8.3 IMPACT ASSESSMENT

To estimate the effect of entrainment on the SIO a conservative approach was undertaken, which results in an overestimate of potential entrainment effects by substituting conservative assumptions where information is limiting. For example, organisms identifed only to family were added to organisms identified for selected species to obtain total entrainment estimates. In addition, the station, either C, D, or E, which provided the highest entrainment estimate was utilized in the entrainment calculations. In general, these were intake stations for early life stages and the discharge station for later life stages.

Densities calculated from the field collections during a species period of occurrence were multiplied by the flow of the power station to estimate the number or organisms entrained. The calculation assumes units are operating at 100 percent flow capacity, which represents the maximum situation. Tables 8.2-13 to 8.2-15 present total entrainment estimates utilizing Stations C, D, and E, respectively, for organisms identified to species. Tables 8.2-16 to 8.2-18 present information for organisms identified to family. Table 8.3-1 presents the maximum value for Tables 8.2-13 to 8.2-15 by species and life stage, which forms the basis of the entrainment assessment. Table 8.3-2 presents similar information for unidentified SIO.

Once the number of organisms entrained is estimated, the number of adults that could have potentially developed from these entrained individuals is calculated under the conservative assumptions of the equivalent adult model. This model, first formulated by Horst (1975 and 1978), has been widely reviewed and used in the assessment of entrainment effects (Dahlberg 1978; Saunders 1978; Taylor 1978). Goodyear (1978) has produced a U.S. Fish and Wildlife Service guide on the use of the equivalent adult model for assessing the effects of entrainment.

The actual formulation of the model is very simple: in equilibrum, the fecundity of a breeding pair will be reduced in one generation to two breeding adults: i.e.,

$$2 = S_e \times F \qquad (8.3\text{-}1)$$

where

S_e is the survival from egg to adult,

F is the fecundity of a female during her life.

or

$$S_e = 2/F \qquad (8.3\text{-}2)$$

The survivorship from egg to adult is equal to the product of the suvivorship from egg to larvae (E) and the survivorship from larvae to adult (S_l):

$$S_e = E \times S_l \qquad (8.3\text{-}3)$$

Therefore, if the entrained life stage is larvae, then F in Equation 8.3-2 must be multiplied by the survival from egg to larvae to give the survivorship from larvae to adult.

$$S_l = 2/E \times F \qquad (8.3\text{-}4)$$

The number of entrained larvae (N_l) is multiplied by S_l, and the number of entrained eggs (N_e) is multiplied by S_e. The products are added together to give the number of adults (N_a) that would have resulted, assuming no density dependence.

$$N_a = S_l \times N_l + S_e \times N_e \qquad (8.3\text{-}5)$$

The model formulation relies on the following assumptions:

1. The population is in equilibrium, such that the number of fish in the population at any time and the proportion of fish at any age are constant, with stable age distribution. If the historical information on the fish population shows an increasing or decreasing trend in population size, the numerator of Equation 8.3-2 can be appropriately modified.

2. The lifetime of a fish in the population is the most probable age to which a fish will live or the mean generation time of the population.

3. The reference to a breeding pair applies to a situation where the number of males equals the number of females. If a skewed sex ratio exists in the population, Equation 8.3-2 can be altered accordingly.

4. The exploitation of eggs and larvae occurs at the times eggs are laid and larvae hatch.

5. The number of equivalent adults represents the annual loss in an equilibrium density-independent population with a stable age distribution. This loss is distributed in proportion to the stable age distribution.

Therefore, the minimal information required for the equivalent adult model is age of sexual maturity, longevity, and average fecundity. Fecundity is a relatively easy parameter to estimate and is generally available for most species.

Another perspective on entrainment can be seen in Section 10.6. The hydrodynamic model was utilized to investigate the effect of entrainment on the abundance patterns in the area of the plant. Several initial density gradients were utilized to correspond to the results of field sampling for the SIO (Section 8.2). Since the entrainment occurs at the intake and any organisms which suffer mortality will be absent at the discharge, abundance differences associated with entrainment occur at the discharge. Water with zero-density plankton was input to the model at the POD and mixed with water containing plankton at the previously established concentrations (dependent on initial density gradients). The results of the analysis described in Section 10.6 clearly show that the major source of organisms is offshore.

This conclusion is reached since entrainment effects are localized and do not extend throughout the area modeled. This result can only occur if the plankton concentrations within the modeled area are high enough to counteract the input of zero-density water at the POD. The use of three separate cases provides an indication of the differential effect of entrainment mortality on plankton concentrations to the northwest, to the southwest, or evenly distributed across the study area. The results indicate that populations concentrated offshore are less affected by entrainment, and populations concentrated offshore, in the northwest section of the study area, are affected least of all. For all three cases, this analysis clearly shows that even under conservative assumptions, entrainment has localized effects.

8.3.1 Assessment of SIO Entrainment

The following sections present available information on population parameters for each SIO. These data were utilized as input to the equivalent adult model and to evaluate the effects of plant operation on the species population in the Crystal Bay area. To assist in evaluating the assumption of 100 percent through-plant mortality and the existing distributions near the discharge area, available information on thermal tolerances of SIO has been summarized and provided in Appendix VI.

8.3.1.1 Anchoa mitchilli (Bay anchovy)

Spawning occurs in the Delaware River estuary from about May to September (Stevenson 1958). In the Tampa Bay area, Springer and Woodburn (1960) took almost ripe individuals in July, September, and December. Gunter (1945), working in Texas, took nearly ripe individuals from March until August when sampling was terminated. This indicates a very long breeding season. Spawning is reported to be protracted year-round in warmer waters (Hoese and Moore 1977). Houde (1974) collected anchovy eggs from Florida waters at all seasons of the year.

Anchovies migrate to shallow waters during the spring and summer (Stevenson, 1958). During spawning, the sex ratio is 1:1, but at other times there is a statistically significant larger number of females than males (Stevenson, 1958). Eggs are pelagic when spawned. Hildebrand and Cable (1930) reported that the eggs hatch at the surface and some young appear to descend to the bottom at a very early age. Kuntz (1914) reported that 12 to 16 hours after spawning, the eggs begin to sink. Stevenson (1958) gave numbers of eggs per 1/25th of the right ovary for 15 specimens; he estimated that 7 percent of the eggs in the ovary are spawned. Calculating from these numbers, the number of eggs spawned per right ovary ranges from 731 at a standard length of 51 mm to 1080 at a standard length of 75 mm. Numbers of eggs per individual are at least double this since the right ovary is generally smaller than the left. A regression of fecundity on standard length is also given (Stevenson 1958). In the present study, nine gravid first year females were found to have 1173 to 4387 eggs per female (aver. 2240).

Length-frequency tables from Springer and Woodburn's (1960) studies in Tampa Bay indicated that there were usually two and some times three year classes; this is in agreement with Gunter's (1945) findings. Stevenson (1958) concluded that individuals that were spawned early in the season could themselves spawn the next year at age one, while others first spawned at age two. Hildebrand and Cable (1930) reported spawning individuals of 2 1/2 to 3 months of age; however, Stevenson (1958) inferred that these fish were actually spawned very late the previous season. Sexual maturity is attained at a length of 35 to 40 mm in Delaware Bay (Stevenson, 1958); 40 to 50 mm in Chesapeake Bay (Hildebrand and Cable, 1930); 45 to 60 mm off North Carolina (Hildebrand, 1963, cited in FPC 1977); and 56.3 mm (males) and 60.0 mm (females) off Texas (Gunter, 1945).

The equivalent adult calculation assumes a one year life cycle with average fecundity of 2240. The eggs have a short duration; one day was assumed for the calculation. Based on Houde (1977), the eggs were estimated to have a 92 percent hatching success and 40 percent survival from prolarvae to postlarvae.

Equivalent adult estimates were derived from conservative assumptions which underlie Table 8.3-1. All life stages (eggs, prolarvae, postlarvae, and juveniles) were represented in the entrainment estimate. Bay anchovy was the most abundant organism entrained. The equivalent adults associated with the eggs, prolarvae and postlarvae are 10.4, 0.75, and 6.7 million, respectively. The loss of juveniles, assuming they are at the midpoint between postlarvae and adult, would result in 3.8 million equivalent adults.

Table 8.3-2 provides calculated entrainment numbers for those organisms not identified to species. For the bay anchovy, those organisms identified as Anchoa sp. were considered as bay anchovy. The prolarvae and postlarvae of Anchoa sp. are entrained in numbers comparable to those for the same life stages of A. mitchilli. Therefore, the addition of these unidentified organisms would not change any conclusions for bay anchovy.

8.3.1.2 Polka-dot Batfish

There is little life history information on this species, therefore, no equivalent adult calculation has been made. The effect of entrainment is very minor. Juveniles were the only life stage collected and the occurrence was short in duration and comprised of a few individuals. Station E was the only entrainment station at which any life stage was caught (Tables 8.2-13 and 8.2-15). The juvenile polka-dot batfish total entrainment was 190,000 (Table 8.3-1).

8.3.1.3 Orthopristis chrysoptera (Pigfish)

In the area of the Crystal River Generating Station, pigfish were present only 6 months of the year, being scarce during the cooler months (Grimes & Mountain 1971). In the Cedar Key area, pigfish were caught all year except January and were most abundant during the warm months (Reid 1954). In St. Andrew Bay, Florida, however, pigfish were least abundant in summer (Pristas et al 1978). Pigfish are winter-spring spawners (Hoese and Moore 1977) and spawning at Crystal River probably begins in March (Grimes and Mountain, 1971). Hildebrand and Schroeder (1928) reported spawning in June in Cheasapeake Bay. However, Joseph and Yerger (1956) felt that in Alligator Harbor, Florida, pigfish spawn several months earlier than this, and by June the young are approximately 40 mm in length. A statistically significant larger number of females than males was observed in fall in St. Andrew Bay (31.6% male), but not in winter or spring (summer not tested) (Pristas et al 1978). Three gravid females taken at Crystal River had 17302 to 2[illegible]60 eggs per female (average 21660).

Since only pigfish postlarvae were identified, there is no effect projected to the earlier life stages. Table 8.3-1 shows that the largest number of larvae (760,000) was at Station C. Assuming that the average life expectancy is 2 years, the survival from egg to adult would be 9.23×10^{-5}. There is no available information on the survival of egg and prolarval pigfish. If it is assumed that about 10 percent of each life stage survives, then the entrained postlarvae would represent about 71,000 equivalent adults.

These projections can be compared with the 1982 commercial landings of 2158 lb for the west coast of Florida, using an average weight of pigfish of 0.032 lb derived from the trawl collections at Crystal River. The number of adults lost through entrainment is roughly equivalent to the incidental commercial catch.

Consideration of all unidentified Haemulidae eggs (Table 8.3-2) as pigfish would add eggs as an entrainable life stage for the species. This would result in 40,000 equivalent adults. While adding the unidentified individuals increases the estimate of equivalent adults, it does not change the conclusion that entrainment effects are acceptable.

8.3.1.4 *Lagodon rhomboides* (Pinfish)

Pinfish apparently move offshore to spawn (Cameron, 1969) in November and December in the Crystal River area (Grimes and Mountain, 1971). Spawning begins early in December and lasts through March (Grimes and Mountain 1971). Fall spawning was reported by Reid (1954) for the Cedar Key region. Larvae migrate inshore to estuarine nursery areas between spring and fall (Kjelsen and Johnson 1976; Cameron 1969). Small larvae (less than 11 mm) are rarely found within estuaries, but postlarval stages (11-22 mm) do occur in nearshore and estuarine waters. Joseph and Yerger (1956) reported pinfish of 17 mm were first collected in Alligator Harbor in the latter part of May and were still common as late as July. Age 0 fish move away from the shallows to deeper water as cooler temperatures approach (Grimes and Mountain 1971).

Pinfish were most abundant in St. Andrew Bay in spring and fall; no statistically significant difference in numbers of males vs females were detected in spring, summer, or fall (winter not tested) (Pristas et al 1978). Cameron (1969) made reference to two age classes and presented growth curves from a number of studies. Spawning has apparently not been observed in nature, nor have ova or recently hatched larvae been described (Schimmel, 1977).

Caldwell (1957) reported the fecundity of pinfish as 90,000 and stated that spawning occurs at age 3. There is no information on the survival of eggs and larvae of pinfish, so a 10 percent survival was assumed for each life stage. Table 8.3-1 provides estimates for total entrainment. The equivalent adults associated with the entrainment of postlarvae is 37,000 and of juveniles is 47,000. Equivalent adults associated with entrainment represent slightly more than 1 percent of the recreational catch for Region 4 (Taylor-Manatee Counties) in 1980 which consisted of 6,395,000 individuals.

8.3.1.5 Bairdiella chrysoura (Silver perch)

Silver perch are found in deeper waters offshore in winter and move inshore to bays and coastal lagoons in spring to spawn (Gunter 1945; Springer and Woodburn 1960). Hildebrand and Cable (1930), though, found spawning in various North Carolina locations including harbors, estuaries, and sounds up to 15 miles out to sea. In the Tampa Bay area, Springer and Woodburn (1960) believed spawning to be in April and early May. Joseph and Yerger (1956) concluded that silver perch have a long spawning season in Alligator Harbor (northern Florida) since young were taken in June and September. Grimes and Mountain (1971) working in the Crystal River area reported spawning in the spring. Ripe individuals and eggs were taken at temperatures from 19.4° to 28°C (Miller 1965; Kuntz 1914). The eggs are pelagic (Welsh and Breder 1923; Kuntz 1914). Hatching time is temperature dependent; 40 to 50 hours at 18 to 21°C (Welsh and Breder 1923) as compared to 18 hours at higher temperatures (Kuntz 1914). Larvae have been taken at temperatures between 16.4 and 31.8°C (Jannke 1971), and juveniles between 4.8 and 32.5°C (Thomas 1971).

Silver perch attain a length of about 140 mm SL by the end of their first year, and perhaps gain an additional 60 mm during their second year. Sexual maturity is reached after the second year at a length of 150 to 210 mm SL (Welsh & Breder 1923; Hildebrand & Schroeder 1928). Fecundity of a mature female (140 mm SL) was estimated at 52,800 eggs (Hildebrand and Schroeder 1928). According to Moe and Martin (1965), longevity is slightly more than 2 years; however, older fish, including a 230 mm specimen (age VI), have been reported (Welsh and Breder 1923). Eleven females collected at Crystal River had from 17920 to 147050 eggs per female (average 48140).

Silver perch are sexually mature at age 2 with specimens as old as age VI collected. Silver perch was assumed to spawn 3 times at the average fecundity of 48,140. Eggs were assumed to have a 50 percent survivorship in view of the short duration of this life stage. Other life stages were assumed to have a 10 percent survival.

The entrained prolarvae, postlarvae, and juveniles (Table 8.3-1) are equivalent to 2, 6,000 and 600 adults, respectively. This is a very small fraction (0.19 percent) of the 1980 recreational catch for Region 4.

Unidentified sciaenid eggs and prolarvae, while a portion may be silver perch have been assumed for conservatism to be spot.

8.3.1.6 Cynoscion nebulosus (Spotted seatrout)

Spawning season as reported in various locations is as follows: Pearson (1929, in Texas - March to October, with peak in April and May; Klima and Tabb (1959), in northwest Florida - late April through September, with a peak in late May and early June; Moffet (1961) in west Florida (Fort Myers, Cedar Key, Apalachicola) - May through September, peaking in summer; Sundararaj and Suttkus (1962), in Louisiana - July and August; Springer and Woodburn (1960) in Tampa Bay - first occurs in April. Spawning occurs in bays and lagoons (Gunter, 1945), in less turbulent portions of estuaries (Tabb 1966), in bays and lagoons somewhat offshore in water not over 10-15 feet deep (Pearson 1929), at night close to shore (Pearson 1929), and in estuaries well above the reach of daily tides (Tabb 1966). Jannke (1971) indicated that spawning may occur year round in the Everglades. Eggs are initially buoyant (Fable et al 1978; Pearson 1929) but soon sink (Fable et al 1978; Tabb 1966; Futch 1970; Guest and Gunter 1958). The young are usually hatched inshore, but if hatched offshore they move inshore (Hildebrand and Cable 1934).

Estimates of fecundity are as follows: Pearson (1929) in Texas specimens: two nearly ripe seatrout of 48 and 62 cm, 427,819 and 1,118,000 eggs, respectively; Tabb (1961) in the west coast Florida and Texas samples: 15,000 eggs at 32.5 cm standard length, 150,000 at 44.2 cm, 400,000 at 50.0 cm, and 1,100,000 at 62.5 cm. Sundararaj and Suttkus (1962) in Louisiana reported: age I, 283 mm total length, 140,485 eggs (N=8); age II, 376 mm, 354,325 eggs (N=9); age III, 450 mm, 660,960 eggs (N=8), and age IV, 504 mm, 1,144,492 eggs (N=3). Miles (1950) in Texas found , age II, 100,000 eggs; age III, 300,000 eggs, and age IV, 560,000 eggs. Moody (1950) in Cedar Key, Florida reported: 464,000 almost mature eggs in a female of 397 mm. Sundararaj and Suttkus (1962) also give the percentage of total eggs spawned for each age group: I-8.6 percent, II-24.5 percent, III-40.6 percent, and IV-26.8 percent.

The growth rate of female spotted seatrout is greater than for males (Moffet 1961; Tabb 1961; Moody 1950) and the females apparently outlive the males (Moffet 1961). The sex ratio changes throughout the lifespan (Tabb 1961). Males are outnumbered by females nearly 2 to 1 in the first 3 year classes. By the sixth year males may be outnumbered by as much as 8 to 1 (Klima and Tabb 1959).

Distributions of lengths by gender for specimens from Laguna Madre, Texas were presented by Klima and Tabb (1959) as were average lengths by age class. Moffet (1961) presented mean standard lengths by age class and sex. Welsh and Breder (1923) and Pearson (1929) (cited in Moody 1950) presented average lengths by age class for the first six and eight winters, respectively. Futch (1970) graphed length vs age for a composite of six populations of spotted seatrout.

Most of the males die by the age of 5 or 6 years (Moffett 1961). Female longevity is estimated at 8 to 9 years (Moffett 1961; Pearson 1929), or perhaps 10 years (Tabb 1961). Sundararaj and Suttkus (1962) estimate longevity at 5 years for females and 3 years for males. Excluding the first year (age group 0), about 90 percent of the females are evenly distributed between age groups I and III (Sundararaj and Suttkus 1962); these also represent the largest spawning classes (Guest and Gunter 1958).

The only life stage of spotted seatrout identified in entrainment samples at Crystal River was postlarvae. Table 8.3-1 provides the estimate of 6.5 million for total entrainment. Utilizing an average fecundity from Sundararaj and Suttkus (1962), a 2 year reproductive life, and an assumed 10 percent survival for the egg and larval life stages resulted in an estimated 900 equivalent adults lost. This number of equivalent adults is a very small fraction (0.05 percent) of the recreational catch for 1980 for Region 4.

Identified sciaenid eggs and prolarvae, while a portion may be seatrout, have been assumed to be spot. The allocation of all unidentified organisms in this taxon to one species results in a conservative analysis.

8.3.1.7 Leiostomus xanthurus (Spot)

In the Cedar Key area spawning apparently takes place in winter and early spring (Reid 1954). Kilby (1950, cited in Reid 1954) indicated a breeding season of the January through March for the same area. Young were taken in January and February and were found in shallow waters, channels, and both deep and shallow flats (Reid 1954). Adults were present inshore most of the year but were scarce in mid-winter (Reid 1954; Pristas and Trent 1978). In St. Andrew Bay, Pristas and Trent (1978) found significantly fewer males in autumn and winter (26.3 percent and 35.6 percent males, respectively). Sundaravaj (1960, cited in Thomas 1971) assumed that the majority of spot died before reaching three years of age. Pacheo (1962, cited in Thomas 1971) suggested a mortaility rate of 50 percent after the first year for spot in Chesapeake Bay. Thomas (1971) presented some length-frequency data.

Spot have a fecundity of 70,000 to 90,000 (an average of 80,000 was used for analysis) and an average life expectency of 3 years. Spot were assumed to spawn once and have a 10 percent survival rate for early life stages. The entrainment of spot postlarvae and juveniles (Table 8.3-1) resulted in an estimated loss of 280,000 and 410,000 equivalent adults, respectively. Together these represent 20,700 lbs assuming an average weight equivalent to that derived from the trawl catch (0.03 lbs). This is approximately equivalent to the 1982 commercial landings for Citrus-Pasco and Levy Counties.

All unidentified sciaenid eggs and prolarvae were conservatively assumed to be spot. The unidentified individuals exceeded the identified individuals and were for earlier life stages. The effect of entrainment of eggs and prolarvae (Table 8.3-2) results in 27,500 and 360 equivalent adults, respectively. While this addition increases the estimates of equivalent adults, due to the conservatism of the analysis, this addition should not alter entrainment conclusions.

8.3.1.8 Sciaenops ocellatus (Red drum)

Pearson (1929) indicated, based on the occurrence of larvae and very young red drum, that spawning occurs from mid-October to mid-November off the coast of Texas. Theiling and Loyacano (1976) stated that it is generally accepted that red drum spawn from September through November. The eggs are buoyant (Vetter and Hodson 1983; Holt et al 1981a, 1981b) though they will sink at salinities of less than 25 ppt (Holt et al 1981b; Vetter and Hodson 1983). Spawning apparently occurs in the Gulf of Mexico near passes leading into tidal marshes (Pearson 1929; Bass and Avault 1975; Holt et al 1981a; Holt et al 1981b). Yolksac larvae are negatively buoyant (Holt et al 1981a). The young move shoreward to bays and lagoons which are used as nursery areas (Holt et al, 1981a; Bass and Avault, 1975; Pearson, 1929). The young remain inshore until six months of age in Louisiana (Bass and Avault 1975). They remain inshore for an indefinite period in Texas (Pearson 1929), while Osburn et al (1982) indicated that essentially non-migrating populations of immature fish (year classes I-III) are found in the bays. Mature adults are apparently remain offshore in the Gulf (Pearson, 1929; Simmons and Breuer 1962 cited in Osburn et al 1982; Yokel 1966 cited in Theiling and Loyacano 1975; Ross et al 1983).

Maturity does not occur until at least age IV, probably age V (Pearson 1929) at a total length of at least 75 cm. Modal total lengths for the first three year classes are approximately 34, 54, and 64 cm, while fish in the fourth year class have a mode of probably 75 cm; by the end of the fifth year the average length is 83 to 85 cm (Pearson 1929). A weight of 10 pounds or more is attained before first spawning (Pearson 1929). Using two methods of calculation, Pearson estimated fecundity of about 3,382,886 to 3,410,000 eggs for a female 90 cm long. Holt et al (1981a) stated that maturity is reached in 3-5 years, with the average female producing 1/2 to 2 million eggs per season. Vetter and Hodson (1983) reported one female which spawned in the lab produced approximately 10^6 eggs.

Only red drum postlarvae were identified from meroplankton collected at Stations C, D, or E. Table 8.3-1 provides an estimate of 300,000 for annual entrainment. An average fecundity of 3,400,000 for one reproductive period was used for analysis. A 10 percent survival of eggs and larvae was assumed. The entrainment of postlarvae results in the loss of 18 equivalent adults, which is an insignificant fraction of the 229,000 red drum reported in the recreational catch in 1980 for Region 4.

8.3.1.9 Mugil cephalus (Striped mullet)

Although many authors have reported that striped mullet spawn inshore or within a few miles of the beach, it seems that spawning occurs offshore on the northwest coast of Florida (Finucane et al 1978; Anderson 1958 cited in Finnucane 1978; Arnold and Thompson 1958; Broadhead 1953). The eggs are pelagic (Finucane et al 1978). According to Gunter (1945) spawing occurs off the Texas coast from late October to early January, peaking in late November and early December. Moore (1974), on the other hand, indicated that spawning occurs from December to May off Port Aransas, Texas and that individuals may spawn more than once in the same spawning season. Finucane et al (1978), indicated spawning occurs in early winter in the northwest Gulf of Mexico off Texas. Fish with mature or maturing gonads were mostly found to be three or more years old (Moore 1974). Prejuveniles leave the open ocean and enter intertidal estuarine areas (Major 1978).

Since no life stages were identified from meroplankton collections at Stations C, D, or E, there is no effect of entrainment calculated for the striped mullet population.

If all the Mugillidae noted in Table 8.3-2 are assumed to be striped mullet, the entrained life stages would be postlarvae and juveniles. Assuming a fecundity of 1.2 million (Futch 1966) and a 10 percent survival between life stages, the entrainment of postlarvae and juveniles results in 95 and 5800 equivalent adults. This represents a minor fraction of the over 2.5 million pounds of stripped mullet landed by commercial fisherman in Citris - Pasco and Levy Counties in 1982.

8.3.1.10 Penaeus duorarum (Pink shrimp)

Pink shrimp spawn offshore (Costello and Allen 1970; Tabb et al 1972; Williams 1955 in waters of 10-20 fathoms at temperatures between 19 and 31°C (Tabb et al 1972; Eldred et al 1965) at minimal bottom temperatures of 23.9°C (Williams 1965).

During spawning, eggs are cast free and drift for about one-half hour and then become demersal for approximately 14-16 hours prior to hatching (Tabb et al 1972). The highest spawning rate was observed from April to July in Florida (Tortugas area) (Cummings 1961), and spawning probably occurs year round in the Tortugas grounds (Perez-Farfante 1969). Eldred et al (1961) reported peak spawning to occur in the Tampa Bay area from April through September, with limited spawning in February and December. High temperatures may suppress spawning and more optimal temperatures probably cause peaks in spring and fall (Eldred et al 1961).

Fecundity estimates from a regression of fecundity and total length range from 66,000 (105 mm) to 460,000 (187 mm) ova for shrimp from the Tortugas and Sanibel fishing grounds (Martosubroto, 1974). Regressions on body weight and ovary weight were also given. Females probably spawn more than once during their lifespan (Cummings 1961; Perez-Farfante 1969), and a small female which spawns in the spring may spawn again in the fall after attaining a larger size (Eldred et al 1961). Kutkuhn (1962) also indicated semiannual spawning peaks. Males and females may achieve sexual maturity at minimum total lengths of 75 and 85 mm respectively at 9 or 10 weeks old (Eldred et al 1961). Kutkuhn (1962) gave an age estimate of 15 weeks and 107 mm total length as the age of recruitment to the Tortugas fishery. He also estimated 83 weeks to be the maximum lifespan. Juveniles inhabit coastal bays, estuaries, and as they grow, gradually move into deeper water (Costello & Allen 1966).

Survival rates of larvae on the Tortugas shelf average 83 percent per day (Munro et al 1968). From mark-recovery experiments on the Sanibel and Tortugas grounds of Florida, Costello and Allen (1966) estimated shrimp fishing mortality for Sanibel shrimp to be 6.8 percent for each 2-week period and all other losses were estimated to be 14.8 percent. For the Tortugas, fishing mortality was 13.1 percent for each 2-week period and all other losses were 19.7 percent. The instantaneous rates are: for Sanibel, .0689 for the fishery and .1644 for all others; for Tortugas, .1385 for the fishery and .2185 for all others. These rates, as the investigators pointed out, cannot be readily accepted as estimates of natural mortality since they include other losses such as migration and mortality from marking, handling, or releasing procedures. Also, true natural mortality may shift with changes in the fishing industry. Iversen (1962) reports the catchability of untagged shrimp (e.g., the instantaneous mortality due to fishing) from the Tortugas grounds to be .02393 and the instantaneous rate of emigration and natural mortality (e.g., instantaneous mortality rate due to other causes) to be .05998.

The sex ratio of males to females is about 1:1 for inshore populations (Tabb et al 1962; Eldred et al 1961; Saloman 1965) but varies geographically, seasonally, and with size class (Eldred et al 1961). As they mature, the larger shrimp move offshore; females attain larger size than males (Iversen and Idyll 1960; Williams 1955).

Since no life stages of pink shrimp were identified in meroplankton collections at Stations C, D, or E, there is no effect of entrainment calculated for the pink shrimp population.

Assuming that all <u>Penaeus</u> sp. are pink shrimp, the entrainment estimates from Table 8.3-2 have been used to estimate equivalent adults. An average lifetime fecundity of 200,000 was utilized, and 10 percent survival between life stages was assumed. The equivalent adults associated with mysis, postlarvae, and juveniles are 22, 18830, and 10230, respectively. Utilizing the average weight from the trawl samples at Crystal River of 0.007 lbs, the equivalent adults represent an insignificant fraction of the more than one million lbs of pink shrimp landed in Citrus-Pasco and Levy Counties in 1982.

8.3.1.11 Callinectes sapidus (Blue crab)

Williams (1965) reported that blue crabs mature in about 14 months and attain a maximum age of 3 years. Most spawn at about age 2 (Williams 1965; Pearson 1945; Churchill 1919.) Spawning occurs from late April (Williams 1965) and mid-May (Pearson 1948) until early or mid-September (Williams 1965; Pearson 1948). Some females produce two sponges (egg masses)in the same summer (Pearson 1948; Williams 1965). A third sponge may be produced the following year, at age 3 (Williams 1965; Pearson 1948; Churchill 1919). Williams reported the spawning peak to occur in June. Generally, gravid females move offshore where eggs hatch at higher salinities (Churchill 1919). Estimates of the number of eggs per sponge are given as 700,000 to two million by Williams (1965), 1,750,000 to 2,000,000 for a sponge of usual size by Churchill (1919), and up to 2,000,000 by Davis (1965). Of the eggs spawned, Van Engel (1958 cited in Oesterling 1976) estimated only about one ten-thousandth of one percent (.000001) will survive to become adults. Based on a study spanning 13 generations, Pearson (1948) reported the lack of a significant correlation between the abundance of the spawning stock and the number of offspring. Rather, there is a significant correlation between the volume of water discharged from the James and Potomac Rivers during the spawning season with the index of abundance for the resulting adults. This implies that salinity may be the important factor affecting survival of the young, at least at the level of fishing existing at the time.

Williams (1965) reported year round spawning occurs in Texas with peaks in June or early July. Nicols and Keney (1963, cited in Futch 1965) reported that spawning occurs primary throughout the year in Florida waters, but peaks from May through November. Oesterling (1976) reported that spawning occurs primarily during the spring and summer months, and is generally considered to occur in areas of higher salinity at the mouths of estuaries and offshore. However, unlike reports for the eastern seaboard, female crabs move, not offshore, but northward alongshore to a spawning area. There appears to be one primary spawning ground for the Gulf Coast in the Apalachicola Bay region, although spawning does occur all along the coast. In the St. Johns River, many if not all females spawn twice either in the same season or over two seasons, though few live more than one year past maturity (Tagatz 1968). The maximum age is little more than four years and crabs reach harvestable size in less than one year. Eggs number between one and two million per sponge (Tagatz 1968), while Futch (1965) reported that Florida female crabs produce about two million eggs per sponge.

Only megalops were identified from meroplankton collections at Stations C, D, or E. Table 8.3-1 provides an estimate of 360,000 entrained annually. The survival to megalops was assumed to be 10 percent and two sponges were assumed during the average life time. Therefore, the loss due to entrainment is about

2 equivalent adults. This is a nonsignificant fraction of the almost 4 million pounds of commercial landings in 1982 for Citrus-Pasco and Levy Counties.

The unidentified Callinectes sp. were assumed to be entrainable life stages of blue crab. The megalops (Table 8.3-2) entrained would represent about 200 additional equivalent adults. This addition does not change the conclusions for blue crab entrainment.

8.3.1.12 Menippe mercenaria (Stone Crab)

In North Carolina ovigerous females have been taken from May to August (Williams 1965). Futch (1966) reported that in Florida spawning apparently occurs throughout the spring and summer. Females, migrate offshore to spawn and are capable of producing six egg masses in 69 days, each containing 500,000 to one million viable eggs (Williams 1965). The postlarvae migrate inshore to bays and estuaries.

In the Cedar Key areas, however, it appears that females may remain inshore on the grass-flats to spawn. Spawning occurs from March through October with peaks in June and September (Bender 1971). In the Anclote area zoea were collected from March to November with peak densities from July to September, and megalops were collected from May to November, with most taken in July (FPC 1977). Juveniles under 8 mm carapace length were collected in Florida Bay from October through April indicating an extended spawning season (Manning 1960). Savage and Sullivan (1978) reported that sexual maturity is reached in about 10 months. Powell and Gunter (1968) reported a changing sex ratio in the number of males to females over the year at a jetty in the Port Aransas, Texas area. The ratios were 4.28 to 1 for December-January 1947-1948, 5.00 to 1 for May-June, and 2.65 to 1 for July - August.

The equivalent adult estimate for stone crabs utilized a fecundity of 750,000 and a lifetime production of 5 egg masses. Total survival was taken from Porter (1960), and a 10 percent survival from the last zoeal stage to megalops was assumed.

The equivalent adult estimate of less than 3,700 is mostly the result of Stage 1 zoeal entrainment (Table 8.3-1). The equivalent adult estimates are 3297, 6, 15, 6, 5 and 313 for zoeal Stages 1 to 5 and megalops, respectively. This number represents an insignificant fraction of the almost 950,000 lb landed in 1982 in Citrus-Pasco and Levy Counties.

8.3.1.13 Lolliguncula bevis (Brief squid)

Little is known about the ecology of brief squid in terms of short-term and long-term distribution patterns (Laughlin and Livingston 1982). Early life history data is also limited (Vecchione 1982). An eight year study of the brief squid's spatial and temporal distribution was conducted in the Apalachicola estuary by Laughlin and Livingston (1982). The most suitable habitat in the estuary was concluded to be channels and/or passes with high current velocity and salinities of 20-30 ppt. Small numbers occurred from January to April during times of relatively low salinities and temperatures. Abundance increased dramatically in May when mean salinities were intermediate and water temperatures high (22-25°C). A similiar situation was noted in October and November. While migration onshore and offshore is strongly correlated with temperature and salinity, fluctuations within the estuary were related to abunadnce of zooplankton (Laughlin and Livingston, 1982). Dragovich and Kelley (1964) reported that juvenile squid, which comprise most of the squid catches in estuaries (90%) feed preferentially on zooplankton.

Little life history information is available on the brief squid. It produces egg capsules that may contain up to 200 eggs per capsule and hundreds of the capsules are found in groups. Assuming a life time production of 500 eggs per individual, the entrainment estimate (Table 8.3-1) results in about 3600 equivalent adults. The brief squid was represented in low numbers from April to December at many stations. Therefore, the effect of entrainment can have only a minor effect on the population.

8.3.2 Entrainment Conclusions

The results of the entrainment estimates under conservative assumptions have provided the basis for equivalent adult projections. Where possible, these projections have been compared to other forms of population exploitation, such as commercial or sport fishing statistics. These analyses for the SIO demon-strate that for most species the entrainment effects represent a small fraction of present exploitation. Hydrodynamic modeling indicates that the source for the entrained organisms is not limited to the area immediately surrounding the plant. Therefore, entrainment is expected to have an acceptable level of exploitation on the SIO.

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TABLE 8.3-1

MAXIMUM ENTRAINMENT FOR EACH SIO BY LIFESTAGE
ANNUAL NUMBER ENTRAINED IN MILLIONS

Species	Life Stage	Total Entrainment	Station
Bay anchovy	Eggs	11674	D
	Prolarvae	767.8	D
	Postlarvae	686.6	E
	Juveniles	154.6	C
Polka-dot batfish	Juveniles	0.19	E
Pigfish	Postlarvae	0.76	C
Pinfish	Postlarvae	16.69	E
	Juveniles	2.15	E
Silver perch	Prolarvae	0.08	C
	Postlarvae	21.64	C
	Juveniles	0.22	C
Spotted seatrout	Postlarvae	6.50	E
Spot	Postlarvae	12.28	E
	Juveniles	1.73	E
Red drum	Postlarvae	0.30	C
Blue crab	Megalops	0.36	D
Stone crab	Stage 1	3029.43	E
	Stage 2	254.63	E
	Stage 3	52.01	E
	Stage 4	14.84	E
	Stage 5	0.38	C
	Megalops	2.35	E
Brief Squid	All	0.91	C

TABLE 8.3-2

MAXIMUM ENTRAINMENT FOR UNIDENTIFIED SIO TAXA

Species Name	Life Stage	Total Annual Entrainment (Millions)	Station
Anchoa sp.	Prolarvae	192.6	E
	Postlarvae	1088	E
Haemulidae	Eggs	433.5	E
Sciaenidae	Eggs	1102	C
	Prolarvae	14.63	D
Mugillidae	Postlarvae	0.57	E
	Juveniles	3.5	E
Penaeus sp.	Mysis	0.22	C
	Postlarvae	18.83	C
	Juveniles	1.023	E
Callinectes sp.	Megalops	34.83	E

~~1.0 Introduction~~

~~2.0 Plant Design~~

~~3.0 Description of Crystal Bay~~

~~4.0 Previous Studies~~

~~5.0 Plan of Study~~

~~6.0 Benthos~~

~~7.0 Impingement~~

~~8.0 Entrainment~~

9.0 Fisheries

9.0 FISHERIES

Samples of juvenile and adult fish were collected by using four different gear types at various locations throughout the study area. The data are intended to provide information on the local fish community and to support evaluation of thermal, impingement and entrainment effects on fish populations. As in the impingement and entrainment evaluations, selected species are emphasized.

The fisheries program included a short-term effort to collect blue and stone crabs and to tag and recapture blue crabs. These data were intended primarily to identify patterns of local movement and coastal migration.

9.1 SAMPLING AND LABORATORY ANALYSIS

9.1.1 Sampling Procedures

Fisheries samples were collected in the vicinity of the Crystal River Power Station at monthly intervals from June 1983 through May 1984. Several gear types, including otter trawls, beach seines and a drop net, were used. Open water otter trawls were collected at night. Tidal creek trawls and all other fisheries samples were collected during the day. Station locations are shown in Figure 9.1-1.

A 3.05 meter otter trawl constructed of 3.8 cm mesh in the body, 1.3 cm mesh in the cod end and a 6.5 mm mesh nylon cod end liner was used for the open water trawling. Seven samples were collected at each station. The net was released from a moving boat and dragged along the bottom for 2 minutes (per haul).

Duplicate beach seine collections were made at each station using a 22.9 meter long by 1.8 meter deep seine constructed of 6.5 mm mesh. The seine was deployed in the following manner: an anchor attached to the end of the seine was placed on the beach. The seine was payed out as the other end was walked perpendicular to the beach. When approximately three-quarters of the length of the seine had been deployed, the net was walked in a semicircular formation. After the distal wing was on the beach, the two ends of the net were drawn together and the net was hauled onto the beach.

The drop net apparatus consisted of a portable frame from which a 1.6 mm mesh net was suspended and then remotely triggered to enclose a 16 m^2 water column. The trigger line was pulled after an acclimation period of approximately 2 hr. After the net was dropped, the enclosed area was swept five times with a 6.5 mm mesh seine. This was followed with a series of three sweeps with a 1.0 mm mesh seine. Two replicates were collected on each sampling date.

Four creeks were sampled with a 3.05 meter otter trawl constructed of 3.8 cm mesh in the body, 1.3 cm mesh in the cod end, with a cod end liner of 3.2 mm mesh nylon. Seven samples were collected at each site. The net was released from a moving boat, and dragged along the bottom for 2 minutes (per haul).

A blue crab tagging/recapture study was conducted during a 16 week period from September through December 1983. A total of 120 plastic coated standard wire mesh crab traps were set and retrieved weekly along four transects, designated A through D, within the study area. Each transect consisted of 30 individual traps, which were evenly spaced into six groups containing five traps each. Each group of five traps along a transect was designated as an individual station (Figure 9.1-2).

Each individual crab trap was baited with shad. Traps were retrieved, emptied, and reset every 7 days, at which time all healthy viable blue crabs were tagged and released. To avoid tag loss due to molting or death, only mature healthy female crabs and healthy male crabs larger than 127 mm carapace width were tagged. Tags were fastened to the carapace of the blue crab with 40 pound test monel. The tags were sequentially numbered and contained information pertinent to how the tag was to be returned. The tag number, date, and location of capture, carapace width to the nearest millimeter, sex, and general appearance of each tagged crab were recorded. Crabs were released approximately 200 m from the point of capture. When previously tagged crabs were recaptured, the tag number, sex, carapace width, date, time, and location of recapture were recorded and the crab was then released.

In addition to tagged blue crabs, any stone crabs (*Menippe mercenaria*) which were captured, as well as any blue crabs which could not be tagged, were measured for carapace width, sex was noted, and the specimens released.

To supplement the number of blue crabs tagged, all blue crabs impinged on the travelling screens during a 24 hr period were collected once weekly during the tagging study. The dates and times of collection were designated to correspond with the regular impingement sampling schedule. During this time, all viable blue crabs were placed in a divided water table. At the end of a minimum 24 hr holding period, each healthy crab was removed and tagged in the same manner as described previously. All blue crabs, dead or alive, were also measured for carapace width and total weight for the impingement study. The total number of crabs held, as well as percent mortality, were recorded. Tagged impinged crabs were then divided randomly into three equal groups and transported to three predetermined release points within the study area. These release points were designated as Stations E, F, and G (Figure 9.1-2).

Along with the field work, an extensive public notification program was initiated in cooperation with the Florida Department of Natural Resources (FDNR). Notices of the tagging project were sent to local licensed commercial crabbers, bait shops, docks, and processing houses in an attempt to enhance the number of tag returns. Included in this notification was a description of the study and the tags used, and the announcement of a nominal reward for tag returns with desired information. FDNR coordinated the tag returns to provide consistency with their statewide program.

9.1.2 Laboratory Analysis

All fish and macroinvertebrates were identified, counted, and weighed by species. Identifications were made utilizing standard literature sources and MML's reference collection. Nomenclature of fishes followed that established by the American Fisheries Society. Taxonomy was based on external characteristics as given in major taxonomic keys. A voucher specimen for each species was retained. The identifications of any questionable specimens were verified by external taxonomic specialists. A reference collection of all taxonomically confirmed species was maintained.

In addition to the general analyses, selected important organisms were examined in detail and analyzed for length-weight relationships, overt parasites, and disease. Additionally, certain species were analyzed for sex, reproductive condition, fecundity, and age as shown in Table 9.1-1.

Twenty-five individuals from each of the nine selected important species obtained by beach seining and trawling in each experimental (north of the intake canal) or control (south of the canal) area during each month were examined for obvious instances of parasitism and disease. External sexual characteristics were noted. Each species was also sexed internally, their stages of maturity recorded, and their reproductive condition examined. The latter was reported following standard classifications: immature, mature, ripe/gravid, or spent. Fecundity of ripe or gravid fish was determined by the gravimetric method. Age was determined using otoliths or scales for fish species subjected to fecundity analyses. Analyses were performed for each month of the study. Sex and reproductive state (e.g., gravid, egg-bearing) of important macroinvertebrates were recorded where possible.

TABLE 9.1-1

DETAILED STUDIES OF SELECTED IMPORTANT ORGANISMS

Species	Sex	Reproductive Condition	Fecundity	Age	Length-Width	Disease and Parasites
Polka-dot batfish	X	X			X	X
Pigfish	X	X	X	X	X	X
Pinfish	X	X	X	X	X	X
Silver perch	X	X	X	X	X	X
Spotted seatrout	X	X	X	X	X	X
Spot	X	X	X	X	X	X
Red drum	X	X	X	X	X	X
Striped mullet	X	X	X	X	X	X
Bay anchovy	X	X	X	X	X	X
Blue crab	X	X				
Stone crab	X	X				
Pink shrimp		X				

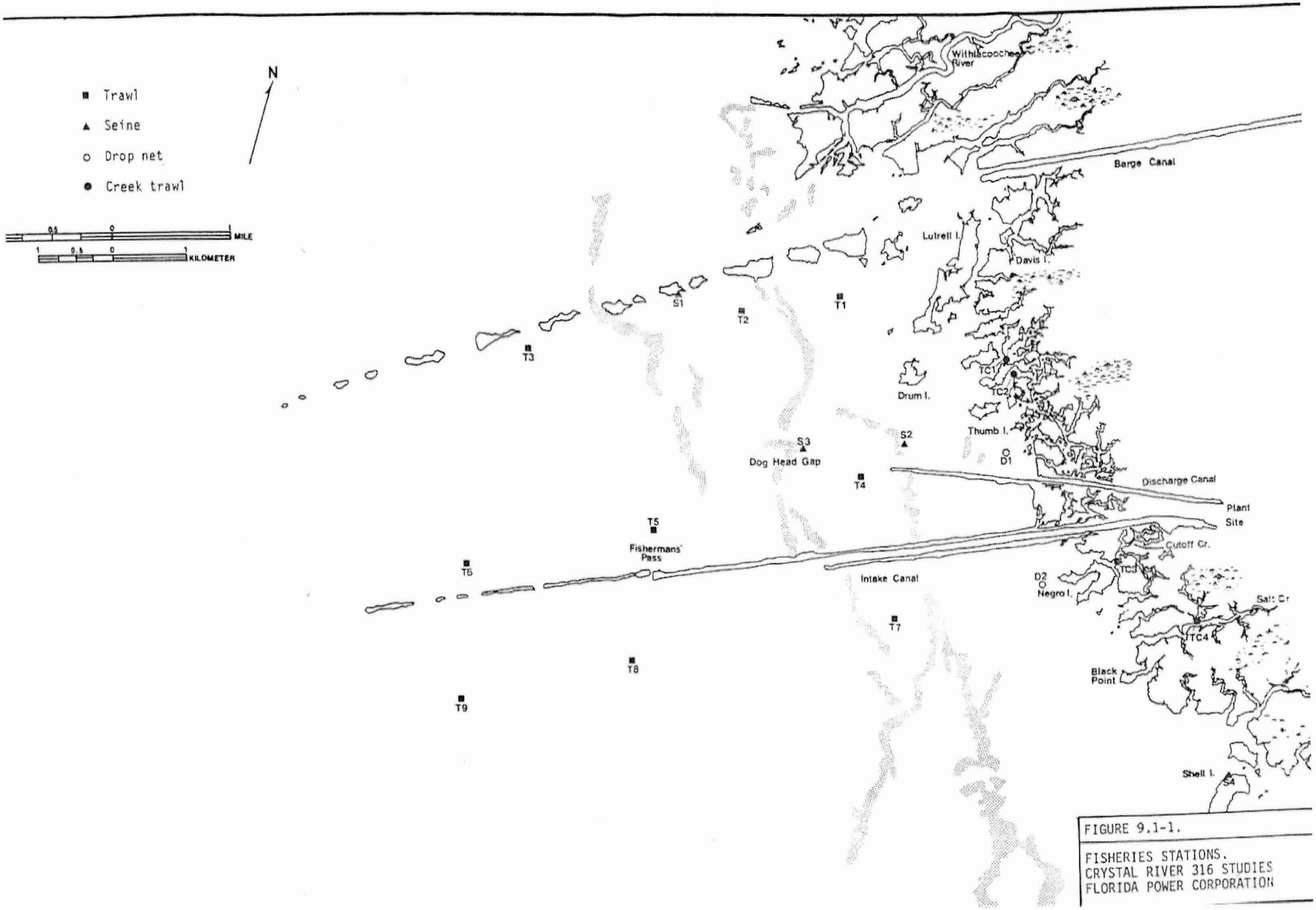


FIGURE 9.1-1.

FISHERIES STATIONS.
CRYSTAL RIVER 316 STUDIES
FLORIDA POWER CORPORATION

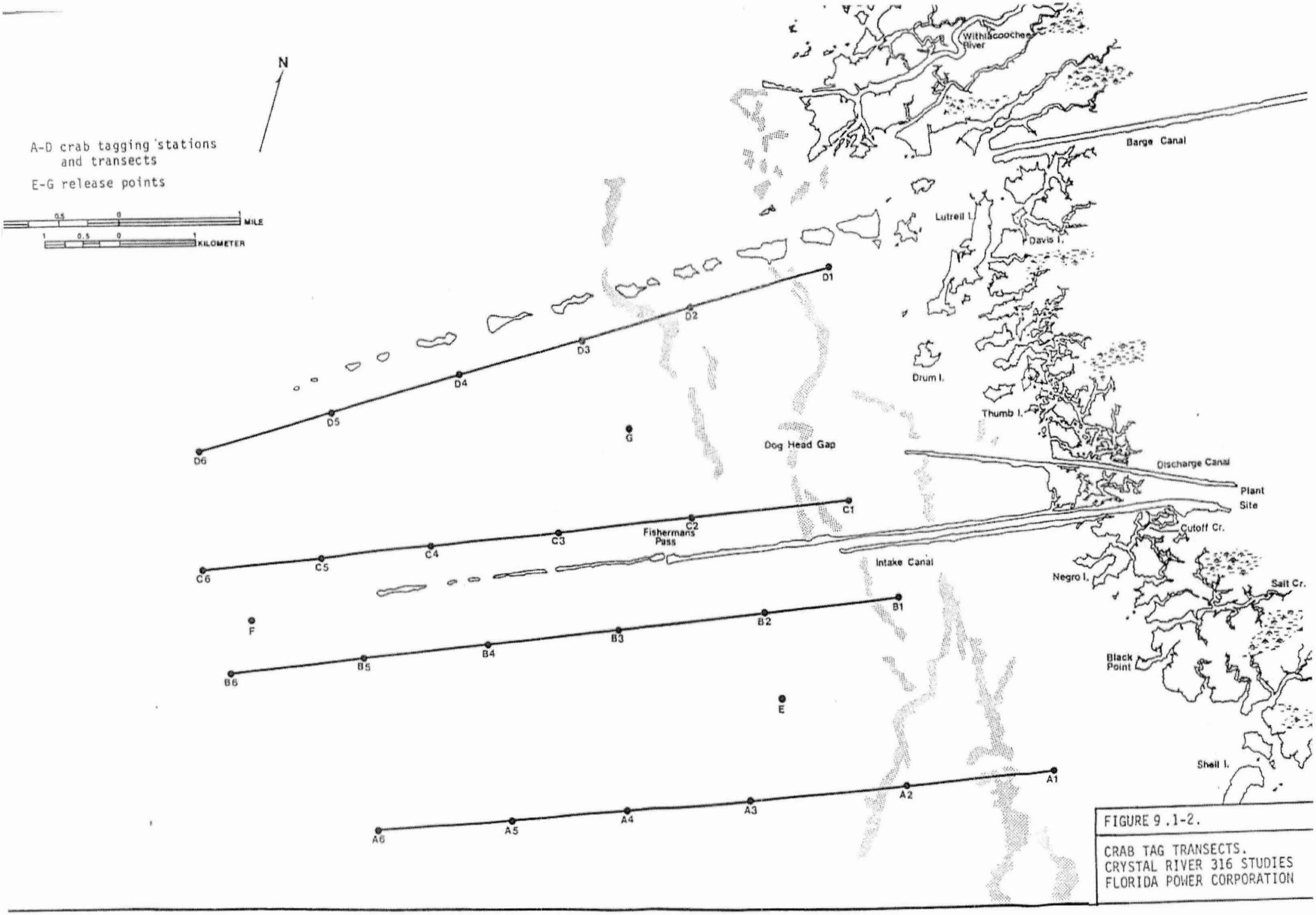


FIGURE 9.1-2.

CRAB TAG TRANSECTS.
CRYSTAL RIVER 316 STUDIES
FLORIDA POWER CORPORATION

9.2 RESULTS

Fish and invertebrate numbers and biomass have been provided in quarterly reports by gear type, month, and station. Summary tables for SIO are provided in Appendix VII. In general, numbers were small, although occasional large collections did occur. As a result, one or two samples have a large effect on total values. Quantitative analyses which can be performed are limited. The following sections report the results of fisheries sampling by gear type.

9.2.1 Trawl

The trawls captured a total of 98 species of fish and 108 species of invertebrates. The total catch of fish varied seasonally with lowest numbers in January and February (see Figure 9.2-1). The peak number at any one station occurred in May (Station T9), but similarly high densities occurred in April, June, July, and August (Table 9.2-1). Highest densities at all stations occurred in late spring and summer (May, August, September, June). Invertebrate densities followed a similar seasonal pattern although low densities found in December and January continued through June, and then increased to a peak in July and August.

Fish biomass followed the same general seasonal pattern seen in the density data (see Figure 9.2-2). Invertebrate biomass was lowest from December through February, however, peak values occurred from March through May rather than in summer.

The variability in the data associated with capturing a school of fish can efffectively mask patterns of distribution. For example, trawling in April at Station T4 yielded 502 spot which was 91 percent of the catch at the station and 38 percent of the catch at all stations. At the same time, some general patterns do appear consistently from month to month. Comparisons among transects (northern, T1-3, central, T4-6, southern, T7-9) indicate the lowest densities of both fish and invertebrates along the central transect (see Tables 9.2-2 and 3). The transects to the north and south had similar numbers overall. Highest numbers of fish were collected to the north in 1983 and to the south in 1984. Numbers of invertebrates were consistently higher to the south. Fish biomass was highest to the south except in the fall. Based on average fish weights, the larger fish were collected along the central or southern transects.

Within transects, distributional trends vary from month to month, but to the north, Stations T1 or T2 generally had the highest numbers and T3 the lowest. On the central transect, the variation was similar with highest densities inshore at Station T4 and lowest offshore at Station T6. To the south, the offshore station (T9) frequently had the highest numbers and the central station (T8) had the lowest.

Diversity (Shannon-Weaver) evenness (after Pielou 1975) and richness (number of species) were calculated for each trawl station in each sampling month. A summary table is included in Appendix VII (Table VII-23). Comparing across transects, richness was often lower along the central transect and was considerably higher along the southern transect in 1984. Evenness was slightly higher on the central transect in the winter and spring. Diversity was generally similar on all three transects. During 1983, diversity within transects increased with distance offshore along the north and central transects. Evenness and richness also increased offshore. Along the southern transect, diversity was highest inshore until April 1984 at which time the offshore station was most diverse. Evenness was frequently highest at T8 and richness was highest at T7 or T9.

In addition to evaluating population parameters for trawl data, total density and biomass, the data for each SIO were summarized (see Appendix VII, Tables VII-1 to 22). Several species were captured in very low numbers precluding detailed evaluation of their distributions; these included squid, stone crab, and polka-dot batfish. Blue crab occurred in low numbers but peaked in April and May; they were most consistently found at T1 and T2. Spotted seatrout numbers were also low, peaked in May and concentrated at T1-3 and T5. Bay anchovy were rarely collected in trawls; numbers peaked in the summer with most anchovies taken at Stations T1-4.

Other SIO were collected in greater numbers. Spot was present throughout the year with highest numbers in spring and summer at Stations T1-4. Based on biomass values, the smaller specimens were inshore at Station T1 and T4 and the largest spot were at Station T3. Pigfish were collected primarily in spring and summer, but their concentration was to the south. Pinfish occurred at about the same time, and they were also collected primarily at the southern stations. Moderate numbers of pinfish were also taken at Stations T1 and T2.

Silver perch were most common in summer and fall with the highest densities inshore at Stations T1, T2, and T7. Based on average weight comparisons, the smaller specimens were found at these stations. Pink shrimp were taken throughout the program with highest densities occurring in the summer. Numbers were higher inshore at that time but showed considerable variation at other times.

9.2.2 Seine

Seine collections yielded 49 species of fish and 15 species of invertebrates. Figure 9.2-1 provides a summary by month of the total number of fish collected. In general, the seines sampled a limited number of species, and of the species collected, many occurred in small numbers. Invertebrates were rare except at Station S1 in February when several species of shrimp common in grassbed habitats were collected (see Table 9.2-1). Fish captured in large numbers were usually juveniles of schooling species. Large numbers were taken in March at Station S1 (clupeids, spot) and S2 (clupeids), in February at Station S1 (spot), and in September at Station S2 (bay anchovy). Excluding these particularly large catches, lowest densities occurred from November through April and the highest in June and July. No clear pattern of distribution emerged. Station S2 did have the lowest density and biomass seen at the site in any given month over half of the time, but values at other stations were rarely much higher. The highest density per sampling date occurs most frequently at Station S1.

Diversity, evenness, and richness (see Appendix VII, Table VII-46) were very variable, both across stations and month to month. Diversity remained relatively high at S4 and tended to be highest at Station S1 or S4. Lowest values in winter were at Station S2. Richness was highest in winter at Station S4 and in spring at Station S1.

SIO information from seines is very limited (Tables VII-24 to 45). Stone crab, pink shrimp, red drum, and pigfish were collected only on one date. Silver perch were collected twice. Small numbers of batfish were collected over 5 months; all but one occurred at Station S1. Low numbers of blue crabs were found at all stations over 8 months.

Spot were collected mostly in February and March with highest numbers at Station S1. Pinfish were also collected in highest numbers in February and March at Station S1. Bay anchovy were collected in all months except January, February, and April. The station at which the maximum density occurred varied over time but was most often S2. Striped mullet occurred in varying numbers, mostly from August through February. Only four specimens were collected at Station S2.

9.2.3 Drop Net

Drop nets sample primarily small, shallow water inhabitants and species which move into shallow areas with the tide. Drop net collections contained 42 species of fish and 24 species of invertebrates. Numbers of organisms were generally low and variable (see Figure 9.2-1). Highest numbers were collected in February, November, October, and September (see Table 9.2-1). Lowest numbers occurred in December and January. The number of fish caught at Station D1 generally exceeded the number at Station D2, except in June, August, January, and December. Fish biomass was also usually higher at Station D1; exceptions were in July, April, and March when biomass was greater at Station D2. In contrast, more invertebrates were consistently taken at D2. Biomass of invertebrates was also generally higher at Station D2.

Diversity at drop net stations was highest at D2 in 10 of 12 months (Table VII-67). Diversity was lower at Station D1 in the spring despite higher richness. Evenness was correspondingly lower. Richness was generally higher at D2.

Selected species were uncommon in drop net collections (see Tables VII-47 to 66). Seatrout and bay anchovy were taken only at Station D1. Mullet, batfish, and silver perch were collected only at Station D2. Of the species collected at both stations, spot occurred in larger numbers at Station D1 and pigfish and pink shrimp were mostly at Station D2. Pinfish and blue crabs were about evenly distributed.

9.2.4 Creek Trawl

Given the locations and conditions sampled, this gear sampled organisms moving in and out of the creeks on a relatively high tide. Forty-three species of fish and 27 species of invertebrates were collected. Juvenile fish predominated. The largest numbers of fish were collected from January through May with the peak in March (see Figure 9.2-1). Invertebrate numbers were highest from November through March (Table 9.2-1). Fish biomass was highest in the spring; a secondary peak occurred in November.

Fish densities tended to be lowest at Station TC4 and at Station TC1. Peak densities tended to be at Station TC2. The same pattern was observed for the invertebrates collected.

Diversity in creek trawl samples was almost always higher at TC4 or TC1 and lowest at TC2 (see Table VII-86). Evenness tended to be lowest at TC2 or TC3. Richness increased at TC2 in the fall and early winter; in the spring, highest richness was at TC1 or TC2.

Mullet, spotted seatrout, pigfish, and bay anchovy were collected in small numbers (see Tables VII-68 to 85). Silver perch were generally rare but a large number were collected in May at Station TC1. Pink shrimp were taken at all stations over all months with the largest numbers collected at Station TC2. Blue crabs showed similar seasonal and spatial patterns; numbers were slightly higher at TC1. Spot were collected in only 5 months but in relatively high numbers. Peak numbers were in February and March at Stations TC1 and TC2. Pinfish was the most commonly collected SIO with highest numbers from February through May, at Station TC2. These peak values were made up of small fish which began to appear in January. Average weight continued to increase through May.

9.2.5 Crab Traps

During the 4 months of trapping, 7294 blue crabs and 6251 stone crabs were captured (Table 9.2-4). Of the blue crabs, 6123 were collected in crab traps, tagged, and released. An additional 220 crabs were impinged, tagged, and released. These results and subsequent analyses utilize collection data without correction for Catch Per Unit Effort (CPUE). CPUE by station and week of sampling was reviewed and evaluated statistically, but the results and conclusions described below and displayed in subsequent tables were unchanged.

Only about 17 percent of the blue crab captures occurred in September and October. At the same time, 43 percent of the stone crabs were caught (Table 9.2-5). In general, blue crabs were captured in larger numbers inshore on all four transects. In September and October, Stations A1, B1, C1, D1, and D2 accounted for about 73 percent of the catch. Numbers generally decreased at stations toward the offshore end of each transect. Stone crabs were concentrated toward the offshore end and center of the transects. Densities along Transect B were somewhat more homogeneous in having comparable numbers of stone crabs at B1-3 and B6, but the largest numbers were at B4 and B5.

In November and December, stone crabs maintained the pattern of largest numbers offshore and in the center of the transects (see Table 9.2-6). Blue crabs continued to be caught in large numbers at the inshore stations, but similar numbers were taken at the first four stations on each transect indicating an increase in densities 4-7 kms offshore.

Highest numbers of blue crabs were trapped at Transect D throughout the study. Transect A yielded the next highest number. Transects B and C had similar numbers, with B yielding slightly more overall. Stone crabs were most abundant at Transect B and least abundant at Transect D.

Data from crab traps were also evaluated in terms of sex and carapace size. Overall, stone crabs were 65 percent males, the percentage lower in November and December (61 percent) compared to September and October (70 percent) (see Tables 9.2-7 to 9.2-10). The distribution along a transect is similar for both sexes; male stone crabs were collected in higher numbers along Transects A and B while females were least dense on Transect A. At almost all stations, females were smaller than males.

The blue crabs collected were about 74 percent females. In September and October, however, only about 48 percent were females. The population in November and December was about 79 percent females. Both males and females were most dense inshore in September and October. Later, the males contined to be most dense inshore while females occurred in larger numbers toward the center of the transects. Highest numbers of both males and females were at Transect D, lowest numbers were at Transects B and C. Female blue crabs were generally larger than males, but no pattern of distribution based on size was apparent.

Immature blue crabs were not collected in September but then appeared in increasing numbers through December. They made up less than 4 percent of the catch. Parasitized specimens were also taken in increasing numbers each month and represented 3 percent of the blue crabs collected. Parasitized specimens averaged 110.5 mm.

A total of 3422 tagged blue crabs were recaptured. One hundred thirty-three crabs were recaptured initially by MML; of these, 68 were recaptured more than once. Most of these multiple captures involve only a second recapture although one crab was taken four times. The number of crabs recaptured represented 54 percent of the tagged crabs; 96 percent of the recaptures were from fishermen while 4 percent were taken by MML crab traps. Of all the recaptures, about 67 percent came from Crystal Bay. Of the Crystal Bay recaptures, about 79 percent were females.

Numbers of crabs recaptured in Crystal Bay are shown by release location in Table 9.2-11. The table records multiple recaptures in terms of both the original release station and the secondary release point for each recapture. The recapture location numbers refer to grid elements as shown in Figure 9.2-3. For recaptures reported by fishermen, locations are approximated based on information reported with the tag return, conversations with fishermen, and field observations. Data on recaptures are also presented by sex, (Tables 9.2-12 and 9.2-13) but males are relatively few in number and the pattern of recaptures is similar for both sexes. Thus results are discussed in terms of total numbers. Comparing recaptures by transects provides the best indication of local north-south movement. Crabs released on Transect A are recaptured primarily on Transect A (39 percent) or Transect B (44 percent). Recaptures after release on Transect B were mostly (71 percent) on Transect B, recaptures from Transect C were either on Transect C (38 percent) or Transect D (54 percent), and those from Transect D were recaptured along Transect D (80 percent). The latter value is biased by the lack of traps further north. The data do indicate a movement of crabs to the north from all transects but particularly from A and C with more limited numbers released on Transect B being recaptured on C or D. There is also some movement to the south from Transects B, C, and D.

Within each transect, there was some east-west movement indicated. Crabs released at inshore stations, e.g., A1, B1, B2, D1, and D2, were often found further offshore. Crabs released at central stations, e.g., A4, B4, D3, and D4, tended to be recaptured inshore.

In Table 9.2-14, the release and recapture data is presented in terms of the average time between the two events in order to consider rate of movement. The times are highly variable, and the variation in number of crabs recaptured requires careful interpretation. For crabs released at a point on a given transect, recaptures occur more quickly on the same transect than on other transects. On Transect A, recaptures on Transects C or D occur over the same range of average times as recaptures on Transect B. It is possible, using weighted averages for recaptures on the four transects, to define the time from release along Transect A until recapture as increasing with distance north: Transect A (22.5 days), Transect B (29.1 days), Transect C (34.1 days), and Transect D (34.8 days).

In addition to recaptures in Crystal Bay, recaptures were recorded north and south. Table 9.2-15 provides a summary of the numbers of crabs recaptured at various locations. The southern section of Crystal Bay accounted for only 0.5 percent of the recaptures. About 27 percent of the total recaptures were from Waccasassa Bay and less than 6 percent from further north. As would be expected, releases from northern transects in Crystal Bay accounted for higher numbers of recaptures to the north. Recaptures to the south came mostly from Transects A and B. Males accounted for all but one of the crabs recaptured to the south but only about 5 percent of the crabs moving north.

Average time between release and recapture is provided in Table 9.2-16. In general, crabs were recaptured most quickly in Crystal Bay with the time span increasing with distance from Crystal Bay. Maximum times occurred with crabs recaptured near Apalachicola River (about 225 km NW). Crabs recaptured to the south (10 km) had unexpectedly high times, similar to times seen about 200 km northwest.

Over 900 crabs were recaptured in Waccasassa Bay. A comparison was made of recapture times in Waccasassa Bay and release stations along Transects B and C. For each comparably located station, the time to recapture is less from Transect B than Transect C. Comparing Transects D and B, three of the comparable stations on B have shorter times until recapture in Waccasassa Bay. Crabs from Transect A take longer than crabs from B but sometimes more and sometimes less time than crabs from C and D. Comparing weighted average times by transect indicates the shortest recapture time from Transect B (43.8 days) and the longest time from Transect C (52 days). The average time from Transect D (45 days) is similar to that from Transect B but lower than from Transect A (49.7 days).

9.2.6 Special Studies of SIO

Evidence of disease or parasitism was encountered in only two species. Fifty-seven batfish, all with an intestinal nematode, were collected and sacculinid parasites were found on 76 blue crabs of 422 collected. All but one batfish was from trawl collections, the largest number occurred at Station T7, and parasitized fish were taken in 10 of the 12 collections. Almost 72 percent of the parasitized batfish were collected in the control area. All but two of the blue crabs reported were also from trawl collections, the largest number were taken at Station T9, and they occurred in all months with higher numbers in April and May. In other gear, only 2 of 115 crabs were parasitized. In the trawls, a significantly greater percentage of parasitized crabs occurred in the thermal area (56 percent) compared to the control area (44 percent). This pattern was reversed only in the spring (control, 63 percent; thermal, 37 percent).

Gravid females of only three species were collected and analyzed; all were less than 1 year old. Three pigfish were collected in March 1984 at Stations T7 and T9. Fecundity ranged from 17302 to 28160 (average 21660) eggs per female. Nine bay anchovies were found to have 1173 to 4387 (average 2290) eggs per female. One specimen was taken in June 1983 at Station T4, three were collected in March 1984 at Stations T1 and T2, and the remainder were at Stations T7 and T8 in April. Eleven silver perch ranged from 17920-147050 (average 48140) eggs per female. All were collected in March at Stations T1 and T4 or in April at Stations T1, T4, T8. While the numbers involved are too small to warrant quantitative analysis, it can be noted that the March occurrence of silver perch and bay anchovy was at stations closest to the thermal discharge.

The SIO collected for special studies were analyzed for several other parameters to identify possible differences between thermal and control areas. For these analyses, thermal stations were defined as T1, T2, T4, S2, S3, D1, TC1, and TC2. These were compared to fish collected at Stations T7, T8, T9, S4, D2, TC3, and TC4.

Age

Each SIO was evaluated by age class in each month of the study. The number of specimens was generally small and variable. Bay anchovy were all first year fish. In all months when they were found only in one area (July, September, November, January, February), the fish were in the thermal area. In March and April higher numbers occurred at control stations while in May, August, and October, numbers were higher at thermal stations. Pigfish were 0-3 year classes; older fish were generally found at the control stations. Young-of-the-year were also most commonly at control stations.

Pinfish were of the 0 or 1 year classes. Numbers of young fish were highest at control stations except in early summer when comparable numbers were collected in both areas. Older specimens were more common at control stations. Silver perch were 0, 1, or 2 year classes; young fish occurred in higher numbers at the thermal stations throughout the year. Spotted seatrout were 0, 1, or 3 year classes but fish for which age was determined were too uncommon to consider distribution. One spot was in its second year; all others were young-of-the- year. Numbers were either equal in both areas (November, February, March, April, May) or higher at thermal stations. Mullet were 0, 1, or 2 year classes, but generally occurred in low numbers in one area or the other. Only two red drum were collected; both were age 1.

Sex

Each SIO for which sex was determined was considered in terms of total numbers at thermal or at control stations. Results are shown in Table 9.2-17. The ratio of females to males was higher in the thermal area compared to the control area for bay anchovy, batfish, silver perch, and pink shrimp. The ratio was lower for pigfish, pinfish, seatrout, mullet, and blue crab.

Reproductive Condition

The reproductive condition of specimens analyzed for each SIO was considered in terms of total numbers in control and thermal areas. Most species were either not collected in comparable conditions in both areas or were collected in similar numbers in both areas. Immature specimens found in larger numbers at thermal stations included bay anchovy, silver perch, spotted seatrout, spot, pink shrimp, and blue crabs. Immature batfish, pigfish, and pinfish were more common in control areas. Numbers of mature pinfish were higher in the control area. Mature bay anchovies had higher numbers in the thermal area.

Only bay anchovies, pigfish, pinfish, and silver perch were found in significant numbers for any condition other than immature. More mature silver perch tended to be collected in the thermal area; pinfish and pigfish were the reverse. Anchovies in all conditions were either in similar numbers in both areas or in higher numbers in the thermal area.

Length-Weight

The length-weight and condition index data were available in sufficient abundance for analysis of six species: bay anchovy, batfish, pigfish, pinfish, silver perch, and spot. The analysis examined differences in length-weight and condition factor by sex, season, and location (thermal vs control). The analysis is a regression of log of weight on log of length using one of the above factors as a covariate.

The analysis of the effect of sex on the length-weight relationship indicated that significant differences existed only for silver perch. Silver perch females have a greater rate of increase in weight by length (slope) than male silver perch.

In the analysis of the effects of season on the length-weight relationship a separate seasonal analysis was conducted for each sex for silver perch and for all specimens of the other five species. These tests revealed differences in log weight vs log length slopes for four species. For bay anchovy, the fall and spring specimens had a lower slope than summer and winter collected specimens. Mean size also differs with season with the smaller specimens being collected in the summer. Summer collected pinfish were large in size and had a weight-length slope greater than all other seasons. Fall collected pinfish were also large in size and had significantly greater slope than winter and spring collected specimens. Silver perch females were significantly smaller in the summer, but the larger spring specimens had a lower weight-length slope than specimens collected at other times of the year. Spot collected in the spring, while moderate in size, had weight-length slope significantly greater than specimens collected at other times of the year.

In the analysis of the effects of thermal vs control areas, four species displayed significant differences. In spring and fall, bay anchovy in the thermal area had a significantly lower weight-length slope than those collected in the control area. Spot collected in summer, fall, and winter showed the same pattern, but significantly larger specimens were collected in the thermal area. Female silver perch collected in summer, fall, and winter in the thermal area had a significantly greater weight-length slope than specimens collected in the control area. Pigfish showed the same pattern and were significantly smaller in size in the thermal area.

Reference for 9.2

Pielou, E. C. 1975. Ecological Diversity. John Wiley and Sons, New York. 165 pp.

TABLE 9.2-1

FISHERIES SAMPLING DATA
NUMBERS OF FISH (F) AND INVERTEBRATES (I)

Month	Sampling Gear							
	Trawl		Seine		Creek Trawl		Drop Net	
	F	I	F	I	F	I	F	I
June	1742	625	1342	4	-	-	190	379
July	1277	2005	1084	-	444	172	151	501
August	2130	1834	559	13	334	129	42	79
September	1912	989	2047	1	314	117	410	-
October	1004	455	576	3	233	79	449	122
November	679	392	108	3	555	354	533	1021
December	554	269	36	26	80	807	28	292
January	121	605	67	2	788	2865	40	42
February	435	855	2898	147	1644	889	1418	6
March	1033	890	9846	7	3575	386	76	1
April	1304	774	75	13	636	125	136	-
May	2448	449	1028	10	1489	326	56	-

TABLE 9.2-2

NUMBER OF FISH COLLECTED BY TRAWL

Location	Month												
	J	J	A	S	O	N	D	J	F	M	A	M	
Northern Transect:													
T1	540	375	362	369	83	60	74	8	96	335	96	318	
T2	327	226	475	377	201	139	112	25	52	41	68	311	
T3	62	121	139	191	86	109	17	7	25	24	33	280	
Transect Total	929	722	976	937	370	308	203	40	173	400	197	909	6164
Central Transect:													
T4	82	28	67	197	105	92	169	15	25	40	551	103	
T5	49	61	158	144	59	29	58	8	13	23	20	154	
T6	19	24	68	41	26	21	24	6	18	19	37	107	
Transect Total	150	113	293	382	190	142	251	29	56	82	608	364	2660
Southern Transect:													
T7	145	97	215	155	111	99	12	17	89	152	358	249	
T8	46	31	231	49	140	59	72	16	56	64	61	156	
T9	472	314	415	389	193	71	16	19	61	335	80	770	
Transect Total	663	442	861	593	444	229	100	52	206	551	499	1175	5815

TABLE 9.2-3

NUMBER OF INVERTEBRATES COLLECTED BY TRAWL

Location	Month J	J	A	S	O	N	D	J	F	M	A	M	
Northern Transect:													
T1	72	489	217	166	25	30	31	45	127	50	36	36	
T2	88	186	264	85	28	24	18	73	92	129	132	74	
T3	40	409	120	40	28	16	13	28	41	89	79	48	
Transect Total	200	1084	601	291	81	70	62	146	260	268	247	158	3468
Central Transect:													
T4	30	214	108	75	39	28	4	4	20	92	102	20	
T5	47	164	73	25	23	15	25	17	27	26	41	42	
T6	13	99	76	30	29	16	33	22	27	13	22	12	
Transect Total	90	477	257	130	91	59	62	43	74	131	165	74	1653
Southern Transect:													
T7	77	165	248	145	86	137	13	83	249	216	204	45	
T8	40	41	218	56	67	19	56	99	92	69	54	25	
T9	218	238	510	367	130	107	76	234	180	206	104	147	
Transect Total	335	444	976	568	283	263	145	416	521	491	362	217	5021

TABLE 9.2-4

NUMBER AND AVERAGE WIDTH OF CRABS TRAPPED

FROM SEPTEMBER 1983 THROUGH JANUARY 2, 1984

STATION	BLUE CRAB NUMBER	BLUE CRAB WIDTH (MM)	STONE CRAB NUMBER	STONE CRAB WIDTH (MM)
A1	742	142.9	11	79.8
A2	333	144.2	252	80.7
A3	325	148.5	368	80.3
A4	462	149.7	271	82.2
A5	63	153.2	362	82.8
A6	58	149.9	295	84.5
B1	533	146.1	238	81.9
B2	370	149.8	287	79.1
B3	312	147.6	288	79.3
B4	209	149.1	409	81.1
B5	100	147.8	464	81.6
B6	0	.	382	80.6
C1	351	140.5	144	78.3
C2	174	148.3	175	76.5
C3	435	149.4	185	78.3
C4	224	151.3	276	79.7
C5	111	145.5	332	79.4
C6	50	153.2	340	81.3
D1	574	152.8	6	82.7
D2	765	152.5	17	81.1
D3	605	148.2	148	79.2
D4	378	148.3	246	79.9
D5	95	148.2	344	80.1
D6	25	153.3	411	79.7

TABLE 9.2-5

NUMBER AND AVERAGE WIDTH OF CRABS TRAPPED

THROUGH OCTOBER 31, 1983

STATION	BLUE CRAB NUMBER	BLUE CRAB WIDTH (MM)	STONE CRAB NUMBER	STONE CRAB WIDTH (MM)
A1	228	141.6	2	84.5
A2	56	138.9	97	79.7
A3	23	142.3	131	80.7
A4	25	140.2	123	82.2
A5	3	141.7	127	85.6
A6	0	.	92	87.4
B1	147	149.8	115	82.3
B2	28	148.7	115	77.7
B3	14	148.0	144	78.7
B4	15	154.0	223	81.5
B5	4	150.8	240	83.1
B6	0	.	105	81.8
C1	119	137.2	74	78.0
C2	23	146.7	56	77.5
C3	30	151.1	107	79.3
C4	26	148.2	161	80.4
C5	13	150.7	117	79.8
C6	5	147.6	164	83.6
D1	211	153.8	1	70.0
D2	182	146.0	9	82.4
D3	38	145.1	107	78.8
D4	13	160.9	122	80.9
D5	5	163.8	132	80.4
D6	4	148.8	106	80.6

TABLE 9.2-6

NUMBER AND AVERAGE WIDTH OF CRABS TRAPPED

FROM NOVEMBER 1, 1983 THROUGH JANUARY 2, 1984

STATION	BLUE CRAB NUMBER	BLUE CRAB WIDTH (MM)	STONE CRAB NUMBER	STONE CRAB WIDTH (MM)
A1	514	143.4	9	78.8
A2	277	145.2	155	81.3
A3	302	148.9	237	80.1
A4	437	150.2	148	82.3
A5	60	153.8	235	81.3
A6	58	149.9	203	83.2
B1	386	144.8	123	81.6
B2	342	149.9	172	80.0
B3	298	147.6	144	80.0
B4	194	148.7	186	80.7
B5	96	147.6	224	79.9
B6	0	.	277	80.1
C1	232	142.1	70	78.6
C2	151	148.6	119	76.0
C3	405	149.3	78	76.9
C4	198	151.7	115	78.8
C5	98	144.9	215	79.1
C6	45	153.9	176	79.2
D1	363	152.3	5	85.2
D2	583	154.5	8	79.6
D3	567	148.4	41	80.2
D4	365	147.8	124	79.0
D5	90	147.3	212	79.9
D6	21	154.1	305	79.4

TABLE 9.2-7

NUMBER AND AVERAGE WIDTH OF FEMALE CRABS TRAPPED

THROUGH OCTOBER 31, 1983

STATION	BLUE CRAB NUMBER	BLUE CRAB WIDTH (MM)	STONE CRAB NUMBER	STONE CRAB WIDTH (MM)
A1	105	145.6	1	90.0
A2	31	144.9	4	74.8
A3	16	143.1	18	74.7
A4	13	150.5	21	75.0
A5	2	154.0	12	76.9
A6	0	.	3	75.0
B1	67	159.8	8	78.3
B2	12	161.6	46	73.7
B3	9	156.6	64	77.3
B4	14	154.8	52	74.1
B5	4	150.8	63	77.3
B6	0	.	7	81.4
C1	40	142.8	19	75.5
C2	15	142.7	27	78.1
C3	18	156.4	51	76.5
C4	24	149.5	66	75.9
C5	11	156.1	41	75.4
C6	5	147.6	28	78.2
D1	29	146.3	0	.
D2	86	157.7	2	86.0
D3	23	154.0	73	77.2
D4	8	159.1	61	78.0
D5	4	165.3	61	77.0
D6	4	148.8	46	77.1

TABLE 9.2-B

NUMBER AND AVERAGE WIDTH OF MALE CRABS TRAPPED

THROUGH OCTOBER 31, 1983

STATION	BLUE CRAB NUMBER	BLUE CRAB WIDTH (MM)	STONE CRAB NUMBER	STONE CRAB WIDTH (MM)
A1	107	141.4	1	79.0
A2	23	133.6	93	79.9
A3	7	140.4	113	81.6
A4	11	130.5	102	83.7
A5	1	117.0	115	86.5
A6	0	.	89	87.8
B1	71	143.5	99	82.6
B2	14	142.7	69	80.4
B3	5	132.6	80	79.8
B4	1	143.0	171	83.8
B5	0	.	177	85.2
B6	0	.	98	81.8
C1	58	143.1	52	79.3
C2	8	154.0	26	77.5
C3	11	144.2	45	83.7
C4	2	132.5	77	84.1
C5	2	121.0	63	83.0
C6	0	.	111	85.0
D1	181	155.3	1	70.0
D2	70	144.7	7	81.4
D3	10	141.6	34	82.2
D4	4	166.8	61	83.8
D5	1	158.0	71	83.2
D6	0	.	60	83.3

TABLE 9.2-9

NUMBER AND AVERAGE WIDTH OF FEMALE CRABS TRAPPED

FROM NOVEMBER 1, 1983 THROUGH JANUARY 2, 1984

STATION	BLUE CRAB NUMBER	BLUE CRAB WIDTH (MM)	STONE CRAB NUMBER	STONE CRAB WIDTH (MM)
A1	212	157.6	1	89.0
A2	185	153.8	25	79.7
A3	251	152.4	58	76.8
A4	409	151.0	56	76.9
A5	57	155.5	84	76.1
A6	54	151.4	60	77.1
B1	192	155.8	15	81.9
B2	273	155.4	49	76.2
B3	264	150.3	59	78.2
B4	186	149.7	72	76.8
B5	88	151.0	113	77.7
B6	0	.	92	76.7
C1	95	151.9	8	79.6
C2	104	152.4	46	74.3
C3	365	151.6	43	75.7
C4	184	153.2	56	76.1
C5	78	149.1	117	77.0
C6	40	157.8	86	75.4
D1	64	162.6	0	.
D2	411	160.6	6	77.5
D3	496	151.2	26	81.5
D4	335	149.8	64	75.7
D5	84	148.8	98	75.6
D6	19	155.0	147	78.4

TABLE 9.2-10

NUMBER AND AVERAGE WIDTH OF MALE CRABS TRAPPED

FROM NOVEMBER 1, 1983 THROUGH JANUARY 2, 1984

STATION	BLUE CRAB NUMBER	BLUE CRAB WIDTH (MM)	STONE CRAB NUMBER	STONE CRAB WIDTH (MM)
A1	228	137.1	8	77.5
A2	49	141.4	130	81.7
A3	30	143.5	179	81.2
A4	20	146.8	92	85.5
A5	1	132.0	151	84.2
A6	1	128.0	143	85.7
B1	149	137.6	108	81.5
B2	33	139.3	123	81.6
B3	17	144.9	85	81.2
B4	4	138.8	101	83.6
B5	3	125.3	111	82.2
B6	0	.	185	81.8
C1	118	139.7	62	78.5
C2	40	145.0	73	77.0
C3	21	138.2	35	78.3
C4	6	147.2	59	81.4
C5	8	145.5	98	81.7
C6	3	126.0	90	82.9
D1	288	151.3	5	85.2
D2	129	148.1	2	86.0
D3	35	139.8	15	77.9
D4	14	142.7	60	82.6
D5	4	132.3	114	83.6
D6	2	146.0	158	80.4

TABLE 9.2-11

TOTAL NUMBER OF CRABS RECAPTURED

RECAPTURE LOCATION	RELEASE LOCATION																										
	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	E	F	G
01	.	.	2	3	.	.	.	1	1	2	.	.	2	.	7	.	4	.	1	6	2	8	.	1	.	.	.
03	.	.	1	.	.	.	.	.	1	.	.	.	1	.	2	.	.	.	.	.	.	1	.	.	.	.	.
04	.	3	.	1	.	.	.	.	3	1	.	.	.	.	1	2	.	.	.	1	4	6	.	.	.	.	.
05	6	2	6	3	1	3	5	7	5	4	4	.	14	10	43	12	6	2	19	63	86	16	8	3	2	2	.
06	4	1	.	6	.	.	3	6	2	2	1	.	9	6	12	2	4	3	7	48	23	14	1	.	.	3	6
07	.	.	.	1	.	.	.	2	2	.	.	.	1	1	2	.	1	.	1	14	3	1	.	1	.	.	.
08	.	.	.	1	.	.	1	.	.	1	.	.	5	2	5	.	.	.	67	10	.	1	1	.	1	1	1
09	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.
11	14	9	14	25	1	3	27	10	18	18	2	.	6	1	2	4	2	1	3	5	2	5	.	.	1	2	.
12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
13	.	.	1	.	.	.	.	.	1	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
14	.	.	.	.	1	.	.	1	1	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	1
15	.	.	.	.	.	.	2	.	1	.	.	.	.	.	3	1	.	.	.	1	.	.	1	1	.	.	.
16	1	.	6	8	.	2	2	.	1	2	3	.	10	8	2	.	1	.	.	.	.	.	.	.	.	1	.
17	1	1	1	3	.	.	.	.	.	.	1	.	12	11	.	2	2	1	37	5	2	1	1	1	.	.	.
18	.	.	.	.	.	.	.	.	.	1	.	.	21	6	5	4	2	.	8	8	2	3	1	.	.	1	.
19	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
21	3	4	2	6	1	2	.	.	6	1	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2	.	.
22	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
23	3	3	3	8	2	6	11	10	3	.	8	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.
24	13	15	17	33	9	6	37	65	38	42	13	.	3	.	1	.	1	.	.	1	.	.	.	.	4	1	.
25	15	7	16	25	2	3	15	25	18	9	5	.	.	.	2	3	.	.	.	.	1	.	.	.	1	.	.
26	5	9	6	7	.	2	10	4	12	4	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
27	27	9	11	20	6	1	37	33	9	2	3	.	.	1	1	2	.	.	1	.	.	1	.	.	3	4	.
28	13	8	2	6	1	.	37	7	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.
29	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.
30	3	.	.	.	.	.	7	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
34	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
35	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
36	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
37	18	14	25	15	.	1	.	8	11	5	1	.	.	.	2	1	1	.	1	.	.	2	.	.	2	.	.
38	73	26	4	4	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	2	.
39	28	10	1	4	.	1	3	2	2	1	.	.	.	.	.	.	1	.	.	.	2	.	.	.	.	1	.
40	44	12	10	6	1	1	10	6	3	1	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.

TABLE 9.2-12

NUMBER OF FEMALE CRABS RECAPTURED

RECAPTURE LOCATION	RELEASE LOCATION																										
	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	E	F	G
01	.	.	1	3	.	.	.	1	1	2	.	.	2	.	7	.	4	.	1	5	2	8	.	1	.	.	.
03	.	.	1	.	.	.	.	.	1	.	.	.	1	.	2	.	.	.	.	.	.	1	.	.	.	.	.
04	.	3	.	1	.	.	.	.	3	1	.	.	.	.	1	2	.	.	.	1	4	5	.	.	.	.	.
05	5	2	6	3	1	3	4	5	5	4	3	.	11	9	40	12	5	2	11	52	78	16	8	2	2	2	.
06	3	1	.	6	.	.	2	6	2	2	1	.	7	6	11	2	4	3	4	39	23	12	1	.	.	1	4
07	.	.	.	1	.	.	.	2	1	.	.	.	.	1	2	.	1	.	.	3	3	1	.	1	.	.	.
08	.	.	.	1	.	.	1	.	.	1	.	.	1	.	4	.	.	.	1	.	.	1	1	.	.	.	.
09	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
11	14	9	14	25	1	3	24	10	16	18	2	.	5	1	2	4	2	1	.	5	2	5	.	.	1	1	.
12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
13	.	.	1	.	.	.	.	.	1	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
14	.	.	.	.	1	.	.	1	1	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.
15	.	.	.	.	.	.	1	.	1	.	.	.	.	.	3	1	.	.	.	1	.	.	1	1	.	.	.
16	1	.	6	8	.	2	2	.	1	2	3	.	7	7	1	.	.	.	.	.	.	.	.	.	.	1	.
17	1	.	1	3	.	.	.	.	.	.	1	.	6	6	.	2	2	1	3	2	2	1	1	1	.	.	.
18	.	.	.	.	.	.	.	.	.	1	.	.	14	4	5	3	2	.	1	3	2	3	.	.	.	1	.
19	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
21	.	3	2	6	1	2	.	.	6	1	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2	.	.
22	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
23	3	3	3	8	2	6	8	10	3	.	8	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.
24	10	12	17	31	9	6	34	56	36	42	13	.	1	.	1	.	1	.	.	1	.	.	.	.	3	1	.
25	12	7	14	25	2	3	11	25	17	9	5	.	.	.	2	3	.	.	.	.	1	.	.	.	1	.	.
26	3	6	6	7	.	2	8	4	12	4	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
27	18	8	11	18	6	1	27	30	6	2	3	.	.	.	.	2	.	.	.	.	.	1	.	.	2	2	.
28	7	8	2	6	1	.	8	5	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
29	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
30	1	.	.	.	.	.	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
34	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
35	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
36	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
37	12	12	24	12	.	1	.	7	10	4	1	.	.	.	2	1	.	.	1	.	.	1	.	.	2	.	.
38	53	22	2	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	1	.
39	10	8	.	3	.	1	2	2	2	1	.	.	.	.	.	.	1	.	.	.	2	.	.	.	.	.	.
40	18	10	10	6	1	1	8	4	3	1	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.

TABLE 9.2-13

NUMBER OF MALE CRABS RECAPTURED

RECAPTURE LOCATION	RELEASE LOCATION A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	E	F	G
01	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
03	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
04	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
05	1	.	.	.	.	.	1	2	.	.	1	.	3	1	3	.	1	.	8	11	8	.	.	1	.	.	.
06	1	.	.	.	.	.	1	.	.	.	.	.	2	.	1	.	.	.	3	9	.	2	.	.	.	2	2
07	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	1	11	.	.	.	.	.	.	.
08	.	.	.	.	.	.	.	.	.	.	.	.	4	2	1	.	.	.	66	10	.	.	.	.	1	1	1
09	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.
11	.	.	.	.	.	.	3	.	2	.	.	.	1	.	.	.	.	.	3	.	.	.	.	.	.	1	.
12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
15	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
16	.	.	.	.	.	.	.	.	.	.	.	.	3	1	1	.	1	.	.	.	.	.	.	.	.	.	.
17	.	1	.	.	.	.	.	.	.	.	.	.	6	5	.	.	.	.	34	3	.	.	.	.	.	.	.
18	.	.	.	.	.	.	.	.	.	.	.	.	7	2	.	1	.	.	7	5	.	.	1	.	.	.	.
19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
21	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
23	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
24	3	3	.	2	.	.	3	9	2	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	1	.	.
25	3	.	2	.	.	.	4	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
26	2	3	.	.	.	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
27	9	1	.	2	.	.	10	3	3	.	.	.	.	1	1	.	.	.	1	.	.	.	.	.	1	2	.
28	6	.	.	.	.	.	29	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
29	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.
30	2	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
34	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
35	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
36	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
37	6	2	1	3	.	.	.	1	1	1	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.
38	20	4	2	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
39	18	2	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
40	26	2	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

TABLE 9.2-14

AVERAGE TIME BETWEEN RELEASE AND RECAPTURE IN DAYS

RECAPTURE LOCATION	RELEASE LOCATION A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	E	F	G
01	.	.	40	42	.	.	.	40	35	24	.	.	78	.	36	.	43	.	39	40	39	28	.	49	.	.	.
03	.	.	102	.	.	.	.	.	8	.	.	.	45	.	21	.	.	.	.	.	.	16	.	.	.	.	.
04	.	36	.	14	.	.	.	.	14	46	.	.	.	.	4	15	.	.	.	11	6	8	.	.	.	.	.
05	26	63	10	26	69	39	30	16	22	17	50	.	37	24	22	23	27	20	29	25	22	19	30	60	10	18	.
06	45	14	.	46	.	.	26	16	37	23	18	.	54	34	22	20	20	34	46	26	21	28	17	.	.	18	34
07	.	.	.	98	.	.	.	45	58	.	.	.	21	36	32	.	63	.	25	22	24	33	.	16	.	.	.
08	.	.	.	14	.	.	36	.	.	15	.	.	22	8	17	.	.	.	18	24	.	22	7	.	14	5	9
09	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	7	.	.	.	.	.	.	.
11	21	21	19	18	18	20	22	22	17	18	26	.	57	28	33	24	19	26	99	49	40	29	.	.	11	18	.
12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.
13	.	.	34	.	.	.	.	.	28	28	16	.	.	.	.	28	.	.	.	.	.	.	.	.	.	.	.
14	.	.	.	.	46	.	.	28	14	.	.	.	.	35	.	7	.	.	.	.	.	.	.	.	.	.	24
15	.	.	.	.	.	.	16	.	14	.	.	.	.	.	7	7	.	.	.	64	.	.	6	6	.	.	.
16	111	.	89	87	.	84	131	.	92	84	74	.	18	7	25	.	79	.	.	.	.	.	.	.	.	89	.
17	5	52	52	52	.	.	.	.	.	.	48	.	26	15	.	53	47	47	50	49	52	52	83	47	.	.	.
18	.	.	.	.	.	.	.	.	.	81	.	.	24	48	67	49	78	.	48	38	63	46	6	.	.	105	.
19	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13	.	.	.	.	.	.	.
21	30	45	27	47	54	42	.	.	19	23	.	.	.	.	.	.	.	.	.	103	41	.	.	.	22	.	.
22	.	.	101	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	.	.	.	.	.	.	.
23	55	13	54	32	6	30	10	19	16	.	11	.	.	.	.	8	.	.	.	.	.	.	9	.	.	.	.
24	29	27	25	27	17	34	15	11	17	26	21	.	23	.	11	.	9	.	.	63	.	.	.	.	39	24	.
25	22	10	27	25	3	17	28	17	12	14	17	.	.	.	32	49	.	.	.	.	4	.	.	.	25	.	.
26	21	18	24	21	.	17	31	13	9	14	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
27	23	36	37	21	12	20	22	15	41	32	24	.	.	92	58	40	.	.	71	.	.	28	.	.	26	44	.
28	46	69	25	60	149	.	69	49	.	128	128	.	.	51	.	.	.	.	.	.	.	.	.	.	203	.	.
29	64	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	80	24	.
30	8	.	.	.	.	.	13	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
34	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
35	.	.	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
36	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
37	19	27	25	31	.	24	.	30	22	26	24	.	.	.	43	82	36	.	107	.	.	44	.	.	11	.	.
38	17	10	15	16	10	.	12	.	.	.	.	.	.	.	.	.	.	.	.	15	.	.	.	.	27	19	.
39	20	25	104	4	.	23	31	20	6	19	.	.	.	.	.	.	3	.	.	.	6	.	.	.	.	12	.
40	25	33	37	66	25	92	24	16	13	36	.	.	.	.	.	.	.	.	119	59	.	.	.	.	.	.	.

TABLE 9.2-15

TOTAL NUMBER OF CRABS RECAPTURED

RECAPTURE LOCATION	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	E	F	G
	RELEASE LOCATION																										
SOUTH CRYSTAL BAY	5	1	1	1	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.
CRYSTAL BAY	274	133	130	188	27	31	208	188	138	98	51	.	85	48	90	37	26	7	148	167	128	59	14	7	20	19	8
WACCASASSA BAY	16	14	21	38	9	7	25	37	37	21	14	.	21	40	85	45	21	17	37	133	136	104	31	10	7	11	16
SUWANEE SOUND	1	1	2	4	1	.	.	.	2	1	.	.	.	1	8	1	.	1	1	15	12	7	2	.	.	2	1
HORSESHOE COVE	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	1	.	.	.	.	.	1
DEADMAN BAY	.	.	.	.	1	.	.	1	1	.	.	.	1	.	2	1	.	.	1	3	6	1	2	.	.	2	.
FENHOLLOWAY RIVER AREA	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	4	3	.	.	.	1	1
APALACHEE BAY	2	1	1	7	.	.	1	1	5	1	.	.	3	1	9	7	4	3	.	8	7	7	5	.	4	.	3
DOG SOUND	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	1	2	1	.	.	.	.	.
APALACHICOLA RIVER AREA	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.
WEST OF CAPE SAN BLAS	.	.	.	1	.	.	.	1	.	1	.	.	.	.	1	.	.	.	.	3	1	.	.	.	.	.	.

TABLE 9.2-16

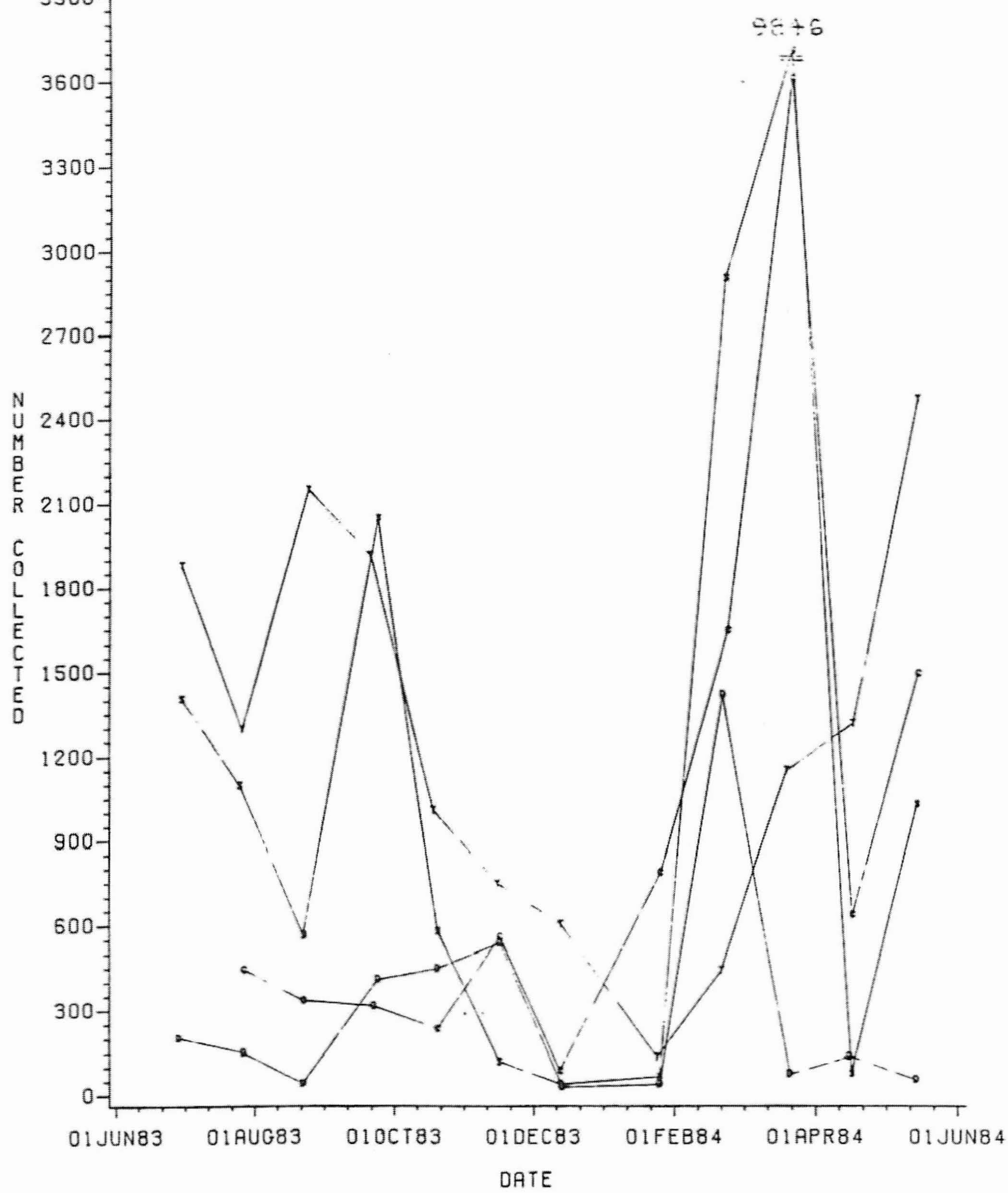
AVERAGE TIME BETWEEN RELEASE AND RECAPTURE IN DAYS

RECAPTURE LOCATION	RELEASE LOCATION																										
	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	E	F	G
SOUTH CRYSTAL BAY	134	150	157	177	.	.	148	.	.	.	.	.	.	.	.	.	.	.	.	157	.	.	.	.	.	15	.
CRYSTAL BAY	24	26	31	31	23	34	31	17	19	26	26	.	34	25	26	30	35	31	34	28	23	25	26	42	38	32	30
WACCASASSA BAY	33	57	43	58	45	55	54	46	45	35	30	.	59	52	47	52	76	40	38	49	44	39	67	28	82	46	81
SUWANEE SOUND	22	18	70	60	78	.	.	.	69	40	.	.	.	121	82	81	.	63	70	54	87	71	69	.	.	82	27
HORSESHOE COVE	.	.	125	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	100	93	.	.	.	.	.	59
DEADMAN BAY	.	.	.	.	96	.	.	104	107	.	.	.	158	.	68	101	.	.	83	60	83	79	80	.	.	70	.
FENHOLLOWAY RIVER AREA	.	.	.	.	.	.	.	.	.	.	.	.	.	.	119	.	.	.	.	78	101	61	.	.	.	115	73
APALACHEE BAY	100	181	147	175	.	.	102	131	109	108	.	.	133	133	116	118	125	98	.	138	142	105	84	.	173	.	79
DOG SOUND	.	.	.	.	.	.	126	103	.	.	.	.	.	.	.	.	.	.	.	108	123	100	.	.	.	.	.
APALACHICOLA RIVER AREA	.	.	.	189	.	.	.	.	.	187	.	.	.	.	.	.	.	.	.	181	198	.	.	.	.	.	.
WEST OF CAPE SAN BLAS	.	.	.	141	.	.	.	130	.	108	.	.	.	.	180	.	.	.	.	147	135	.	.	.	.	.	.

TABLE 9.2-17

NUMBERS OF SIO IN THERMAL AND CONTROL AREAS

Species	Male		Female	
	Thermal	Control	Thermal	Control
Bay anchovy	45	34	142	83
Polka-dot batfish	1	14	15	26
Pigfish	30	141	36	220
Pinfish	124	253	100	262
Silver perch	98	105	217	115
Spotted seatrout	6	4	5	4
Spot	239	69	213	61
Red drum		1	1	
Striped mullet	20	1	34	8
Pink shrimp	339	284	369	276
Blue crab	85	37	132	89
Stone crab		9	2	5



T=TRAWL
C=CREEK TRAWL
S=SEINE
D=DROP NET

FIGURE 9.2-1
NUMBER OF FISH COLLECTED
EACH MONTH BY GEAR TYPE
CRYSTAL RIVER 316 STUDIES
FLORIDA POWER CORPORATION

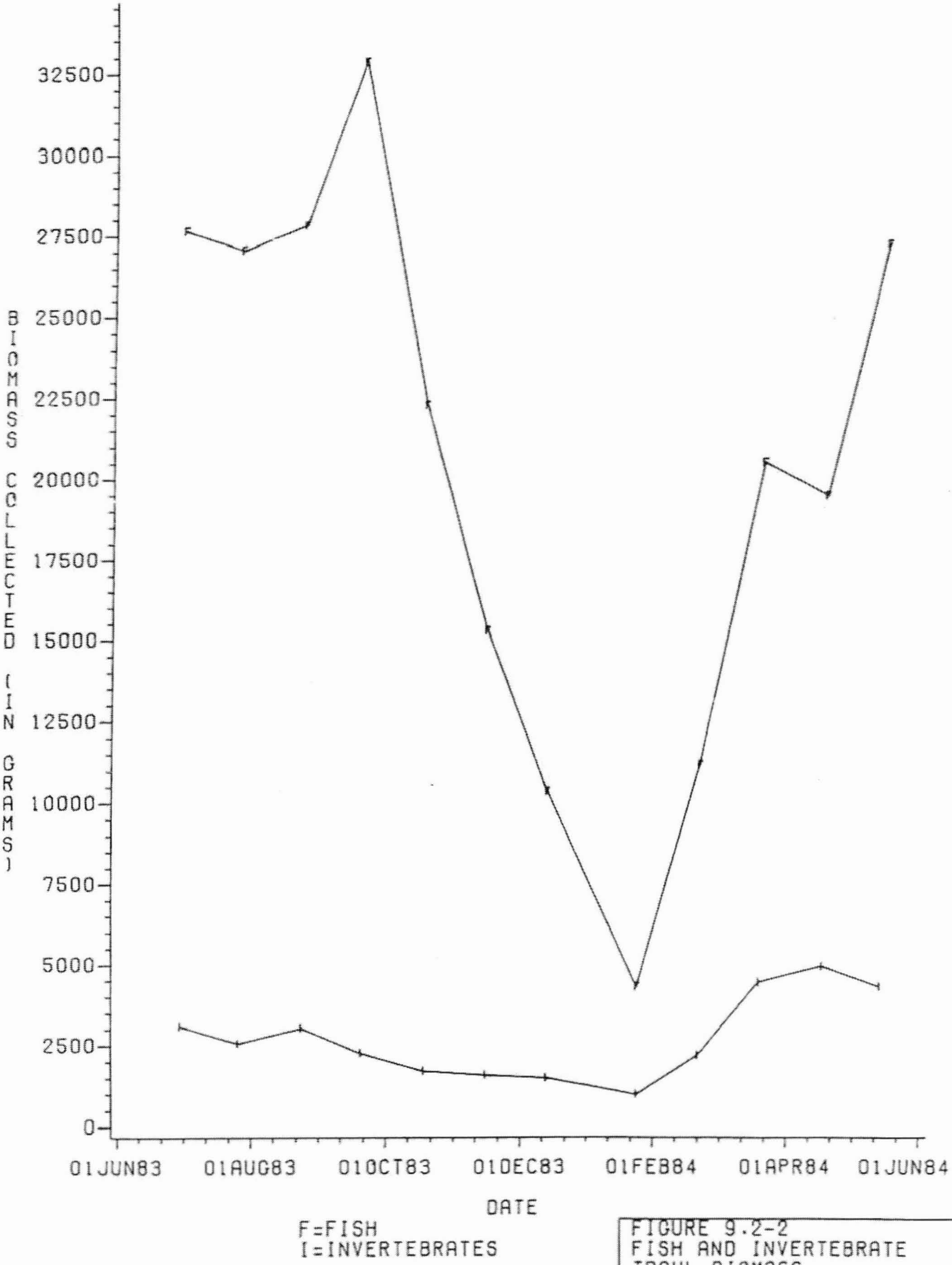
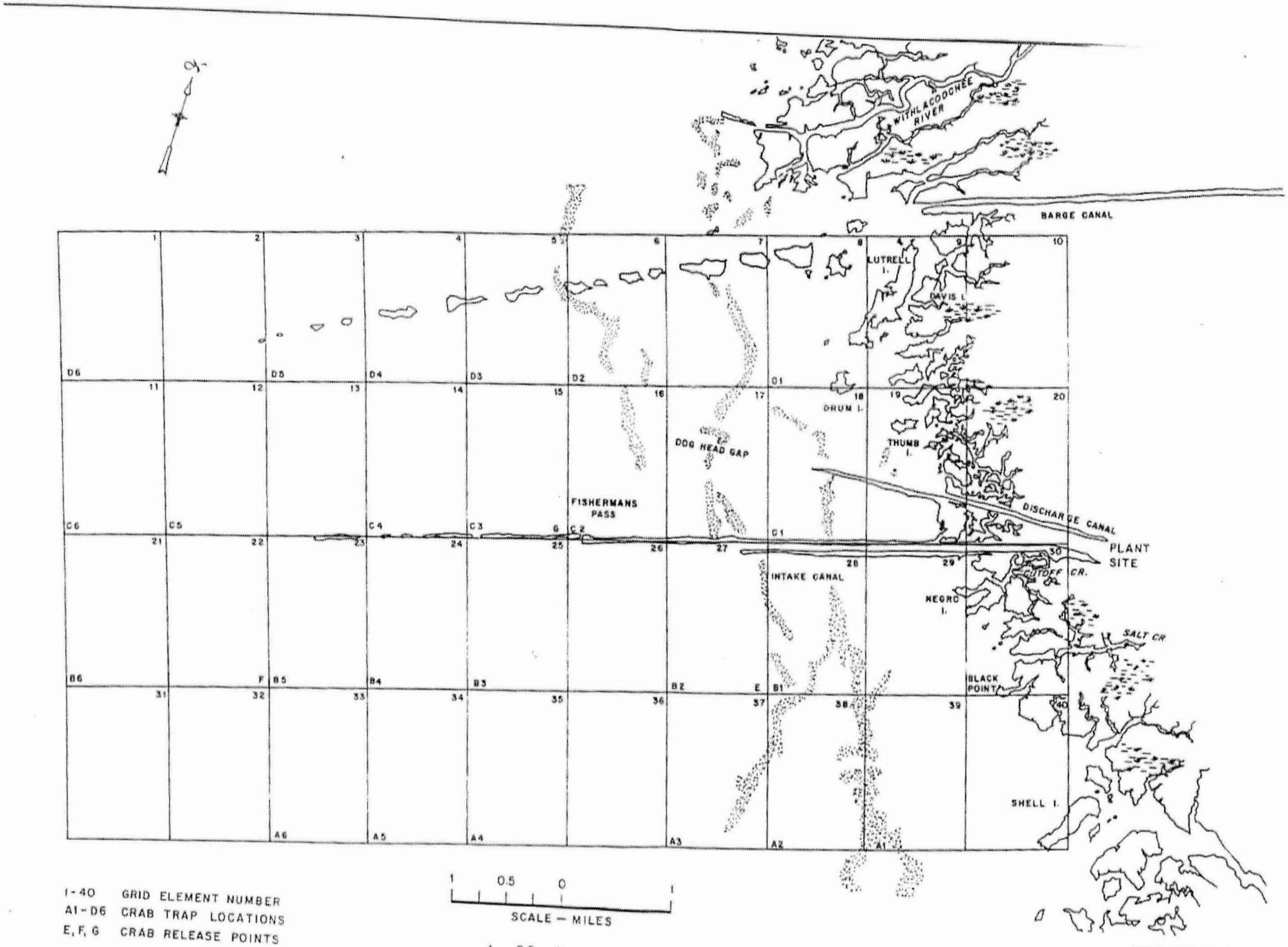


FIGURE 9.2-2
FISH AND INVERTEBRATE
TRAWL BIOMASS
CRYSTAL RIVER 316 STUDIES
FLORIDA POWER CORPORATION



1-40 GRID ELEMENT NUMBER
A1-D6 CRAB TRAP LOCATIONS
E, F, G CRAB RELEASE POINTS

1 0.5 0 1
SCALE — MILES

1 0.5 0 1
SCALE — KILOMETERS

FIGURE 9.2-3

CRAB TAG RETURN GRID AND CORRESPONDING TRAP LOCATION
CRYSTAL RIVER 316 STUDIES
FLORIDA POWER CORPORATION