder.

While not a permit agency for highway construction, the authority for planning, construction, maintenance and operation of the State's highway system rests with the South Carolina Department of Transportation. Roadway projects by the Department are subject to review and comment by OCRM based on the preceding policies, as outlined in the Memorandum of Agreement between the two agencies. In instances where the permit of another State agency is required for a roadway project, the review and certification process of OCRM will apply.

Cooperative efforts between OCRM and the Department of Transportation, not only on project proposals, but also on long-range planning and policy development, are the best means to implement sound coastal management projects. The Memorandum of Agreement (MOA) between these agencies is written so as to allow such cooperation. The legal mandate for cooperative and consistent implementation of the two agencies' programs is found in the Coastal Management Act of 1977 (*Section 48-39-70(A)*), and is further explained in the Legal Authorities section of the full program document.

The State Department of Commerce, with the mandate of improving trade, commerce and employment opportunities in South Carolina, also has the authority to build or acquire roads and highways as part of the promotion of transportation systems in the State. Any projects proposed by the Department of Commerce in the coastal zone would involve coordinated planning efforts with OCRM based on the preceding policies, as mandated by the Act and outlined in the MOA. (Further legal analysis of this authority is provided in the Legal Authorities section of the full program document.)

A majority of road and highway projects also require Federal permits, and these permit reviews are subject to the Federal consistency provisions of the coastal program. Those projects involving Federal funding are subject to the Federal Office of Management and Budget (OMB) Circular A-95 review, and frequently to EIS review, under the National Environmental Policy Act.

Section 48-39-150(A)(2) of the Coastal Management Act states that "If the proposed project is in one or more of the State's harbors or in a waterway used for commercial navigation and shipping or in an area set aside for port development in an approved management plan, then a certificate from the S.C. State Ports Authority declaring the proposed project or activity would not unreasonably interfere with commercial navigation and shipping must be obtained by the Department prior to issuing a permit."

C. AIRPORTS

Policies

1) In the coastal zone, OCRM review and certification of airport permit applications will be based on the following policies:

a) To the extent feasible, new airport facilities shall not encroach into salt, brackish or freshwater wetlands. Permit applications involving dredge or fill to construct these facilities in wetland areas generally will be denied, unless no feasible alternatives exist or an overriding public interest can be demonstrated, and any substantial environmental damage can be minimized.

b) To the extent feasible, the best available techniques and methods shall be used during design, construction and maintenance of airports to avoid erosion or sedimentation problems and prevent concentrated runoff water from aircraft use areas, parking areas and support facilities from directly entering and degrading adjacent surface water bodies or underground resources.

c) Proposals for airport facilities must demonstrate that they will meet applicable Federal and State air quality and noise control guidelines.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered for airport projects in the coastal zone:

a) Consideration of the existing and planned transportation system or network in the area, for example, relationship to other airports and access to adequate transportation service by other modes.

b) Encouragement of joint-use or regional airport facilities where feasible (for example, joint military and civilian airports).

c) Compatibility with character and use of the area; local governments are encouraged to develop plans and procedures which maintain appropriate, compatible use areas around **existing** airports.

d) Alignment of approach corridors and corresponding noise zones during airport planning should consider any bird rookeries located in the area.

Management Authority

OCRM has direct permit authority for all activities or alterations in the critical areas of the coastal zone. This jurisdiction would include any proposed airport facilities located in the critical areas - beach/dune system, coastal waters and tidal wetlands (salt and brackish).

The Department of Commerce has direct regulatory authority over the design, layout, location and other aspects of landing fields and landing strips for the State. Certificates of approval are required from the Department in order to operate or establish an airport. After approval of the coastal management program by the Governor and General Assembly, a system of review and certification of other State agency permits and actions has been implemented. Department of Commerce certificates in the coastal zone will be reviewed by OCRM, based on the preceding policies, as mandated in *Sections 48-39-70(A)* and *48-39-80(B)(11)*. A Memorandum of Agreement facilitates the cooperative efforts of the two agencies.

Most airport facilities also involve Federal Aviation Administration (FAA) approval and/or financing, so these activities will be subject to A-95 review by OCRM, and in some instances, Environmental Impact Statement (EIS) review.

D. RAILWAYS

Policies

1) In the coastal zone, OCRM review and certification of railway permit applications will be based on the following policies:

a) Railways shall be located away from salt, brackish or freshwater wetlands, to the extent feasible. In cases where these wetlands cannot be avoided, bridging rather than filling to create railway beds will be required wherever feasible.

b) Railroad structures through salt, brackish or freshwater wetlands or water bodies must be designed so as not to alter natural waterflow or circulation. Where bridging is not feasible, provision of adequate culverts or other means for water to flow through or under the structure will be required.

c) Bridges over navigable water bodies must provide adequate clearance for commercial or pleasure craft, where appropriate.

d) Railway projects in wetland or water areas are strongly encouraged to include provision for placement of other utilities, such as cables or transmission lines, in their design to reduce the need for future disruption of adjacent wetlands or waterways.

e) To the extent feasible design of railways shall include techniques to prevent direct drainage of runoff water into adjacent water bodies and stabilization of embankments to minimize erosion and water quality degradation due to sedimentation.

f) Conversion of abandoned railroad tracks, bridges and rights-of-way in the coastal zone for reuse as transportation or utility corridors or for recreational uses, such as fishing piers or bicycle trails, is encouraged.

g) The extension of new railway corridors should be based on comprehensive evaluation of the need to provide improved access to existing industrialized areas, or to planned or proposed developments suitable for manufacturing sites.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered for railway projects in the coastal zone:

a) Minimizing possible aesthetic impacts from placement of rail lines and bridges,

b) Integrating railroad planning and development with other transportation facilities, in order to provide adequate transportation systems; for example, where feasible, new highway bridges might be designed to include railways (especially in urban areas where land is more limited and transportation needs are greatest).

c) In floodplain areas railway alignment should parallel the path of water flow, to the extent feasible, in order to minimize disruption of the floodplain ecosystem.

Management Authority

Proposed new railroad construction activities located in any critical areas will require a permit directly from OCRM. These projects will be reviewed according to the Rules and Regulations for Permitting, which are restated here as OCRM policies for the critical areas.

Outside the critical areas, but within the eight-county coastal zone, OCRM will review and certify permit applications to other State agencies involved in railroad projects, based on the preceding policies. The Memoranda of Agreement with these agencies outline the review process as mandated under *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act of 1977.

Section 48-39-150(A)(2) of the Coastal Management Act states that: "If the proposed project is in one or more of the State's harbors or in a waterway used for commercial navigation and shipping or in an area set aside for port development in an approved management plan, then a certificate from the South Carolina State Ports Authority declaring the proposed project or activity would not unreasonably interfere with commercial navigation and shipping must be obtained by the Department prior to issuing a permit."

DHEC-EQC retains permit authority in State waters below mean high water (MHW) in those portions of the coastal zone beyond the critical area. Any dredging and /or filling or placement of facilities below MHW for railroad construction will have to receive this DHEC-EQC permit. As addressed in the MOA between these two agency divisions, OCRM then reviews and certifies the permit for compliance with coastal policies.

The Department of Commerce is authorized to acquire land, including through condemnation, for construction and operation of railroads and related facilities in South Carolina. Activities of the Department will be subject to the terms of the future MOA between the Department and OCRM. (Private railroad companies have the same condemnation powers and authority to construct railroads and associated facilities. Railroad company projects will be subject to OCRM, DHEC, and other applicable permit requirements.)

The S. C. Department of Commerce may also build or acquire railroads as part of its mandate to promote the transportation system of the State for improved trade, commerce and employment. Department of Commerce projects are coordinated closely with OCRM, as outlined in the MOA. Any State permits associated with Department of Commerce railway projects in the coastal zone would be subject to review and certification by OCRM.

In some instances, railway projects may also require Federal permits, subject to review and comment and to the Federal consistency provisions of OCRM.

E. PARKING FACILITIES

Policies

1) In the coastal zone, OCRM review and certification of permit applications for parking lots, garages or other parking facilities will be based on the following policies:

a) The filling or other permanent alteration of productive salt, brackish or freshwater wetlands will be prohibited for purposes of parking unless no feasible alternatives exist, the facility is directly associated with a water-dependent activity, any substantial environmental impacts can be minimized, and an overriding public interest can be demonstrated.

b) Proposed parking facilities must demonstrate compliance with applicable Federal and State water quality standards, specifically those addressing drainage and discharge of storm water runoff.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in location and design of parking facilities:

a) Use of permeable surface materials such as gravel or shell rather than pavement, where appropriate, with consideration to possible air quality and groundwater impacts.

b) Retaining the maximum possible natural drainage and vegetative cover between parking spaces.

c) Provision of buffer areas around parking areas located adjacent to the critical areas, as visual and storm water runoff buffers.

Management Authority

OCRM has permit jurisdiction over any activity altering a critical area of the coastal zone. Any proposal for a parking facility to alter a critical area must therefore obtain a permit from OCRM.

DHEC-EQC regulates the use of land below mean high water outside the critical areas of the coastal zone. A permit to construct parking facilities on such land is required from DHEC. DHEC has permit jurisdiction over the construction and use of parking facilities if the storm water discharge from such a facility has been identified as a significant contributor to pollution. (Otherwise such facilities are exempt from the Department's National Pollutant Discharge Elimination System permit program.) OCRM reviews and certifies the permits for compliance with the preceding coastal management policies, pursuant to *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act of 1977.

III. COASTAL INDUSTRIES

A. AGRICULTURE

Policies

1) In the coastal zone, OCRM review and certification of permits related to agriculture will be base on the following policies:

a) OCRM supports the utilization of coastal resources for productive agriculture in the coastal zone, particularly on prime agricultural lands (as defined by the U.S. Department of Agriculture), as a positive element of coastal economy and to provide sources of food and fiber products to citizens of the State and nation.

b) To reduce negative impacts on productive tidal salt, brackish and freshwater wetlands:

i) The filling or other permanent alteration of these tidal wetlands for the raising of crops will not be approved;

ii) Ditching for drainage from uplands shall avoid passing through productive wetlands to the maximum extent practicable.

c) To minimize negative impacts on water quality from sedimentation and erosion, applicants for permits relating to agricultural activities are encouraged to work closely with the local Soil and Water Conservation District to obtain assistance in reducing sedimentation and erosion problems. Modern conservation techniques recommended by the local Soil and Water Conservation Districts and the U.S. Department of Agriculture Soil Conservation Service should be utilized, including:

i) Methods or techniques such as contouring should be used to reduce direct surface water runoff into adjacent wetlands or water bodies;

ii) Maintenance and utilization of the natural drainage pattern of the land is encouraged as much as possible;

iii) Use of buffer strips of natural vegetation along the edge between watercourses and cultivated soils is encouraged.

d) Best management practices (and any resultant regulations) designed to control nonpoint source runoff that are developed as part of the 208 Water Quality Planning process should be implemented through the management of agricultural activities. Those engaged in agricultural activities are encouraged to contact and work closely with the local 208 planning agency and the local Soil and Water Conservation Districts.

2) In critical areas of the coastal zone it is OCRM policy that:

a) The policies for dredging and filling (*R. 30-12*) and construction of canals and pipelines (*R. 30-12*) shall be applied when these activities are involved in agricultural use in the critical areas.

3) OCRM also **recommends** that the following policies be considered with regard to agricultural use and practice in the coastal zone:

a) Encouraging the utilization of detailed soil surveys prepared by the National Cooperative Soil Survey (which includes Clemson University Experiment Station, U.S. Department of Agriculture - Soil Conservation Service, and the Department of Natural Resources).

b) That local land use plans include considerations for protecting agricultural lands from premature undesirable conversion into other development activities.

c) Encouraging the full implementation of 12-43-220 of the Code of Laws of South Carolina (1976) local governments within the coastal zone to allow property tax incentives to protect farmlands from conversion to other uses.

d) That the soil testing facilities of Clemson University be utilized to determine the correct types and amounts of fertilizers to be applied to agricultural lands.

Management Authority

OCRM has permit jurisdiction over any activity which in any way alters a critical area of the coastal zone. Therefore, any agricultural activity that directly alters a critical area must have a permit from OCRM.

Outside of the critical area of the coastal zone there are few direct controls over agricultural activities. The Soil and Water Conservation Law (§48-9-1210-1320), administered by DHEC empowers local Soil and Water Conservation Districts to adopt rules and regulations, after public referenda, to control soil erosion. As mandated by §48-39-70(A) this authority will be administered in conformance with policies of the approved coastal program.

State and local Areawide Waste Treatment Management Plans, under *Section 208* of the Federal Water Pollution Control Act (Public Law 92-500) are also authorized to address agricultural best management practices in terms of non-point source water pollution. Development and implementation of these planning and regulatory efforts is closely coordinated with OCRM.

DHEC-EQC retains direct regulatory authority over activities below mean high water in the coastal zone outside the critical areas. These permits are reviewed and certified by OCRM, as mandated in *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act.

B. **FORESTRY** (Silviculture)

Policies

1) In the coastal zone, OCRM review and certification of permit applications related to timber production will be based on the following policies:

a) OCRM will cooperate with and support the State Forestry Commission and local Soil and Water Conservation Districts in encouraging good forest management practices on private and public lands in order to maintain a supply of good quality timber into the future, while protecting other forest valves.

b) The disruption of salt, brackish or freshwater marshes for timber related activities such as drainage or access way shall be avoided to the extent feasible. Where no feasible alternatives exist to prevent disruption in these areas, project designs must include the mitigation measures as identified in the policies for each related activity for example, roads, dredging, etc.

c) Erosion control methods are strongly encouraged for all phases of timber operations in order to reduce:

i) excessive erosion and sedimentation;
ii) detrital, nutrient and chemical or toxic runoff; and
iii) disruption of hydrologic cycles.

Logging operations should be managed so that drainage characteristics through forested and swampland areas remain, to the extent feasible, at the pre-existing water quality, volume and rate of flow.

d) The policies applicable to the processing of timber products are those for manufacturing activities ((III) (D) of the Resource Policies).

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in forestry activity in the coastal zone:

a) Timber harvesting should be carried out in such a manner as to minimize effects on and protect soils, watersheds, aesthetics, wildlife, and recreational values. If damage does occur, restoration plans should be developed and carried out within a reasonable time.

b) Local land use plans should include retaining prime forest areas for sustained timber productivity in the future.

Management Authority

Any alteration of a critical area requires a permit from OCRM. Applicants for forestry activities that alter a critical area must obtain a permit from OCRM.

Outside of the critical areas of the coastal zone the State Commission of Forestry conducts forestry activities on State owned forest lands, and offers guidance and technical assistance to private timber operations including fire prevention and control practices. The Forestry Commission's authority will be administered in conformance with the approved coastal management program and the Coastal Management Act, as mandated by §48-39-70(A) and through the Memorandum of Agreement (MOA) executed between the S.C. State Commission of Forestry and OCRM.

DHEC-EQC has jurisdiction for issuance or denial of the State permit for activities below mean high water (MHW) in the rest of the coastal zone outside the critical areas. These permit applications are subject to the review and certification authority of OCRM, as mandated by *Sections 48-39-70(A)* and *48-39-80(B)(II)* of the Coastal Management Act.

C. MINERAL EXTRACTION

Policies

(Existing, active mining sites have been designated as Geographic Areas of Particular Concern (GAPCs) in the coastal zone, because of their unique mineral resource value and potential as development activities dependent on locating in the coastal zone.)

1) In the coastal zone, OCRM review and certification of mining permit applications will be based on the following policies:

a) Applicants for mining permits must submit an approved reclamation plan, as required by the Land Resources Conservation Commission under the S.C. Mining Act.

b) Dredge or strip mining operations are prohibited in wetlands areas, unless no feasible alternatives exist and the benefits of mining outweigh the adverse impacts. If all or part of a mining site must involve water bodies or wetland areas, policies for dredging (VIII (A) of the Resource Policies) shall apply.

c) To minimize negative impacts on water quality, the prevention of direct stormwater discharge from upland sites into adjacent wetlands or water bodies is required whenever possible through inclusion of such techniques as use of vegetated buffer areas, silt curtains and other erosion or sedimentation control methods. Negative effects on groundwater resources should also be avoided.

2) In critical areas of the coastal zone, it is OCRM policy that:
Policies for dredging activities (VIII of this section) and *R.30-12* shall apply to mining operations.

3) OCRM also **recommends** the following policies be considered in mining activities in the coastal zone:

a) Provision of scenic buffer areas around active mining sites.

b) That the study of mineral resources be made before land is committed to development, and those areas found to contain significant mining resources be identified in local land use plans.

Management Authority

OCRM has authority for a direct permit requirement for mining operations in critical areas of the coastal zone, based on *Sections 48-39-50(E)(F)(G)(H)(I)*, and *Section 48-39-130* of the S.C. Coastal Management Act of 1977.

In the coastal zone, within and outside the critical areas, the S.C. Land Resources Conservation Commission is responsible for implementation of the S. C. Mining Act. A permit, terms of which include a complete site reclamation plan, is required for any mining operation. OCRM's review and certification of these permits, as required by *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the Coastal Management Act, is confirmed by the Memorandum of Agreement between these two agencies.

Where mining operations extend below mean high water (MHW) outside the critical areas, DHEC-EQC also has permit jurisdiction. These permit applications are subject to the review and certification procedure of OCRM, as required by *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the Coastal Management Act.

The S.C. Department of Health and Environmental Control has authority over most mining operations for point-source discharge permits (NPDES) or best management practices (for non-point source runoff, under 208 Areawide Waste Treatment management planning).

Where mining operations are located in designated capacity use areas and groundwater pumping is required, a capacity permit is required from DHEC.

D. MANUFACTURING

Policies

1) In the coast zone, OCRM review and certification of permit applications for manufacturing and related activities will be based on the following policies:

a) Nonwater-dependent manufacturing or industrial facilities will be prohibited from locating in shorefront areas unless there are no feasible alternatives. Nonwater-dependent industries will be encouraged to locate in inland areas.

b) The filing or other permanent alteration of productive fresh, brackish and saltwater wetland areas for manufacturing facilities and related activities or structures will be prohibited, unless no feasible alternatives exist and any substantial environmental impact can be minimized. To the extent feasible heavy industry shall be directed away from ecologically sensitive areas such as marshes, forested wetlands, pocosins, etc.

c) Manufacturing operations and sites should be designed and constructed to reduce erosion and sedimentation, and to limit the impacts from direct stormwater discharge into adjacent water bodies and wetlands. Persons proposing to develop manufacturing activities are requested to contact and work closely with the local Soil and Water Conservation District in the county for assistance in developing site plans which reduce sedimentation and drainage problems. Applicants must demonstrate consideration of the following means of reducing these problems and use of these methods where appropriate:

i) Provision of a buffer strip of natural vegetation between the facility and the wetland's edge. This vegetated area should be sufficient in each case to serve its intended purpose: providing a visual screen, a noise buffer, a purification system for stormwater runoff, or a protective area for more ecologically sensitive shoreline areas, especially fringing wetlands.

ii) During site preparation, care should be taken to control storm runoff, soil erosion, and accidental placement of sediments in wetland areas.

iii) The use of permeable surfaces in parking lots and bulk storage areas to provide water recharge areas and minimize the effects of stormwater runoff.

iv) Retain open space or natural (undisturbed) areas around manufacturing sites as buffer zones and recharge areas.

d) Manufacturing facilities must meet the applicable water quality and effluent limitation standards of the U.S. Environmental Protection Agency and the South Carolina Department of Health and Environmental Control, under the National Pollution Discharge Elimination System, *Sections 401* and *402* of the Federal Water Pollution Control Act Amendments (Public Law 92-500). In some cases, pretreatment of industrial wastes before introduction into public waste treatment systems may be required, based on local 201 and 208 Waste Treatment Management Plans, as developed under the Federal Water Pollution Control Act. Siting of industrial facilities is encouraged in areas where waste discharges present the least ecological threat - for example, in areas where disruption of wetlands can be avoided or minimized, in areas with good tidal flushing and water circulation and along watercourses with relatively low water quality classifications.

e) Manufacturing facilities must meet applicable State and Federal air pollution standards and controls, as based on the National Clean Air Act, as amended (P.L. 91-604).

f) In instances where groundwater resources will be utilized either in the processing of effluent discharge stages of the production process, the project shall:

i) meet existing standards and/or management programs of DHEC.
ii) prevent saltwater intrusion and land subsidence, to the extent feasible.
iii) where feasible, provide natural vegetated areas on the site where aquifer recharge can occur to mitigate the impacts of groundwater withdrawals.

g) When located in flood zone areas, manufacturing sites and structures must meet applicable flood-plain management and construction requirements, as based on the Federal Flood Insurance Program.

h) To the extent feasible new water-dependent industries shall locate on already maintained channels of rivers to reduce the need for dredging of new channels. Where no presently maintained channel exists and one becomes necessary, the policies for dredging (VIII of the Resources Policies) will apply.

i) Dock or pier and berthing facilities associated with a manufacturing activity shall be designed to minimize possible negative impacts. The policies for docks and piers or other associated activities will apply.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in planning for or siting of manufacturing uses in the coastal zone:

a) Siting of industrial plants where they are served with existing well-developed road and railroad links to port areas and to major arterial transportation routes.

b) Development of local plans which direct manufacturing growth into areas committed to industrial use where services can be most readily provided.

c) Development of local plans which encourage comprehensive-type industrial parks, to facilitate well-planned, well-managed manufacturing and industrial centers that promote the advantages of locating in South Carolina.

d) Encouraging manufacturing that will provide significant new employment opportunities for coastal residents.

e) Considerations for minimizing noise and aesthetic impacts of manufacturing activities.

f) Consideration for allowing limited public access to the buffer zone as a recreational area.

Management Authority

Any manufacturing use or related activity proposed for the critical areas of the coastal zone would be required to obtain a permit from OCRM. The policies for any related activity, and the procedures of the Rules and Regulations for Permitting would apply.

In the coastal zone outside the critical areas, OCRM will review and certify the permits and projects of other State agencies to insure compliance with the coastal Management program, as mandated in *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act of 1977.

DHEC-EQC has authority for issuance of permits for activities below mean high water. Applications for these permits are reviewed and certified by OCRM for compliance with the coastal management program.

Throughout the coastal zone, the Department of Health and Environmental Control is the State implementing agency for water quality and air quality standards. Permit applications for water and air discharges are subject to certification and review by OCRM.

While not a permit agency, the Department of Commerce, State Development Division, has the responsibility for planning and coordination to promote improved trade, commerce and employment opportunities in the State. Included in the Board's specific authority is promotion of industrial development. When appropriate, OCRM will coordinate and support programs and projects of the Board to insure continued opportunities for manufacturing growth and development while at the same time maintaining sound coastal management policies.

Federal permits are required where any aspects of a manufacturing project fall under the jurisdiction of *Section 10* of the Rivers and Harbors Act; *Sections 401, 402* and *404* of the Federal Water Pollution Control Act Amendments; and the National Clean Air Act (P.L. 91-604, amend.). These permit applications are reviewed and certified by OCRM, and are subject to Federal consistency provisions.

E. FISH AND SEAFOOD PROCESSING

Policies

1) In the coastal zone, OCRM review and certification of permit applications for seafood processing plant proposals will be based on the following policies:

a) Drainage or discharge from any proposed seafood packing or processing operations must meet applicable State and Federal water quality standards.

b) Proposed seafood processing operations must comply with policies for dock and piers, and dredging and filling, where applicable.

c) To the extent feasible fish and seafood processing operations shall not be located where there would be significant adverse impacts on salt, brackish or freshwater wetlands. Filling or other permanent alteration of these wetlands for such purposes will be denied unless no feasible alternatives exist and the public benefits outweigh the adverse impacts.

d) Adequate facilities for proper handling of sewage, litter and other waste products must be provided at the site of new docking areas associated with seafood processing.

e) Care must be exercised in the discharge of water used to pump out the holds of fishing vessels so that water quality is not unnecessarily degraded and so that such discharges comply with applicable Department of Health and Environmental Control and United States Coast Guard regulations.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in fish and seafood processing operations in the coastal zone:

a) Consideration should be given to the utilization of fish wastes or by-products for meal or fertilizers.

Management Authority

In the critical areas of the coastal zone, OCRM has direct permit authority over seafood processing plants and related facilities.

In the rest of the coastal zone, OCRM, which has jurisdiction outside the critical areas for activities below mean high water, in wetland areas and submerged bottoms.

The Department of Health and Environmental Control (DHEC) has permit authority for direct wastewater discharges, and for "401" water quality certifications for projects which require Federal permits. Through coordinated, joint efforts of both agencies, OCRM will review and certify DHEC permits for their compliance with coastal policies.

Federal permits may also be required for dredging or filling, construction of docking areas, and for wastewater discharged associated with seafood processing.

F. AQUACULTURE

Policies

1) In the coastal zone, OCRM review and certification of aquaculture permit applications will be based on the following policies:

a) The impoundment of previously undisturbed, productive salt, brackish or freshwater wetlands for aquaculture will be prohibited where other feasible alternatives exist.

b) Aquaculture proposals must demonstrate compliance with applicable State and Federal water quality standards for discharge or drainage.

c) For each aquaculture proposal the value and yield which is anticipated from the project should be weighed against any environmental damage, such as loss of habitat from impounded areas. This consideration will be included by OCRM in its decision-making, and applicants may be asked to provide relevant information towards the determination of such costs and benefits.

d) Applicants for aquaculture operations must provide an acceptable management plan for the operation.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in planning and research for aquaculture projects in the coastal zone:

a) Encouraging research efforts for "passive aquaculture" as opposed to use of artificial impoundments including:

- i) fixed structure aquaculture (for example, setting supports and lines. This should be limited to open water areas where they can be placed on the periphery and not interfere with navigation).
- ii) tray culture for shellfish.
- iii) penning areas for soft shell crabs.
- iv) trap culture for fish.
- v) bottom culture, to avoid navigational problems.
- vi) "agrarian" approaches, such as mechanized harvesters, seed beds, and restocking.

Management Authority

Any aquaculture activity that alters a critical area requires a permit from OCRM. The Rules and Regulations for Permitting apply to aquaculture activities which alter a critical area.

Outside of the critical areas in the coastal zone DHEC-EQC has permit authority for uses of land and water below mean high water. Permit applications for aquaculture activities are subject to review and certification for coastal management program compliance by OCRM, under *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act. This certification authority extends to permits for impoundments or any other activity requiring a Board permit.

The Department of Health and Environmental Control has regulatory authority over aquaculture since many operations require an NPDES point-source discharge permit. The Department of Natural Resources (DNR) has regulatory authority over the living marine resource management aspects of aquaculture. In addition, DNR leases coastal bottoms for shellfish production. This regulatory authority must be administered in compliance with the approved coastal management program and the Coastal Management Act. OCRM is granted enforcement authority for such compliance under *Section 48-39-70(A)* of the Act.

IV. COMMERCIAL DEVELOPMENT

Policies

1) In the coastal zone, OCRM review and certification of permit applications for commercial buildings will be based on the following policies:

a) For locations immediately adjacent to the shoreline, water-dependent commercial activities will be given priority consideration. Water-dependent is interpreted here to include activities which functionally require access to shoreline, for example, ship or boat repair or commercial fishing. Second priority will be given to water-related commercial uses which are significantly enhanced economically by proximity to the shoreline, for example, motel or restaurant activities.

b) Commercial proposals which require fill or other permanent alteration of salt, brackish or freshwater wetlands will be denied unless no feasible alternatives exist and the facility is water-dependent. Since these wetlands are valuable habitat for wildlife and plant species and serve as hydrologic buffers, providing for storm water runoff and aquifer recharge, commercial development is discouraged in these areas. The cumulative impacts of the commercial activity which exists or is likely to exist in the area will be considered.

c) Location of new commercial development in riverine and coastal areas where flooding has been a recurring, serious problem is discouraged. Within the 100-year flood plain of coastal waters, commercial development must meet the existing Federal Insurance Administration (Department of Housing and Urban Development) national building standards. Inclusion of buffer areas and protection of salt, brackish and freshwater wetlands will help absorb flood water surges and is encouraged in commercial development plans.

d) Drainage plans and construction measures for commercial development should be designed to lessen or eliminate erosion, water quality degradation and other negative impacts on adjacent waters and wetlands - for example, through buffering and filtering runoff water, use of naturally vegetated and permeable surfaces rather than paving, and grass-ditching and surface drainage rather than direct storm water discharges. Best management practices developed as part of the Areawide 208 Waste Treatment Management Program should be implemented through the management of major new commercial developments.

e) Adequate sewage disposal systems (septic tanks or treatment systems), meeting Federal Environmental Protection Agency, South Carolina Department of Health and Environmental Control, and local health department standards must be provided in new commercial development.

f) Shorefront commercial development that disrupts existing public access will be prohibited. Developers of commercial property on immediate beach or river-front are strongly encouraged to provide such area for general public use in their plans. Policies in the Beach and Shoreline Access segment, Chapter IV (D), will be considered in review of commercial activities.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

Management Authority

Any commercial activities and associated development which alter a critical area require a permit from OCRM. Commercial buildings and structures must meet the requirements of the Rules and Regulations for Permitting to obtain an OCRM permit.

Outside of the critical areas in the coastal zone DHEC-EQC has permit authority over the use of land and water below mean high water for any activity, including commercial developments. OCRM review and certification of these permits pursuant to *Section 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act is based on the preceding coastal management policies. Similarly, permits required for certain air pollution, sewage treatment or other associated support facilities by the Department of Health and Environmental Control are also subject to OCRM review and certification.

V. RECREATION AND TOURISM

A. PARKS (and open spaces)

Policies

(A number of State parks in the coastal zone have been identified as Geographic Areas of Particular Concern (GAPCs) because of their unique value as natural areas and as important recreational use areas. The priority of uses for these specific parks is addressed in the GAPC segment, Chapter IV[A].)

1) In the coastal zone, OCRM review and certification of permits for parks and related facilities will be based on the following policies:

a) Water-dependent recreational uses will be given priority consideration over other types of recreational development in locations immediately adjacent to shoreline, wetlands or open water. For example, boating or swimming oriented parks would be considered water-dependent and receive priority over golf courses and tennis courts.

b) Parks and open spaces are preferred uses in wetland areas, flood prone areas, beaches, and other environmentally significant or sensitive natural areas, with due consideration for types and intensity of development which reflect the "carrying capacity" of the area to accommodate influxes of large numbers of people without distraction or disruption of natural systems.

c) Park plans and designs must incorporate the following design features where appropriate:

i) preservation of a maximum of existing natural vegetation and open space.
ii) maximum use of permeable surfaces (rather than paved surfaces).
iii) provision of adequate parking (based on "carrying capacity" of the park) or alternative transportation access located in-shore or in less sensitive areas.
iv) construction methods that mitigate erosion and other environmental damage.

d) Park proposals which include filling or other permanent alteration of productive salt, brackish or freshwater marshes will be denied, unless no feasible alternatives exist.

e) Cooperative local, State and Federal efforts to maintain or enhance existing air and water quality in and near valuable recreational resource areas.

2) In critical areas of the coastal zone, it is OCRM policy that:

Any park facilities which would require construction or alteration of a critical area would be reviewed for an OCRM permit on the basis of the Rules and Regulations for the particular type of project, for example, a dock and pier, or a walkway.

3) OCRM also **recommends** the following policies be considered in the planning and design of parks and open space areas in the coastal zone:

a) Provision of nature interpretation areas and nature-oriented facilities.

b) Park structures and facilities which provide for elderly and handicapped visitors.

c) Provision of new scenic vistas to the ocean, beaches, wetlands and other natural areas, and protection and enhancement of existing scenic areas.

d) Consideration of energy use, with preference to non-motorized recreational access and activities when appropriate.

e) Analysis of the recreational potential of surplus State and Federal lands.

f) Maintenance of any fee charged for use of public recreational facilities at a nominal level.

g) Encouraging park development along utility easements and abandoned rights-of-way, and on dredge material disposal areas - especially intensive-type or active parks since these are areas of previously altered natural environment.

h) Structures which are visually compatible with natural surroundings, in terms of such factors as scale, building materials and color.

Management Authority

OCRM has direct permitting jurisdiction over any proposed park facilities located in the critical areas - waters, wetlands, beaches, beach/dune system. This is a very important aspect of park management since recreation at the water's edge is expected to be the most significant recreational demand.

Outside the critical areas, but within the coastal zone, the Department of Parks, Recreation and Tourism (PRT) will cooperate in implementation of the preceding policies of the Coastal Management Program. PRT is the lead State agency with respect to the development and maintenance of the State park system. The Memorandum of Agreement between these two agencies confirms and outlines this cooperative recreational planning effort mandated by *Section 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act.

Where any part of a proposed recreational area outside of critical areas will involve encroachment below mean high water (MHW), a permit would be required from DHEC-EQC. These permits are reviewed and certified by OCRM for their compliance with the coastal program.

The majority of public recreational facilities in the coastal zone (as throughout the State) will be financed in full or in part by the U. S. Department of the Interior, Heritage Conservation and Recreation Service. These project proposals will be subject to A-95 review as well as the Federal consistency provisions of the coastal program.

B. COMMERCIAL RECREATION (tourist attractions, including, but not limited to amusement parks, boardwalks, and theme parks)

Policies

1) In the coastal zone, OCRM review and certification of permits for commercial recreation will be based on the following policies;

a) Proposals which include the filling or other permanent alteration of productive salt, brackish or freshwater wetlands will not be approved unless no feasible alternatives exist.

b) For locations immediately adjacent to the shoreline, the water-dependent nature of the project must be demonstrated, particularly if adjacent wetlands or water bodies will be significantly impacted. Water-dependent is defined here to mean those activities which require access to waters of the coastal zone as an essential aspect of their primary function.

c) Construction methods and design features which minimize the possible degradation of adjacent water quality from erosion or storm water drainage are strongly encouraged, for example, use of silt screens and curtains, berm and swale drainage systems rather than direct discharge, and maintaining permeable surface rather than extensive pavement as much as possible.

d) Commercial recreation centers must demonstrate compliance with applicable State and Federal standards for sewage treatment facilities.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) Further, OCRM **recommends** that the following policies be considered in planning for tourist attractions in the coastal zone:

a) Minimizing negative aesthetic impacts, for example, disruption of scenic vistas or significant alteration of the character of an area.

b) Development of local planning and zoning controls which address the location and design of tourist attractions.

c) Locating tourist activities in areas convenient to existing population centers rather than placement in remote areas which may encourage strip-development.

Management Authority

OCRM has direct permit authority over any activity in the critical areas of the coastal zone, including tourist-oriented or commercial recreation facilities. Therefore, the proposed construction of such structures in the critical area is subject to permit requirements of OCRM. Possible impacts on the critical areas are the major concern of these tourist developments.

In the rest of the eight county coastal zone, State permits are required from DHEC-EQC for construction below mean high water (MHW). These permit applications are reviewed and certified by OCRM for their compliance with policies of the Coastal Management Program. This review and certification authority is mandated by *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act of 1977.

The Department of Health and Environmental Control has permit authority over certain aspects of facilities open to the public, including sewerage systems and other sources of environmental pollution. These permit applications are subject to the review and certification process of OCRM.

In some cases where dredging or filling in water or wetland areas would be required, such commercial recreation areas are under the jurisdiction of Federal permit authority on the basis of *Section 10* of the Rivers and Harbors Act and 404 of the Federal Water Pollution Control Act of 1972, as amended. These permits are subject to the Federal consistency provisions of the Coastal Management Program.

VI. MARINE-RELATED FACILITIES

MARINAS, BOAT RAMPS, and DOCKS and PIERS

A. MARINAS

Policies

1) In the coastal zone, OCRM review and certification of permit applications and marina proposals will be based on the following policies:

a) To the extent feasible marinas shall locate only in areas that will have the least adverse impact on salt, brackish or freshwater wetlands and water quality.

b) To the extent feasible marinas shall be located in areas where maximum physical advantage exists and where the least initial and maintenance dredging will be required.

c) Marinas should avoid or minimize the disruption of currents. Dead-end or deep canals without adequate circulation or tidal flushing will not be permitted unless it can be determined that water quality will not be adversely affected.

d) Marina designs should minimize the need for excavation and filling of shoreline areas.

e) Provision of facilities for the proper handling of petroleum products, sewage, litter, waste and other refuse must be made in new marinas, with regard to South Carolina Department of Health and Environmental Control (DHEC) specifications.

f) In review and certification of marina permit applications outside the critical areas, OCRM will consider the extent of public demand for the facilities, as demonstrated by the applicant.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in marina location and design:

a) Adequacy of transportation access from the landward side.

b) Adequacy of parking facilities.

c) Upland facilities which are compatible with and enhance recreational boating opportunities.

Management Authority

In critical areas of the South Carolina coastal zone, permits are required from OCRM for all new marina projects, including associated dredging and construction of docks, piers or other structures. (OCRM's direct permit responsibility is explained in detail in the legal analysis in Chapter V [A].)

Beyond the critical areas, the creation of new marinas in the coastal zone is subject to the permit requirements of DHEC-EQC for activities below mean high water (MHW). These permits are subject to the provisions of *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the 1977 Coastal Management Act by which OCRM reviews and certifies each permit application in the coastal zone for compliance with provisions of the coastal program.

Permits may also be required from the Department of Health and Environmental Control (DHEC) if sewage treatment facilities are included as part of a marina project proposal or if 401 Water Quality Certification is required. Permits issued by DHEC in the coastal zone are subject to review and certification by OCRM.

Marina facilities also require permits pursuant to certain Federal statutes which receive review and comment by OCRM and its staff and will be subject to the Federal consistency provisions of the South Carolina Coastal Management Program.

The State Ports Authority also has regulatory authority over marinas since *Section 48-39-150(A)(2)* of the Act provides that:

> If the proposed project is in one or more of the State's harbors or in a waterway used for commercial navigation and shipping or in an area set aside for port development in an approved management plan, then a certificate from the South Carolina State Ports Authority declaring the proposed project or activity would not unreasonably interfere with commercial navigation and shipping must be obtained by the Department prior to issuing a permit.

B. BOAT RAMPS
Policies

1) In the coastal zone OCRM review and certification of applications for boat ramps will be based on the following policies:

a) Filling of productive salt, brackish, or freshwater wetlands for boat ramp construction is prohibited unless no feasible alternatives exist in adjacent non-wetland areas. In addition, the amount of fill required must be minimized.

b) The following priorities are considered when justifying boat ramp location in sensitive areas:

i) public use - open to all citizens.
ii) restricted use - open only to citizens of a particular area or organization.
iii) private use.

c) Boat ramp locations requiring dredging of productive salt, brackish or freshwater wetlands to provide channel access to deep-water will be discouraged.

d) Boat ramps must be constructed of environmentally acceptable materials.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** the following policies be considered in location and design of public boat ramps in the coastal zone:

a) Provision of adequate transportation access from the landward side.

b) Provision of adequate parking in non-wetland areas.

c) Incorporation with other public recreational and boating facilities to improve recreation opportunities.

d) Adequate facilities, for example, trash receptacles, restrooms, drinking water fountains, lighting.

e) Provision for continuing maintenance.

Management Authority

In critical areas of the coastal zone, a permit from OCRM is required for any boat ramps which are proposed. (All boat ramps must involve filling in periodically inundated areas, in fact, below mean high water, in order to provide boats with access to the water. This filling is defined by the South Carolina Coastal Management Act as an alteration to a critical area - in this case, tidelands and/or coastal waters).

Boat ramps located in other than critical areas of the State are subject to permit requirements of DHEC-EQC for activities on State-owned submerged bottoms (below MHW). In the coastal zone, these permit applications are also reviewed and certified by OCRM for consistency with the coastal management program, pursuant to *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act.

In some areas a Federal agency permit may be required. These permit applications must be reviewed and certified by OCRM and are subject to Federal consistency provisions.

C. DOCKS AND PIERS

Policies

1) In the coastal zone, OCRM review and certification of permits for docks and piers will be based on the following policies:

a) Docks and piers will not be approved where they interfere with navigation or reasonable public use of the waters.

b) Docks and piers shall be constructed in a manner that does not restrict waterflow.

c) Docks and piers must be limited to a reasonable size and extension for the intended use.

d) Docks and piers should be located and designed to minimize disruption and shading out of salt, brackish or freshwater wetland vegetation.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in location and design of docks and piers:

a) Developing joint-use or community piers in future subdivisions rather than the proliferation of individual structures.

b) Use of construction materials which are easily maintained and repaired, for safety and aesthetic considerations.

c) Attention be given when property is subdivided to provide waterfront lot-owners with adequate riparian access, so that conflicts over the alignment of docks and piers will be avoided.

Management Authority

A permit directly from OCRM is required for docks and piers in the critical areas of the coastal zone. The Rules and Regulations governing permitting and the process specified therein are applied to docks and piers.

Outside the critical areas, a permit from DHEC-EQC is required for activities involving navigable waters of the State and all lands below the mean high water line in tidally-influenced areas and ordinary high water in non-tidal areas.

OCRM reviews and certifies these permit applications in the coastal zone for their compliance with the Coastal Management Program, based on the preceding policies, as mandated by *Section 48-39-70(A)* and *48-39-80(B)(11)* of the Coastal Management Act.

Docks and piers may also be subject to Federal agency permit authority based on *Section 10* of the Rivers and Harbors Act and *Section 404* of the Federal Water Pollution Control Act. OCRM is involved in review and certification of such permit applications. Private docks and piers which meet certain size specifications are covered under the provisions of a general permit to the citizens of South Carolina from the U. S. Army Corps of Engineers. This is discussed in detail in Appendix K.

D. DOCK MASTER PLANS

Pursuant to the Coastal Zone Management Act, OCRM is charged with the responsibility of developing a comprehensive coastal management program. The waters and marshes of the coast below mean high water are held in trust for all the people of the State, and are therefore public waters and marshes. Docks and piers support an important form of water dependent recreation, and boating demand continues to increase. It is imperative that consideration is given to all competing uses of this resource. While individual permitting of private docks, piers, and boat ramps have been a primary tool in managing such projects and alterations in the coastal zone, this piecemeal approach is no longer sufficient to deal with competing interests and new development along the coast. In addition to the policies of the Act, Section *R.30-11(C)* of the rules and regulations requires OCRM to consider the extent to which long-range, cumulative effects of any project that may result within the context of other possible development and the general character of the area. Additionally, OCRM is charged with considering overall plans and designs for a project that can be submitted together and evaluated as a whole, rather than piecemeal and in a fragmented fashion.

To the end of providing more comprehensive review of coastal impacts, OCRM will require the development of dock master plans along the shoreline of properties undergoing development. This is necessary to protect sensitive coastal waters, to avoid future conflicts over dock alignment and/or water access between adjacent landowners, and to assist in comprehensive management of the coast.

The dock master plan will take one of two forms to be decided by the applicant: (1) the application for a dock master plan general permit for the construction of all future dock, piers, and boat ramps in the development, or (2) the preparation of a conceptual dock master plan which will guide the individual permitting of all future docks, piers, and boat ramps in the development. In both cases, a master plan must be prepared pursuant to rules and regulations of OCRM and the requirements contained herein. If the applicant decides to pursue option (1) above, normal OCRM permitting procedures must be followed. If the applicant decides to pursue option (2) above, the following procedures must be followed.

If lands adjacent to navigable coastal waters are developed and such development requires coastal zone consistency certification, the landowner or developer must submit a dock master plan which will provide basic information, as required herein, about the property and proposed uses of the adjacent State waters and marshes. If a development is to proceed in two or more phases, the level of detail outlined in this document is only required for the phase seeking consistency determination. Only a master plan depicting the phases and the estimated number of docks for each phase will be required for the remainder of the entire development, to be updated as dock master plans are prepared for consistency determination in future phases. It is understood that phases not undergoing development may be subject to change.

The conceptual dock master plan document will be annotated by OCRM staff to reflect coastal management and environmental concerns, to include recommended revisions to the conceptual dock master plan to address or alleviate those concerns; if no concerns are identified, OCRM will find the dock master plan conceptually consistent with the Coastal Zone Management Program, subject to any site specific concerns identified through any future permit applicants. OCRM review comments will be transmitted to the applicant with a copy placed on file at OCRM. If any facts are disputed, the applicant may submit further comments and information which will be made part of the file; OCRM staff will attempt to reconcile the disputed facts. No further action is required by the applicant.

A dock master plan which is conceptually consistent does not guarantee issuance of any dock permits. The conceptual dock master plan will be used as a guideline and an additional consideration when dock permitting applications are made. As with all applications reviewed by OCRM, the project will be judged on its own merits as well as compliance with the Coastal Management Act permitting regulations and the Coastal Management Program Document.

A dock master plan, either as a general permit or as a conceptual master plan to guide individual dock permitting, must be submitted for all projects subject to OCRM consistency certification. OCRM will deny certification of a project if no master plan or inadequate information is submitted. However, in the case of the conceptual master plan to guide individual dock permitting, once the plan with all required information is submitted by the applicant, the requirements are considered met. The proposed dock master plan shall be filed with the permitting section together with the recommended changes by OCRM staff. Appeals of decisions on conceptual Dock Master Plans are inappropriate inasmuch as the decision is advisory to the permitting section. Appeals can only be taken once a decision on a permit is made by OCRM.

1) **Goals and Objectives**

a) To determine whether a given property is suitable for water access.
b) To establish guidelines for extending property lines to define corridors in which dock construction will take place.
c) To establish guidelines for determining the appropriate spacing of docks in order to control congestion.
d) To maintain the accessibility and navigability of coastal waters.
e) To establish guidelines for determining the appropriate length of docks.
f) To maximize public access to the water.
g) To protect geographic areas of particular concern (GAPCs) as well as the values of a water body and protected critical areas as set forth in *Section 48-39-20* and *Section 48-39-30* of South Carolina's Coastal Zone Management Act.
h) To encourage the use of community docking facilities.
i) To prevent degradation of water quality.

2) **Submittal Requirements**

Dock master plans must be submitted on a site plan prepared by an engineer, surveyor, or landscape architect licensed and registered in the State of South Carolina. The plan may be shown in conjunction with any other site drawings, i.e., storm water, wetlands, etc., but must contain the following:

a) Property lines, both existing and proposed.
b) The critical area line which has been approved by OCRM.
c) The adjoining water bodies, accurately portrayed as to location and size. The channelward edge of marsh vegetation and the location, width and depth of the main creek channel must be depicted, as well as any other creeks, inlets, or sloughs in excess of 20 feet in width.
d) The proposed dock corridors must be shown on the site plan as property line extensions. The corridors must be referenced to a recoverable reference point. The dock corridor is defined as a pair or more of recoverable lines extending from the property lines toward open water between which a dock may be constructed. The extended lines should normally be a straight extension of the property line but may vary to accommodate site specific conditions.
e) All docks existing on the water body in the vicinity of the proposed docks must be accurately shown on the plat, both as to size and location. On smaller creeks of less than 50 feet in width, existing docks on the opposite bank must be shown.
f) All proposed community docks, boat ramps and other OCRM permitted structures must be shown on the plat.

g) If the plat is of an area covered by an existing dock plan prepared by OCRM or another governmental body, the dock corridor plan shown on this plat must reflect this plan.

h) Any deed restrictions of the property that would affect dock size or placement must be shown on the plat.

i) Individual docks on lots should not be shown on the plan; but rather, the estimated total project number of docks along a specified shoreline of common ownership, along with information concerning the typical size of proposed docks and floats. The size of the proposed docks will be used as indication of the approximate size of vessels which would use the proposed docking facilities.

j) The spacing, location, and length of dock corridors must be in accordance with OCRM regulations for general permits for Dock Master Plans.

3) **Specific Review**

To reduce negative impacts, all dock master plans will be evaluated as to the suitability of providing individual docks for every waterfront lot. Although in some situations single family docks are appropriate, more favorable consideration will be given to the use of community docks and joint use docks. In making this evaluation the following factors will be considered:

a) Proximity to alternative access (boat ramps, marinas, community docks and others).

b) Size of a navigable channel.

c) Size of lots (water frontage).

d) Distance to open water.

e) Environmental sensitivity of adjacent waters and coastal resources.

f) Impact of proposed docks on GAPCs, including access to those GAPCs.

g) Other possible development and the general character of the area, including impacts to adjacent property owners.

h) The degree to which construction of a dock or docks will affect public access to public waters and the traditional recreational uses of the water body including fishing, crabbing, and oystering.

4) **Implementation**

a) Reference must be given to the dock master plan in all contracts for sale of affected lots.

b) Dock master plans will be filed with the permitting division of OCRM, available for public review and used for consideration of future permit decisions.

c) The dock master plan shall be presumed to take precedence over applications inconsistent with such plan unless new information is revealed in the application to address and overcome concerns identified in the Dock Master Plan.

d) Revisions to dock master plans will follow the same agency review procedure as outlined for new plans.

VII. WILDLIFE AND FISHERIES MANAGEMENT

A. WILDLIFE AND FISHERIES MANAGEMENT

Policies

The following policies were developed by OCRM in conjunction with the South Carolina Department of Natural Resources for inclusion in the S. C. Coastal Program.

1) In the coastal zone, including critical areas, OCRM issuance or review and certification of permit applications which would impact wildlife and fisheries resources will be based on the following policies:

a) Activities deemed, by OCRM in consultation with the South Carolina Department of Natural Resources, to have a significant negative impact on wildlife and fisheries resources, whether it be on the stocks themselves or their habitat, will not be approved unless overriding socio-economic considerations are involved. In reviewing permit applications relative to wildlife and fisheries resources, social and economic impacts as well as biological impacts will be considered.

b) Wildlife and fisheries stocks and populations should be maintained in a healthy and viable condition and these resources should be enhanced to the maximum extent possible.

c) Critical wildlife and fisheries habitat should be protected and enhanced to the extent possible.

Management Authority

The South Carolina Department of Natural Resources (DNR) is the principal State agency with statutory authority for the protection, management and conservation of wildlife and marine resources, including fish, game, non-game and endangered species. The Memorandum of Agreement between OCRM and the Department confirms the cooperative relationship between OCRM and the Department which has authority in the establishment, implementation, administration and enforcement of State game, fish and shellfish laws.

B. ARTIFICIAL REEFS

Policies

In the critical areas of the coastal zone, it is OCRM policy that:

a) The location and development of artificial reefs should not interfere with navigation or with existing fisheries, and they should be compatible with all existing and approved uses for an area.

b) Materials utilized in the construction of artificial reefs must not create any adverse environmental impacts.

c) The development of artificial reefs for fisheries management purposes shall be encouraged, particularly in areas where the biological productivity will be enhanced.

d) In considering areas for artificial reef development, the possible impacts on historical or archaeological resources in the area will be considered.

Management Authority

Many artificial reefs along the South Carolina coast are beyond the 3-mile limit of State jurisdiction, and therefore, located outside the coastal zone.

Any artificial reefs located landward of the three-mile limit would be within the "coastal waters" critical area, as defined in *Section 48-39-10(F)* of the S. C. Coastal Management Act of 1977. Alterations in these areas are subject to the direct permitting authority of OCRM. The Rules and Regulations for Permitting and the previously stated policies would be applied to all artificial reef proposals in the critical areas.

Coordination with the South Carolina Department of Natural Resources (DNR) will be essential in any artificial reef proposals or projects for siting, construction and maintenance. DNR is the State agency mandated to protect, manage and conserve wildlife and marine resources.

C. IMPOUNDMENTS

Policies

1) In the coastal zone, OCRM will apply the following policies in review and certification of permit applications for wetland impoundments:

a) Impoundment of previously undisturbed salt, brackish or tidal freshwater wetlands will be discouraged.

b) Impoundments are preferred in areas dominated by vegetation and water salinities characteristic of freshwater conditions rather than salt or brackish conditions.

c) The construction of dikes or embankments to create impoundments must not block public waterways navigable to commercial and recreational craft unless there is an overriding public necessity.

d) Wetland impoundments must be constructed in such a manner as to minimize adverse environmental impacts, including consideration for control of mosquitoes.

e) Permit applications for wetland impoundments must include a detailed plan, subject to review and approval by OCRM.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in location and design of wetland impoundment proposals:

a) The inclusion of buffer zones, where appropriate, between the impoundment dike and the mean high water line of adjacent waterways, to help both in preventing erosion and providing limited marine and terrestrial habitat.

VIII. DREDGING

A. DREDGING

Policies

1) In the coastal zone, OCRM review and certification of permit applications for dredging projects will be based on the following policies:

a) To the extent feasible dredging should be performed only during closed shellfishing season if proposed in a productive shellfish area.

b) Suspended sediments must be kept to a minimum. The use of structures such as weirs and silt curtains to minimize water quality degradation is encouraged. Where highly toxic sediments are encountered, dredging will be prohibited unless the activity is consistent with other dredging policies, as well as those for manufacturing or other industrial activities.

c) Dredging should not reduce water circulation, water currents, mixing, flushing or salinity in the immediate area.

d) Dredging for establishment of new canals which involves permanent alteration of valuable wetland habitats will be prohibited unless no feasible alternative exists or an overwhelming public interest can be demonstrated. Establishment of canals for purposes of creating waterfront lots from inland property, especially where dead end canals would result, will be prohibited unless it can be demonstrated that there will be no significant environmental impacts.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

Management Authority

In the critical areas of the coastal zone, a permit from OCRM is required for any dredging activity other than a Federal activity (in which case Federal consistency provisions would apply). The Rules and Regulations of OCRM outline the conditions that must be satisfied for such permits to be issued.

Outside the critical area of the coastal zone, DHEC-EQC has permit authority for dredging activity below mean high water. OCRM must review and certify applications to DHEC as being in compliance with the preceding policies, as mandated by *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act, and as outlined in the Memorandum of Agreement between the two agencies.

In certain locations, permits from Federal agencies will be required for dredging operations. OCRM will review and certify these permit applications for their consistency with the coastal program.

B. DREDGED MATERIAL DISPOSAL

Policies

1) In the coastal zone, OCRM review and certification of permit applications for dredged material disposal projects will be based on the following policies;

a) To the maximum extent feasible, dredged material must not be placed on high value natural habitats such as salt, brackish or freshwater wetlands; submerged vegetation; oyster reefs or tidal guts. Where upland disposal is not possible, areas of relatively low productivity should be utilized, or ocean disposal should be employed

b) Upland dredge material disposal sites must be stabilized and maintained where necessary to prevent erosion and direct water run-off.

c) Where water disposal is necessary, natural channels must not be blocked with dredged material, and impact on existing water circulation should be minimized. Deposition in water areas of higher flushing rate will decrease damage from suspended sediments and oxygen depletion.

d) Consideration must be given to the temporal aspects of spoil deposition such as impacts on spawning seasons, fish migrations, waterfowl nesting and wintering areas, and mosquito control.

e) The selection of upland dredge disposal sites should include consideration for minimizing negative impacts on valuable terrestrial wildlife or vegetative habitats.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following policies be considered in planning for dredged material disposal:

a) Consideration for future maintenance of the spoil area, for example, development of spoil islands which have been found to be beneficial for terrestrial habitat and migratory waterflow.

b) Abandoned sand or gravel pits in proximity to a dredge site, where spoil can be more adequately contained, should be used for disposal areas.

c) Consideration for reuse of spoil disposal sites, such as development of public parks or recreational areas.

d) Conservation for the mining of spoil areas so as to extend their life expectancies.

e) Prior to major dredging projects, the economic and environmental feasibility for alternative use of the dredged material should be studied. The physical and chemical characteristics of the spoil should be determined in order to decide the most appropriate disposal options. Spoil suitable as fill material for residential, commercial or industrial development should be utilized for such uses. Spoil shells can be used to stimulate oyster production or for dike construction. Beach renourishment and spoil disposal are related issues and should be addressed concurrently.

Management Authority

In the critical areas of the coastal zone, OCRM has direct permitting authority for location of disposal sites for dredged material. The policies in the Rules and Regulations for Permitting, as well as the procedures thereunder, shall be applied.

Act 508 of the 1978 S. C. General Assembly gave OCRM authority for the granting of rights and easements to the Federal government for spoil disposal sites for purposes of maintenance of navigable waterways, including the Atlantic Intracoastal Waterway. This authority was shifted from the S. C. Development Board where it had previously been located. (S.C. Code *Section 3-5-40*, et seq., Supp. 1993)

Outside of the critical areas in the coastal zone, DHEC-EQC has permitting authority for dredged material disposal sites which are below mean high water. Permit applications to DHEC are reviewed and certified by OCRM as being consistent with the Coastal Management Program, as mandated by *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act.

Section 150(A)(2) of the Coastal Management Act states that:

> If the proposed project is in one or more of the State's harbors or in a waterway used for commercial navigation and shipping or in an area set aside for port development in an approved management plan, then a certificate from the South Carolina State Ports Authority declaring the proposed project or activity would not unreasonably interfere with commercial navigation and shipping must be obtained by the Department prior to issuing a permit.

The Department of Health and Environmental Control has responsibility for vector control throughout the State. Their expertise in mosquito abatement and control will be important in evaluation of the plans for on-going disposal area management. Comments from DHEC, Vector Control Division, are solicited on all OCRM permit applications.

In most areas a Federal agency permit will be required for dredge material disposal. Permit applications to appropriate Federal agencies must be reviewed and certified by OCRM, under Federal consistency provisions of the Coastal Management Program.

C. UNDERWATER SALVAGE

Policies

1) In the coastal zone, OCRM review and certification of underwater salvage permits will be based on the policies for dredging activities when applicable, VIII(A).

2) In the critical areas of the coastal zone, it is OCRM policy that:
Any dredging and dredge material disposal associated with a salvage operation will be subject to the policies for dredging as expressed in the Rules and Regulations for Permitting, and VIII(A)(1) of this section.

Management Authority

Underwater salvage operations are subject to the permitting authority of OCRM if such operations will alter or disturb a critical area. The Institute of Archeology and Anthropology also controls such operations through a permitting program. Application for such permits will be reviewed and certified for consistency with the Coastal Management Program, as mandated by *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act.

Outside of the critical areas in the coastal zone, underwater salvage operations may be subject to DHEC-EQC authority, in addition to that of the Institute of Archeology and Anthropology. OCRM review and certification of permit applications to DHEC are required.

In some areas a permit for underwater salvage operations may be required by a Federal agency. Applications for these permits must be reviewed and certified by OCRM, subject to Federal consistency provisions.

IX. PUBLIC SERVICES AND FACILITIES

A. SEWAGE TREATMENT (treatment plants and associated transmission systems, lagoons, impoundments, and outfalls; septic tanks)

Policies

1) In the coastal zone, OCRM review and certification of sewage treatment and disposal permit applications will be based on the following policies:

a) Sewage treatment facilities and transmission systems in the coastal zone must meet applicable Federal, State and local construction and water quality standards.

b) OCRM will coordinate with designated 208 Areawide Waste Treatment Management implementation agencies (pursuant to *Section 208* of the Federal Water Pollution Control Act Amendments, P. L. 92-500) and other agencies with responsibility for implementing comprehensive plans affecting sewage treatment, to ensure that proposed projects are compatible with growth and development plans and that alternative locations for sewage treatment facilities are considered.

c) Construction of such facilities in productive salt, brackish or freshwater wetlands will not be approved where feasible alternatives exist. For locations adjacent to such sensitive habitats, priority consideration will be given to major public facilities over smaller, private package plants.

d) Sewage treatment facilities shall be constructed to limit effluent discharge as much as possible into areas containing productive shellfish beds. Construction of facilities shall in no case degrade the existing water quality classification of the receiving water body, and if the current classification is not the highest achievable, the plans shall show a consideration for the water body ultimately achieving the highest classification. In addition, the facilities shall be constructed in conformance with the appropriate policies contained elsewhere in the plan. Where appropriate, construction of the facilities and associated transmission systems shall be timed so as not to disrupt spawning seasons or migrations of significant marine resources.

e) Outfall locations should consider water depth, circulation and mixing in order to protect water quality. Effluent should not be discharged into poorly flushed estuarine areas.

f) Maximum study and analysis should be given to alternatives to conventional treatment methods; for example, land disposal, water conservation techniques, land application and overland flow.

g) OCRM will ensure that all proposed septic tank systems requiring a State permit will meet current DHEC standards and regulations.

h) OCRM will also coordinate with local health departments, DHEC, and other implementing agencies to ensure that septic tank standards and regulatory enforcement are adequate to protect coastal resources.

i) Extension of public sewage treatment systems with excess capacity into previously undeveloped areas where the resulting growth would have detrimental impacts on the critical areas is discouraged.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications. In addition to the Regulations, the following policies also apply:

a) OCRM will coordinate with the Department of Health and Environmental Control (DHEC) and the designated 208 Areawide Waste Management and 201 Construction Grants implementation agencies to ensure that protection of critical areas is given priority in their programs and that processes are developed to prevent adverse effects from sewage facilities and discharges.

b) OCRM will coordinate with DHEC-Office of Health Services and local health departments or other implementing agencies to ensure that septic tank standards and regulatory enforcement are adequate to avoid adverse effects on critical areas.

3) OCRM also **recommends** that the following policies be considered in planning and design of sewage treatment facilities:

a) Providing visual buffer areas around sewage treatment facilities.

b) Private package treatment plants proposed in subdivision areas and other developments should either be contained in the existing 208 Waste Treatment plan or receive 208 program approval before they are constructed.

c) Excess capacity in treatment facilities should not be approved unless the projects are contained in 208 plans and meet population projection for the area.

Management Authority

In the critical areas of the coastal zone, proposed construction of any new structure or facility to treat sewage must first receive a permit from OCRM. This authority extends to placement of pipes or lagoons or any other activity which alters a critical area. Normal maintenance and repair and actual effluent discharge are exempted; however, OCRM has the opportunity for review and comment on these activities.

In the coastal zone outside of the critical areas, there is an overlap of State agency authorities for sewage treatment facilities. Both the Budget and Control Board and the Department of Health and Environmental Control (DHEC) have regulatory authority over several aspects of sewage treatment facility placement and operation (discussed in detail in the Legal Authorities chapter in the full program document). DHEC retains regulatory authority over septic tanks with flow rates of 1500 gallons per day or greater (*Section 44-1-140*, S.C. Code of Laws). The permits of these agencies, whether issued jointly or independently, are subject to review and certification by OCRM to ensure compliance with the preceding policies, as mandated by *Section 48-39-70(A)* and *48-39-80(B)(11)*.

B. SOLID WASTE DISPOSAL

Policies

1) In the coastal zone, OCRM review and certification of permit applications for solid waste disposal sites and facilities will be based on the following considerations:

a) All solid waste disposal sites in the coastal zone must meet applicable Federal, State water and air quality standards and local regulations for siting and operation.

b) The location of solid waste disposal or landfill sites in salt, brackish or freshwater wetlands will not be approved unless no alternative exists and an overwhelming public need can be demonstrated. Wherever possible, solid waste disposal sites must be located in appropriate upland sites, where they will not pollute surface water, coastal waters or ground waters. Site-specific evaluations are made in each case by the Department of Health and Environmental Control to determine the suitability of the site, considering variables such as soil permeability, the characteristics of the leached refuse, and the distance from groundwater.

2) In critical areas of the coastal zone, it is OCRM policy that:

a) Wetlands shall not be utilized as depositories for waste materials [*R.30-12*].

b) Policies for deposition of dredged materials shall also apply to solid waste disposal activities (excluding incineration).

3) OCRM also **recommends** that the following be considered in solid waste disposal planning in the coastal zone:

a) Maximum study and analysis should be given to alternative means or techniques for refuse disposal such as recycling, reuse, burning for generation of electrical power, etc.

Management Authority

The alteration of a critical area, which includes filling or draining, requires a permit from OCRM. The Rules and Regulations for Permitting apply to proposed solid waste disposal sites or facilities for critical areas.

Outside of critical areas in the coastal zone DHEC-EQC requires permits for any use, including filling, of lands below mean high water. Permit applications for solid waste disposal in such areas must be reviewed and certified by OCRM for compliance with the coastal management program. The Department of Health and Environmental Control issues permits for and otherwise regulates solid waste disposal outside of critical areas. Such permit applications are also subject to OCRM review and certification. The administration of these regulatory authorities must be in compliance with the rules, regulations and policies of the Coastal Management Program as specified in *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the Coastal Management Act of 1977.

C. PUBLIC/QUASI-PUBLIC BUILDINGS (structures including but not limited to churches, governmental administration buildings, public park information centers, police and fire stations, public beach restroom facilities)

Policies

1) In the coastal zone, OCRM review and certification of permit applications for public/quasi-public buildings will be based on the following policies:

a) For locations immediately adjacent to the shoreline, the water-dependent nature of the structure must be demonstrated. A water-dependent facility is one which requires access to or use of the water as an essential aspect of its primary function.

b) Permanent alterations to productive salt, brackish or freshwater wetlands, from either dredging or filling for the construction of public buildings will not be approved unless no feasible alternatives exist or there is an overriding public interest or need.

c) The use of construction methods and site drainage plans which reduce erosion hazards and limit the direct discharge of storm water run-off an encouraged in order to protect coastal water quality. To the extent feasible, public buildings should not be located in high flood zone areas, as designated under the Federal Flood Insurance Program. Where public buildings must be located in these zones, they must meet applicable Flood Insurance criteria and/or building standards.

d) Plans for major public buildings or complexes must include adequate sewage disposal systems (septic tanks or treatment systems), meeting Federal Environmental Protection Agency, South Carolina Department of Health and Environmental Control, and local health department standards.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) Further, OCRM **recommends** that the following policies be considered with respect to public/quasi-public buildings in the coastal zone:

a) Encourage visual compatibility, to the maximum extent practicable with surrounding development and natural resources in terms of scale, height, materials, color, texture, and geometry of building and site design.

b) Development of local plans and development regulations that address the location and design of public/quasi-public buildings.

Management Authority

The construction of any public/quasi-public building in a critical area requires a permit from OCRM. Any alteration of a critical area requires a permit under OCRM's direct permit authority as implemented through the Rules and Regulations for Permitting.

The S. C. Department of Health and Environmental Control has permit authority for any septic tank (1500 gpd or greater) or sewage system associated with such buildings. These permit applications are subject to review by OCRM for certification of compliance with the preceding policies of the Coastal Management Program, based on *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the Coastal Management Act of 1977.

If fill below the mean high water is proposed for site preparation or construction, a permit would be required from the Budget and Control Board. These applications also are subject to the review and certification process of the Council.

D. DAMS AND RESERVOIRS

Policies

1) In the coastal zone, OCRM review and certification of permit applications or project proposals for dams and reservoirs will be based on the following policies:

a) Floodplain and ecosystem management and other non-structural solutions are generally preferred to the erection of dams or flood control structures.

b) Water control structures and water management programs should be designed to preserve or upgrade existing water quality. Best management practices should be used upstream of the dam or reservoir to reduce agricultural and construction run-off and sedimentation thereby reducing the threat of eutrophication in the reservoir. This will also reduce the load of sediments deposited behind the dams, thereby prolonging the life of the facility.

c) To the extent feasible, dams should allow for retaining some degree of circulation of waters and sediment flow. This will help preserve water quality and aquatic habitats downstream, and maintain the sediment budget, which is important to related erosion problems in beach and shoreline areas downstream.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

3) OCRM also **recommends** that the following additional policies be considered for dams and reservoirs in the coastal zone:

a) Installation of fish lifts where appropriate to facilitate the migratory passage of fish.

b) Design of release gates to allow water to be let out from different depths in the reservoir for control of temperatures at appropriate levels for downstream aquatic life.

c) When wildlife habitats are inundated or otherwise disturbed by construction of dams or flood control structures, lands suitable for wildlife management should be acquired elsewhere.

d) Encourage the restoration of previous natural conditions in abandoned reservoir areas.

Management Authority

Any dam or reservoir proposed to alter a critical area would be under direct permit jurisdiction of OCRM.

DHEC-EQC has permit authority over the construction of dams and reservoirs, other than those constructed by the U.S. Army Corps of Engineers or Soil Conservation Service, or licensed by the Federal Energy Regulatory Commission or S. C. Public Service Authority. This authority is for the safe maintenance of such structures and is based on the powers of inspection and certification for dams and reservoirs. (S. C. Dams an Reservoirs Safety Act, Act 60 of the 1977 General Assembly.) Permit applications for this activity will be reviewed by OCRM for certification of their compliance with the preceding policies. This review and certification process is mandated by *Sections 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act.

The S. C. Public Service Authority (PSA) has authority to construct dams for certain purposes in the Cooper and Santee Rivers in the coastal zone. Coordination of the activities and policies of the two agencies, as mandated by *Section 48-39-70(A)* of South Carolina's coastal legislation, will be accomplished through provision of the Memorandum of Agreement between PSA and the Coastal Council.

The South Carolina Budget and Control Board has authority for permits for alterations to waters or submerged bottoms of the State below the mean high water line (MHW), outside the critical areas. These permits are subject to the review and certification process of OCRM as mandated by *Section 48-39-70(A)* and *48-39-80(B)(11)* of the South Carolina Coastal Management Act.

E. WATER SUPPLY

Policies

1) In the coastal zone, OCRM review and certification of permit applications for water supply facilities will be based on the following policies:

a) OCRM will coordinate with DHEC in its efforts to ensure that groundwater is adequately managed, and that proposed withdrawals will not cause saltwater intrusion, land settling or other negative impacts.

b) OCRM will coordinate with designated 208 Areawide Waste Treatment Management implementation agencies (pursuant to *Section 208* of the Federal Water Pollution Control Act) and other agencies with responsibility for implementing comprehensive plans affecting water supply, to ensure that proposed projects are compatible with growth and development plans and that alternative locations for water supply facilities are considered.

c) Water supply facilities and transmission systems in the coastal zone must meet applicable Federal/State, and local construction and water quality standards.

d) Construction of such facilities in or adjacent to productive salt, brackish, or freshwater wetlands will be prohibited unless no feasible alternatives exist. Construction activities should be timed so as not to disrupt shellfish harvesting, spawning seasons or migratory fish populations.

2) Within the critical areas of the coastal zone OCRM has direct permitting authority and shall apply the current OCRM Regulations (printed under separate cover) when making decisions on direct permit applications.

Management Authority

Water supply activities, including the use of pipelines, pumping stations and treatment plants, in a critical area require a permit from OCRM.

Outside of the critical areas of the coastal zone, the Department of Health and Environmental Control (DHEC) has regulatory authority and issues permits concerning water supply. DHEC requires a permit for construction, expansion, or modification of public water supplies. Permit applications for this activity must be reviewed and certified by OCRM for compliance with the Coastal Program as mandated by *Section 48-39-70(A)* and *48-39-80(B)(11)* of the S. C. Coastal Management Act. In capacity use areas, as declared by DHEC, permits are required for the extraction of more than 100,000 gallons per day of groundwater and may be required for lesser amounts. (This does not apply to domestic wells.) These permit applications are also subject to the review and certification authority of OCRM.

X. EROSION CONTROL

The planning process, policies, and management authority for this element are contained in Chapter IV(C), Erosion Control Program.

XI. ENERGY AND ENERGY-RELATED FACILITIES

The planning process, policies, and management authority for this element are contained in Chapter IV(B), Energy Facility Planning Process.

XII. ACTIVITIES IN AREAS OF SPECIAL RESOURCE SIGNIFICANCE

The following types of areas in the South Carolina coastal zone have been identified through the resource inventory efforts of the Office of Ocean and Coastal Resource Management (OCRM) as being unique and either environmentally fragile or economically significant to the coastal area and the State. These areas of special resource significance are:

- Barrier Islands
- Dune Areas (outside the critical area)
- Navigation Channels
- Public Open Spaces
- Wetlands (outside the critical area)

Because of this sensitivity and their role as an integral part of the coastal ecosystem, alterations in these areas are likely to have direct effects on the critical areas. Because of their value and characteristics OCRM employs the additional resource policies presented in this section in review and certification of any permits associated with an activity in one of these areas. This is done in an effort to protect the value of the critical areas and of all coastal resources. The applicable policies for the individual activity which is proposed, as well as the general guidelines for evaluation of all projects, are also considered by OCRM in permit and project reviews in these areas.

Management Authority

OCRM has no direct permit authority in any of these areas (with the exception of critical areas of a barrier island and navigation channels, which come under the "coastal waters" category if within the critical areas boundary, and are then under the direct permit jurisdiction of OCRM.) Resource policies in these areas will be implemented through the "network" of existing State agency authorities, and OCRM's review and certification of the permit actions of these agencies (as discussed in detail in the "Legal Authorities and Networking" segment of Chapter V.) The specific state agency with direct authority for each project will depend on the type of project or permit involved in the development proposal.

A. BARRIER ISLANDS

Policies

Because of their fragile and dynamic nature and their resource value, OCRM will consider the following additional policies in review of permit proposals on barrier islands. (Within critical areas of a barrier island, the Rules and Regulations for Permitting applicable to the proposed activity will apply.)

1) Construction and development on barrier islands shall retain to the extent feasible existing dune ridges, drainage patterns and natural vegetation in landscaping and construction plans in order to maintain the value of the island as a storm buffer. Intensive or high density type development may not be suitable on some barrier islands which are less stable or more prone to erosion or other hazard risks; these factors must be taken into consideration when alternative development plans are formulated.

2) Because of their proximity to and strong ecological relationship with the critical areas of the coastal zone, project proposals for activities on barrier islands must demonstrate

reasonable precautions to prevent or limit any direct negative impacts on the adjacent critical areas (beaches, beach/dune system, coastal waters and wetlands).

3) New road or bridge projects involving the expenditure of public funds to provide access to previously undeveloped barrier islands will not be approved unless an overwhelming public interest can be demonstrated, for example, provision of access to a public recreation area or other facility. Preference will be given to ferry access in those instances where public funds cannot be expended for road access.

4) The extension of public services, such as sewer and water facilities, to barrier islands should only be proposed in a comprehensive approach which considers the natural "carrying capacity" of the island to support development and which integrates these facilities to parallel the level of access which is available to the island.

5) OCRM encourages and supports State, local and private efforts to acquire coastal barrier islands for inclusion in preservation and protection programs. Public recreational benefit should be one primary motivation for these efforts, and where appropriate, barrier islands should be maintained for recreational use, based on the capacity of individual areas to accommodate human activity.

B. DUNE AREAS (OTHER THAN CRITICAL AREAS)

Policies

In review and certification of permit applications to other State agencies for proposals in the sand dune areas, OCRM will consider the following additional policies:

1) Because of their proximity to and strong physical and ecological relationship with the beach and beach/dune system critical areas of the coastal zone, project proposals in secondary sand dunes must demonstrate reasonable precautions to prevent or limit any direct negative impacts on the adjacent critical areas.

2) Special attention must be given in new construction activities in ocean-front areas to prevent or mitigate negative impacts on adjacent property owners, specifically, increased erosion or loss of protective dune formations on adjacent lots due to unnecessary destruction of or encroachment onto stable dunes.

3) Project proposals in ocean-front and sand dune areas must conform to the policies of the Beach Erosion, and Beach and Shoreline Access sections of the Program, as well as other applicable Resource Policies.

Recommended Policies

1) Local governments with coastal shorefronts are encouraged to develop and implement strong local zoning and building ordinances for beach and sand dune areas.

2) Property owners, development interests and local governments are encouraged to institute and observe set-backs or buffer zones for construction in beach and dune areas.

C. NAVIGATION CHANNELS

Policies

(A majority of navigation channels in the South Carolina coastal zone are within the critical areas, and therefore, subject to direct jurisdiction of OCRM for the issuance of the State permit required for any alteration, and the Rules and Regulations for Permitting shall apply, as well as the following general policies.)

OCRM will consider the following policies in review and certification of permit applications for projects in or directly affecting existing navigation channels:

1) Development which would result in loss of navigability will be prohibited.

2) Development which might increase upland soil and shoreline erosion problems and resulting siltation of navigation channels must utilize the best mitigation measures feasible that will effectively relieve the problem.

3) The South Carolina State Ports Authority, as mandated under *Section 48-39-150(A)(2)* of the Coastal Management Act, shall review applications for permits in navigable waterways in the critical areas and certify prior to the issuance of such permit that the project or activity would not unreasonably interfere with commercial navigation.

4) Resource Policies and Rules and Regulations for Permitting which apply to Dredging and Dredge Material Disposal shall be applied.

D. PUBLIC OPEN SPACES

Policies

OCRM will apply the following policies in review and certification of permit applications located in or which would directly affect public open space areas:

1) Project proposals which would restrict or limit the continued use of a recreational open area or disrupt the character of such a natural area (aesthetically or environmentally) will not be certified where other alternatives exist.

2) Efforts to increase the amounts and distribution of public open space and recreational areas in the coastal zone are supported and encouraged by OCRM.

E. **WETLANDS** (OUTSIDE THE CRITICAL AREAS)

Background

OCRM is required by both State and Federal law to review projects in the State's coastal zone which require State and Federal permits to determine if the project is consistent with the Coastal Zone Management Program. To provide incentive for developers to approach wetland management on a comprehensive basis, and to provide some flexibility when developing adjacent to wetlands, OCRM uses a wetland master planning concept as stated below. The concept is simple and effective and has greatly reduced wetland conflicts in the coastal zone. Wetland master planning is applied to all projects undergoing consistency certification in the coastal zone, including *Section 404* wetland permits issued by the U.S. Army Corps of Engineers. The Corps of Engineers is mandated by Federal law to delineate wetlands. Once delineated by the Corps of Engineers, OCRM manages the wetlands through the policies contained in Chapter III of the State's Coastal Zone Management Program document.

Wetland Master Planning

OCRM encourages a comprehensive approach to wetland management. To promote such an approach, OCRM utilizes a "wetland master planning" concept.

If a pre-development wetland master plan is prepared for a project, identifying all wetlands, drainage patterns and conceptual development, isolated freshwater wetlands of one (1) acre or less in total size may be incorporated into the project development without restrictions provided:

1. The wetlands contain no endangered species or critical habitat, and;

2. The wetland losses are adequately mitigated.

The wetland master plan must be certified by OCRM with input from other reviewing agencies. In the absence of a wetland master plan, the Resource Policies, Chapter III, Coastal Zone Management Program, will be utilized to guide project certification.

Policies

OCRM will apply the following policies in review and certification of permit applications in freshwater wetland areas:

1) Project proposals which would require fill or other significant permanent alteration of a productive freshwater marsh will not be approved unless no feasible alternative exists or an overriding public interest can be demonstrated, and any substantial environmental impact can be minimized.

XIII. STORMWATER MANAGEMENT GUIDELINES

Most land disturbing activities in South Carolina must comply with the requirements and applicable regulations of the Erosion and Sediment Reduction Act of 1983 (48-18-10, **et. seq.**), or the Stormwater Management and Sediment Reduction Act of 1991 (48-14-10, **et. seq.**). The final regulations, effective on June 26, 1992, pursuant to the Storm Water Management and Sediment Reduction Act of 1991, establish the procedure and minimum standards for a statewide stormwater program. Section *R.72-304F* of the regulations states that "OCRM, in coordination with the Commission, will serve as the implementing agency for these regulations in the jurisdictions of the local governments which do not seek delegation of program elements in the counties of Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Horry and Jasper." In addition, Section *R.72-307C(5)(g)* states that "For activities in the eight coastal counties, additional water quality requirements may be imposed to comply with the OCRM Stormwater Management Guidelines. If conflicting requirements exist for activities in the eight coastal counties, OCRM guidelines will apply."

Pursuant to the Coastal Zone Management Act, OCRM is responsible for protecting the environmentally sensitive areas of our coast. While the regulations of the Stormwater Management and Sediment Reduction Act adequately address most nonpoint source pollution problems, the need exists for establishing additional criteria to protect sensitive coastal waters.

A. STORMWATER RUNOFF STORAGE REQUIREMENTS

The regulations of the Stormwater Management and Sediment Reduction Act require that "permanent water quality ponds having a permanent pool shall be designed to store and release the first 1/2 inch of runoff from the site over a 24-hour period. The storage volume shall be designed to accommodate, at least, 1/2 inch of runoff from the entire site." For all projects, regardless of size, which are located within one-half (1/2) mile of a receiving water body in the coastal zone, this criteria shall be storage of the first 1/2 inch of runoff from the entire site or storage of the first one (1) inch of runoff from the built-upon portion of the property, whichever is greater. Storage may be accomplished through retention, detention or infiltration systems, as appropriate for the specific site. In addition, for those projects which are located within 1,000 (one thousand) feet of shellfish beds, the first one and one half (1 1/2) inches of runoff from the built-upon portion of the property must be retained on site.

Receiving water bodies include all regularly tidally influenced salt and freshwater marsh areas, all lakes or ponds which are used primarily for public recreation or a public drinking water supply, and other water bodies within the coastal zone, excluding wetlands, swamps, ditches and stormwater management ponds which are not contiguous via an outfall or similar structure with a tidal water body.

B. PROJECT SIZE REQUIRING STORMWATER MANAGEMENT PERMITS

Section *R.72-305B(1)* states that "for land disturbing activities involving two (2) acres or less of actual land disturbance which are not part of a larger common plan of development or sale, the person responsible for the land disturbing activity shall submit a simplified stormwater management and sediment control plan meeting the requirements of *R.72-307H*. This plan does not require preparation or certification by the designers specified in *R.72-305H* and *R.72-305I*." Due to the potentially damaging effect of certain projects of less than two (2) acres of land disturbance, stormwater management and sediment reduction plan submittal and regulatory approval shall be required for those smaller projects located within 1/2 mile of a receiving water body. Single family homes that are not part of a subdivision development are exempt from this requirement.

C. STORMWATER MANAGEMENT REQUIREMENTS FOR BRIDGE RUNOFF

The following is the criteria used to address stormwater management for bridges traversing saltwater and/or critical areas.

1) No treatment is necessary for runoff from bridge surfaces spanning SB or SA waters. This runoff can be discharged through scupper drains directly into surface waters. However, the use of scupper drains should be limited as much as feasibly possible.

2) If the receiving water is either ORW or SFH then the stormwater management requirements shall be based on projected traffic volumes and the presence of any nearby shellfish beds. The following matrix lists the necessary treatment practices over the different classes of receiving waters.

3) The Average Daily Traffic Volume (ADT) is based upon the design carrying capacity of the bridge.

AVERAGE DAILY TRAFFIC VOLUME (ADT)

		0-30,000	G.T. 30,000
	ORW (within 1000' of shellfish beds)	***	***
	ORW (not within 1000' of shellfish beds)	**	**
Water Quality Class.	SFH (within 1000' of shellfish beds)	**	***
	SFH (not within 1000' of shellfish beds)	**	**
	SA	*	*
	SB	*	*

*** The first one (1) inch of runoff from the bridge surface must be collected and routed to an appropriate stormwater management system or routed so that maximum overland flow occurs encouraging exfiltration before reaching the receiving body. Periodic vacuuming of the bridge surface should be considered.

** A stormwater management plan must be implemented which may require the overtreatment of runoff from associated roadways to compensate for the lack of direct treatment of runoff from the bridge surface itself. Periodic vacuuming should be considered. The use of scupper drains should be limited as much as feasibly possible.

* No treatment is required. The use of scupper drains should be limited as much as feasibly possible.

D. GOLF COURSES ADJACENT TO RECEIVING WATER BODIES

Golf course construction and maintenance practices result in the potential for significant negative impacts from the runoff of sediments, pesticides, herbicides and other pollutants. For this reason, when golf courses are constructed adjacent to receiving water bodies then the following practices are to be incorporated:

1) Minimum setbacks from the receiving water body of 20 feet for all manicured portions of the golf course (fairways, greens and tees) are required unless other acceptable management techniques are approved and implemented to mitigate any adverse impacts.

2) All drainage from greens and tees must be routed to interior lagoons or an equivalent stormwater management system.

3) To prevent the conversion of the stormwater system to critical area and to maintain positive drainage at high tides, all outfalls from the lagoon system must be located at an elevation above the critical area (if the discharge is to critical area) AND above the normal water elevation a distance to allow for storage of the first one inch of runoff. The volume which must be stored shall be calculated by multiplying the area of all the greens and tees by one inch. (Previously constructed stormwater management systems which meet all current and future storage requirements will not be required to modify outfalls.)

4) No greens or tees shall be located on marsh hummocks or islands unless all drainage can be conveyed to the interior lagoon system or to an equivalent onsite stormwater management system

5) Stormwater impacts to freshwater wetlands shall be limited by providing minimum 20 foot buffers, or an accepted alternative, between manicured areas (fairways, greens and tees) and the wetlands. This minimum buffer must be increased if land application of treated effluent is utilized in the area.

6) An integrated pest management system designed in accordance with current best technology practices must be employed on the course to limit the application of chemicals which, if over applied, may leach into the ground and adjacent surface waters.

7) In accordance with S.C. Department of Health and Environmental Control requirements, a two (2) foot separation must be maintained between the surface of the golf course and the ground water table where spray effluent is applied.

8) The normal ground water elevation must be established by a registered engineer or soil scientist.

9) All projects which are within 1000 feet of shellfish beds must retain the first 1 1/2 inches of runoff as otherwise described in c above.

10) If spray effluent or chemicals are applied to the turf via the irrigation system, all spray heads must be located and set so as to prevent any aerosols from reaching adjacent critical areas.

E. MINES AND LANDFILLS

Due to the significant amount of land disturbance involved in the construction of mines and landfills, these types of operations need to strictly adhere to sediment/erosion control requirements particularly when they are located near coastal waterways. When mining or landfill projects are located within 1/2 mile of receiving water bodies, pumping of ground water from sediment basins must be done with floating intakes only. Pumping of these basins must cease whenever the water levels come to within two (2) feet of the pond bottom. In addition, landfill planning must be designed on a comprehensive site basis for storm water management and sediment/erosion control; to include management practices for each separate cell as it is phased into the landfill.

F. NOTICE OF APPROVAL

All notices of approval must be in written form.

XIV. MITIGATION GUIDELINES

The avoidance of wetlands is preferable to mitigation. Mitigation of wetlands impacts is considered only after all policies of the S.C. Coastal Council Program Document and the Coastal Zone Management Act have been addressed and the policies are found to allow an alteration to wetlands. A mitigation plan must be submitted by the applicant and approved by OCRM for all projects which (1) require a coastal zone consistency determination, and (2) impact federally defined jurisdictional freshwater wetlands in the coastal zone, unless (3) OCRM determines that the impacts are so minimal as not to warrant mitigation. Mitigation requirements should be consistent with requirements of other regulatory agencies. Coastal zone consistency determination is required for all development projects in the eight county coastal zone of South Carolina which require state or federal permits or are direct federal activities. Activities which are exempted from both state and/or federal permits are not subject to consistency determination.

A. TYPES OF WETLAND IMPACTS WHICH MAY REQUIRE MITIGATION

1) Disposal of fill material. The direct placement of fill material into wetlands thereby changing elevations, flow pattern, and/or vegetative species composition.

2) Dredging or excavation of wetlands. The removal of vegetation and soils to create open water, for mining of resources, or for other purposes.

3) Clearing of wetlands. The removal of vegetation for the construction and maintenance of road rights-of-way (which do not require filling), utility easements, golf course play-throughs, or other purposes. The mitigation is one-time front-end mitigation in accordance with an approved mitigation plan and is not required for, and will not prevent, the continued maintenance of cleared areas. Mitigation is not required for hand clearing (non-mechanized clearing) of wetlands.

4) Ditching of wetlands. The excavation of ditches within federally defined jurisdictional wetlands with the purpose of lowering the water table and eventually causing a permanent alteration to the wetland system's hydrologic regime.

B. TYPES AND REQUIREMENTS OF MITIGATION

Applicants can choose the form of mitigation that best meets their site specific needs and opportunities. Options include (1) protection and enhancement (buffering), (2) restoration, or (3) creation, or a combination thereof. Any other form of mitigation will be evaluated on a case-by-case basis.

1) **Protection and enhancement of wetland systems (buffering).** The buffering of a wetland system is to provide additional protection to the values and functions of the natural system.

   a) **Upland buffers**. "Upland" buffers are non-jurisdiction areas adjacent to wetland systems which will be left undisturbed. Limited clearing or underbrushing and pathways may be allowable in accordance with an approved mitigation plan. The clearing must be limited to small trees and shrubs less than 4 inches DBH (diameter at breast height). Larger trees must remain undisturbed unless they constitute a safety hazard. The soils must not be disturbed other than the planting of shrubs or trees for landscaping. Pathways must be no greater that four (4) feet in width and must not be paved or boarded. Sod, grassed lawns, gardens, fences or structures will not be allowed within the buffer. Completely undisturbed buffers with adequate assurances of protection can be reduced ten (10) feet in width (reference paragraph (e) below).

b) **Open water buffers**. Open water systems constructed adjacent to wetlands can be used as buffers provided that the hydrologic regime of the wetland is not altered.

c) **Assurances of protection**. Assurances for the protection of preserved wetlands, created wetlands, and buffers will be provided by the applicant as part of the application/certification process. This may take the form of deed restrictions, conservation easements, or other assurances of protection.

d) **Drawings**. A site plan must be submitted showing all wetlands and their associated buffers. Open water buffers must include a cross-section of the system with the seasonal high groundwater elevation and supporting documentation. Buffer areas and their protected wetlands must be platted and recorded, along with a description of the restrictions. This information must be made available to the property owners or potential buyers.

e) **Sizes of buffers**. Buffers in single family residential developments should average 35 feet in width; high density residential and light commercial (total commercial site development less than two acres) must average 50 feet; and heavy commercial and industrial developments must maintain an average 75 feet buffer area. The widths are averages; consideration will be given to physical and design constraints. Buffer areas must be plainly marked before, during, and after any construction activities to ensure that no encroachment occurs. Permanent signs saying "Protected Natural Area" are preferred. Buffer widths may be reduced by 10 feet in accordance with paragraph (a) above if set aside as completely undisturbed natural areas.

f) **Ratio of buffers to impacts**. No ratio of the area of buffers compared to the area of impacts will be used. The buffer must be adequate to protect the remaining wetlands in their entirety, generally requiring the buffer to completely circumvent the wetland system. However, consideration will be given to the total area of impacts versus buffer in evaluating the mitigation plan.

2) **Creation of wetland systems**. The creation of wetland systems involves the conversion of uplands (or non-jurisdictional wetlands) into wetlands. The wetland creation plan must be designed by a qualified professional wetland scientist to ensure a reasonable chance of success.

a) **Site selection**. Sites suitable for creation are prior converted wetlands, cut-overs, agricultural lands, or very young forest stands.

b) **Drawing submittals**. Drawings of the creation site should include a general location map; a specific site map plan view of the proposed creation area; cross-sectional drawings showing ground elevations and seasonal high groundwater elevation; and a conceptual vegetation cross-section before and after restoration.

c) **Hydrological engineering**. Plans must be submitted demonstrating that a long term wetland hydrological regime will be achieved. Creation adjacent to existing wetlands may be beneficial to obtain hydrology.

d) **Soils**. If at all possible, hydric soils from a wetland area to be filled or excavated should be used for the base soils of the created wetland. The creation site should be excavated below grade and backfilled with the hydric topsoil to a depth of 6 to 16 inches. This will provide a stock of seed and rhizomes to assist in vegetating the creation site. Usable hydric soils should be moved and spread quickly. If hydric soils are not available, non-hydric topsoils must be used. Under no circumstances should bare sub-soil be used as a planting medium.

e) **Establishment of vegetation**. A planting plan is necessary unless circumstances do not warrant such a plan. A planting schedule and species composition should be included in the plans. Vegetation should match that being altered as to species, density, and diversity.

f) **Evaluation of success**. A monitoring program must be established to assure compliance with success criteria. Both vegetation and hydrology must be addressed. Any problems detected during monitoring must immediately be evaluated as to the cause and measures must be taken to alleviate the problem and/or readjust the mitigation plan. Normal success criteria is 75% survival of plants over a three year period and/or a predominance of hydrophytic plant species from natural regeneration unless otherwise established in the mitigation plan. In addition, the monitoring must demonstrate a long-term wetland hydrologic regime has been achieved.

g) **Contingency plan**. A contingency plan must be developed on how detected problems will be corrected.

h) **Implementation schedule**. An implementation schedule for the mitigation must be submitted.

i) **Ratio of created wetlands to impacted wetlands**. A normal ratio is 1.5:1 unless the unavoidable loss occurs in extremely high value wetlands, i.e., sensitive habitat or geographical areas of particular concern in which cases mitigation ratios may be higher.

3) **Restoration of degraded systems**. This includes the restoration of wetland conditions on lands previously altered by man-made changes in vegetation, hydrology, or soils. Areas suitable for restoration include agricultural lands,

mining sites, silvicultural lands, industrial sites, and other degraded wetland systems.

a) **Documentation**. The degraded nature of the system must be documented by the applicant before a restoration plan can be considered.

b) **Drawings**. Drawings of the proposed restoration site should include a general location map; a specific site map; plan view; the jurisdictional lines of the degraded wetland; cross sectional drawings showing ground elevations, drainage ditches, the seasonal high groundwater elevation; and a conceptual vegetative cross-section before and after restoration.

c) **Hydrological modification**. Any restoration project of an area that has been hydrologically altered must include a plan to restore the hydrologic regime.

d) **Establishment of vegetation**. Restoration plans must address the re-establishment of hydrophytic vegetation. In some cases natural re-vegetation will be appropriate. In others, a planting plan may be necessary; the planting plan should include species composition and their sizes, plant spacing and a planting schedule.

e) **Success evaluations**. Plans should include a monitoring plan to ensure the success of the project. A minimum of 75% survival rate and reasonable growth of planted species must be achieved to be considered successful. Natural regeneration of hydrophytic species may be considered in the evaluation. Failure to meet success criteria will require re-evaluation to correct any problems.

f) **Contingency plan**. A contingency plan must be developed for any areas that fail to meet the success criteria.

g) **Implementation schedule**. An implementation schedule for the restoration plan must be submitted.

h) **Ratio of restored wetlands to impacted wetlands**. The ratio of restored wetlands to impacted wetlands will be established on a case-by-case basis, depending upon the severity of the degraded wetland system. Ratios will generally be greater than 1.5:1.

4) **Offsite mitigation**. Offsite mitigation proposals will be considered if onsite mitigation is not possible. However, this does not preclude the consideration of offsite mitigation in other circumstances if the mitigation will provide a significant ecological benefit to the State of South Carolina. All mitigation must be within the State.

5) **Mitigation banking**. Mitigation banking will be considered for publicly constructed linear projects such as highway or pipeline construction and projects where no onsite mitigation is possible. The use of banking for other than the projects above will be considered in concert with other regulatory agencies if and when such mitigation banks or proposed or developed.

C. MONITORING AND COMPLIANCE

1) **Monitoring Reports**. A schedule for the submittal of monitoring reports to be prepared by the applicant will be established at the time of project approval. These reports will be used to determine when a project has achieved an acceptable success status.

2) **Compliance**. All projects involving mitigation will be placed on OCRM's periodic monitoring schedule for compliance. Periodic site inspections will be made by staff of OCRM, South Carolina Department of Natural Resources, U. S. Army Corps of Engineers or the U. S. Fish and Wildlife Service. Mitigation projects which are not in compliance with the applicant's approved plan will face enforcement procedures.

D. NOTICE OF APPROVAL

All notices of approval must be in written form.

CHAPTER IV

SPECIAL MANAGEMENT AREAS

A. GEOGRAPHIC AREAS OF PARTICULAR CONCERN

1. Introduction

Statutory Requirements

The Federal Coastal Zone Management Act of 1972, while recognizing the entire coastal zone of each state as an important and vital resource, also declares that certain areas are of even more, special significance, and warrant particular attention to their preservation and development. The Act requires, in *Section 305(B)(3)*, that each state inventory and designate the "Areas of Particular Concern" within its coastal zone as part of the state's program.

Section 923.21 of the Coastal Zone Management Development and Approval Regulations (**Federal Register**, Vol. 44, No. 61, March 1979) defines the Federal requirements for Geographic Areas of Particular Concern (GAPCs). The subsection reads as follows:

(a) **Requirement.** In order to meet the requirements of subsections 305(b) (3) & (5) of the Act, States must:

(1) Designate geographic areas that are of particular concern, on a generic or site-specific basis or both;

(2) Describe the nature of the concern and the basis on which designations are made;

(3) Describe how the management program addresses and resolves the concerns for which areas are designated; and

(4) Provide guidelines regarding priorities of uses in these areas, including guidelines on uses of lowest priority.

The major emphasis in the GAPC segment of a coastal management program, from the Federal viewpoint, is on the adequacy of the State's authority to manage those areas or sites which have been identified. To a lesser extent, the reasons specific areas are significant as coastal resources and the criteria which establish this significance are also important for inclusion. The individual states may inventory and identify those areas which are significant given the coastal problems or issues which are characteristic of that particular state. Guidance for this designation process is provided in the coastal legislation passed in South Carolina in 1977.

Section 48-39-80(B)(4) of the South Carolina Coastal Zone Management Act mandates that this comprehensive program include the identification of special management areas. It reads as follows:

In devising the management program OCRM shall:

(a) Inventory and designate areas of critical state concern within the coastal zone, such as port areas, significant natural and environmental, industrial and recreational areas.

These "areas of critical state concern" parallel the geographic area of particular concern requirements mandated by Federal legislation. The designation process and the areas identified as GAPCs can be devised so as to be consistent with policies for preservation and development of South Carolina's coastal resources, as stated in the South Carolina Coastal Zone Management Act.

Selected Approach

In order to meet both the Federal and State requirements, this report identifies, maps, and describes the Geographic Areas of Particular Concern in the eight-county coastal zone.

South Carolina has defined Geographic Areas of Particular Concern in its coastal zone in terms of three broad categories:

- Areas of unique natural resource value, including those exhibiting scarce or vulnerable natural habitats and physical features; those offering substantial recreational value; and those of vital importance in protecting and maintaining coastal resources.

- Areas where activities, development, or facilities depend on proximity to coastal waters, in terms of use or access.

- Areas of special historical, archeological or cultural significance.

For each of these categories, standards or criteria are defined, priority of uses within the area are specified, and the specific geographic sites or areas within the coastal zone are identified. Detailed descriptions of each designated site are found in Appendix F.

In the earliest phases of coastal zone management in South Carolina, an extensive National Resources Inventory was completed. This inventory, the pertinent State and Federal regulations, and considerable assistance from the Heritage Trust Program were the initial basis for designation of Geographic Areas of Particular Concern (GAPCs) within each of the four categories.

When a first draft of the GAPC segment was completed and adopted in draft form by the former South Carolina Coastal Council (now the Office of Ocean and Coastal Resource Management), it was mailed to the many individuals, and State and Federal agencies on the Council's mailing list. Numerous comments, corrections, and additions were received as a result, and subsequently these have been incorporated.

In addition, the County Citizens Working Groups, organized in each of the eight coastal counties, (described in Chapter V(E)) received copies of the first draft of the GAPC document. Meetings were held to discuss the Geographic Areas of Particular Concern in detail with staff and Council members. As a result, substantive input from every section of the coastal zone was received in the designation of South Carolina's Geographic Areas of Particular Concern.

The areas included in this section are of such special importance and concern to South Carolina that the State has established regulatory and /or management controls over them. The inclusion of these areas within the scope of the management program combined with the critical areas designated by the S. C. Coastal Management Act -- tidelands, coastal waters, beaches, beach/dune system -- effectively cover all those areas of specific resource concern in South Carolina's coastal zone.

The authority which assures adequate management of GAPCs is *Sections 48-39-70(A)* and *48-39-80(B)(11)* (described fully in the Legal Analysis section) of the South Carolina Coastal Management Act. This coordination and certification authority is affirmed by Memoranda of Agreement (MOAs) executed between OCRM and each of the State agencies with authority over GAPCs. These MOAs specify the type and level of coordination as well as that programs will be administered in a manner consistent with OCRM policies for coastal zone of South Carolina. Their management in the future will be coordinated to ensure consistency with the policies of OCRM for Geographic Areas of Particular Concern.

Implementation

Special management consideration will be given to those areas designated as GAPCs through the process of issuance of permits in the critical areas, and review and certification of permits in the coastal zone. When a project overlaps with, is adjacent to, or significantly affects a GAPC, OCRM will carefully evaluate the project based on the criteria listed as the priority of uses which specifically address each type of GAPC. A project would be prohibited if it would permanently disrupt the uses of priority for the designated area. A project would be strongly discouraged or the permit conditioned if the project would interrupt, disturb or otherwise significantly impact the priority uses of the designated area.

For example, in consideration of the permit for a project adjacent to a State Park which would significantly interfere with the primary recreational activities of that GAPC, every effort would be made to preserve this highest priority use of the park. Although all listed priority uses would receive protection, OCRM would be committed to especially safeguard the highest priority use.

Future Designation of Geographic Areas of Particular Concern

As development and implementation of the coastal zone program continues, other areas which may deserve particular attention will be further studied. Nominations of potential GAPCs can be made to OCRM by other State agencies, Federal agencies, local governments, organizations, and interested private citizens. A new designation would be possible under any of the three existing GAPC categories.

When these potential areas of concern are identified, they will be reviewed by OCRM to determine the nature of concern, if they satisfy the appropriate designation criteria, and what type of management needs exist to ensure adequate preservation or control of the areas. OCRM can designate additional GAPCs after the management program has received final approval without requiring formal amendment to the program. Future designations can be accomplished once the required management authority is determined and executed.

New GAPCs would be automatically added, for example, when Heritage Trust Preserves and Scenic Rivers are designated as parts of the Heritage Trust Program or as a result of the Scenic Rivers Act in South Carolina. In addition, if a new natural resource area is developed or if a significant new coastal dependent activity needs special attention, application to OCRM for designation as a new GAPC would be appropriate. As new GAPCs are designated in South Carolina, OCRM will specify the priority uses for each new area.

Policies for Geographic Areas of Particular Concern

OCRM has designated the Geographic Areas of Particular Concern discussed in this document because of their unique importance as natural, aesthetic, recreational, scientific, or economic resources in the coastal zone. The existing State management authority for each GAPC is identified, and the priority of uses within each area is specified. In addition, management policies and permitting Rules and Regulations of OCRM for certain specified activities or alterations shall apply to designated GAPCs, where relevant.

Goals

The goals of the South Carolina coastal zone management program for preservation and development of GAPCs are:

> To give highest priority to the identified primary value of a GAPC when considering the preservation or development of that area.
>
> To ensure that management of GAPCs is consistent with other policies of the South Carolina Coastal Zone Management Program.

Objectives

The management of GAPCs shall be carried out in such a manner as to:

- prevent, where possible, the disruption of valuable coastal resources.
- protect the integrity of natural resource areas and preserve the unique and fragile areas.
- protect the habitats of wildlife and marine species, particularly those with special commercial, recreational or ecological value.
- improve access to and management of recreational areas.
- increase the usefulness of and access to economically important resources, without undue restrictions on the activities, while minimizing negative environmental impacts.
- avoid preemption of appropriate commercial growth where it is consistent with the use of the areas.
- encourage environmentally sound growth patterns and development practices where growth and development are priority uses of the area.
- discourage development in high-risk areas, where damage to life, property, and coastal resources in likely to be severe.

Areas of Preservation and Restoration

The Federal Regulations (*Section 923.22*, **Federal Register**, Vol. 44. No. 61, March, 1979) state that:

> Designations may be made for the purpose of preserving or restoring areas for their conservation, recreational, ecological, or aesthetic values.

The categories of GAPCs entitled Areas of Unique Natural Resource Value and Areas of Special Historic, Archeological or Cultural Significance include those designations of preservation and restoration areas. The priority of uses specified for each area will guide the protection of the areas once designated.

2. Geographic Areas

a. Areas of Unique Natural Resource Value

Unique natural resource areas include those exhibiting scarce or vulnerable habitats, living marine resources, and physical features; those offering substantial recreational value; and those of vital importance in protecting and maintaining coastal resources.

This category of Geographic Areas of Particular Concern (GAPCs) is especially significant because South Carolina's natural environmental attributes are a resource of great value, for ecological, aesthetic, recreational and commercial reasons. In the past, development has been relatively slow, so there are still unspoiled natural areas and abundant wildlife in the coastal zone to enjoy and protect. For example, over 400,000 acres of tidal marsh represent a vital link in the life cycle of a majority of commercial and sport fish species. The forests, marshes, streams, beaches, and coastal waters warrant critical attention in the State's coastal management program because of both their ecological and economic importance. It has become increasingly evident that these are finite and limited resources which need careful preservation and thoughtful management.

Management Authorities

Several different programs which involve State ownership, regulatory or management authority over natural resource areas exist in South Carolina. The specific authority is described in detail for each individual program in the following pages and is used in conjunction with OCRM's authority as described in the implementation section on the preceding page.

Criteria for designation

The criteria for designation of a natural area as a GAPC are that the area offers unique or important natural features which warrant special attention in the coastal management program.

To indicate the resource values which make these areas particularly significant, general criteria have been developed, drawing from the objectives contained in each of these programs. (Certain of the individual programs have further, specific criteria which are used to qualify areas for inclusion within the program, and these will be identified where such exist.)

OCRM recognizes the following criteria for designation of natural resource areas as Geographic Areas of Particular Concern:

1. The area consists of representatives of one or more coastal ecosystem types or habitats, is intact in the sense that essentially all of the expected species and ecological processes are present in normal numbers and vigor, and meets one of the following conditions:

    a. Alteration or destruction of the area would substantially impair the ability of one or more ecosystem types to perpetuate themselves;

    b. The area has qualified as critical habitat for an endangered or threatened species, under the Endangered Species Act of 1973;

c. The area is unusually large or undisturbed in comparison to others of a similar kind, thus affording a unique opportunity for scientific observations or recreation.

2. The area represents superior habitat for species, which, while not endangered or threatened, are of vital importance as commercial or sports-oriented coastal resources.

3. The area affords maximum recreational opportunities in the coastal zone because of access to beaches or other waterfront, presence of unique physical or cultural features or natural habitats (see #1 above), and/or wide range of active and passive recreation opportunities in a natural setting.

1) The Heritage Trust Program

Management Authority

The South Carolina Heritage Trust Program was established by passage of State legislation in April 1976 (Act 600 of 1976). (An Advisory Board and initial staff efforts had begun subsequent to an Executive Order in 1974.) The Heritage Trust Advisory Board and the Department of Natural Resources (DNR) Board administer a system which provides for inventory, preservation, use and management of unique and outstanding natural or cultural areas. The public policy stated within the Act is:

> To secure for the people, both present and future generations, the benefits of an enduring resource of natural and cultural areas and features by establishing a system of Heritage Preserves and Sites.

This program provides for dedication of areas or sites by the owner to the Trust through transfer of fee simple title or lesser forms of ownership interest, such as open space easements. The Advisory Board and DNR Board review the proposed areas, which are nominated by the staff of DNR, other State agencies, and citizens of the State.

A major requirement of the program is provision of management criteria, rules and regulations, and "allowable use" guidelines for Heritage Preserves. A management plan must be developed for each property in the Heritage Trust. These management mechanisms are intended "to preserve the primary natural character of such areas or features and to provide the maximum public usage thereof which is compatible and consistent with the character of the area." (*Section 4 (7)*)

Priority of Uses

The following are the uses of priority for areas deeded into the Heritage Trust Program, beginning with the use of highest priority:

1) Uses which are consistent with the management plan developed for each property.

2) Uses which allow public enjoyment of the area as long as the primary natural character of the area is not disrupted.

3) Uses which are compatible with the area's wildlife and wildlife management.

Prohibited uses are any which jeopardize the integrity of the Heritage Trust Program.

Designated Sites

Because of their unique value as wildlife habitats and natural areas, all Heritage Trust lands in the coastal zone have been designated as Geographic Areas of Particular Concern. As the Heritage Trust Program identifies priority areas for preservation or acquisition efforts, this information will also be reviewed by OCRM staff and considered for designation as GAPCs, or as future or potential GAPCs.

2) State Wildlife Preserves

The extensive system of wildlife preserves and game management areas owned or leased by DNR are irreplaceable resources, as both protected wildlife habitats and recreational hunting and fishing areas. Because of their value to residents and visitors of the South Carolina coastal area, they have been identified as Geographic Areas of Particular Concern.

Management Authority

DNR is empowered to acquire land areas and enter into agreements with landowners and with the Federal government for purposes of managing wildlife species and establishing specific sanctuaries and game management areas (*Section 50-3-100*, Code of Laws of South Carolina, 1976). The areas owned and managed by DNR are vital resources of the coastal zone, for conservation of the State's wildlife and also for recreational hunting and fishing opportunities. As part of this management responsibility, a full management plan is prepared for each preserve, identifying short and long-term uses and guidelines for protection and use of the area.

Where critical areas, as defined in the South Carolina Coastal Management Act (Act 123 of 1977), occur within these preserves, additional control is afforded, since OCRM permits would be required for any alterations within the critical areas of these preserves.

Priority of Uses

The following are the uses of priority for areas designated as State Wildlife Preserves, beginning with the highest priority:

1) Uses which are consistent with the wildlife management plan for each preserve.

2) Uses which are compatible with the preserve's wildlife, wildlife habitats and wildlife management and simultaneously provide public recreational opportunities, such as hunting and fishing.

Designated Sites

Because of their significance as natural habitats and their inclusion under ownership and/or management authority of DNR, all existing wildlife preserves and game management areas in the eight coastal counties are GAPCs. As new acquisitions are made into the State system of wildlife preserves and game management areas, these will be designated as GAPCs in the South Carolina coastal zone.

3) State Parks

State park facilities in the coastal zone are valuable resources for the recreational, scenic and educational enrichment of residents and visitors alike. Because of this significance, major existing parks have been recognized as Geographic Areas of Particular Concern.

Management Authority

The South Carolina Department of Parks, Recreation and Tourism (PRT) is mandated to control and maintain the State parks system, and can accept or purchase lands for this purpose, with approval of the State Budget and Control Board (*Section 51-71*, S. C. Code of Laws, 1976). PRT must prepare a master plan for each major park facility, identifying plans for development of facilities, and the preservation and use guidelines for the park.

On a more long-range basis, PRT is developing an update to the South Carolina State Comprehensive Outdoor Recreation Plan (SCORP). The function of SCORP is to provide a guide for statewide recreation planning and development, and to maintain eligibility for Land and Water Conservation funds from the Federal Heritage Conservation & Recreation Service.

Where critical areas form part or all of State park facilities, OCRM will also have regulatory control. Any alterations within critical areas will require an OCRM permit. This authority will aid in assuring that the use and development of these cherished recreational resources remain consistent with policies and guidelines of the State's coastal zone program.

Priority of Uses

The following are the uses of priority for State Parks, beginning with the use of highest priority:

1) Varied recreational activities open to the public.

2) Non-intensive uses which require minimal feasible alteration and maintain the natural functions of the area.

3) Provision of educational opportunities to visitors of the parks.

Designated Sites

All existing State parks in the coastal zone are designated GAPCs. As PRT and OCRM identify other recreational resources which warrant particular State concern in the coastal program, these will be reviewed for designation. Proposed park sites should be included as priority or potential GAPCs. When new sites are added to the State parks system, these will be designated automatically.

4) Scenic Rivers

South Carolina is fortunate to have many river segments that still remain in a natural or near natural state. As such, these areas represent an important historical, cultural, and recreational resource. Rivers were the primary transportation system for early America, both for Indians and the later explorers and settlers. Consequently, archeological sites are found at waterfront locations.

Bounded by large expanses of swamp, several Lowcountry river segments have witnessed little development pressure and remain in primarily wilderness conditions. Other segments are good representatives of natural areas with wide species diversity.

As recreational resources, the rivers serve as a "one-way water trail," offering boaters a unique sense of adventure. The silent movement of a canoe affords the opportunity to observe numerous wildlife species which would not be possible to approach in other modes of transportation. The recreational potential of South Carolina's coastal rivers is both impressive and unique.

In recognition of this tremendous resource, OCRM recognizes river segments which have been designated as Scenic Rivers as Geographic Areas of Particular Concern.

Management Authority

In an effort to preserve and protect South Carolina's rivers, the 1974 South Carolina General Assembly passed the Scenic Rivers Act (Act 1106), which authorized DNR to designate scenic rivers. Proposals for designation may be made by State agencies, local governments, or citizens groups. To qualify, a river must possess unique and outstanding scenic, recreational, geologic, fish and wildlife, historic or cultural values, in addition to relatively unpolluted waters.

DNR is mandated to develop a comprehensive water and related use plan for designated rivers, with emphasis on protecting the significant resources of these scenic rivers. The management plans for each river segment must address the following:

Class I -- Maintenance of the wilderness character, with camping and river access allowed only at designated public access areas. Prohibiting new roads or buildings, mining and commercial timber harvesting.

Class II -- Preservation of the scenic values, with riparian landowners allowed customary agricultural activities, silviculture, and construction of compatible farm-use buildings. Mining and construction of roads paralleling the river are prohibited.

Class III -- Preservation of the scenic values, with landowners allowed agricultural, residential, recreational, commercial, and light industrial activities. Mining and construction of new roads paralleling the river are prohibited.

Where all or portions of a designated scenic river is located in the critical areas of the coastal zone, OCRM will also have management authority. A permit would be required for any activities or alterations in such a river segment.

The Federal Wild and Scenic Rivers Act (P.L. 90-542) was enacted in 1968. The three basic river classifications in that Act are: 1) wild, 2) scenic, and 3) recreational. These classifications generally parallel the three categories in the South Carolina Act; however, rules for management in the Federal law are more rigorous.

There are presently no national wild and scenic rivers in the coastal zone of South Carolina. However, the Federal Heritage Conservation & Recreation Service has inventoried numerous rivers in the coastal zone of South Carolina.

Criteria for Designation

The following criteria are those established for a river segment to qualify under the South Carolina Scenic Rivers program:

Class I -- Natural river

i) It must be free-flowing (no impoundments or diversions).
ii) The shorelines and scenic vistas must be essentially unchanged by man.
iii) There must be no extensive paralleling roads closer than one mile.
iv) In river gorges, there must be no extensive paralleling roads within one-quarter of the rim.
v) There must be only a limited number of road crossings and spur roads.

Class II -- Pastoral river

May be partially or predominately used for agriculture, silviculture and other dispersed human activities which do not substantially interfere with public use and enjoyment of rivers and the shores.

Class III -- Partially developed

The adjacent areas may be affected by works of man, but still possess actual or potential scenic, recreational or historic values.

Priority of Uses

The following are the uses of priority for Scenic Rivers, beginning with the use of highest priority:

1) Uses which are consistent with the management plans developed by DNR. Each plan will be a comprehensive water and related use plan designed to protect the significant resources of each river section designated.

2) Uses which maintain long-term natural functions of the river while affording public recreational activities, especially those of a passive nature.

The lowest priority uses would be those not related to the goals of the Scenic Rivers Program but which do not alter, reduce, or degrade the river resources or the integrity of the Scenic Rivers Program.

Designated Sites

All designated scenic rivers in the coastal zone are GAPCs. When new designations are made and easements or titles donated, these rivers automatically will be considered to qualify as GAPCs.

5) Marine and Estuarine Sanctuaries

The coastal waters and wetlands of the State are valuable natural resources which have yet to be spoiled by development or real estate speculation. The preservation and protection of these resources is paramount in determining the growth of the seafood as well as the tourist industries. There are many citizen groups active in pursuing these goals; and State governmental agencies, in particular DNR, have instituted research programs to document and inventory the marine environment. On this basis, OCRM feels that any area designated by the State of South Carolina, in conjunction with the U.S. Department of Commerce, as a marine or estuarine sanctuary will be a Geographic Area of Particular Concern (GAPC).

a) Marine Sanctuaries

Management Authority

Title III of the Marine Protection, Research, and Sanctuaries Act of 1972 (P.L. 92-532, 86 Stat. 1061), provides the Secretary of Commerce, with approval from the President, the power to designate those areas of ocean waters as far seaward as the outer edge of the Continental Shelf and all other coastal waters where the tide ebbs and flows, as marine sanctuaries. These sanctuaries are intended to preserve or restore such areas for their conservation, recreational, ecological or aesthetic values. The Secretary of Commerce, prior to designating a marine sanctuary, must consult with the Secretaries of State, Defense, Interior, and Transportation and give due consideration to the views of the responsible officials of the affected state. The designation becomes effective sixty days after it is published, unless the governor of the state involved certifies to the Secretary of Commerce that the designation, or a specified portion, is unacceptable to his/her state. In this case the designated sanctuary will not include the certified unacceptable areas or become final until such time as the governor withdraws his certification of unacceptability.

On March 13, 1974, the Secretary of Commerce authorized the Administrator of the National Oceanic and Atmospheric Administration to exercise the authority granted under Title III. With this authority, NOAA has to develop proposed objectives, guidelines, criteria and procedures for designation of marine sanctuaries.

Potential marine sanctuary sites, where development seems imminent, are screened by the Federal Office of Ocean and Coastal Resource Management (OCRM) and the National Marine Fisheries Service. Development includes potential offshore as well as onshore sites, and is considered "imminent" if it is likely to occur within 18 months, or if actions to be taken within 18 months will establish the likelihood of development. OCRM offers the opportunity for state coastal zone management offices, commercial fishing organizations, development interests, environmental groups and the public-at-large to submit recommendations for marine sanctuary sites.

If any marine sanctuary areas are designated by the Secretary of Commerce, SCDHEC-OCRM is mandated under the State coastal zone management law (*Section 48-39-50(J)*, Act 123 of 1977) "to manage estuarine and marine sanctuaries and regulate all activities therein, including the regulation of the use of coastal waters located within the boundary of such sanctuary." The primary management authority would rest with OCRM. Its regulatory authority would also apply since any marine sanctuary would be located within the State's critical areas.

To date, the general management principles for marine sanctuaries mainly address regulation of development to be harmonious with the overlying principles of preservation and protection of the sanctuary. The classification of these areas will not affect multiple use which may be permitted to the extent the uses are compatible with the primary(s) for which each sanctuary is established. The establishment of marine sanctuaries may be to complement public or private, local, State or Federal government lands which have been set aside for similar purposes. The overall management of the sanctuary must include an initial and comprehensive environmental assessment. (This should complete the original EIS which must be submitted upon nomination.) A continued monitoring program and guidelines to enforce the policies also must be formulated.

Criteria for Designation

The program objectives for marine sanctuaries emphasize the idea of preserving, restoring or enhancing these areas for their conservational, recreational, ecological, research or aesthetic values. Examples of coastal waters which might meet designation status include:

(a) Areas necessary to protect valuable, unique or endangered marine life, geological features, and oceanographic features.
(b) Areas to complement and enhance public areas such as parks, national or state monuments and other preserved areas.
(c) Areas important to the survival and preservation of the nation's fisheries and other ocean resources.

(d) Areas to advance and promote research which will lead to a more thorough understanding of the marine ecosystem and the impact of man's activities.

b) Estuarine Sanctuaries (Reserves)

Management Authority

Section 315 of the Federal Coastal Zone Management Act of 1972 addresses the subject of estuarine sanctuaries and states that the Secretary may "make grants to any coastal state for the purpose of acquiring, developing, or operating estuarine sanctuaries..." Thus, the initiative for participating in the estuarine sanctuary program lies with the state, whereas nominations for marine sanctuaries can come from local, state or federal agencies or any interested persons.

The term "estuarine sanctuary," as defined in the Act, means "a research area which may include any part or all of an estuary and island, transitional area, and upland in, adjoining, or adjacent to such estuary, and which constitutes to the extent feasible a natural unit..." The purpose of establishing an estuarine sanctuary is to set aside an area which would serve as a natural field laboratory "to provide long-term opportunities for research, education and interpretation on the ecological relationships." (**Federal Register**, Vol. 58, No. 134, July 15, 1993)

These reserves would be areas which are relatively undisturbed by man at the time of acquisition and, therefore, could be used to make baseline ecological measurements. The designation of these areas would provide them with long-term protection, and multiple use of the reserves would be allowed to the extent that such use or uses are compatible with the primary uses of research and education.

The estuarine reserve program is intended to provide research data which would assist in coastal zone management decision-making. The State's coastal zone management program must be designed to protect the estuarine reserve. Management of estuarine reserves and land and water use regulations and planning considerations must be applied to adjacent lands. Management of estuarine reserves is the responsibility of the applicant state, and the reserves are intended to be incorporated into the state coastal zone management program. However, designation does not have to await the development and approval of a state's management program where operation of the reserve would aid in program development.

In South Carolina, OCRM and the management program, which is its responsibility, have authority for estuarine reserve planning and implementation of the necessary management policies and techniques. At this time, there are two designated estuarine reserves in the South Carolina coastal zone: the North Inlet/Winyah Bay NERR and the Ashepoo-Combahee-Edisto NERR.

Criteria for Designation

State applications for grants to establish estuarine reserves are carefully reviewed and judged on the following criteria:

1. Benefit to the coastal zone management program.

2. The ecological characteristics of the ecosystem, including its biological productivity, diversity and representativeness.
3. Size and choice of boundaries (should approximate a natural ecological unit).
4. Cost (Federal share of the cost for each sanctuary is limited to $2,000,000.).
5. Enhancement of non-competitive uses.
6. Proximity and access to existing research facilities.
7. Availability of suitable alternative sites already protected which might be capable of providing the same use or benefit.
8. Conflict with existing or potential competing uses.
9. Compatibility with existing or proposed land and water use in contiguous areas.

Designated Sites

All existing estuarine sanctuaries (reserves) are designated as GAPCs, as well as future reserves or marine sanctuaries.

Priority of Uses

Priority of uses will be determined for each estuarine reserve and marine sanctuary as it may be designated in the future. The priority of uses would be developed in accord with the Federal guidelines and monitoring program affecting the estuarine reserve or marine sanctuary and OCRM's regulatory authority over reserves and sanctuaries.

6) Shellfish Areas

a) Commercial Leases

Oysters and clams constitute extremely important economic resources of the coastal zone, and as such, the areas suitable for shellfish production in the coastal waters of the State are very significant. OCRM recognizes those bottom areas leased for commercial shellfishing as Geographic Areas of Particular Concern.

Management Authority

Section 50-17-310 of the Code of Laws of South Carolina, governing the Marine Fisheries Laws for the State, authorizes DNR to lease portions of the water bottoms owned or controlled by the State, for the purposes of commercial shellfishing. Any State resident licensed to do business and who makes his/her livelihood primarily or largely through the commercial shell-fishing industry may lease shell-fish bottoms, in areas totaling not more than 500 acres to any one individual. (Leases for other than commercial uses may be made to State residents for areas totaling as many as two acres. The adjacent upland landowner has preference for a two acre lease in adjoining tidewaters, if this application is made before other leases are granted.) These lease agreements are valid for a five-year period. Once an application has been made and the Division of Marine Resources has determined the area capable of producing shellfish, the boundaries are surveyed and established within the terms of the lease. No other leases for gathering shellfish can be granted within the perimeter boundaries.

Each lessee is required to plant 125 bushels of shell or seed oysters for each acre, in an effort to prevent overharvesting and depletion of this valuable resource. "Each lease or portion of a lease from which oysters are harvested must be replanted during the following planting season." (*Section 50-17-340*, S.C. Code of Laws, 1976)

OCRM has authority over coastal waters and tidelands to mean high water, and above mean high water where wetlands are contiguous to coastal waters and integrally a part of estuarine systems. An OCRM permit is required for all activities or alterations in these "critical areas," as defined in *Section 48-39-130* of Act 123 of 1977. In assessing permit applications, OCRM must consider "The extent to which the applicant's completed project would affect the production of fish, shrimp, oysters, crabs or clams or any marine life or wildlife, or other natural resources in a particular area..." (*Section 48-39-150(A)(3)*) The Rules and Regulations for Permitting (Chapter 28, *R.30-1* through *30-13*, **State Register**), state specifically that consideration will be given to the rights of the lessee when permits are being evaluated for construction of docks or piers over shellfish lease areas.

b) Recreational Shellfish Grounds

Recreational shellfishing is a popular outdoor activity along the coast of South Carolina. Gathering oysters and clams is not only a unique form of recreation, but a source of fresh seafood for families of the area. As a valuable coastal resource and habitat of a significant living marine resource, recreational shellfish grounds are recognized as Geographic Areas of Particular Concern.

Public oyster grounds are areas along the South Carolina coast where State residents may gather shellfish for their personal use, and these areas must be designated with metal signposts. State shellfish grounds, also marked with signs, are open to all recreational shellfishermen, and by permit to commercial shellfishermen (who may obtain their shells or seed oysters from these State-owned beds).

Management Authority

The Division of Marine Resources, DNR, is mandated to keep open shellfishing areas for the personal use of South Carolina residents, with approval by the County legislative delegations. These public shellfish beds are not to exceed 50 acres in any one county, and their maintenance and adequate marking is the responsibility of the Division. (*Section 28-792* S.C. Code of Laws, 1976)

The regulations for shellfishing, *Section 28-761* of S.C. Code of Laws, apply to recreational shellfishing, and establish the season and the limits for gathering. The Marine Resources Division of DNR has jurisdiction over these areas and conducts numerous management activities, including maintenance of markers; planting of shell and seed oysters, and thinning of over-crowded beds; and periodic surveying of additional productive areas.

The same management authorities of the Budget and Control Board and Department of Health and Environmental Control apply to public and State shellfish grounds as are applicable in commercial lease areas. A detailed discussion is offered in Part 1 of F. Shellfish Areas.

c) Other State-managed Shellfish Grounds (Seed beds)

Certain especially productive submerged bottoms in the Wando River, North and South Santee Rivers and North Santee Bay have been designated by the Marine Resources Division of DNR as seed bed areas. These vital resource areas serve as one of the major sources of seed oysters and, in the case of the Santee River, seed clams, for transport to other coastal waters, in order to restore and enhance shellfish resources.

Management Authority

The Marine Resources Division of the S. C. Department of Natural Resources (DNR) manages these seed bed areas. There is no specific legislation dealing with seed beds; however, DNR is mandated generally to: 1) manage the State's fishery resources, 2) protect and develop shellfish resources, and 3) manage State-owned submerged bottoms. (*Sections 50-5-20*, *50-17-1250* and *50-17-1210* of South Carolina Code of Laws, 1976, as amended).

A special permit is required for commercial taking of clams or oysters in these areas. The public is allowed the same rights of use as on other public shellfish grounds.

Priority of Uses

The following are the uses of priority for all commercial and recreational shellfish areas beginning with the use of highest priority:

1) Water-dependent uses which do not reduce or degrade the quality of shellfish lease area or limit access to the area.

2) Water enhanced activities or nonwater-dependent uses which do not reduce or degrade the quality of the shellfish lease area or limit access to the area.

Designated Sites

All commercial and public shellfish grounds are GAPCs.

7) Groundwater Resources

Groundwater is an abundant resource in the coastal zone of South Carolina; however, there are potential problems of quality and quantity. Proper management can ensure the continuing productivity of groundwater resources, but data collection and extensive study are necessary because this is a complex resource. Groundwater can flow vertically as well as horizontally, and vertical wells can pass through several aquifers. The water in each aquifer is likely to vary in quantity and quality. In such a case, it is difficult to determine which aquifer(s) might be responsible for the poor water quality or if the capacity of one of the aquifers might be exceeded, at the expected pumpage, to the detriment of other wells in the area.

Because groundwater serves as the vital water supply source for many coastal communities, and the resource may suffer from over-use or waste disposal problems (i.e., septic tanks and seepage from landfills), it is an extremely significant resource of the coastal zone. Those regions which have been identified as potential problem areas, requiring special regulation and coordination of groundwater use, are recognized as Geographic Areas of Particular Concern.

Management Authority

The Groundwater Use Act of 1969 (*Section 49-5-10* et. seq., S.C. Code of Laws, 1976) authorizes DHEC to designate "capacity use areas" (CUA). OCRM supports the implementation of this act and designation of CUAs as significantly important. The designation process is as follows: A county, municipality or sub-division of State government may request a review by DHEC if it is believed that a situation exists, or is emerging, where the use of groundwater may require coordination or regulation to protect the interests and rights of residents, property owners or the general public. DHEC or its agent will then conduct an investigation and submit findings and recommendations. Recommendations will include identification of area groundwater problems, appropriate conservation measures, and boundaries of CUA.

Based on the report, DHEC may adopt an order declaring a CUA, give public notice of the declaration , and hold at least one public hearing. After the public hearing, DHEC will take final action on the CUA designation and publish that action as part of its official regulations.

Once a CUA has been designated, DHEC instructs its agent to prepare proposed regulations commensurate with the degree of control which is needed. The Department must hold at least one public hearing on the proposed regulations and publish the final action as part of the official rules. These regulations may be modified or revoked, subject to a public hearing.

These regulations may include the following provisions:

1) provisions requiring water users to submit reports concerning quantity and source of waters withdrawn and nature of use.
2) provisions concerning timing of withdrawals, to abate unreasonable adverse effects and salt water encroachment.
3) provisions concerning well depth, spacing controls, prescribed pumping levels, and maximum pumping rates.

When adopting or modifying the regulations and when reviewing permit applications, the Department shall consider:

1) number of persons using an aquifer and their respective withdrawals.
2) nature and size of the aquifer.
3) physical and chemical nature of any impairment.
4) probable severity and duration of such an impairment.
5) injury to public health, safety or welfare which may result if such impairment were not prevented or abated.
6) kinds of businesses or activities related to groundwater uses.
7) the importance and necessity of the uses claimed by permit applicants and the extent of any injury or detriment expected to be caused to other water users.
8) diversion or reduction in flows in other water courses or aquifers.

The Department also has legal authority to protect groundwater resources, with regard to surface pollution. This is accomplished through a statewide permitting system for septic tanks and waste disposal by earth burial. (Acts 1157, 1094, 203 and 1492; *Sections 32-8, 1202* and *1251*,. S.C. Code of Laws, 1976; regulations PC-SW-1 and 2; SCPCA-SWG-1, 2 and 3)

Criteria for Designation

The decision to designate a capacity use area is based on the report of DHEC or its agent, which describes the groundwater situation and trends. If the situation is poor or deteriorating such that the public interest is in jeopardy, a CUA is likely to be declared. Once this happens, no person shall withdraw, obtain or utilize groundwater in excess of 100,000 gallons per day (gpd) without first obtaining a permit from the Department. All permits will be subject to the CUA regulations.

Priority of Uses

The Ground Water Use Act of 1969 is specific in the considerations which the Department must make in determining whether and to what extent ground water use is permissible. Unreasonably adverse effects on the resource or on water users including public, potential and present users is not permitted. The Act provides that the water resources be put to beneficial use to the fullest extent capable to conserve and maintain conditions which are conducive to the development and use of the ground water resources.

In highest to lowest priority, the following priorities will apply to ground water uses in areas designated as capacity use areas within the coastal zone:

1) Ground water uses which are beneficial uses and are consistent with all provisions of the Ground Water Use Act and regulations promulgated by the Department.

2) Ground water uses which are wasteful, or not beneficial or are found to cause unreasonable adverse effects on other water users or the long-term condition of ground water resources in the coastal zone.

Designated Sites

All or a portion of declared CUA's in the coastal zone may be designated as GAPCs depending upon the relative extent of ground water use problems.

8) Threatened or Endangered Species Habitats

Policy has been affirmed by both the Federal government and State government in South Carolina that conservation of the natural ecosystem upon which endangered and threatened species depend is a high priority. Untempered economic growth and development can result in the depletion or extinction of various species of fish, wildlife and plants. These species of fish, wildlife and plants are of esthetic, ecological, educational, historical, recreational, and scientific value to our people, our Nation, and to the international community.

The United States has committed itself through numerous treaties with other countries to a pledge of conservation involving migratory birds, fisheries and wildlife preservation, for example. The scope of our responsibility as people and a Nation to protect the delicate balance of the natural ecosystem is demonstrated by these treaties of Federal and State legislation. As a result, OCRM will recognize all designated threatened and endangered species habitats as Geographic Areas of Particular Concern.

Management Authority

In view of the National and State concern for endangered species, the South Carolina legislature passed the Non-game and Endangered Species Act in 1974 (Chapter 15, *Section 50-15-10* through *50-15-90*, S.C. Code of Laws, 1976) The Act instructs DNR to conduct investigations on non-game wildlife to determine population distribution, habitat needs, limiting factors, and management measures necessary for their continued existence. Based on such investigations, DNR must issue appropriate regulations and develop management programs. The regulations may establish proposed limitations relating to taking, possession, transportation, exportation, processing, sale, offering for sale, or shipment of particular wildlife species.

DNR is charged with the responsibility to establish programs necessary for the management of non-game and endangered wildlife. The programs may include research, census taking, law enforcement, education, and acquisition of land or aquatic habitats. The Endangered Species Program is coordinated closely with the Heritage Trust Program which allows donations of land and easements.

DNR must issue a list of State endangered species, including the United States List of Endangered Native Fish and Wildlife and the United States List of Endangered Foreign Fish and Wildlife. The list will be reviewed and updated at least every two years. It is unlawful to take, possess, transport, export, process, sell, offer for sale, ship, or receive any of the identified species. DNR is directed to enforce the Act and may issue special permits for scientific, educational, or other purposes.

The State lists current endangered species and, where appropriate, may designate critical habitat areas, according to the Federal Endangered Species Act. The State Heritage Trust Program and Endangered Species Program work in close coordination in assessing, acquiring and managing sites that constitute endangered species habitat. If a critical area is formally designated, the effects of any Federally funded program in that area must be more carefully considered. This review by the State Clearinghouse is an indirect extension of State management authority effectuated under the Federal Endangered Species Act of 1973. The Secretary of Interior makes the final conflict resolution in such a situation.

The Federal Endangered Species Act of 1973 (PL 92-205, December, 1973, amended by PL 94-32, June 1976, and PL 94-359, July 1976) was passed with the purpose of providing

> "...a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved to provide a program for the conservation of such endangered species and threatened species (§ 2(b))."

The national policy is stated as follows:

> "...all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act."

The Secretary of Interior is authorized to publish a listing of endangered and threatened species based on the best available scientific data and, thereafter, to establish rules and regulations regarding the control of taking, sale, import, export, or other disruption of each species. Endangered species are those in danger of extinction throughout all or a significant portion of their range. Threatened species are defined as those likely to become endangered within the foreseeable future. The bases of the South Carolina and national programs are parallel, and the protective mechanisms similar in that impact on endangered species is considered.

OCRM is mandated to consider impacts on wildlife species in granting of permits for activities in critical areas of the coastal zone. OCRM will also review and comment on other permits, applications, environmental impact statements and Federally-funded projects (A-95 process) throughout the coastal zone. OCRM comments will include an evaluation of the potential impacts on any designated critical habitats for threatened or endangered species.

Criteria for Designation

South Carolina Endangered Species are any species of wildlife whose prospect for survival or recruitment within the State are in jeopardy or likely to become so in the foreseeable future. The causes may be: 1) destruction or modification of habitat; 2) species over-utilization for scientific, commercial, or sporting purposes; and 3) other natural or man-made factors. Species on the Federal endangered species lists for native or foreign fish and wildlife are included.

Priority of Uses

The following are the uses of priority for all areas identified or designated as critical habitats for threatened and endangered species, beginning with the use of highest priority:

1) Uses which are compatible with all regulations and management programs developed to protect any designated habitat area under the Federal or State Endangered Species Acts.

2) Uses which maintain the natural functions of areas identified or designated as critical habitat areas of species listed on the State or Federal threatened or endangered species lists.

3) Non-structural, non-intensive uses which do not create irretrievable damage to any species listed as a threatened species.

Within an area officially designated as a critical area habitat under the State or Federal Endangered Species Acts, uses are prohibited which violate the integrity of the State or Federal legislation.

Designated Sites

All designated threatened and endangered species habitat areas are GAPCs. Certain critical habitat areas have been identified but no formal designations have been made to date since most of these areas are already a part of Federal or State preserves or refuges on the coast. At such time as specific habitat areas are designated and management guidelines or rules and regulations are promulgated, these will be adopted as GAPCs.

b. Activities or Facilities Dependent on Coastal Location

This category includes those activities which are dependent on their proximity to coastal waters, in terms of use or access; or on proximity to specific coastal resources, such as minerals or other raw materials. (For initial purposes, port facilities and actively operating mining sites have been identified.)

Industrial and commercial uses are crucial to the economy of the South Carolina coastal zone. In addition to preservation and protection of natural areas, the State's coastal zone management program must address the development of coastal resources. It must provide the citizens of the State with guidance on the best manner in which to capitalize on development opportunities while minimizing negative environmental effects, disruption of other coastal resources, or infringement on the rights of other coastal property owners.

Uses and facilities dependent on coastal location, for water access or proximity to other coastal resources, are recognized as Geographic Areas of Particular Concern due to their unique dependence on coastal location and because of the economic importance and possible environmental impacts of these activities.

Criteria for Designation

To qualify as a GAPC under this category, an activity or facility must meet one or more of the following criteria:

1) Significant quantities of water, such that it can only be obtained in a coastal location, are an absolutely necessary component of the process for a particular industrial or commercial activity.
2) Access to coastal waters, primarily for transportation purposes, not only enhances but is fundamental to the given activity.
3) Minerals, energy-related resources, or other coastal resources occurring in the coastal zone are the primary purpose of an activity which is the major source of income for a given individual or company, and proximity to that resource is vital to success of the operation.

1) **State Ports**

State Ports facilities are a major attraction of industrial investments, and also play an important role for South Carolina agriculture.

These valuable economic assets are, by definition, dependent on their coastal location for access to the transportation corridor provided by coastal waters. While their maintenance and further development are vital to the South Carolina economy, these activities can have significant environmental impacts and also secondary development effects, particularly on other industrial and commercial uses and on public services, such as transportation.

Because of their importance as an economic resource and their dependence on a coastal location, the port facilities in South Carolina have been recognized as Geographic Areas of Particular Concern.

Management Authority

The South Carolina State Ports Authority (SPA) was created by Act 626 of the 1942 South Carolina General Assembly (*Sections 54-1, -12, -15, and -20*, S.C. Code of Laws, 1976). Under direction of a seven member board appointed by the governor, the SPA has the responsibility for development, construction, operation, and promotion of the State's ports. The SPA has jurisdiction over waters, shores, and tidal tributaries of the harbor at Charleston, Georgetown and Port Royal. It has the power to sue and be sued; the power of eminent domain; the power to acquire and dispose of property, and to take State property not otherwise in use; and the authority to issue revenue bonds.

Section 48-39-110 of the South Carolina Coastal Management Act has mandated another requirement for the SPA. It reads as follows:

> The South Carolina State Ports Authority shall prepare and submit to the Department a management plan for port and harbor facilities and navigation channels. Upon approval by the Department of such management plan it shall become part of the comprehensive coastal management program developed by the Department. The South Carolina State Ports Authority shall include in the management plan a designation of the geographical area appropriate for use by public and private port and harbor facilities and military and naval facilities and submit this to the Department for approval.

Joint development of this required port and harbor management plan, coupled with OCRM's permit authority in the critical areas, including coastal waters and wetlands that might be part of a harbor area, will result in coordinated efforts between the SPA and OCRM. And it will ensure that port modifications or expansion activities and management of the ports system remain consistent with the goals of coastal zone planning.

Priority of Uses

The following are the uses of priority for all state ports created and operated by the South Carolina State Ports Authority (SPA) beginning with the use of highest priority:

1) Uses which require water access or uses for which the water orientation is the central purpose of the activity, such as maritime shipping, fishing, marine industry, and recreational boating. Included in the uses of highest priority for state ports are provisions to assure safety within the ports. These water-dependent uses should have no prudent or feasible alternative.
2) Water-related uses which do not reduce or degrade the natural value or resources within the port.
3) Nonwater-dependent or nonwater-related uses which retain future flexibility of the port for water-dependent needs.

Designated Sites

The South Carolina Ports Authority owned and managed port facilities are designated as GAPCs.

2) **Navigation Channels**

Navigation channels are closely related to the preceding category in that they enable travel to and from major ports, facilitate industrial and commercial activities and allow for recreational and commercial boating. Thus channel maintenance and development are vital to the economy of the coastal zone and the state and the nation as a whole. Like port development, channel maintenance and development may have secondary effects of an environmental or developmental nature.

Because navigation channels depend upon a coastal location and are vital to the State's economy, they have been recognized as Geographic Areas of Particular Concern.

Management Authority

The provisions of Chapter I, Title 49 of the 1976 South Carolina Code of Laws declare that "(A)ll streams which have been rendered or can be rendered capable of being navigated by rafts of lumber or timber by the removal of accidental obstructions and all navigable water courses and cuts are hereby declared navigable streams and such streams shall be common highways and forever free..." The section also prohibits the obstruction of waterways and provides for condemnation of land for rights-of-way and outlets for inland waterways.

Enforcement of this statute rests jointly with the Budget and Control Board and the Attorney General's office.

Section 48-39-150(A)(2) of South Carolina's Coastal Management Act requires that OCRM consider navigation channels in its permitting process. Permit applications for activities "in a waterway used for commercial navigation or shipping" must be reviewed by the South Carolina State Ports Authority prior to permit issuance for certification that the proposed project will not "unreasonably interfere with commercial navigation and shipping."

The Act also requires OCRM to consider "the extent to which the activity would harmfully obstruct the natural flow of navigable water" and "the extent to which the activity could cause erosion (and) shoaling of channels."

Priority of Uses

Existing navigation channels should be maintained and utilized, while at the same time conserving the natural environment. The following are the uses of priority for navigation channels in the coastal zone, beginning with the use of highest priority:

1) Beneficial uses which require water access or uses for which the water orientation is the central purpose of the activity, such as maritime shipping, fishing, and recreational boating, providing these uses are conducted in such a way as to minimize adverse environmental impacts.
2) Water-related uses which do not reduce or degrade the environmental quality of the waterway.
3) Nonwater-dependent or nonwater-related uses which do not obstruct navigation and do not impair the natural surroundings.

Designated Sites

All waterways within the coastal zone which meet the legal standards for navigability are designated as GAPCs.

3) **Mining Operations**

There are over 344 active mines in South Carolina. Extraction of minerals by mining is a basic and essential activity, making an important contribution to the economic welfare of this State and the Nation.

While it is not practical to extract minerals required by society without disturbing the earth's surface and producing waste materials, it is possible to conduct mining in such a way as to minimize its effects on the surrounding environment. Proper reclamation of mined land is necessary to prevent undesirable land and water conditions that would be detrimental to the environment and to the general health, safety, and welfare, and property rights of the citizens of the State.

As such, areas of ongoing mining operations qualify as Geographic Areas of Particular Concern (GAPCs), due to their geologic, economic, and environmental significance, and their dependence on a coastal location for access to particular mineral resources.

Management Authority

The provisions of Act 274 of the 1972 General Assembly, entitled, The South Carolina Mining Act, S.C. Code, *Sections 48-20-10* et. seq., are intended to allow the mining of valuable minerals and provide for the protection of the State's environment with the subsequent beneficial use of the mine and reclaimed land. The expressed purposes of the South Carolina Mining Act are as follows:

a) That the usefulness, productivity, and scenic values of all lands and waters involved in mining within the State will receive the greatest practical degree of protection and restoration.

b) That from the effective date of the Act, no mining shall be carried on in the State unless plans for such mining include reasonable provisions for protection of the surrounding environment and for reclamation of the area of land affected by mining.

Mine operators must obtain an operating permit from the Department. The permit application must be accompanied by a reclamation plan which must be approved by the Department, and the permit applicant must file a performance bond to ensure compliance with this reclamation plan. The operator shall file an annual report with the Department that describes the reclamation carried out and estimates the acreage to be actively mined in the next twelve months.

The basic idea of the reclamation plan is to develop a strategy for mining a resource and returning the land to an economically useful, environmentally sound, and aesthetically pleasing form. In the coastal zone, ponds or lakes are the main reclamation practice. This is because of availability of water from streams or a high water table. These water bodies must have certain shoreline construction for long-term safety and stability, a certain percentage of shallow area for spawning, and certain minimum depths to control vegetation. The potential exists for a mining company to turn this reclamation process into a profitable real estate enterprise.

The South Carolina Mining Council serves as an appeal body for any permit decisions made by the Department.

Priority of Uses

The following are the uses of priority for all active mining sites within the coastal zone in South Carolina, beginning with the use of highest priority:

1) The extraction of minerals in a manner consistent with all permit conditions and reclamation plans pertaining to the mining site.

2) Uses which do not interfere with the extraction of minerals for which mining permits have been acquired or with the reclamation plans for the site.

Specific Sites

Areas of ongoing mining operations qualify as GAPCs due to their geologic, economic and environmental significance and their dependence on a coastal location.

c. Areas of Special Historic, Archeological or Cultural Significance

The coastal zone of South Carolina is rich in historic, archaeological, and cultural features. The coastal area was the location of early colonial settlements and, prior to this, the territory of various Indian tribes. Both residents and visitors, alike, perceive these resources as valuable assets and their preservation and protection as an important issue in the growth and development of the Lowcountry. Historic societies are very active throughout the area, and the value placed on the South Carolina heritage by its citizens cannot be over-emphasized. On this basis, areas of specific historic, archeological and cultural significance are felt to be important as Geographic Areas of Particular Concern (GAPCs) in the coastal zone.

Management Authority

To date, there is no specific legislation for historic preservation in South Carolina. However, since 1960 the State, through its Historic Preservation Officer, has developed "a program recognized nationally as an innovative and exemplary type of state-federal partnership in preservation and implementation." (**South Carolina Historic Preservation Plan**, Vol. III, 1977) Through 1975, this State led all others in an annual amount of federal funds received for preservation programs.

The National Historic Preservation Act of 1966 as amended, states that:

> The Secretary of the Interior is authorized to expend and maintain a national register of districts, sites, buildings, structures and objects significant in American history, architecture, archeology and culture, hereinafter referred to as the National Register....

Executive Order 11593 of May 13, 1971, further emphasized the leadership of the Federal government in historic preservation efforts.

The National Register program is implemented and administered by State Historic Preservation Officers (SHPOs) who are responsible for the survey and nomination process, in conjunction with a review board of professionals in the field. Also, the SHPO and the State review board are responsible for preparation and review of the State's historic preservation plan, which includes background information on the State (Volume III).

Properties and sites listed on or eligible for listing on the National Register receive full consideration of their historic or archeological values through OMB Circular A-95 review process, whereby Federal, State, and local agencies comment on proposed Federal activities or funding. *Section 106* of the National Historic Preservation Act of 1966, as amended, provides that:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally-assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation...a reasonable opportunity to comment with regard to such undertaking.

In South Carolina the Department of Archives and History, Historic Preservation Division, and the Institute for Archeology and Anthropology as well as OCRM are involved in the State Clearinghouse process for project proposals subject to A-95 review and also review Environmental Impact Statements (EIS), pursuant to the National Environmental Policy Act of 1969. The Historic Preservation Division estimated that they annually review over 500 A-95 project clearances, project notifications, and environmental impact statements for possible impact on the historic environment. While the review and comment process for Federal, federally-assisted, or federally-licensed projects affecting properties on or eligible for the National Register does not provide a veto power, it does ensure that historic values are thoroughly considered. Experience with the process has shown ample regard is given to relevant comments or objections by State agencies.

OCRM is mandated to consider historic and archeological resources in implementation of its permitting authority in critical areas of the coastal zone. In evaluating applications for alterations in the critical areas, OCRM must consider, among other factors, "the extent to which the development could affect...irreplaceable historic and archeological sites of South Carolina's coastal zone" (*Section 48-39-150(A)(6)*).

Historic and archaeological sites which have been named to the National Register and sites selected from those which have been determined eligible to be named to the National Register will be designated GAPCs. The Department of Archives and History's on-going inventory will provide OCRM with complete information on all known historic and archaeological sites for permit assessments and project evaluations. OCRM may, in consultation with the State Historic Preservation Officer, apply the National Register Criteria to properties which may be eligible for inclusion in the National Register. If a property appears to meet the criteria, an opinion may be requested from the Keeper of the National Register who will determine the property's eligibility for inclusion in the National Register. As sites are listed, they will automatically be designated as GAPCs. As sites are determined to be eligible for listing, they may be designated as GAPCs.

Criteria for Designation

The following criteria are those adopted by the Secretary of the Interior and are used in nominating sites to or determining eligibility for the National Register. (These evaluation criteria are recognized by OCRM for designating GAPCs under this category.):

> The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or
B. that are associated with the lives of persons significant in our past; or
C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. that have yielded, or may be likely to yield, information important in prehistory or history.

Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

A. a religious property deriving primary significance from architectural or artistic distinction or historical importance; or
B. a building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or
C. a birthplace or grave of a historical figure of outstanding importance if there is no other appropriate site or building directly associated with his productive life; or
D. a cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or
E. a reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or
F. a property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historical significance; or
G. a property achieving significance within the past 50 years if it is of exceptional importance.

Priority of Uses

The following are the uses of priority for areas of special historic, archeological, or cultural significance which have been named to the National Register, beginning with the use of highest priority.

1) Uses which preserve the historical or cultural values for which the site was placed on the National Register.
2) Educational opportunities for the public regarding the historical, archeological or cultural significance of the site as long as the site is not disturbed.

Designated Sites

Historic and archeological sites which have been named to the National Register and sites selected eligible to the National Register are designated as GAPCs. As new sites are listed, they will automatically be designated as GAPCs. As sites are determined to be eligible, they may be designated as GAPCs.

B. ENERGY FACILITY PLANNING PROCESS

1. Introduction

The Federal Coastal Zone Management Act, as amended in July 1976, requires in *Section 305(b)(8)* that each state's management program must include:

> A planning process for energy facilities likely to be located in, or which may significantly affect, the coastal zone, including, but not limited to a process for anticipating and managing the impacts from such facilities.

The South Carolina Coastal Management Act states in *Section 48-39-80(B)(6)* that in the development of the State's coastal management program OCRM shall:

> Provide for adequate consideration of the local, regional, state and national interest involved in the siting of facilities for the development, generation, transmission and distribution of energy, adequate transportation facilities and other public services necessary to meet requirements which are other than local in nature.

Therefore, OCRM has the Federal and State mandate to include in its management program a planning process to incorporate the siting of energy facilities in the coastal zone in a manner which is consistent with the other necessary uses of the coast. In addition, OCRM is mandated to consider the national interest when making these decisions.

Section 923.13 of the coastal zone management development and approval regulations (**Federal Register**, Vol. 44, No. 61, March 1979) outlines the minimum requirements which the energy planning process must contain.

(1) Identification of energy facilities which are likely to locate in, or which may significantly affect a State's coastal zone.
(2) Procedures for assessing the suitability of sites for such facilities.
(3) Articulation and identification of enforceable State policies, authorities and techniques for managing energy facilities and their impacts.
(4) Identification of how interested and affected public and private parties will be involved in the planning process.

Policies

Throughout the coastal zone, OCRM issuance of permits or review and certification of applications for permits for energy facilities and energy-related facilities will be based on the following policies:

a. Nonwater-dependent energy and energy-related facilities are prohibited from locating along the shorefront unless no feasible alternative is available or an overriding public interest can be demonstrated, and any substantial environmental impact can be minimized. (A water-dependent facility is one which can demonstrate that dependence on, use of, or access to coastal waters is vital to the successful functioning of its primary activity.) All water-dependent structures should be designed and constructed so as to minimize encroachment on the aquatic ecosystem and minimize destruction to the wetlands, beach areas, and dunes. Inland siting of all but water-dependent facilities is preferred to waterfront siting.

b. New water-dependent facilities should locate on already maintained channels or rivers to reduce the need for dredging of new channels. Where no presently maintained channel exists and one becomes necessary, the policies for dredging (VIII(A) of the Resource Policies) will apply.

c. Expansion of existing energy and energy-related facility sites by each energy supplier is preferred to the development of new energy sites by that supplier if applicable Federal and State air and water quality standards are not violated.

d. Energy and energy-related facilities must meet the applicable water quality and effluent limitation standards of the U. S. Environmental Protection Agency and the South Carolina Department of Health and Environmental Control, under the National Pollution Discharge Elimination System, *Sections 401 and 402* of the Federal Water Pollution Control Act Amendments (Public Law 92-500). In some cases, pre-treatment of wastes may be required before introduction into public waste treatment systems, based on local 201 and 208 Waste Treatment Management Plans, as developed under the Federal Water Pollution Control Act.

e. Energy and energy-related facilities must meet applicable State and Federal air pollution standards and controls, as based on the National Clean Air Act, as amended (P.L. 91-604).

f. In instances where groundwater resources will be utilized either in the processing or effluent discharge stages of the production process, the project shall:

1) meet existing standards and/or management programs of the Department.
2) prevent saltwater intrusion and land subsidence, to the extent feasible.
3) wherever feasible, provide natural vegetated areas on the site where aquifer recharge or percolation can occur to mitigate the impacts of groundwater withdrawals.

g. The filling, dredging and/or drainage of productive fresh, brackish and saltwater wetland areas for energy and energy-related facilities will be prohibited, unless no feasible alternative exists or an overriding public interest can be demonstrated, and any substantial environmental damage can be minimized. These facilities should be directed away from ecologically sensitive areas such as marshes, forested wetlands, and pocosins.

h. Where other activities are associated with energy or energy-related activity sites, such as construction of navigation channels, docks and piers, parking, commercial buildings, or transportation access, the policies for that particular activity, found in the Resource Policies, shall apply.

i. Energy and energy-related facilities and sites should be designed and constructed to minimize erosion and sedimentation, and to limit the impacts from direct stormwater discharge into adjacent water bodies and wetlands. Persons proposing to develop these sites are encouraged to contact and work closely with the local Soil and Water Conservation District in the county for assistance in developing site plans which reduce sedimentation and drainage problems. The following considerations shall be included in site location, construction and design whenever feasible:

1) provision of a buffer strip of natural vegetation between the facility and the water's edge. This vegetated area provides a visual screen, a purification system for stormwater runoff, and a protective area for the more ecologically sensitive areas, especially fringing wetlands.
2) during site preparation, the controlling of storm run-off, soil erosion, and accidental placement of sediments in wetland areas.
3) the use of permeable surfaces in parking lots and bulk storage areas to provide water recharge areas and minimize the effects of stormwater run-off.
4) retainment of open space or natural (undisturbed) areas around sites as buffer zones and recharge areas.

j. Unless a waterfront location is required for the operation of an energy or energy-related facility, major structures, such as electric generating facilities, should be located outside of flood prone areas. When energy and energy-related facilities must be located in flood prone areas, they must meet applicable flood management and construction requirements, as required by the Federal Flood Insurance Program. Inclusion of buffer areas and protection of salt, brackish and freshwater wetlands, which help absorb flood water surges, are strongly encouraged.

k. When electric generating facility applications are evaluated, the following considerations of need must be taken into account:

1) evaluation of forecasted need for the facility.
2) alternative means of meeting the energy demands, whenever feasible.

l. When the energy or energy-related facility applications are evaluated, the following considerations of available, alternative sites must be taken into account:

1) the extent and severity of environmental disruption at various sites.
2) short and long-range economic and social impacts on the community for various sites.
3) comparison of the degree to which the proposal could be modified at different sites if necessary to more fully meet environmental standards.

m. Permit applications for energy and energy-related facility proposals will consider the extent and significance of negative impacts on Geographic Areas of Particular Concern (GAPCs). Applications which will negatively impact GAPCs will not be approved or certified unless no feasible alternative exists or an overriding public interest can be demonstrated, and any substantial environmental damage can be minimized. The determination of significant negative impacts will be made in each case with reference to the specific priorities of use for each type of GAPC.

n. Prior to permitting and certification of energy and energy-related facilities, including oil refineries and petrochemical facilities, the extent and significance of negative impacts on the quantity or quality of these valuable coastal resources will be considered:

1) unique natural areas - destruction of endangered wildlife or vegetation or significant marine species (as identified in the Living Marine Resources segment), degradation of existing water quality in the area.
2) public recreational lands - conversion of these lands to other uses without adequate replacement or compensation, interruption of existing public access, or degradation of environmental quality in these areas.
3) historic or archeological resources - irretrievable loss of sites identified as significant by the Department of Archives and History or the South Carolina Institute of Archeology and Anthropology, without reasonable opportunity for adequate professional examination and/or excavation, or preservation.

o. "Installation of cables, pipelines, and transmission lines is preferred in non-wetland areas; however, excavating activities in critical areas are sometimes required. Excavation and filling also are sometimes required to construct foundation structures attendant to the installation of overhead transmission line crossings. These installations shall be designed to minimize adverse environmental impacts." *(R.30-12(D)(1))* Outside of the critical areas these installations should also be designed to minimize adverse environmental impacts.

p. The following standards will be applied both within and outside the critical areas. "In addition to standards for dredging and filling, the following standards are applicable (for the installation of cables, pipelines, and transmission lines):

1) To the maximum extent feasible, alignments must avoid crossing the critical areas.
2) Creation of permanent open water canals to install pipelines is generally prohibited since such projects usually interfere with drainage patterns and may adversely affect water quality through accelerated bank erosion.
3) Dimensions of excavated canals for cables and pipelines should be minimal. Silt curtains are recommended for all excavations.
4) Wherever feasible, all excavations in wetland areas must be backfilled with the excavated material after installation of the appropriate structure, while being careful to maintain the original marsh elevation.
5) Appropriate erosion control measures shall be employed during the crossing of wetland areas. Where appropriate, revegetation with suitable wetland species will be required.
6) Alignments of new projects should be designed to utilize existing rights-of-way and topographic features, wherever possible." *(R.30-12(D)(2,a-f))*

q. Locations for new pipelines shall avoid offshore munition areas, chemical and waste disposal areas, and geological faults, as determined significant by authoritative sources, and wherever possible shall avoid heavily used waterways and significant and productive fish and shellfish habitats.

r. All transmission facilities and pipelines should follow existing roadways and railways and be attached to bridges and crossovers where applicable, especially in wetland areas, to prevent unnecessary alteration or disruption of adjacent wetlands or waterways. The number of pipelines and new transmission lines shall be limited as much as possible. All pipelines through the coastal zone will be laid in pipeline corridors to be developed in coordination with OCRM.

s. Siting of nuclear power plants or liquefied natural gas (LNG) facilities is strongly discouraged in hazardous areas such as:

1) geological faults as determined significant by authoritative sources, or;
2) flood prone areas.

t. Siting of nuclear power plants or liquefied natural gas facilities is prohibited in or near areas of significant population, except where no feasible alternative exists or an overriding public need can be demonstrated.

u. The plans for temporary and permanent disposal of all types of nuclear waste which will be associated with a proposed nuclear power plant will be considered as a vital part of the evaluation of the facility application in determining the overall safety and environmental impacts of the nuclear power plant.

v. Transportation patterns associated with proposed liquefied natural gas facilities will be considered a vital part of evaluation of the facility application in determining the overall safety and environmental impacts of the LNG facility. LNG should be regasified and moved as a gas by pipelines unless no other feasible alternatives are available. Where absolutely necessary to transport LNG over land, safety precautions as strenuous as those required over water must be followed in order to avoid subjecting South Carolina residents to unacceptable safety hazards.

Recommended Policies

OCRM also **recommends** that the following policies be considered:

a. The location of new energy and energy-related facilities is generally preferred in already developed areas which are capable of accommodating additional development without significant expenditure of public funds for infrastructure or in areas which the local government and OCRM deem to be both environmentally and economically compatible with the type of energy development proposed. Thus, onshore development is preferred where adverse physical, economic, and institutional impacts will be less than those which are likely to be experienced in less developed areas such as those which are more dependent on tourism and the resort industry. (The exception to this siting policy would be the locating of liquefied natural gas (LNG) and nuclear facilities. Specific policies included on the preceding pages shall apply in these two instances.) Care should be taken that proposed new facilities be located, wherever possible, in areas where they will minimize disruption of existing land use of the area.

b. Renewable sources of energy such as solar, wind, tidal power, geothermal and biomass, including experimental and demonstration projects, will be encouraged to locate in the coastal zone to the extent that they meet all Federal and State air and water quality standards and are consistent with other OCRM policies.

c. The use of recoverable energy sources such as co-generation (combined industrial production of electricity and heat) is also encouraged.

d. Upgrading of old generating facilities operated by each energy supplier is preferred to construction of new facilities by that supplier.

e. Recommendations of the U.S. Department of Energy to encourage the development of small-scale, diversified, dispersed industrial systems are encouraged.

f. A coordinated effort in consumer, commercial, industrial, governmental and recreational energy conservation and support for the Department of Energy Extension Service Concept is encouraged.

C. EROSION CONTROL PROGRAM

1. Introduction

The widespread concern for effects of coastal erosion is reflected in the coastal management legislation passed on both the Federal and State levels. The Federal Coastal Zone Management Act, as amended in July 1976, provides in *Section 305(a)(9)* for:

> A planning process for (a) assessing the effects of shoreline erosion (however caused), and (b) studying and evaluating ways to control, or lessen the impact of, such erosion, and to restore areas adversely affected by such erosion.

In addition, the rules and regulations promulgated as a result of the Federal legislation by the Office of Ocean and Coastal Resource Management, guiding program development and approval, require States to include in their coastal management programs an erosion planning process. *Section 923.25*, **Federal Register**, Vol. 44, No. 61, March 1979, states that:

1) The management program must include a method for assessing the effects of shoreline erosion and evaluating techniques for mitigating, controlling or restoring areas adversely affected by erosion.
2) There must be an identification and description of enforceable policies, legal authorities, funding techniques and other techniques that will be used to manage the effects of erosion as the State's planning process indicates is necessary.

The South Carolina Coastal Management Act in *Section 48-39-120* mandates OCRM to develop a comprehensive beach erosion control policy and gives authority to OCRM for the implementation of the policy, including permitting powers for erosion control, authority to remove erosion control structures which have an adverse effect on the public interest, and the authority to accept and spend Federal and State erosion control funds in areas which provide full and complete access to the public. The Erosion Control Program is a close look at the existing South Carolina coast, the patterns of erosion and the interactive dynamics involved in those patterns, the policies which will guide OCRM when evaluating alternative erosion control measures, the policies guiding the expenditure of public funds for erosion control, and the legal authority for implementation of the Program.

In July 1988 the State's General Assembly passed the South Carolina Beachfront Management Act. This act, which was subsequently amended in the 1990 session, requires the use of scientific studies of coastal processes to establish precise building setback lines along the coast. In addition, the Act bans the future construction of seawalls, limits the size of buildings within the predicted erosion zone and adopts a policy of retreat away from the erosional beach.

The Act is intended to protect both life and property, protect unique habitats and preserve the beach for future use by all citizens. One important provision of the Act specifically requires the adoption of local beachfront management plans by local governments.

2. Policies

a. FUNDING POLICIES

Regarding the expenditure of public funds for beach and shore erosion control measures throughout the coastal zone, it is OCRM policy that:

1) Public funds can be expended for beach or shore erosion control only in areas, communities, or on barrier islands to which the public has full and complete access (as defined in the shoreline access segment of the program and South Carolina's Beachfront Management Plan).

2) Public funds can be expended only for beach erosion control measures which are deemed by OCRM to be consistent with the Beach Erosion Control Policies in this section and any applicable rules and regulations promulgated pursuant to the Act.

3) Public funds can be expended only for erosion control measures which are consistent with the overall coastal management program.

4) Funding for particular erosion projects shall be approved by OCRM only after adequate consideration has been given to the erosion control problems and needs of each coastal county and the relative benefits of the particular project.

5) Consideration will be given to the extent to which the proposal will maximize the protection of public health, safety, and welfare.

6) For expenditure of public funds, the full range of alternative erosion control measures which are possible, including no action, must be studied. Before decisions are made, consideration must be given to the long and short-range costs and benefits of the various alternatives.

7) Removal or modification of existing publicly-funded control structures will be authorized by OCRM based on the applicable policies in this section and determination that the structure has an adverse impact on the public interest, as mandated by *Section 48-39-120(C)* of the Act.

b. GENERAL CONSIDERATIONS

OCRM will consider the following before any erosion control projects are approved:

1) The type of materials employed, their useful life expectancy along with anticipated maintenance and replacement costs.

2) The economic justification of the proposed project in comparison with available erosion control alternatives including consideration of the anticipated damage and economic loss due to failure.

3) Rate of rise or fall of sea level at the location.
4) Sediment transport and sand budget in the project area.

5) Extent of up or downdrift damage due to installation or lack of installation of the erosion control structure.

6) The extent to which the project fits into a comprehensive shore protection program for that particular stretch of beach, aimed at preserving the beach profile in its present slope and configuration.

c. EROSION CONTROL POLICIES

OCRM will apply the following policies in its review and evaluation of permits for the following erosion control activities:

Seawalls, Bulkheads and Revetments (Riprap)

No new erosion control structures or devices are allowed seaward of the setback line except to protect a public highway which existed on June 25, 1990 (*R.30-13(N)(3)(a)*).

Groins

1) Significant volumes of sand via the littoral transport system should be available.

2) The extent to which the downdrift beach areas will be damaged must be determined before construction.

3) The adequacy of shore anchorage of groins to prevent "flanking" as a result of erosion must be demonstrated.

4) The positive effect and applicability of a groin system in a comprehensive shore protection program must be demonstrated.

5) Care must be taken to insure that groins do not interfere with public access (*R.30-13(N)(1)(e)*).

Offshore Breakers and Jetties

1) Since these structures tend to impound littoral drift on their updrift sides, provisions should be made so that sand is pumped at appropriate intervals to downdrift areas so as not to starve these areas of sand thereby creating or worsening an erosion problem.

2) Where feasible, jetties shall be designed to provide public recreational fishing opportunities (*R.30-13(N)(1)(f)*).

3) Construction activities shall be scheduled so as not to interfere with nesting and brood-rearing activities of sea birds, sea turtles, or other wildlife species (*R.30-13(N)(1)(c)*).

4) These structures should be consistent with other erosion measures being undertaken as part of any comprehensive shoreline protection projects.

Artificial Beach Nourishment

1) A thorough study of littoral transport mechanics as well as beach slope, grain size, and berm geometry should be done before artificial nourishment is attempted.

2) Sand for artificial nourishment should come from offshore deposits or areas of active accretion and from bars or spits only where it can be clearly demonstrated that no negative impacts will result in downshore areas. Fill material should not come from dune fields, adjoining beaches or nearshore bars.

3) Dredging in the borrow areas should not be in conflict with spawning seasons or migratory movements of significant estuarine-marine species.

4) Dredging offshore shall be done in locations and in such a manner so as not to create anoxic sumps or uncover toxic or anoxic deposits.

5) All other policies concerning dredging and filling (*R.30-12,G*) will be applied to beach nourishment proposals.

6) Careful study must be given to the type (size, quality, etc.) of fill material most suitable for use in a particular beach area.

7) Nourishment of beach areas should be scheduled so as not to interfere with nesting or brood-rearing activities of important seabird colonies or other wildlife species.

8) The recreational and public access requirement of the affected beach area will be a major concern when determining the width of the beach fill.

9) Where possible, inlet stabilization and/or navigation projects shall be done in concert with artificial nourishment projects.

10) Structural control measures should be used, where appropriate and feasible, to complement artificial nourishment projects.

Sand Dune Management

1) Private and public projects to restore and stabilize dunes through non-structural means are encouraged.

2) To the extent possible, the secondary dunes should be kept intact to insure protection of adjoining areas against flooding during storms.

3) Buffer areas should be established, where feasible, to allow for frontal dune growth and movement.

4) All plans for dune restoration, reconstruction or stabilization should be part of a comprehensive shoreline protection program.

5) Dune reconstruction should be done only above the existing berm line or in line with existing frontal dunes. Dunes should be constructed using only native material (sand) of the appropriate grain size and stabilized with native vegetation.

Consultation is encouraged with the Natural Resources Conservation Service advisory services in determination of plant materials most suitable for dune stabilization.

6) Walkover structures are encouraged over all frontal dunes (*R.30-13(O)(1)*) However, these walkover structures should not interfere with public access or extend below the mean high water line.

7) Seawalls, bulkheads or revetments should not be placed in front of frontal dunes.

8) Public access should be provided either over frontal dunes via walkover structures or by using natural breaks through frontal dunes. In no case shall access be provided by bulldozing or cutting openings through frontal dunes.

9) In all cases, the primary front-row sand dune, as defined in *R.30-1(C)(39)*, should not be permanently altered.

Recommended Policies

1) OCRM recommends that local governments in shoreline areas institute shorefront construction setback lines as part of their land-planning activities and/or local building codes, subdivision regulations, or zoning ordinances.

2) Private property owners and developers are encouraged to consult with OCRM or with technical consultants to learn the erosion trends and shoreline dynamics in their particular area before initiating construction.

5. Management Authority

The S.C. Coastal Management Act of 1977 explicitly states that the regulatory program developed to control beach erosion is for the purpose of promoting the public health, safety and welfare, and the protection of public and private property from beach and shore destruction.

OCRM has been granted very broad authority to study and control erosion in the coastal zone. Besides the permit program for the alteration of critical areas, which would encompass most erosion control activities, the enabling legislation gives OCRM responsibility to develop and implement a comprehensive beach erosion control program and permit jurisdiction over erosion control and water drainage structures not otherwise covered by law (§48-39-120; 1976 S.C. Code of Laws). OCRM has also been designated as the State agency to accept Federal money for erosion control in areas to which the public has full and complete access. State funds, if available, may be spent by OCRM to alleviate emergency erosion conditions, as declared by OCRM, in areas to which the public has full and complete access. Public access is a pivotal requirement for the allocation of funds by OCRM under the erosion control segment of the coastal management program.

The specific policies for erosion (management control) are designed to accomplish this purpose. Through direct action, such as an order, or as a last resort, by seeking court intervention, OCRM may enforce these policies and insure the implementation of this segment of the program.

D. BEACH AND SHORELINE ACCESS

1. Introduction

The South Carolina coastal zone boasts 158 miles of Atlantic Ocean shoreline - this wealth of beaches is an invaluable and irreplaceable resource for the State. The General Assembly recognized the increasing demands on all coastal resources in the passage of the South Carolina Coastal Management Act of 1977, which mandates development of a comprehensive coastal management program. Among the many findings and concerns expressed in the State legislation are those of protecting public access and preserving and expanding recreational resources. The following beach and shoreline access policies and existing management authority address these issues.

In order to receive Federal approval and thereby continued funding through the Department of Commerce, the State must also meet Federal requirements for shoreline access in its coastal management program. The rules and regulations from the Federal Office of Ocean and Coastal Resource Management for program development and approval read as follows:

(1) The management program must contain a procedure for assessing public beaches and other public areas, including State owned lands, tidelands and bottom lands, which require access or protection, and a description of appropriate types of access and protection.

(2) There must be a definition of the term "beach" that is the broadest definition allowable under state law or constitutional provisions, and an identification of public areas meeting that definition.

(3) There must be an identification and description of enforceable policies, legal authorities, funding programs and other techniques that will be used to provide such shorefront access and protection that the State's planning process indicates is necessary.

(*Section 923.24*, **Federal Register**, Vol. 44, No. 61, March 1979)

2. Definitions

a. Beach

The South Carolina Coastal Management Act (Act 123 of the 1977 South Carolina General Assembly) defines "beaches" as "those lands subject to periodic inundation by tidal and wave action so that non-littoral vegetation is established." (*Section 48-39-10(H)*) This definition includes that area of sand between mean low and spring high water, in other words, the foreshore and the dry sand beach up to the line of vegetation. Beaches are included in the management program as "critical areas," subject to OCRM's direct permitting authority.

b. Public Beach and Public Access

According to the Federal Regulations "public beach" must be defined within each management program. In South Carolina it is defined in terms of State ownership or of demonstrated public use sufficient to create public rights in the land. In South Carolina there is no specific statutory right for public use of the beaches. However, the doctrine of the public trust forms the bases for the public's right to use the foreshore or wet-sand beach seaward or below the mean high water mark. Under this doctrine, title to the foreshore (below mean high water) is presumed to be held by the State in trust for her citizens unless title has been expressly granted to an owner out to the low-water mark.

Based on traditional concepts of law, or common law, the public has rights to use the foreshore for navigation and fishing. In recent years, this traditional interpretation has been expanding in other jurisdictions. In South Carolina, statutory expression in State legislation for coastal management and oil spill monitoring and control, and opinions of the S. C. Attorney General reflecting strong public interest in recreation, have to some degree broadened the common laws basis to include recreational use within the public trust.

Upland access across to the wet-sand beach below mean high water is another important factor in identifying public beach access. Unless the property landward of the wet-sand beach is owned outright by the State - through acquisition, express dedication from developers and owners, or through an express trust - assurance of public rights for use of the "dry-sand beach" or shoreline property adjoining the traditional public beach area below MHW can be made only on the basis of a case-by-case determination.

In South Carolina, confirmation through the courts of these so called "acquired" public rights for accessways on shoreline property will probably be based on the legal theories of (1) prescriptive easement and (2) implied dedication. A prescriptive easement requires a clear showing of continuous and uninterrupted public use without permission of the owner, for a 20-year period. Implied dedication requires evidence of the landowner's intent to dedicate the property for public use and of the public's acceptance by using the land. Under either theory, evidence supporting the extent of public use must be clear and convincing.

Litigation involving particular parcels of shoreline property is clearly an expensive, time-consuming, and cumbersome means for determining "public" versus "private" rights in a particular area. But in some instances where ownership is in question, it can be the only means for such determination. The S. C. Attorney General has brought several claims on behalf of public rights in the past; however, there is no clear statutory authorization for this role and no explicit duty for that office to undertake such an action. The viability of this course of action depends to a large degree on the ability or willingness of the Attorney General or of some concerned private party to initiate a public claim.

c. **Existing Public Access (Full and Complete Access)***

OCRM will use the following definition for "existing public access" for 1) determination of those areas eligible for public funds for erosion control and 2) as a basis for every permitting decision requiring consideration of public assess. In addition, this definition fulfills the federal requirement that a definition of full and complete access be included in the State management plan.

OCRM will find that a stretch of beach is accessible to the public if: (1) reasonable provision is made for transportation facilities, including automobile parking, boat landings, bicycle racks and/or public mass transit. Facilities must be available on a year-round basis, and fees, if charged, must be nominal and serve only to offset actual costs; (2) public walk-ways or access-points to the beach and lateral access to the dry-sand beach are open and readily

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* For the purpose of meeting the requirements of *Section 48-39-320(3)*, the use of public funds for beach restoration projects, full and complete access is defined in South Carolina's Beachfront Management Plan, pp. 101-104.

apparent; (3) access to the area is actually sought by members of the general public with reasonable frequency.

A "stretch of beach" may be delineated by such factors as physical or geographical boundaries (an inlet or marsh, for example) as well as by jurisdiction borders (municipal limits, for instance).

What constitutes "reasonable" for purposes of the preceding definition will be determined in part by the size and population of the surrounding area, the size of the stretch of beach itself, and the availability and nature of upland or marine rights-of-way to the general area of the beach.

3. Policies for Public Shoreline Access

1) OCRM fully endorses and will support, further, and encourage the protection of and, wherever feasible, the expansion of public access to shoreline areas in the coastal zone.

2) OCRM's evaluation to determine whether or not permit applications for alterations in the critical areas are approved will be guided by the policies specified in *Sections 48-39-20* and *48-39-30* of the S. C. Coastal Management Act of 1977, as amended, and:

> The extent to which the development could affect existing public access to tidal and submerged lands, navigable waters and beaches or other recreational coastal resources (*Section 48-39-150*, S. C. Coastal Management Act of 1977).

3) OCRM's review and certification of permit applicants from other State agencies for projects in the coastal zone, including those outside the critical areas will consider:

> The extent of impact on the following aspects of quality or quantity of these valuable coastal resources:
>
> Public recreational lands - conversion to other uses without adequate replacement, **interruption of existing public access**, or degradation of environmental quality in these areas (emphasis added). (See chapter III, (C) Resource Policies.)

4) Public funds can only be expended for beach or shore erosion control in areas, communities or on barrier islands to which the public has full and complete access.

5) The highest priority for expenditure of public funds for acquisition of new parks and recreational areas along beaches or shorelines in the coastal zone will be given to areas which offer full and complete access to the public.

6) OCRM encourages the extension of better access to existing publicly-owned recreation areas, particularly barrier islands, which currently only afford access by private boat and are appropriate for more intensive use. This should include access **to** the area via ferry or provision of boat landings and other facilities; and also access **across** or through the area to the beach-front via paths or walkways. The type and extent of public access must be determined based on the human "carrying capacity" of the area in its natural state in order to protect natural beach features and other environmentally sensitive areas.

7) Lateral beach access-ways should be walk-over structures or staggered pathways at natural breaks in the dunes to prevent disruption of sand dunes or vegetation. Although structures of this type are specifically exempted from direct permit authority, OCRM will be available at any time to assist in their planning and design so as to assure suitability to the environment.

8) The provision of additional parking space in upland areas adjacent to beaches should be a priority for recreational planning by both local and State agencies. Alternatives such as remote parking sites connected to the beach by public transportation, off-island parking, and authorized weekend and holiday use of private, commercial parking spaces should be explored. As mandated in *Section 48-39-100* of the Act, OCRM will be available to provide technical assistance whenever needed.

9) Local governments in the coastal zone, particularly beachfront communities, are urged to incorporate considerations for provision of public access into their local ordinances and comprehensive plans, especially into subdivision regulations which can influence the location and design of new development that might affect public access.

10) Private developers in beach areas, in considering the benefits not only for the public but for protecting private property interests, are encouraged to include provision of reasonable public beach areas and access-ways in their plans for new developments.

11) Recreational planning by State and local governments should include consideration of alternatives to actual ocean-front areas in order to offer other options for recreation and to relieve growing pressure on ocean-front communities. An example of such an alternative is the acquisition and development of recreational areas along rivers which provide for activities such as fishing, swimming or picnicking. Estuaries could also be utilized as recreational areas, provided that their development and use are compatible with the fragile nature of these areas.

12) OCRM advocates the provision of joint-use public docks, public boat ramps and landings throughout the coastal zone in environmentally suitable locations, to meet the needs of recreational boating.

13) OCRM advocates the provision of pedestrian access and fishing catwalks on all new bridges and roadways in the coastal zone, and recommends their addition to existing structures where possible.

14) The provision of new public oyster grounds, as well as the preservation of existing public grounds will be sought by OCRM. (Public shellfish grounds are designated as Geographic Areas of Particular Concern.)

15) The resource policies for park facilities, as well as marinas, boat ramps, docks and piers will apply where appropriate to shorefront areas with public access. (See Resource Policies pertaining to these activities.)

16) OCRM will coordinate planning and acquisition efforts very closely with the SCORP Exchange Council, as well as with State and Federal agencies concerned with public beach recreation.

17) OCRM recognizes the overriding importance of good water quality as a recreational resource, and will strive to maintain and, where possible, improve existing standards. Chapter

V, (D) in the full Program document details the procedure by which the Federal Water Quality Standards are incorporated into South Carolina's coastal planning process.

Additional policies regarding public access are found in the State's Beachfront Management Act of 1988, as amended in 1990.

Recommended Practices

1) OCRM recommends that legislation be introduced to limit the liability of property owners and municipalities in case of injury or accident associated with public access to the beach.

2) OCRM strongly supports the proposal generated by the S. C. Department of Parks, Recreation and Tourism to alter the structure of the State Recreational Land Trust Fund (which may now only be used for State parks) to permit local governments to use the Fund for the purpose of developing land for any recreational purpose. Use of the Fund would enable State and local governments to provide more high quality public access to the beaches.

3) It is recommended that abandoned bridges and railroad trestles be left standing to serve as fishing piers when safety considerations permit. Costs of maintenance may be offset by leasing the structures to a county or local government. It has been suggested in the Resource Policies section that railroad rights-of-way be allowed to serve as access points whenever possible. (II (D) of the Resource Policies)

4) In the planning and design of all public access areas, full consideration should be given to assure access opportunities to elderly and handicapped visitors.

F. SPECIAL AREA MANAGEMENT PLANS (SAMPs)

Introduction

Uses of coastal resources are not always mutually compatible and conflicts of use can occur. Where these conflicts are widespread, a Special Area Management Plan (SAMP) is used to collect and examine data, identify potential development trends and enunciate anticipated conflicts between different uses. The SAMP will be used to develop strategies to protect and manage resources in order to implement coastal zone management policy. During the preparation of the SAMP, alternatives which will address and manage conflicts, and policies which will address the implementation of the plan through the existing permitting regulations and certification policies, will be identified. These alternatives include refinement of policy or application of existing policy on a specific geographical area. The following basic policies will govern the conduct and use of SAMPs:

1) SAMPs may be requested by state, local, or federal entities, in addition to the Department's inherent authority to develop such plans.
2) SAMPs are initiated by the Board.
3) OCRM may request cost sharing from the requesting entity for the development of the SAMP.
4) SAMPs should reflect a coordinated effort by all involved entities, particularly local governments, and recommended resolutions should reflect an effort by all involved entities.
5) SAMPs must be developed with public notice and comment.
6) For implementation, the Board most vote to approve the SAMP.
7) OCRM may, at its discretion, consider SAMPs developed pursuant to the existing Coastal Management Program Document to be included as a Geographic Area of Particular Concern (GAPC). When OCRM seeks to elevate a SAMP to a GAPC the process required by the program document and the Coastal Management Act shall be followed as it relates to GAPCs.
8) If the implementation of the SAMP by OCRM involves other than existing OCRM authorities, such authorities must be approved through the State Administrative Procedures Act process or through CZMP amendment or refinement, as appropriate.

C. RESOLUTION OF CONFLICTS

Appeals Process for Certification (V-9)

Section 48-39-80(B)(11) of the S. C. Code of Laws of 1976, as amended, requires that the Department review and certify permit applications made to state and federal agencies within the coastal zone. In order to be certain that the Department retains its responsibilities in reviewing state and federal permits, any decision of the staff as it relates to a state or federal permit, shall be reviewed by the Department, in accordance with current procedures, upon appeal filed by any person adversely affected by such decision.

1) Notice of Certification

a) Federal permits or licenses - Within ten days after receipt of the consistency certification (consistency statement, required data and information) the Department will insure that a notice of the proposed activity will be published in a newspaper of statewide circulation as well as in a newspaper circulated in the area which is likely to be affected by the proposed activity. Where one newspaper meets both criteria, publication of the public notice in the single newspaper shall be sufficient. The public notice shall include a summary of the proposed activity, announcement that information on the activity is available for public inspection at a Department office, and a request that comments be submitted to the Department by a specified date. The Federal agency and the Department should issue a joint public notice when applicable to avoid duplication of effort and unnecessary delays (CZMP, p. V-26).

b) Direct federal activities

i) The activities of the Army Corps of Engineers will follow the same process as that set forth above in (1)(a).

ii) With regard to all other federal activities, the notice procedure for state permits set forth in (1)(c) will be followed.

c) State permits - Within ten days after receipt of notification from a State agency of a State permit requiring coastal zone management consistency certification, the Department will notify the public of the commencement of the consistency certification determination review through the issuance of a public notice. The public notice will contain the name of the project or activity requiring the permit, the location of the project (county, street or road address), type of activity (i.e., subdivision development, mine, manufacturing expansion), type of permit, name of agency issuing permit, an announcement that information on the project is available for public inspection at a Department office, and a request that comments be submitted to the Department within ten days. Where possible, a joint public notice issued with the issuing agency will meet the above requirements. In those instances where more than one permit is required for a project, as long as no components of the project change, the Department will only place the first permit received on public notice. The Department will take identical action on all sequential permits.

2) Process of Review

a) Federal permits - The Department shall issue a notice of proposed decision on application for certification, including any proposed conditions. Such notice shall be mailed to:

i) the applicant;

ii) agencies having jurisdiction or interest over the certification decision;

iii) any person commenting upon the project or requesting notification.

b) Direct federal activities

i) The activities of the Army Corps of Engineers will follow the process of review for federal permits set forth in (2)(a).

ii) With regard to all other federal activities, the process of review for state permits set forth in (2)(c) will be followed.

c) State permits - The Department will issue a conditional letter of consistency certification or non-certification to:

i) the applicant;

ii) agencies having jurisdiction or interest over the certification of the project;

iii) any person commenting upon the project or requesting notification.

d) The notice, in the case of federal permits, and the letter of certification, in the case of state permits and federal activities, shall provide ten days within which to file an objection or notice of intent to appeal the proposed decision or certification. The right of appeal is extended to the applicant and any person or persons adversely affected by the project.

e) Upon receipt of a notice of intent to appeal a certification decision, the Department shall notify the permittee and the affected agency, providing ten days within which to provide a statement in support of the appellant's position, along with supporting data and information. Additionally, the appellant may provide a brief and any documents deemed pertinent to a Department decision.

f) Upon receipt of the grounds for appeal and supporting information, same will be forwarded to all respondent parties. These parties must provide data, information, briefs, and any other supporting documents within ten days of receipt of the appellant's grounds for appeal and supporting documents.

g) Thereafter, the Department shall forward a copy of all appeal documents and a copy of the file and record of any proceedings to the Panel. Review shall be confined to the foregoing material and record and no additional evidence or testimony shall be allowed. The Panel shall have ten days to review the material and make written demand for oral arguments before the full Panel pursuant to R.30-6.

h) No extensions shall be granted.

3. Final Decision

a) The decision of the staff shall be deemed a final agency decision in the matter unless three members of the Panel request in writing that oral arguments be had before the full Panel.

b) If three members of the Panel make written demand for oral arguments, then oral arguments shall be heard after the ten day comment period by the Panel. Upon review of the decision by the Panel, the written order of the Panel affirming, reversing or modifying the decision shall be deemed the final agency action in this matter. A written order shall be served the same as for appeals under R.30-6.

4. Time Constraints

This appeal process is affected by time constraints on review and certification of federal permits and activities. Thus, the Department's decision may become final before the appeals process is completed. When a certification decision is made by the Department and is affected by federally imposed time constraints, the Department will adhere to the following procedure:

a) The Department shall seek a maximum extension of time from the appropriate federal agency. Any further extensions shall be the responsibility of the appellant.

b) If the appeal is not concluded two days prior to the final date for Department certification and notice of the decision to the federal agency, the original Department decision shall automatically become the final agency decision and the federal agency shall be notified accordingly.

c) Any stays of the federal time constraints on review and certification aside from extensions requested pursuant to (a) above must be obtained by the appellant from the appropriate court.

APPENDIX

GOALS, OBJECTIVES, AND POLICIES OF THE SOUTH CAROLINA BEACHFRONT MANAGEMENT PLAN

(AN EXCERPT FROM SOUTH CAROLINA'S BEACHFRONT MANAGEMENT PLAN)

GOALS, OBJECTIVES, AND POLICIES OF THE SOUTH CAROLINA BEACHFRONT MANAGEMENT PLAN

INTRODUCTION

This section of the plan contains goals, objectives, and policies that will be used to guide the management of the State's beach during the future. The planning period is ten (10) years; every five (5) years the plan is to be reviewed and, if needed, revised. Revisions may include changes based on technical data gathered from the ongoing monitoring of the beachfront changes in the local beachfront management plans, or changes in State law.

The goals, objectives, and policies outlined in this document are organized in a hierarchical manner. First, broad goal statements derived from Section 48-39-260 of the Beachfront Management Act are listed. These goals are intended to be nonspecific and to represent broad courses of action or direction for the plan to follow. Second, the plan's objectives are defined to identify strategies that will be addressed to implement the goals. These objectives are more specific than a goal but do not describe the specific actions the OCRM will take in order to accomplish the objective. Lastly, a number of specific policy statements are listed under each objective to identify specific courses of action that will be used to implement the Beachfront Management Plan. These policy statements will be used in OCRM's day-to-day actions which will implement the plan.

Following the section on goals, objectives and policies is a section describing plan implementation.

STATE COMPREHENSIVE BEACH PLAN

GOALS: (References to the South Carolina Coastal Zone Management Act, as amended, are given in brackets):

PROTECT, PRESERVE, RESTORE AND ENHANCE THE BEACH AND DUNE SYSTEMS. (48-39-260 (1)(a)(b))

IMPLEMENT THE POLICY OF RETREAT. (48-39-260 (2))

IMPROVE PUBLIC ACCESS. (48-39-260 (6))

PROTECT ENDANGERED SPECIES HABITAT. (48-39-260 (1)(d))

DEVELOP AN ORGANIZED DISASTER RESPONSE PLAN. (48-39-260 (8))

IMPROVE DATA BASE OF COASTAL PROCESSES. (48-39-260 (7));

IMPROVE PUBLIC AWARENESS OF COASTAL ISSUES. (48-39-260(1)(C); 48-39-260(2))

GOAL: PROTECT, PRESERVE, RESTORE AND ENHANCE THE BEACH AND DUNE SYSTEMS

OBJECTIVE 1: Protect all sand dunes seaward of the setback line. (48-39-320 2. (D))

> **POLICY:** All beachfront lots proposed for development will be inspected by OCRM staff in order to identify sand dunes. OCRM staff will locate and flag all sand dunes on the lot. All sand dunes must be indicated on the plats. (48-39-310; 48-39-320 2. (D))
>
> **POLICY:** Within the setback area, the disturbance of sand dunes must be avoided where possible. Sand dunes proposed for alteration must be indicated on the submitted permit drawings. The stated reason why alteration is required must be included. Consideration in the building and site design plans to relocate or redesign the building to avoid alteration of sand dunes and vegetation must be addressed. (48-39-320 (B)(4); 48-39-310; 48-39-320 2. (D))
>
> **POLICY:** Important dunes significant to the health of the beach will be protected even if the boundary of the dune extends landward of the setback line. These significant dunes will be identified by OCRM staff from site visits and survey information. (48-39-320 2. (d))
>
> **POLICY:** Within the setback area, mitigation in the form of constructing a new dune and replanting with beach vegetation where feasible, should be included for permitting an alteration of a dune. Off-site mitigation will be considered on a case-by-case basis. (48-39-310)

OBJECTIVE 2: Promote renourishment by providing funding and technical assistance where feasible. (48-39-260 (5))

> **POLICY:** Use the state plan as a guide to fund renourishment projects based upon the state renourishment plan (adopted as a part of this plan). Renourishment projects will be funded based upon erosion rates, benefits to the community, improvement of public access and likelihood of success. (48-39-320 A. (2) (a))
>
> **POLICY:** Technical assistance for renourishment projects is available from OCRM staff. Surveys developed as a part of coastal monitoring projects will be made available to local governments. Additional periodic surveys for proposed renourishment projects may be requested by a local government, and OCRM will attempt to address these requests. (48-39-260 (5))

OBJECTIVE 3: Encourage the construction and planting of new sand dunes within the area between the active beach and the setback line (48-39-310; 48-39-320 (2)(D))

> **POLICY:** The construction of new sand dunes to provide erosion protection and wildlife habitat is encouraged on beachfront lots. In order to encourage this activity OCRM has issued a general permit which enables local property owners

to build these dunes without obtaining an individual OCRM permit. (48-39-320 (2)(D))

POLICY: The construction of new sand dunes may be used as mitigation for other construction activity occurring within the setback area. OCRM will assess each mitigative activity individually, based upon the extent of construction on the lot, nature and location of the proposed dune. (48-39-310)

GOAL: IMPLEMENT THE POLICY OF RETREAT

OBJECTIVE 1: On erosional beaches, limit the size of structures within the setback area. (48-39-260 (2); 48-39-350 (A)(9); 48-39-280 (A))

POLICY: Within the 40-year setback area, buildings will be located as far landward as practicable. Local roadside setbacks will be the minimum necessary to allow development to occur while still allowing the construction of a building of a reasonable size for the intended use. OCRM, in cooperation with local governments in developing their beachfront management plans, will determine the minimum roadside setbacks allowable within the setback area. Practical considerations such as the need for off-street parking spaces, drain fields, and stormwater retention ponds will be considered during the review of these local plans. (48-39-350 (A)(9); 48-39-260 (2))

POLICY: In cooperation with local governments, OCRM will attempt to develop a system to allow larger buildings within a portion of the setback area provided the buildings are located farther landward on the lot than they would normally be allowed by existing local or State regulations. Each proposal will be reviewed on a case-by-case basis.

OBJECTIVE 2: Implement a policy of retreat to move buildings away from active beach. (48-39-260 (2); 48-39-350 (A)(9))

POLICY: Buildings seaward of the setback line that are destroyed beyond repair for any reason (whether by Act of God or man) can only be replaced by a structure no larger than that of the original building. (48-39-290 B. (iv)(a))

OBJECTIVE 3: Implement mitigation guidelines/regulations.

POLICY: The Beachfront Management Act requires OCRM to adopt mitigation guidelines for any construction activity occurring, as well as for any destruction of beach/dune vegetation, seaward of the setback line. (48-39-310; 48-39-320) In order to implement these guidelines OCRM has determined that local mitigation programs, similar to impact fee programs would be the most efficient way to establish and implement this program. Accordingly, OCRM has developed guidelines for mitigation programs and distributed these to local governments.

GOAL: IMPROVE PUBLIC ACCESS

OBJECTIVE 1: Develop programs to acquire public access improvements. (48-39-320 2. (b); 48-39-350 A. (2); 48-39-350 A. (10))

POLICY: OCRM has surveyed the coast of South Carolina and determined that several public access problems exist in some areas of the coast. Specifically, Georgetown County, Hilton Head Island, and southern Charleston County (Seabrook and Kiawah) have identified access problem areas. It is the policy of OCRM that in these areas local governments, or the applicant, are encouraged to improve public access as permits to renourish the beach, relocate inlets, or undertake any alterations within the coastal waters or sand dunes are considered. (48-39-320 2. (b))

POLICY: OCRM will request funding from the Federal government and the State to develop a source of funds to acquire beach property. (48-39-320 A. (g))

POLICY: OCRM will use its permitting and certification authorities to encourage developers, homeowners' associations, or local governments to make efforts to provide public access onto beaches where access is limited or completely restricted. (48-39-320 2. (g))

OBJECTIVE 2: Use public funds for renourishment projects only where full and complete access is provided. (48-39-320 (3))

POLICY: A community must demonstrate that the entire renourishment project area subject to State cost-shared funding has full and complete access existing as of the date of the award and that the entire project is a complete and viable project as defined in OCRM's regulations for renourishment projects and adjusting baselines. OCRM's public access guidelines will be used as the evaluating document in deciding if a beach has full and complete access and in designing public access improvement projects. (48-39-320 (3); 48-39-120 (D))

OBJECTIVE 3: Coordinate with S.C. Department of Parks, Recreation and Tourism and local government to develop new access sites. (48-39-320 (2)(B))

POLICY: OCRM will coordinate with Parks, Recreation and Tourism and local governments to identify potential beach access sites. Regional, community, and neighborhood facilities should be considered. (48-39-320 (2)(B); 48-39-350 A. (2); 48-39-350 A. (10))

POLICY: OCRM will request funding from the Federal government and the State Legislature to develop a joint funding program to acquire and develop parks along with Parks, Recreation and Tourism. Joint use of funds will be explored when feasible. The inventory of need will be used as a key factor in selecting site locations for public access improvement projects. (48-39-320 (3))

GOAL: PROTECT ENDANGERED SPECIES HABITAT

OBJECTIVE 1: Continue coordination with S. C. Department of Natural Resources to better identify endangered species and habitat sites. (48-39-320 (2)(E); 48-39-35 A. (4))

POLICY: Local governments will be required through the local planning process to contact S. C. Department of Natural Resources to identify endangered species habitat areas. The policies of the endangered species guidelines will be implemented by the local governments through their plans. (48-39-320 (2)(E); 48-39-350 A. (4))

POLICY: OCRM will coordinate with S. C. Department of Natural Resources to prepare a list of endangered species habitat areas. The list will be updated annually and used by OCRM staff in the permitting and certification processes. A staff member will be assigned as coordinator. (48-39-320 (2)(E); 48-39-350 A. (4))

OBJECTIVE 2: Include an endangered species impact review as a part of the permit and certification processes administered by OCRM and OCRM approval of local beachfront management plans. (48-39-320 (2)(E))

POLICY: All sites identified by S. C. Department of Natural Resources will become Geographic Areas of Particular Concern (GAPCs) and be protected under the Coastal Zone Management Program. This list will be updated annually by the Natural Resources Department. (48-39-90 (D); 48-39-250 (A)(4))

POLICY: In areas that do not have an approved local beachfront management plan, each individual permit or certification request located along the beachfront will be evaluated as to its impact on endangered species. If an impact is determined, the guidelines for protection of endangered species will be implemented through conditions placed upon the permit or certification. (48-39-350 (B))

OBJECTIVE 3: Limit man's impact to sea turtle nesting areas by use of ordinances at local and state government levels. (48-39-350 A. (4))

POLICY: Local plans will be required to comply with the guidelines for endangered species in order to be approved by OCRM. (48-39-350 (A)(4))

POLICY: OCRM will implement the intent of the lighting ordinances along the beachfront, for areas that do not have approved local beachfront management plans, through the enforcement provisions of the Coastal Zone Management Program and the review of individual permit applications. (48-39-350 (B); 48-39-350 A. (4))

POLICY: Sand fencing and dune construction projects will be conducted in accordance with the adopted guidelines and regulations for the protection of sea turtle nesting areas. (48-39-350 (A)(4))

OBJECTIVE 4: Limit the destruction of dune systems from development activity to protect habitat. (48-39-310)

POLICY: The policies of protecting sand dunes from alteration will be implemented along the coast through the local beachfront management plan and staff review of individual projects in areas that do not adopt approved plans (48-39-310)

POLICY: If a dune is located in an area determined to be a habitat for an endangered species no alteration will be allowed. (48-39-350 (A)(4))

GOAL: DEVELOP AN ORGANIZED DISASTER RESPONSE PLAN

OBJECTIVE: OCRM will develop and implement, as a part of this plan, a disaster response plan describing the actions that OCRM will follow in preparing for a major disaster both before and after the storm event. (48-39-350 (A)(8); 48-39-260 (8))

POLICY: The plan will be adopted by OCRM and used as the agency's strategy for responding to disasters. (48-39-260 (8))

POLICY: The plan will be reviewed and updated annually and changes made as needed. (48-39-260 (8))

GOAL: IMPROVE DATA BASE OF COASTAL PROCESSES

OBJECTIVE 1: Develop a method to collect information on beach erosion and accretion that is capable of collecting historical information and monitoring long-term trends. (48-39-320 A. (1))

POLICY: A monitoring program must be developed to periodically survey beach profiles along the coast. Each station will be surveyed at least twice each year. (48-39-320 A. (1))

POLICY: A system for archiving the information will be developed. Information will be stored on computers in OCRM offices. (48-39-320 A. (1))

OBJECTIVE 2: Use the information in developing setback lines, erosion rates, and renourishment projects. (48-39-320 A. (1); 48-39-280 (A))

POLICY: OCRM will analyze all information for historic trends to determine erosion rates, setback lines, etc. Lines will be evaluated every eight years. Renourishment projects will be evaluated as to the success of the project. Baselines and setback lines can be adjusted in accordance with the adopted guidelines. (48-39-280 (C))

OBJECTIVE 3: Make the information available to engineers, planners and all interested parties along the coast. (48-39-320 A. (4))

POLICY: All information will be released annually to local governmental planning departments. In addition, any engineering firms doing beach renourishment or coastal projects can receive copies of the monitoring results upon request. An annual "State of the Beach Report" identifying trends and erosion rates along the coast will be prepared and made public in April of each year. (48-39-320 A. (2); 48-39-320 A. (5); 48-39-350 A. (1))

OBJECTIVE 4: Fund monitoring projects to improve knowledge. (48-39-320 A. (3))

POLICY: When feasible, OCRM will fund hydrographic surveys, research projects, special studies, etc. to improve knowledge of coastal processes.

OCRM will work with the Sea Grant Consortium and other appropriate agencies to try to identify needed research projects. (48-39-320 A. (3))

GOAL: IMPROVE PUBLIC AWARENESS OF COASTAL ISSUES

OBJECTIVE: OCRM will undertake a public education and public participation program in an effort to make the public more familiar with the methods used to manage the coast and the natural processes that are shaping the beach. (48-39-320 A. (4))

POLICY: OCRM will prepare brochures/pamphlets on coastal processes (the protection of sea turtles, building methods, dunes, etc). (48-39-320 A. (4))

POLICY: OCRM will utilize the media to explain coastal processes. (48-39-320 A. (4))

POLICY: OCRM will release informative studies so that the general public can understand issues related to beach management. (48-39-320 A. (4))

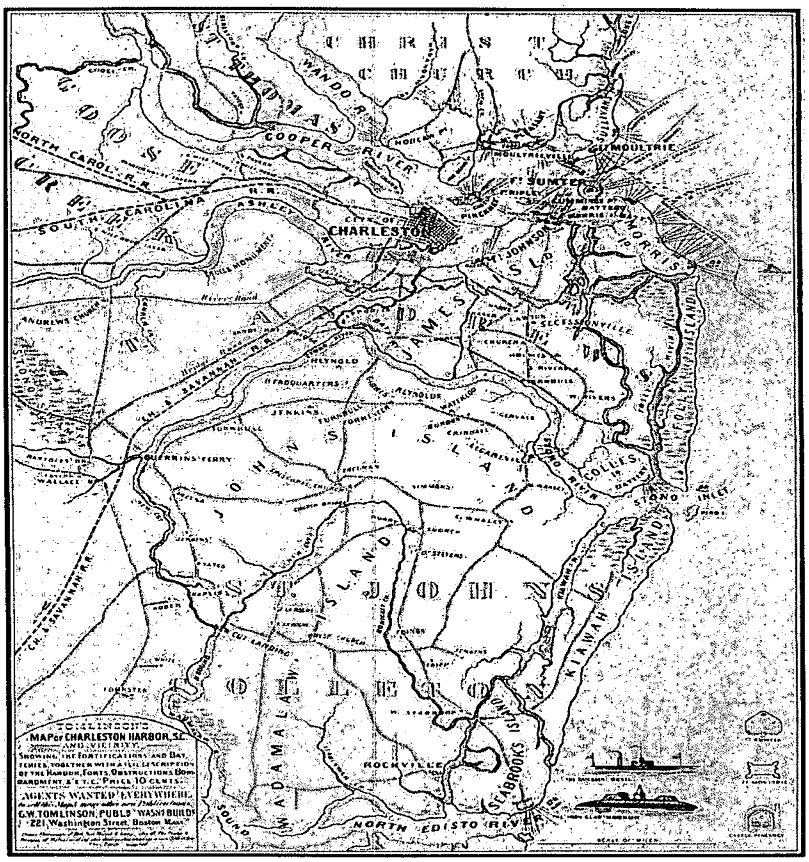
POLICY: OCRM will develop ways (advisory committees, etc.) for the public to become involved. (48-39-320 A. (4))

Sec 9.3 Ref 20

BUREAU OF WATER

South Carolina Department of Health and Environmental Control

A PRELIMINARY ASSESSMENT OF THE GROUNDWATER CONDITIONS IN CHARLSTON, BERKELEY AND DORCHESTER COUNTIES, SOUTH CAROLINA



July 2001

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ILLUSTRATIONS

ILLUSTRATIONS (CONT)

INTRODUCTION

The South Carolina Department of Health and Environmental Control (Department) has been requested to designate the Trident Area, consisting of Berkeley, Charleston and Dorchester Counties, as a Capacity Use Area. The request was made by the Commissioners of Public Works for the Town of Mount Pleasant, commonly known as Mount Pleasant Waterworks (MPWW). The location of the proposed Capacity Use Area, along with the existing Waccamaw and Lowcountry Capacity Use Areas, is shown in Figure 1. In a designated Capacity Use Area, any person withdrawing groundwater in excess of three million gallons during any one month from a single well or from multiple wells under common ownership within a one-mile radius from any one existing or proposed well must obtain a permit from the Department.

Section 49-5-60 of the Groundwater Use and Reporting Act states, in part, that... "In the State where excessive groundwater withdrawal presents potential adverse effects to the natural resources or poses a threat to public health, safety, or economic welfare or where conditions pose a significant threat to the long-term integrity of a groundwater source, including salt water intrusion, the board, after notice and public hearing, in accordance with the Administrative Procedures Act, shall designate a capacity use area. The department, local government authorities, other government agencies, or groundwater withdrawers may initiate the capacity use area designation process. The notice and public hearing must be conducted such that local government authorities, groundwater withdrawers, or the general public may provide comments concerning the capacity use area designation process. A capacity use area must be designated by the board based on scientific studies and evaluation of groundwater resources and may or may not conform to political boundaries. After notice and public hearing, the department shall coordinate the affected governing bodies and groundwater withdrawers to develop a groundwater management plan to achieve goals and objectives stated in Section 49-5-20. In those areas where the affected governing bodies and withdrawers are unable to develop a plan, the department shall take action to develop the plan. The plan must be approved by the board before the department may issue groundwater withdrawal permits for the area."

Comprehensive groundwater investigations in the Trident area have documented progressive water-level declines, salt-water intrusion, and an increasing demand on groundwater resources as a result of rapid industrial and commercial growth, particularly along Highways 52 and 17-A, between Charleston and Moncks Corner. This report investigates the conditions in the Trident area that warrant designation as a Capacity Use Area.

GEOHYDROLOGIC FRAMEWORK

Rock units underlying the Trident area represent a wide range of lithologies, depositional environments, and ages. The oldest units (Cape Fear, Middendorf, Black Creek, and Peedee Formations) are Late Cretaceous in age. Depositional environments range from continental to innershelf marine and their lithologies consist mainly of sand, silt, and clay. Units overlying the Late Cretaceous formations include the Tertiary age Black Mingo, Santee Limestone, and Cooper

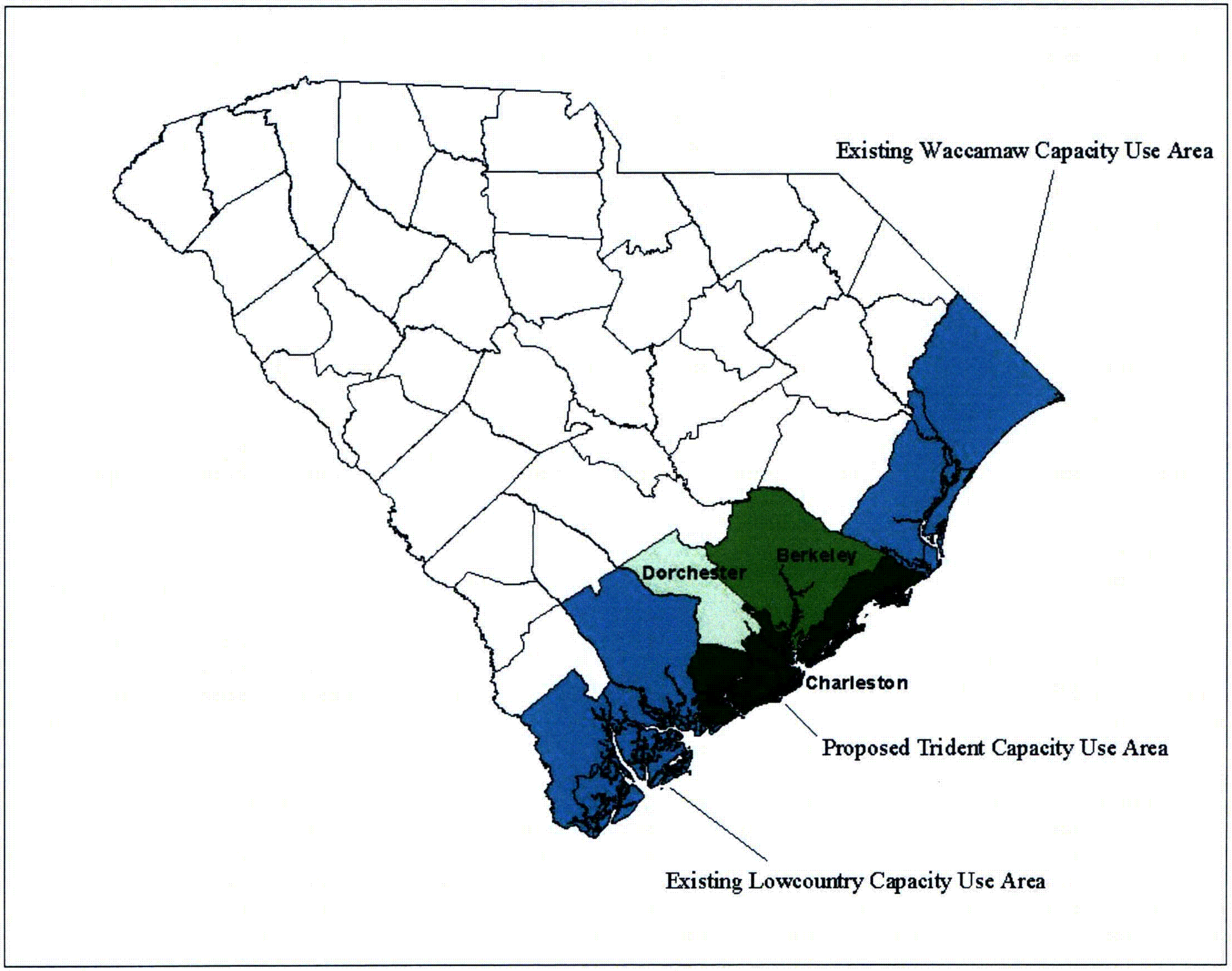


Figure 1. Location of existing Capacity Use areas and the proposed Trident Capacity Use area.

Formations. These units were deposited in marine environments and range from marginal marine to outer shelf deposits. The lithology of the lower part of this assemblage is predominately sand, silt and clay, with the upper part being mainly pure to impure limestone. The Tertiary units are overlain by a sequence of sand, silt, clay, and shells of Pleistocene age, generally no more than 50 feet thick.

These stratigraphic units are part of a wedge of overlapping sediments that thicken towards the coast; from a feather edge at the Fall Line to more than 3,000 feet in Charleston County. Their general occurrence is shown on the geohydrologic section in Figure 2.

Because of their abundance of clay, and therefore lower transmissivities, the Peedee and Cooper Formations are not productive aquifers and act more as confining units. The Black Creek aquifer is not as productive as the underlying Middendorf aquifer and contains objectional amounts of flouride. Therefore, most of the water in the proposed capacity use area is obtained from the Middendorf aquifer, the Santee/Black Mingo aquifer, and the shallow aquifer system.

HISTORICAL PROBLEMS

SHALLOW AQUIFER SYSTEM

The most widely used source of groundwater (primarily for individual residential needs) is the sands and shell beds of the shallow aquifer system. These aquifers are used everywhere in the Trident area, but are most productive in Charleston County where they obtain a thickness of 40 to 60 feet. Although the shallow system probably receives some recharge from the Santee Limestone aquifer, most is provided by local precipitation. In areas near the coast and south of Mt. Pleasant, the shallow aquifers are the only economical means of obtaining potable water for domestic users (Park, 1985). Although they are fairly productive, they are prone to salt-water intrusion. The shallow well field for the Town of Folly Beach became brackish when overpumping resulted in the intrusion of salt water from nearby surface water bodies. Similar problems have occurred on other barrier islands and elsewhere along the coast.

SANTEE/BLACK MINGO AQUIFER

During the summer of 1984, the former South Carolina Water Resources Commission (SCWRC) began receiving reports of groundwater problems occurring south of the Town of Moncks Corner. Many residents reported that water levels had declined below their pump intakes. As a direct result of these complaints, SCWRC initiated a groundwater investigation in the area, with a resultant report on the groundwater conditions in the Santee Limestone and Black Mingo aquifers near Moncks Corner (Meadows, 1987).

At the time of the investigation, the Town of Moncks Corner was utilizing a combination of the Santee Limestone and Black Mingo aquifers for its potable water supply. The Town has since (1995) gone to surface water for the majoity of its potable supply, only 2% of this being supplied by groundwater. The majority of the population in Berkeley County is still dependent on

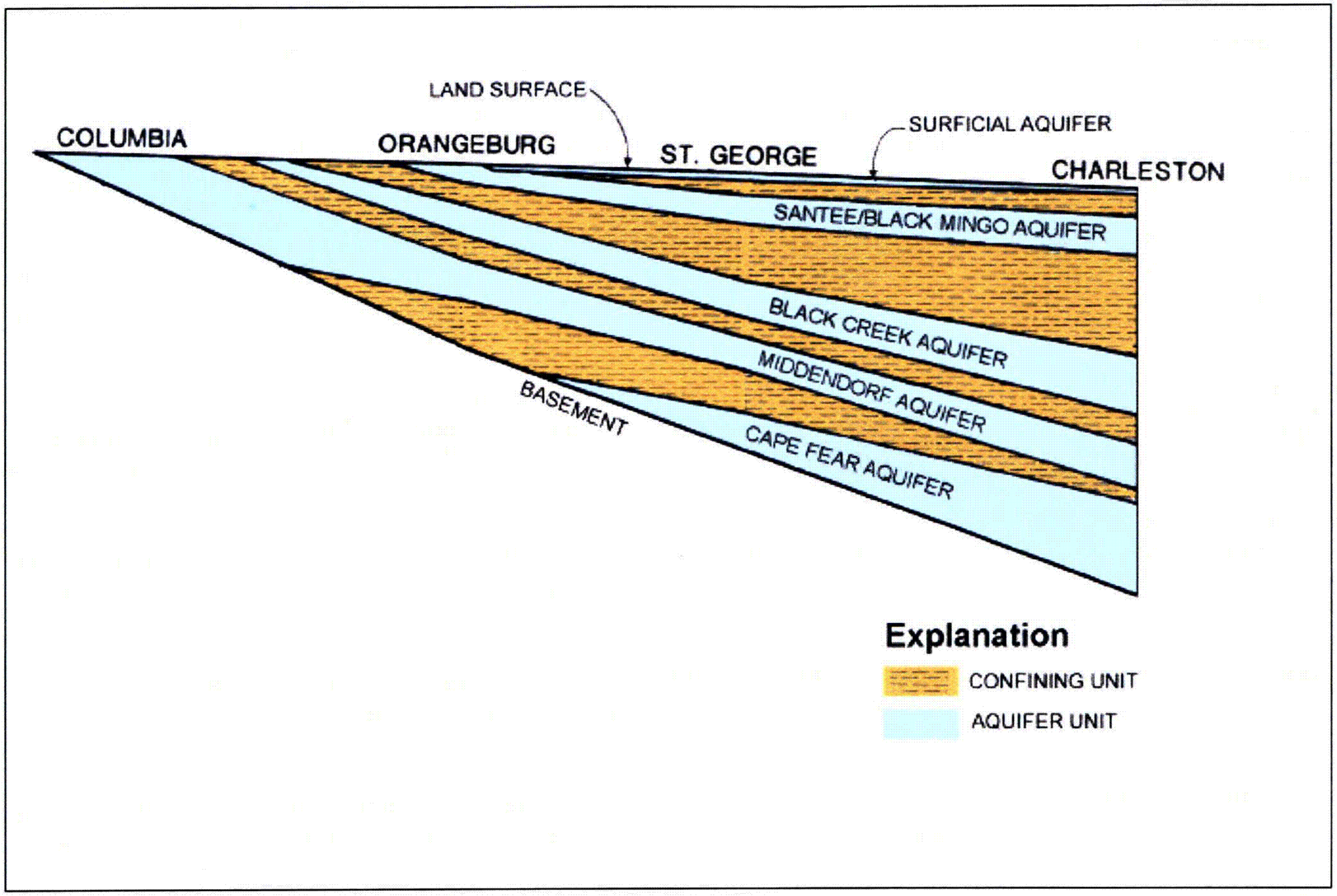


Figure 2. Generalized geohydrologic section (modified from Aucott and Speiran, 1985).

individual residential wells. Well casing is usually seated in the Cooper Formation, with the borehole open to both the Santee and Black Mingo aquifers. With an increase in population comes a natural increase in water use. According to State figures, Berkeley County's population increased by about 13 percent between 1990 and 2000 (State of SC, ORSS, 2000). According to figures from 1985 (Meadows, 1987), 90 percent of the total 7.822 million gallons per day (MGD) of groundwater used came from privately owned wells. Most of the groundwater users in this area, whether public or private, rely solely on the Santee/Black Mingo aquifer system for a potable water supply. Therefore, declining water levels would affect numerous individual domestic wells.

Well BRK-0091, located near Summerville (Figure 3), is completed in the Santee/Black Mingo aquifer. Figure 4 represents a water-level record for this well from 1978 through 1986. Although there are other outside influences depicted on the hydrograph (nearby pumping, etc.), the overall water-level trend has been one of substantial decline, more than 50 feet over an eight year period. The potentiometric map in Figure 5 shows the elevation of water levels for the Santee/Black Mingo aquifer in 1982. Note the "trough" of lower water levels running between Charleston and Moncks Corner. These lowered water levels appear to be caused by a rapid increase in regional pumping. This coincides with the "development corridor" along Highways 52 and 17-A. Meadows estimated the average rate of decline to be about 3 feet per year in this area. Well BRK-0091 was destroyed in June 1992; therefore, water-level data is no longer available for this well.

No other wells in the immediate area are presently being continuously monitored for water levels; however, SCDNR conducted a water-level survey of the Santee/Black Mingo aquifer in the Trident area in November/December 1998. Water-level data from this survey were used to construct a potentiometric map for the Floridan aquifer and Tertiary Sand aquifer (Hockensmith, 2001). (Note: The Floridan aquifer system is comprised, in part, of the Santee/Black Mingo aquifers.) The map depicts a slight rebound in water levels in northern Berkeley County from the 1982 map; however, the "trough" of lower water levels along the development corridor between Charleston and Moncks Corner still persists (Figure 6). Even though the Town of Moncks Corner discontinued use of the Santee/Black Mingo aquifer more than seven years ago, the water levels in the area remain depressed. The aquifer remains heavily relied upon for domestic, irrigation, and industrial supplies.

Jamestown, in Berkeley County, has also experienced declining water levels. In 1978, a limestone quarry, located 2 miles east of town, was withdrawing 36 MGD from the Santee Limestone during quarry dewatering operations. Prior to the quarry reducing its groundwater withdrawals, water levels frequently fell below sea level resulting in creeks drying up, nearby landowners experiencing water supply problems, and sinkholes developing, some as large as 25 feet in diameter. Sinkhole collapses occured on road rights of way, adjacent to houses and in fields near the quarry (Park, 1985). In 1998, the South Carolina Department of Natural Resources (DNR) published "South Carolina Water Plan." The plan contained recommendations regarding "Trigger Levels" for various aquifers. A Trigger Level is defined as the minimum water level allowed in an aquifer

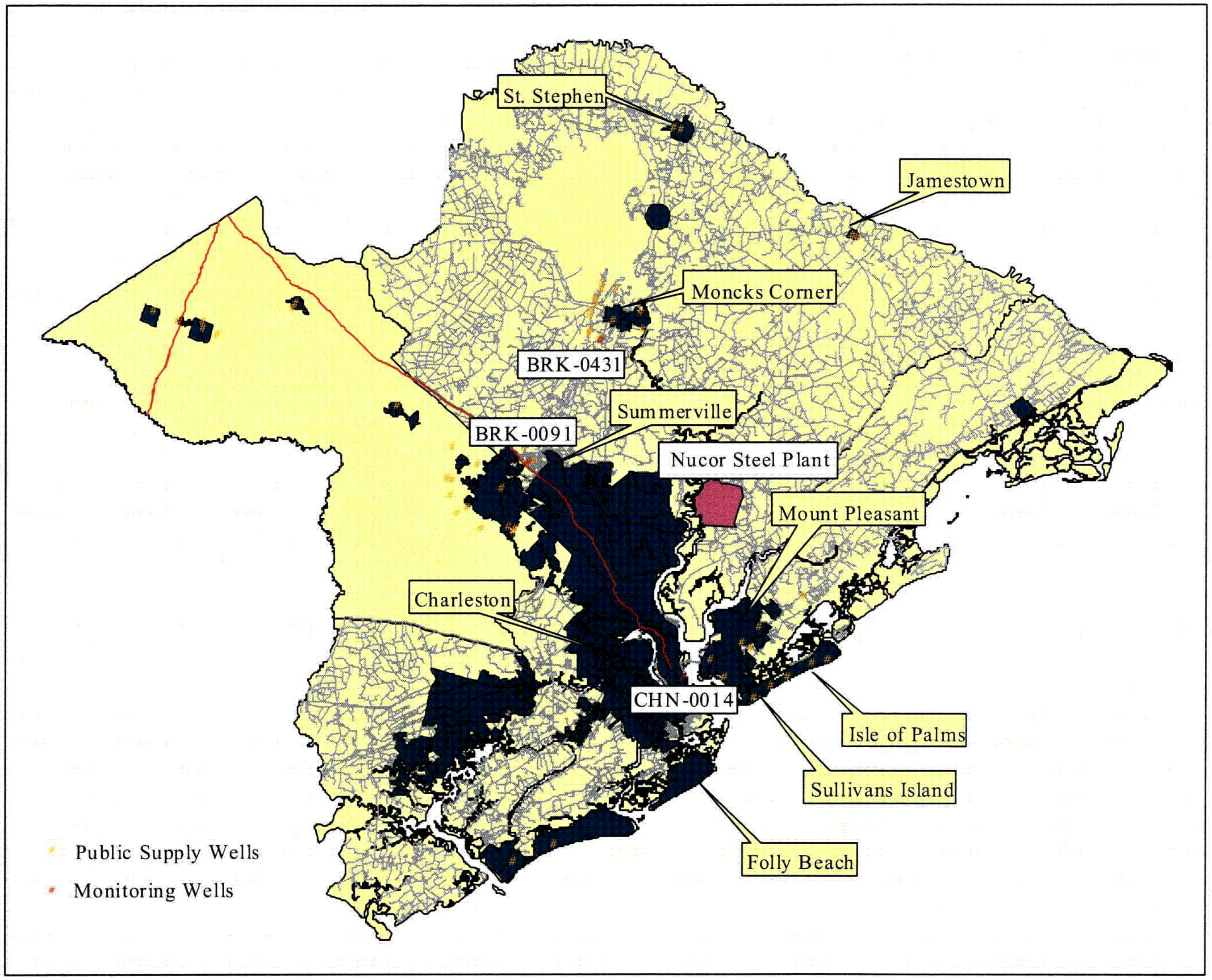


Figure 3. Location of major referenced features.

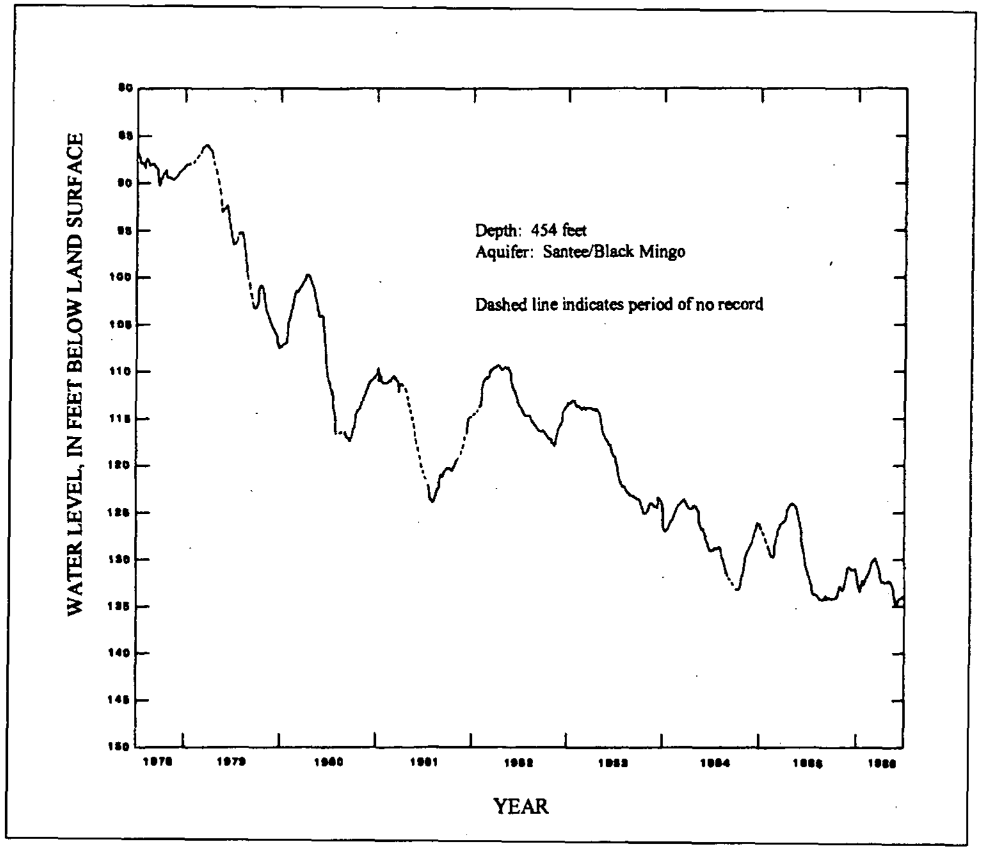


Figure 4. Hydrograph of well BRK-0091, near Summerville, 1978-1986.

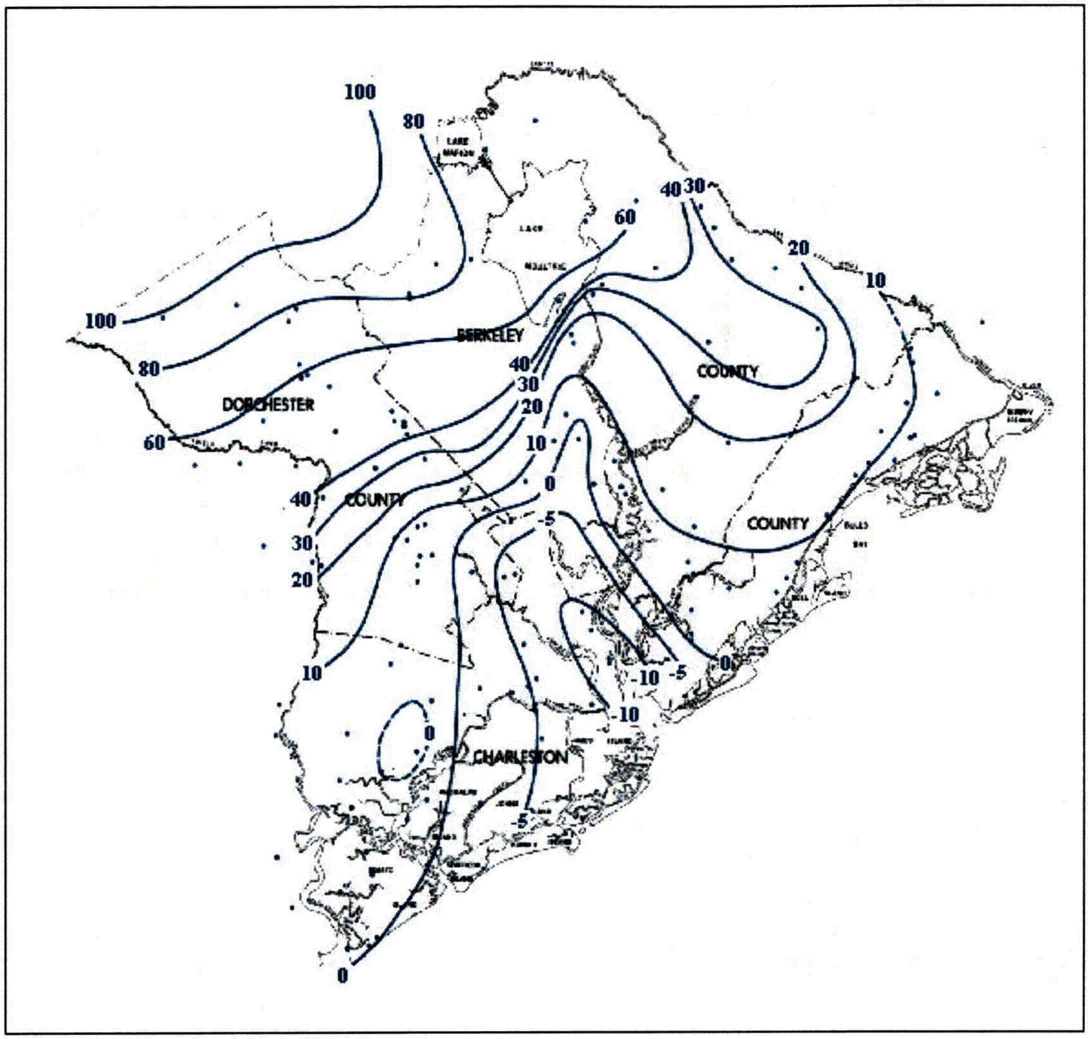


Figure 5. Potentiometric surface of the Santee/Black Mingo aquifers (after Park, 1985).

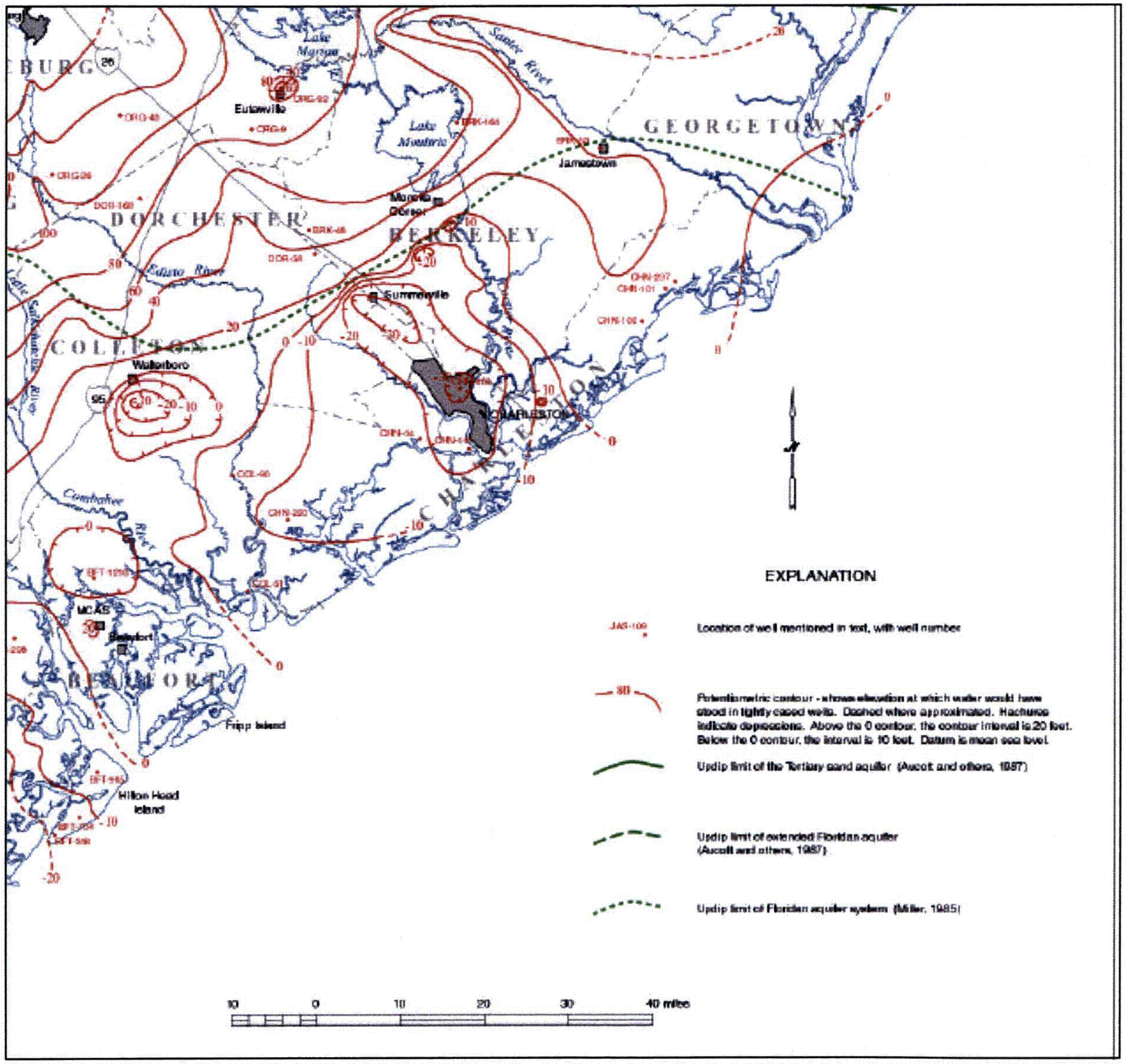


Figure 6. Potentiometric surface of the Floridan Aquifer and Tertiary Sand Aquifer in South Carolina - 1998.

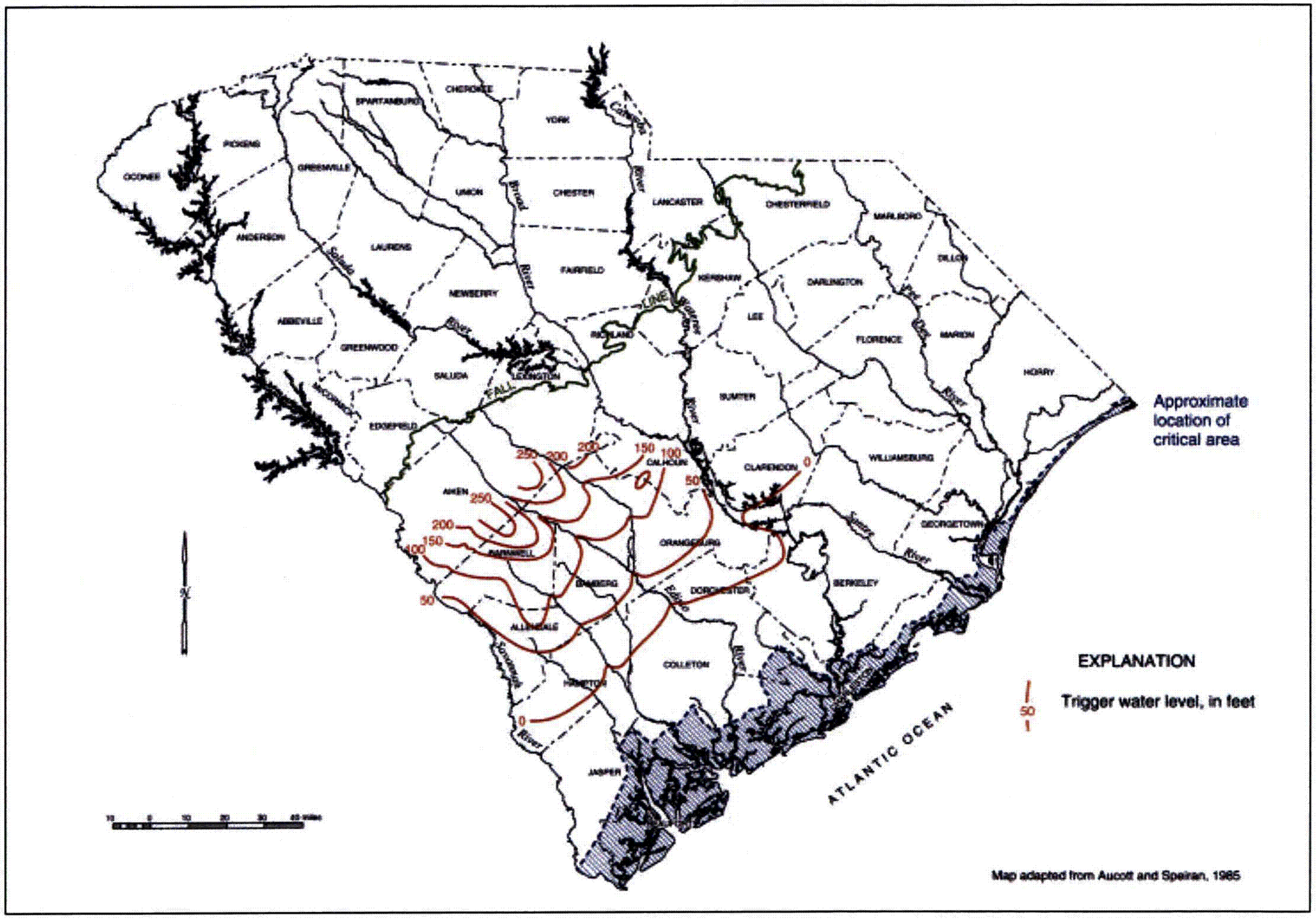


Figure 7. Trigger levels for the Floridan aquifer system.

before the processes to declare a Capacity Use Area is automatically initiated. DNR has determined that the Trigger Level is a water level decline equal to 150 feet below the predevelopment level of an aquifer, except for the Floridan aquifer system, in which the Trigger Level is a decline of 75 feet below the predevelopment level or to mean sea-level, whichever is the least decline. Figure 7 shows the Trigger Levels for the Floridan aquifer system. As shown, the Trigger Level for almost all of Berkeley, Charleston, and Dorchester Counties is when the water level declined to sea-level. The potentiometric map for 1998 (Figure 6) indicates that water levels in much of the area are already below sea level.

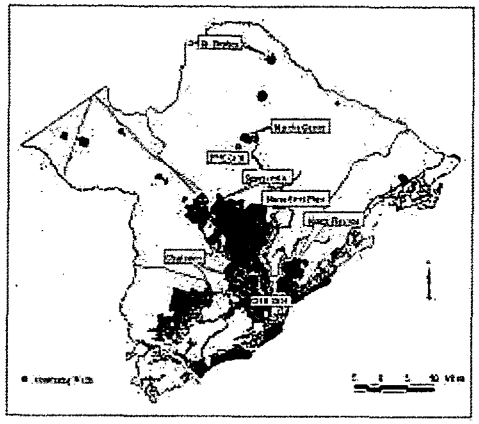
MIDDENDORF AQUIFER

Water levels in the Middendorf aquifer have declined substantially from predevelopment (1879) levels in the Trident area as a result of concentrated public supply and industrial usage. Prior to development, water levels in the Middendorf aquifer in Charleston were 126 feet ***above*** mean sea level (msl). In 1989, they were 10 feet ***below*** msl (Campbell, 1996), a total decline of 136 feet. When measured in March 2000, the water level in Charleston was about 56 feet below msl, a total decline of over 180 feet.

Mt. Pleasant, and, until recently (1994), Summerville, were the major users of water from the Middendorf aquifer in the Trident area. Summerville now receives surface water from the Santee-Cooper Regional Water Authority. In Charleston, the first Middendorf aquifer well (CHN-0014) was drilled in 1879. The well freely flowed under artesian conditions until late in 1989 when continued pumping in the area had lowered water levels to a point below land surface. When completed, the well initially flowed at 465 gallons per minute (gpm). Charleston completed four more wells in the Middendorf aquifer, but these wells produced progressively less water and eventually the city was forced to a surface water source to meet the potable demand. Other users of the Middendorf aquifer in the Trident area include Isle of Palms, St. Stephens, and Jamestown.

Mt. Pleasant has withdrawn water from the Middendorf aquifer since 1968 when the first of six wells was drilled. Average daily withdrawals have increased from 2.4 MGD in 1984 to 5.26 MGD in 1999. An increase in demand on aquifers already stressed could lower water levels even further, unless the withdrawal rates and distribution of new and existing wells are carefully planned (Campbell, 1996). Currently, the MPWW is limited to withdrawing a maximum of 6.8 MGD, the capacity of their reverse osmosis plants.

To address the concerns of users of the Middendorf aquifer (MPWW in particular), the U.S. Geological Survey (USGS), in cooperation with the S.C. Department of Natural Resources-Water Resources Division (SCDNR-WRD), initiated an investigation to compile existing water resource information and incorporate the data into a groundwater flow model (MODFLOW). Modeling can simulate water levels under various pumping scenarios. For example, a simulated scenario can distribute pumping over a large geographic area. Withdrawals from existing and new wells are distributed evenly to meet anticipated average annual demands. This scenario has been revised to include industrial withdrawals of 4.32 MGD (3,000 gallons per minute) at the Nucor steel plant located approximately 11 miles north of Mt. Pleasant in Berkeley County. Figure 8



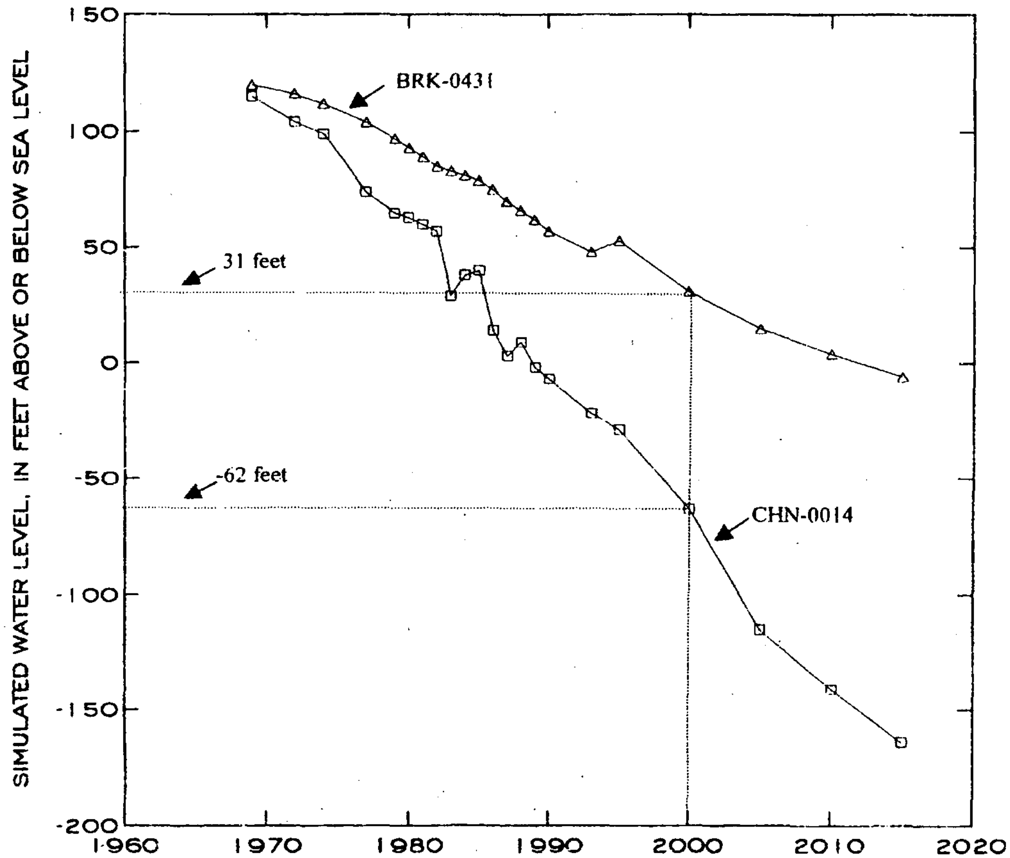


Figure 8. Simulated hydrographs for wells BRK-0431 in Moncks Corner and CHN-0014 in Charleston.

shows hydrographs of simulated water levels from 1970 through 2015 for wells CHN-0014 (located in Charleston) and BRK-0431 (located in Moncks Corner) using this scenario. In 1993, the projected water level for the year 2000 in well BRK-0431 was approximately 31 feet above msl. When measured on March 16, 2000, the actual water level was 29.29 feet above msl - a close match. The projected water level for CHN-0014 was about 62 feet below sea level; when measured in March, the actual water level was 55.85 feet below msl. This slight descrepancy may have resulted from Sullivan's Island ceasing pumping from the Middendorf in May 1996 and the Isle of Palms purchasing 30 percent of its water from surface water sources in December1996.

Concerned about the effects of the Nucor plant's withdrawals, MPWW contracted Synesis Environmental, Inc. (SEI) to investigate groundwater usage from the Middendorf aquifer in the Trident area. SEI used the EZFlow model to simulate the impacts of future groundwater withdrawals on the potentiometric surface of the Middendorf aquifer and for optimization of Mt. Pleasant's withdrawals. Two types of simulation were performed to estimate the impact of Nucor's withdrawal. Historical and future groundwater use were used to simulate hydrographs for wells CHN-0014 and BRK-0431. In addition, simulations were made with Nucor withdrawing 0 MGD and 4 MGD, all other parameters remaining the same. This gives an estimate of the decline in water levels that would be caused solely from Nucor's pumping. Figures 9 and 10 show simulated hydrographs for wells CHN-0014 and BRK-0431, respectively, with Nucor pumping 0 MGD and 4 MGD. The effect of Nucor's simulated withdrawals is quite significant, a 22-foot decline at well CHN-0014 and 24 foot decline at well BRK-0431.

Another indication of the effect of large withdrawals is to look at actual water-level trends. Water levels in Moncks Corner (BRK-0431) were 63 feet above msl in 1983. They declined to their lowest recorded level (29.52 feet above msl) in 1995. When Summerville converted from groundwater to surface water, groundwater levels recovered to 39 feet above msl by November of 1996. Water levels have since declined again to 29.29 feet above msl.

The potentiometric surface for the Middendorf aquifer in 1989 is shown in Figure 11. Note the "0" foot water-level contours in the center of the depression near Mt. Pleasant and Summerville. Figure 12 shows the potentiometric surface for the Middendorf aquifer in 1996. Note the location of the "0" foot contour and that the center of the depression at Mt. Pleasant is now "-125" feet msl. The cone of depression centered around Summerville in 1989 is absent in 1996. Water levels at Mt. Pleasant have declined almost 260 feet since predevelopment. Water-level contours in Figure 12 do not reflect any withdrawals by Nucor Steel, which began pumping in 1997.

The Trigger Levels for the Middendorf aquifer, as defined by DNR, are shown in Figure 13. The potentiometric map in Figure 12 indicates that water levels in the Charleston area are more than 100 feet below the Trigger Level for the Middendorf aquifer.

The conversion to surface water has undoubtedly slowed the rate of groundwater declines; however, groundwater levels are expected to continue declining due to rapid growth in the area. Although most of the large municipalities in the Trident area have converted to surface water for

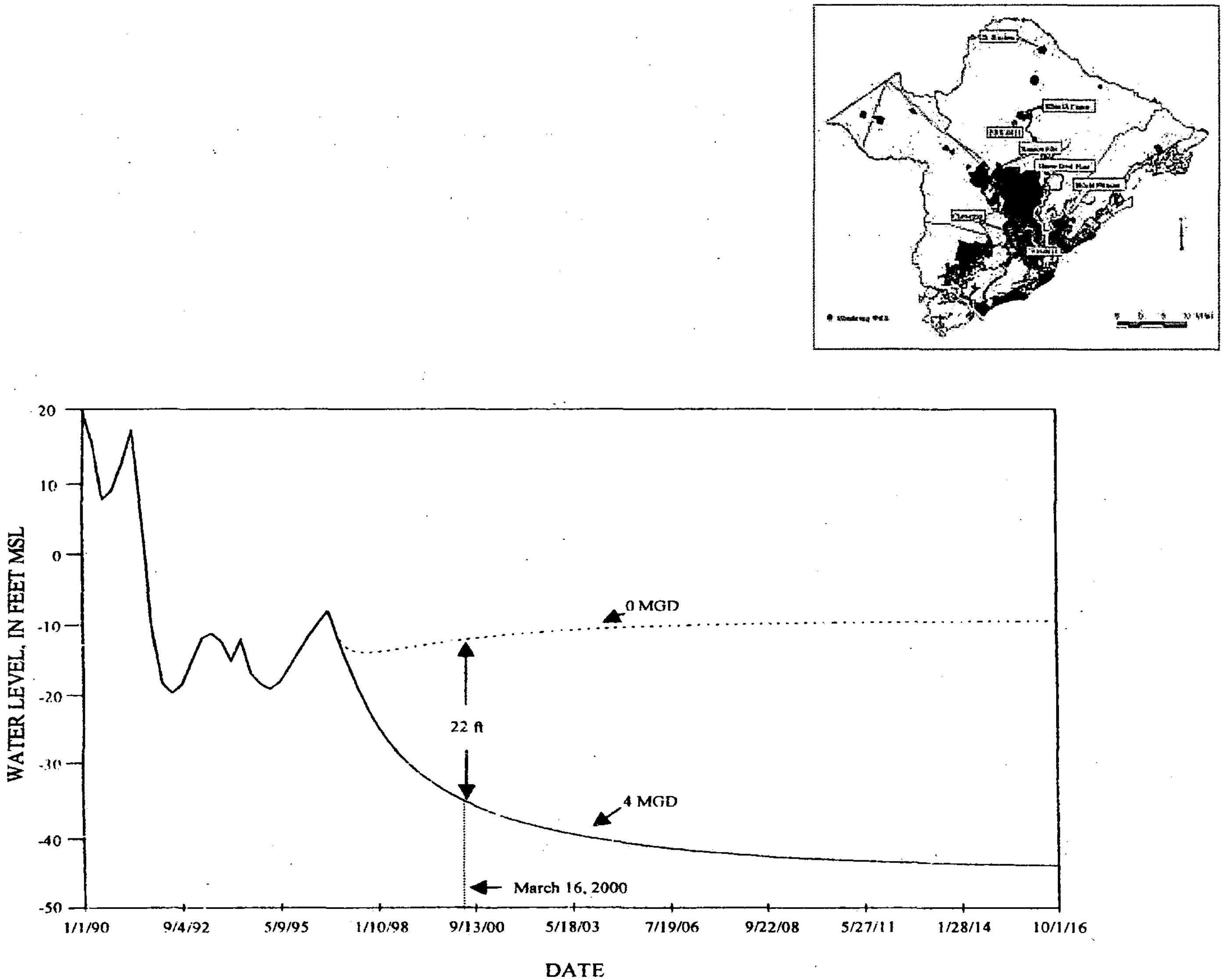


Figure 9. Predicted water-level response at Charleston (CHN-0014) with Nucor pumping.

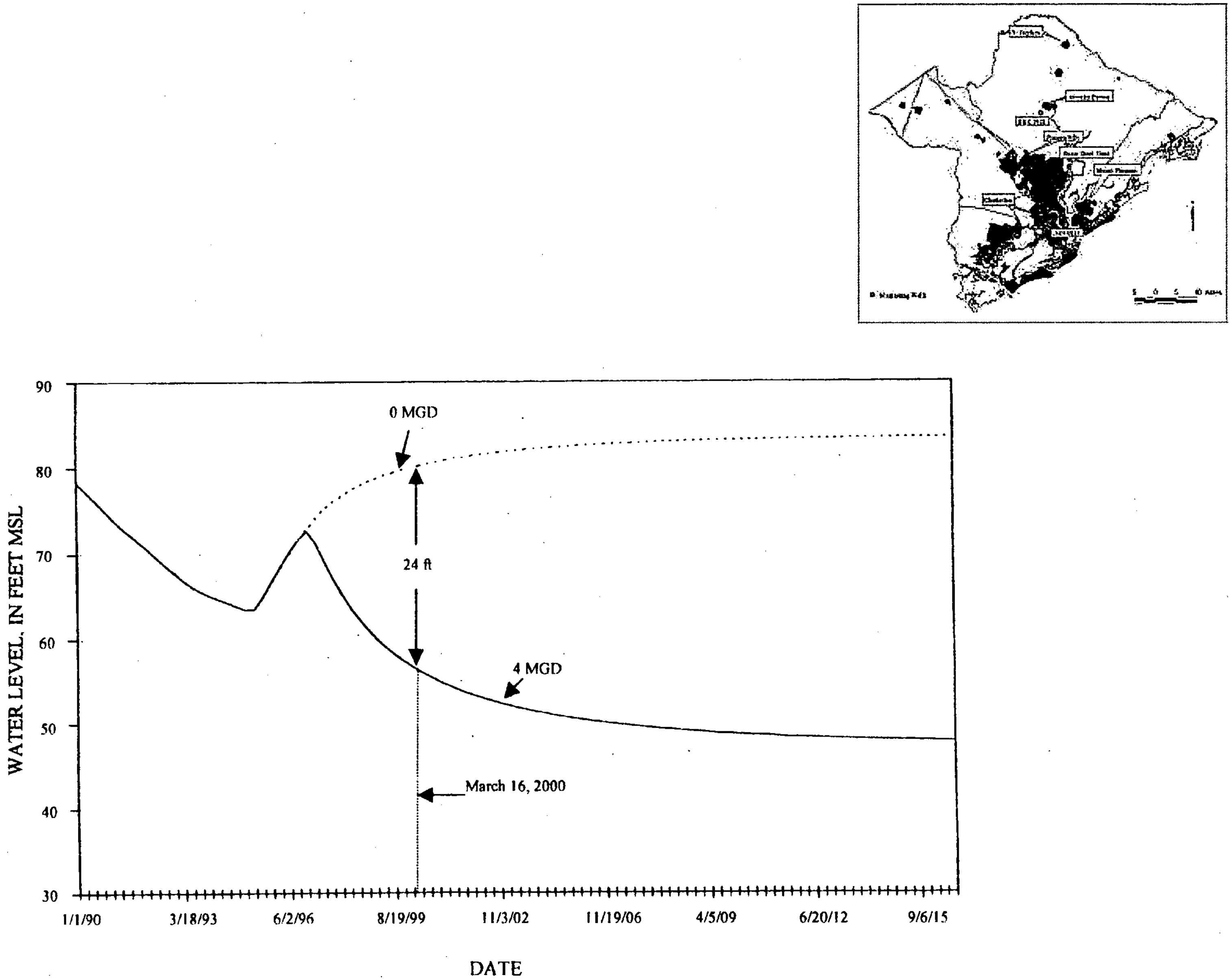


Figure 10. Predicted water-level response at Moncks Corner (BRK-0431) with Nucor pumping.

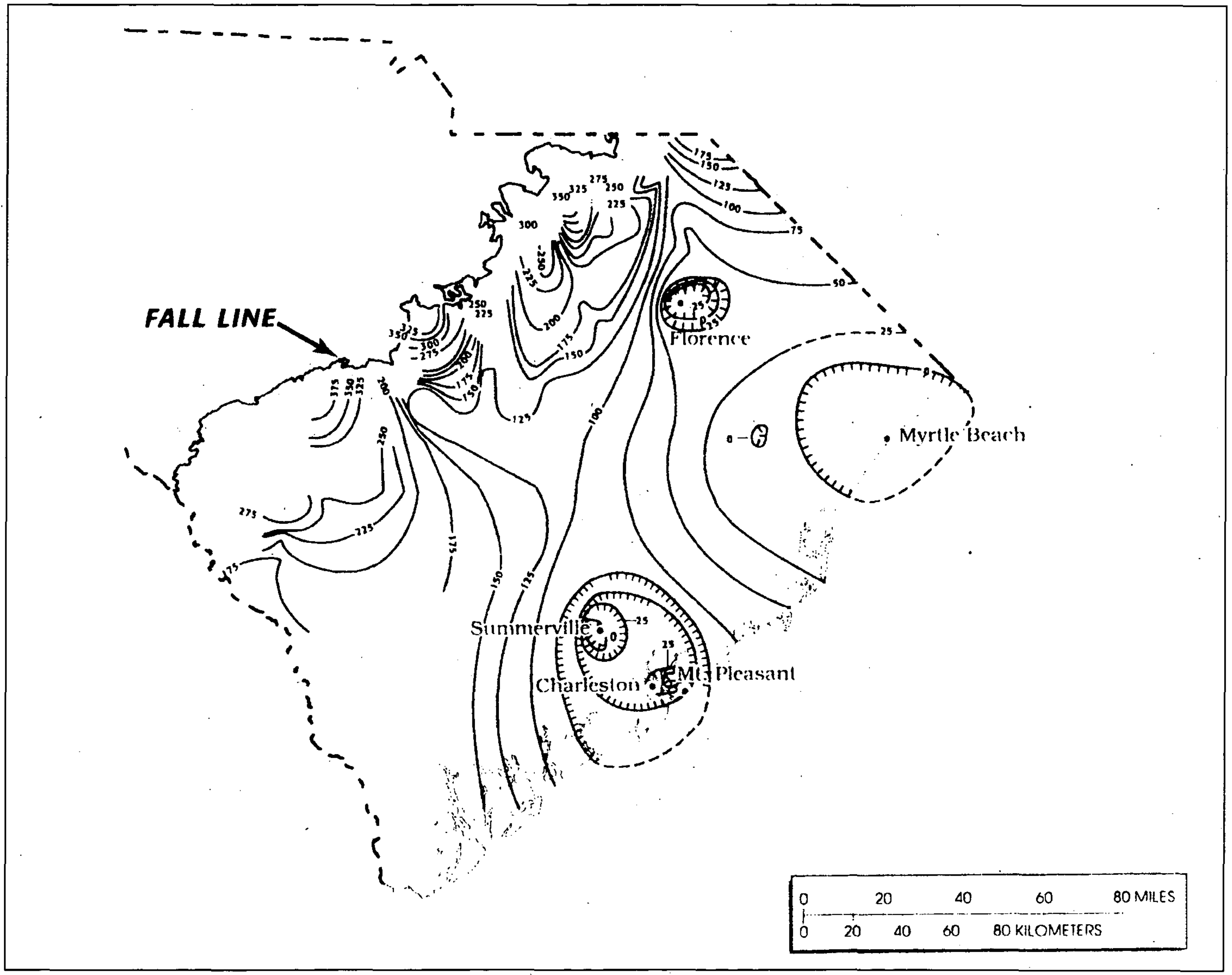


Figure 11. Potentiometric surface of the Middendorf aquifer, 1989 (after Campbell, 1996).

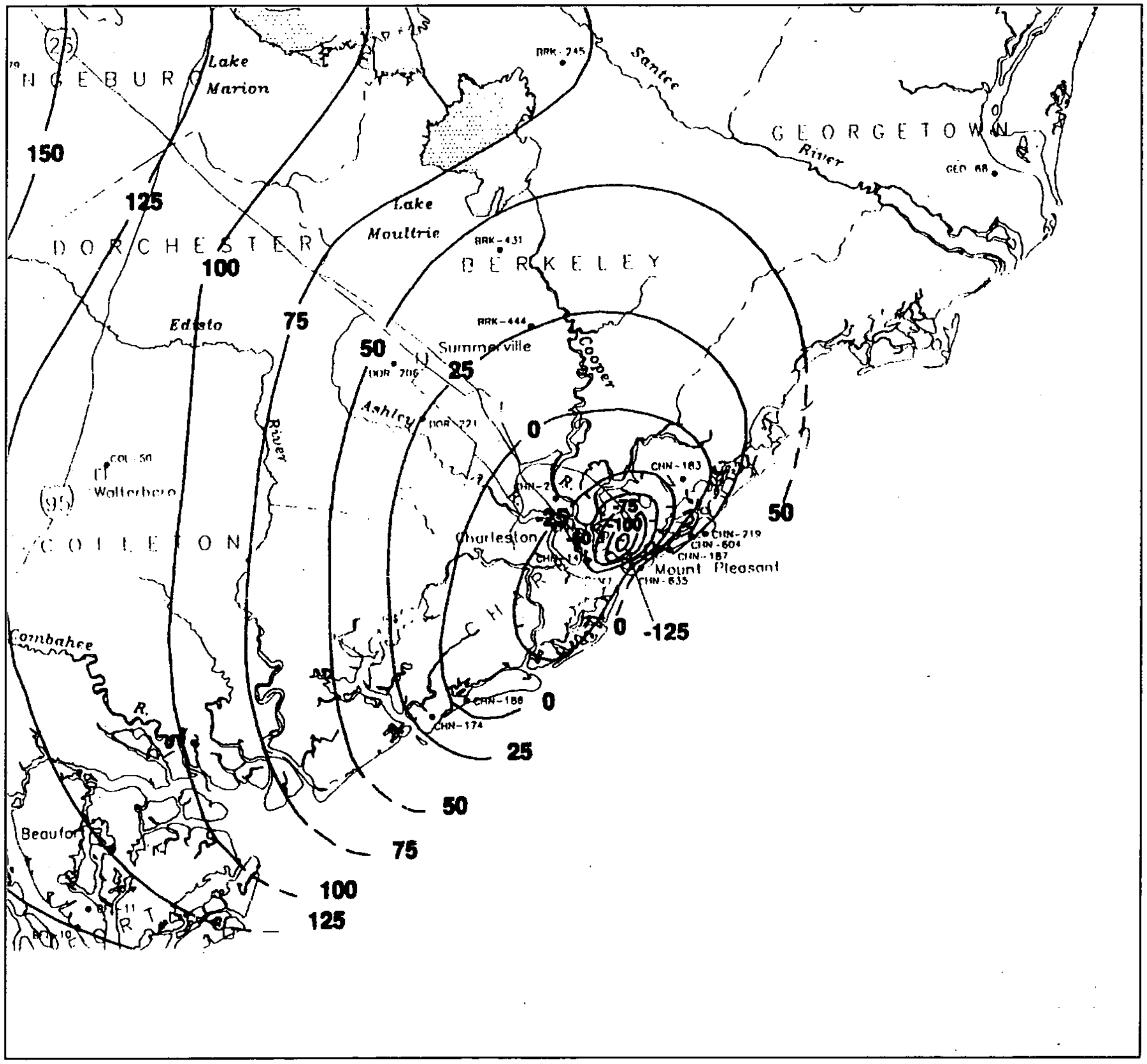


Figure 12. Potentiometric surface of the Middendorf aquifer, November 1996 (Hockensmith and Waters, 1998).

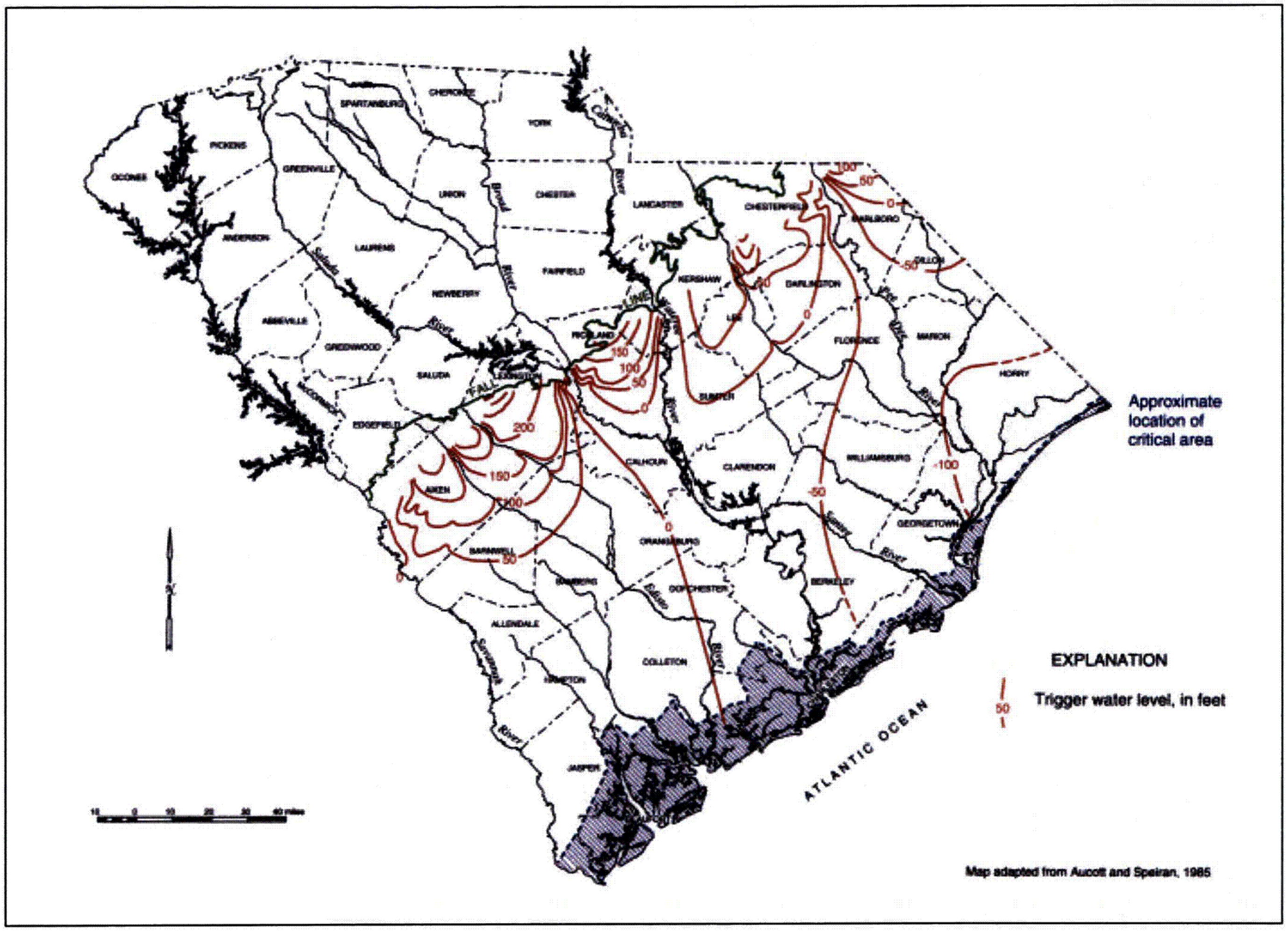


Figure 13. Trigger Levels for the Middendorf aquifer.

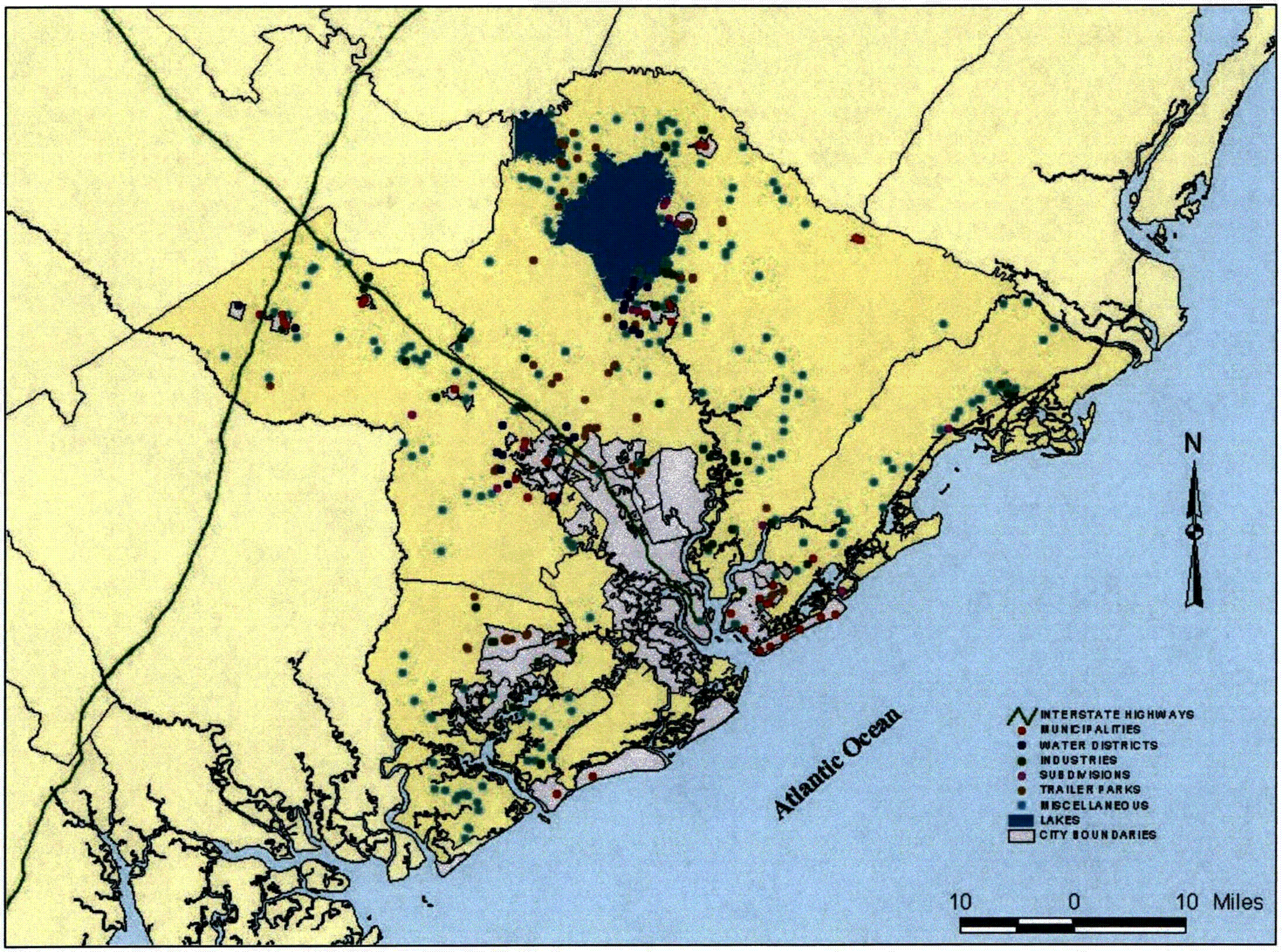
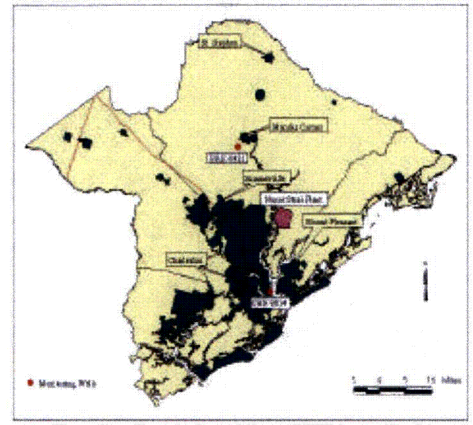


Figure 14. Location of public supply wells in the Trident area.



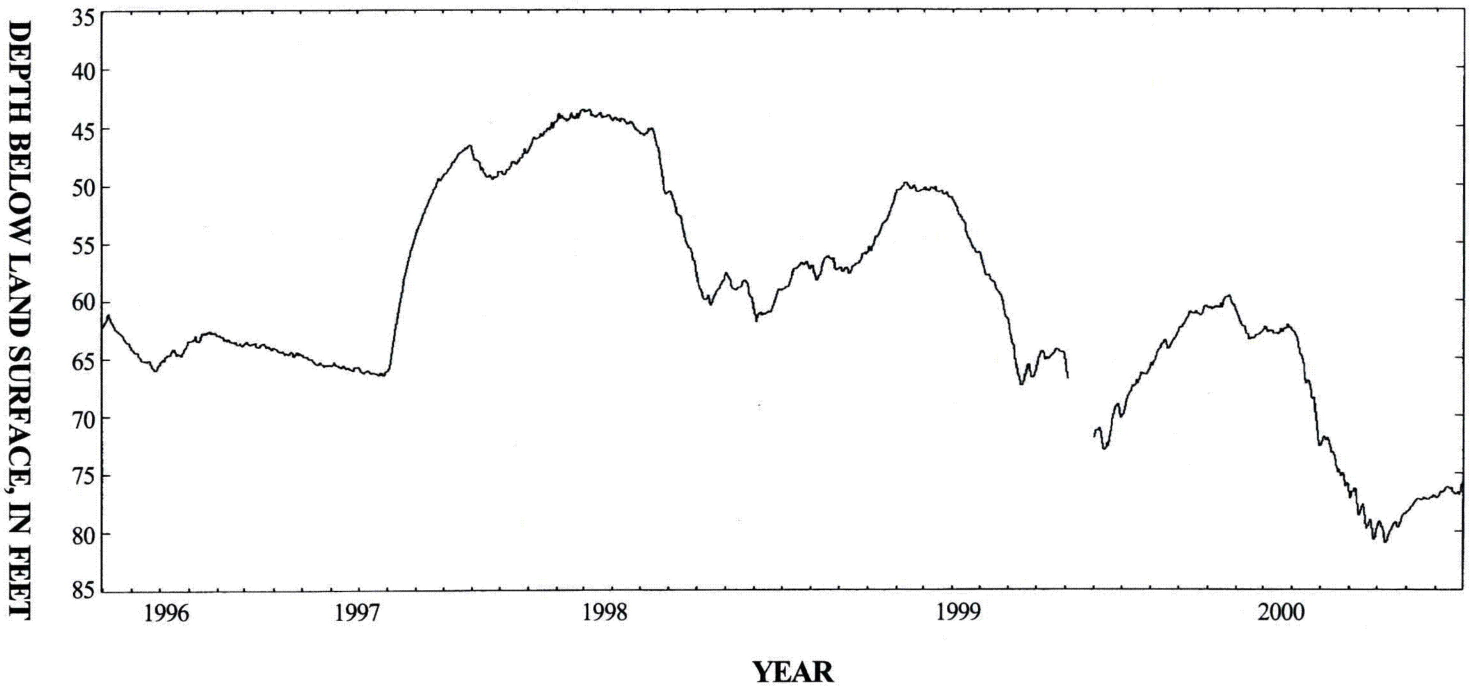


Figure 15. Hydrograph of well CHN-0014, in Charleston.

their potable needs, there are numerous small municipalities, subdivisions, golf courses, and industries (524 total) that still rely solely on groundwater. The location of public supply wells in the Trident area, and their respective uses, is shown in Figure 14. Note the number and dispersion of industrial users. As previously noted, most of the municipalities in the tri-county area have made the conversion to surface water; however, groundwater levels continue to decline. Well CHN-0014 is located in downtown Charleston at the end of the Charleston Peninsula. Although the hydrograph for CHN-0014 depicts some cyclic fluctuations (Figure 15), the overall trend is a declining water level from approximately 62 feet below land surface in October 1996 to almost 77 feet below land surface in September 2000. This downward trend is vividly illustrated in Figure 16. The hydrograph for well BRK-0431 indicates a continuous water level decline from near land surface in early 1990 to about 29 feet below land surface late in 1994. From 1994 until mid-1996, water levels recovered approximately 4 feet (this coincides with Summerville's conversion to surface water). Water levels have since declined to about 40 feet below land surface as of October 2000.

CONCLUSIONS AND RECOMMENDATIONS

Groundwater levels in the Middendorf aquifer have declined substantially from predevelopment (1879) levels in the Trident area as a result of concentrated public supply and industrial usage. Prior to development, water levels in the Middendorf aquifer in Charleston were 126 feet above mean sea level (msl). In 2000, the water level in Charleston was approximately 56 feet below msl, a total decline of **over 180 feet**. Even with the increased use of surface water in the early 1990's, groundwater levels continue to decline. Demands for groundwater are certain to increase in the future. The population of the Trident area increased 40% from 1973 to 1994, and is expected to reach 795,879 by 2030.

Because Berkeley, Charleston, and Dorchester Counties all share the same groundwater resources, and because all of the groundwater regimes in the area are impacted, it is appropriate to include all three counties in the designation. This is consistent with the Lowcountry Capacity Use area, comprised of Beaufort, Jasper, and Colleton Counties and the Waccamaw Capacity Use area, including Georgetown, Horry and part of Marion Counties. If designated, the Trident Capacity Use area, in conjunction with the Lowcountry and Waccamaw areas, will afford a mechanism by which the aquifers underlying all of the coastal counties in South Carolina may be offered some degree of protection. This designation will also provide for measures to abate or control salt-water intrusion and measures to prevent, or at least mitigate, unreasonable adverse effects on water users within the Trident Capacity Use area.

Based on the available technical information, Department staff concludes that the Trident area has developed and utilized groundwater to the degree that coordination and regulation of groundwater supplies has become desirable and necessary. To comply with the Legislative policy provided in Section 49-5-20 and the conditions outlined in Section 49-5-60 of the Groundwater Use and Reporting Act, the staff recommends approving the Mount Pleasant Water Works' request for designation of the Trident area as a capacity use area.

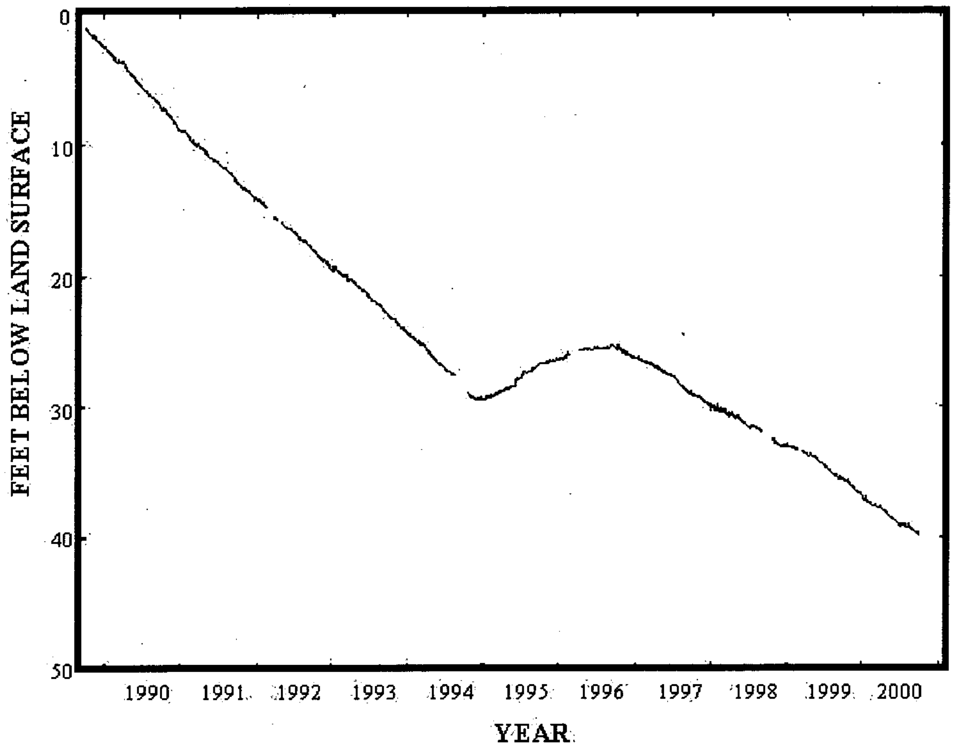


Figure 16. Hydrograph for well BDK-431.

Recommendations for additional data to be gathered concurrently with the designation process are as follows:

1) The thickness and permeability of the shallow aquifer system vary widely throughout the Trident area. The amount of water that can be withdrawn from individual wells will also vary immensely. Pumping tests should be conducted on the shallow aquifers to calculate transmissivities (although they will vary greatly with locale) to determine the maximum "safe yield" to prevent salt-water intrusion. Water quality monitoring should also be conducted. Wells along the barrier islands (Folly Beach, Edisto Beach, etc.) have experienced problems with increased salinity.

2) Brackish water is known to exist in the Black Mingo aquifer near the coast. Therefore, salt-water contamination by inter-aquifer transfer is a problem between the Santee Limestone and the Black Mingo because of their open-hole construction. Monitoring wells should be installed at discrete intervals and strategic locations to determine the magnitude and extent of contamination. Declining water levels are also aggravating the situation. In some instances, water levels have been lowered to the point that homeowners have had to set their pump intakes lower or even have their well deepened. In others, the uncontrolled withdrawal of groundwater has resulted in sinkhole development and land surface collapse. In cooperation with DNR and others, a water-level monitoring network should be established (mostly from existing wells) to determine the growth and effect of increasing groundwater withdrawals.

3) Groundwater withdrawals from the Middendorf aquifer near Charleston have caused the development of a regional cone of depression in the potentiometric surface. With water levels below sea level (-132 feet in Mt. Pleasant) in the Middendorf aquifer, salt water is undoubtedly encroaching upon the Charleston and Mt. Pleasant area at a much higher rate. Annual, or semi-annual, water quality and water level monitoring should be conducted to determine the direction and rate of movement of the salt-water wedge. The Middendorf wells on the Isle of Palms and Sullivan's Island should be sampled regularly for chloride concentrations. Another Middendorf water-level survey should be conducted and a more detailed potentiometric map produced to determine the actual effects of Nucor's withdrawals.

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