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HUDSON RIVER ECOLOGICAL STUDY  
IN THE AREA OF INDIAN POINT  
FOR THE PERIOD  
JANUARY 1 THROUGH DECEMBER 31, 1973

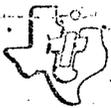
ANNUAL REPORT

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## Striped Bass

Methods. A total of 592 striped bass  $\geq 100$  mm in total length were tagged and released into the Hudson River from the George Washington Bridge (RM 12 [20 km]) to the Troy Dam (RM 152 [243 km]). For details concerning collection gear and procedures, tag types, and handling and tagging procedures, please refer to the section entitled "Mark/Recapture Experiments" in Chapter III.

Results and Discussion. As indicated in Table III-22, recovery rates varied among the size groupings.

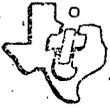
Table III-22  
1973 Striped-Bass Tag Recoveries\*

Total Length at Time of Release (mm)	No. Tagged	No. Recovered	% Recovery
100-149	321	0	0
150-400	122	0	0
> 400	149	17 <sup>†</sup>	11.4
Total	592	17	2.9

\* Floy fingererling tags for 100-149 mm; Dennison internal anchor tags for >150 mm  
<sup>†</sup> Includes two fish released December 1972.

### 1) Tag Returns

None of the tagged fish  $< 400$  mm in total length were recovered; the 17 tag returns, an 11.4% recovery, came from 149 adult fish  $> 400$  mm. Recovery rate for all tagged striped bass was 2.9%.



At least three explanations for not recovering tagged striped bass < 400 mm (TL) can be offered:

- These fish are not retained by sport and commercial fishermen since the minimum legal size in New York is 16 in. FL (417 mm TL, Texas Instruments Incorporated, 1973a).
- Dependence upon project sampling gear alone for recovery effort could be expected, at best, to recapture only 0.68% of the 443 tag releases of striped bass < 400 mm, or about three fish, assuming that the vulnerability of tagged striped bass to project sampling gear was similar to the vulnerability of tagged white perch (Tables III-11 and III-13).
- Apparently the majority of striped bass 100-400 mm in length are distributed in lower bay areas south of the 1973 sampling area (RM 12-52) (U.S. Atomic Energy Commission, 1973a; Clark and Smith, 1969).

Total length of recovered fish at time of release ranged from 492 to 975 mm (Table III-23). Age data available on 11 recoveries revealed a range of from IV-IX. Studies of age at maturity on Hudson River striped bass (Texas Instruments Incorporated, 1973c) showed that, of the 148 fish examined, all males > 3 years of age and females > 7 years were mature; however, no females < 6 years of age were mature. The sex of the 11 tag recoveries was not determined, but at least four can be labelled as mature when tagged since they measured 870 mm, 903 mm, 975 mm, and 745 mm (Table III-23).

Most of the tag returns (70.6%) came from sport fishermen; thus, anglers harvested at least 8.1% of the tagged striped-bass population > 400 mm. Assuming no mortality from tagging, no tag-shedding, and return of all recovered tags, an 8.1% harvest is a minimal estimate of the sport-fishery impact on the large tagged fish. Annual distribution of tag returns from sport fishermen suggests that large striped bass are subjected to angling pressure throughout the spring, summer, and fall (Table III-23).

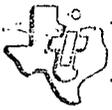


Table III-23  
1973 Striped-Bass Tag Recoveries

Release*		Recovery		Time at Large (days)	Total Length when Released (mm)	Age	Recovery Method†
Date	Location as River Mile (km)	Date	Location				
12/28/72	34 (54)	4/1/73	Long Island Sound, Rye, N. Y.	94	555	-	SF
12/28/72	34 (54)	5/25/73	Long Island Sound, Greenwich, Conn.	147	605	-	SF
1/3/73	34 (54)	4/23/73	Hudson River, RM 34	110	567	-	CF
1/3/73	34 (54)	3/30/73	Long Island Sound, Little Neck Bay, N. Y.	86	588	-	SF
3/9/73	33 (53)	4/23/73	Hudson River, RM 34	45	645	VI	CF
3/9/73	33 (53)	4/27/73	Hudson River, RM 39	49	570	V	PS
3/9/73	33 (53)	7/21/73	Long Island Sound, Mamaroneck, N. Y.	134	670	V	SF
3/13/73	32 (51)	5/1/73	Hudson River, RM 39	49	610	V	PS
3/13/73	32 (51)	6/20/73	Long Island Sound, Matinicock Pt., N. Y.	99	650	V	SF
3/13/73	32 (51)	7/27/73	Long Island Sound, Stamford, Conn.	136	650	V	SF
3/14/73	34 (54)	3/14/73	Hudson River, RM 34	< 1	552	-	SF
3/15/73	33 (53)	7/5/73	Nantucket Sound, Nantucket, Mass.	112	870	VIII	SF
3/26/73	34 (54)	6/7/73	Great South Bay, Robert Moses Bridge, N. Y.	73	575	-	SF
4/3/73	33 (53)	4/13/73	Hudson River, RM 31	10	492	IV	CF
4/19/73	60 (96)	10/12/73	Long Island Sound, Montauk Pt., N. Y.	174	903	VII	SF
4/20/73	59 (94)	6/19/73	Buzzards Bay, New Bedford, Mass.	60	975	IX	SF
4/26/73	59 (94)	9/17/73	Lower New York Bay, Rockaway Pt., N. Y.	145	745	VII	SF

\* All releases were made in the Hudson River.  
† SF = sport fishing; CF = commercial fishing; PS = project sampling.

Commercial gill-net fishermen yielded 17.6% of the tag returns. All commercial returns came from within the Hudson River between RM 31 and 34 (50 and 54 km). Project sampling with gill nets accounted for the remaining two tag returns.

Time at large for tagged fish varied from < 1 to 174 days (mean = 89.6 days). The capture of one fish by a sport fisherman on the same day on which it was tagged indicated quick resumption of normal behavior (Table III-23).



## 2) Migratory Patterns

The 17 tag recoveries had been tagged and released during the winter and spring (December 28 - April 26). The majority (82.4%) of the striped-bass recoveries had been tagged in the Croton Bay area, Group A (RM 32-34 [51-54 km]), as indicated in Table III-24. All recoveries from Group A except two came from either the Hudson River (42.9%) or the western end of Long Island Sound (42.9%); one of the two remaining tag returns came from Great South Bay near the Robert Moses Bridge, Long Island, N.Y. (Figure III-9), and the other from Nantucket Sound off Nantucket, Massachusetts.

Table III-24

Release and Recovery Areas for 1973 Striped-Bass Tag Returns

Release Area for Recovered Fish	No.	Group	No. Recovered and Recovery Area		
			Hudson River RM 31-39 (50-62 km)	Western End of Long Island Sound	Other Localities
Hudson River Croton Bay area RM 32-34 (51-54 km)	14	A	6	6	1, Nantucket Sound, Mass. 1, Great South Bay, Long Island, N.Y.
Hudson River Beacon area RM 59-60 (94-96 km)	3	B	0	0	1, Buzzards Bay, New Bedford, Mass. 1, Eastern Long Island Sound, Montauk Pt., Long Island, N.Y. 1, Lower New York Bay, Rockaway Pt., N.Y.

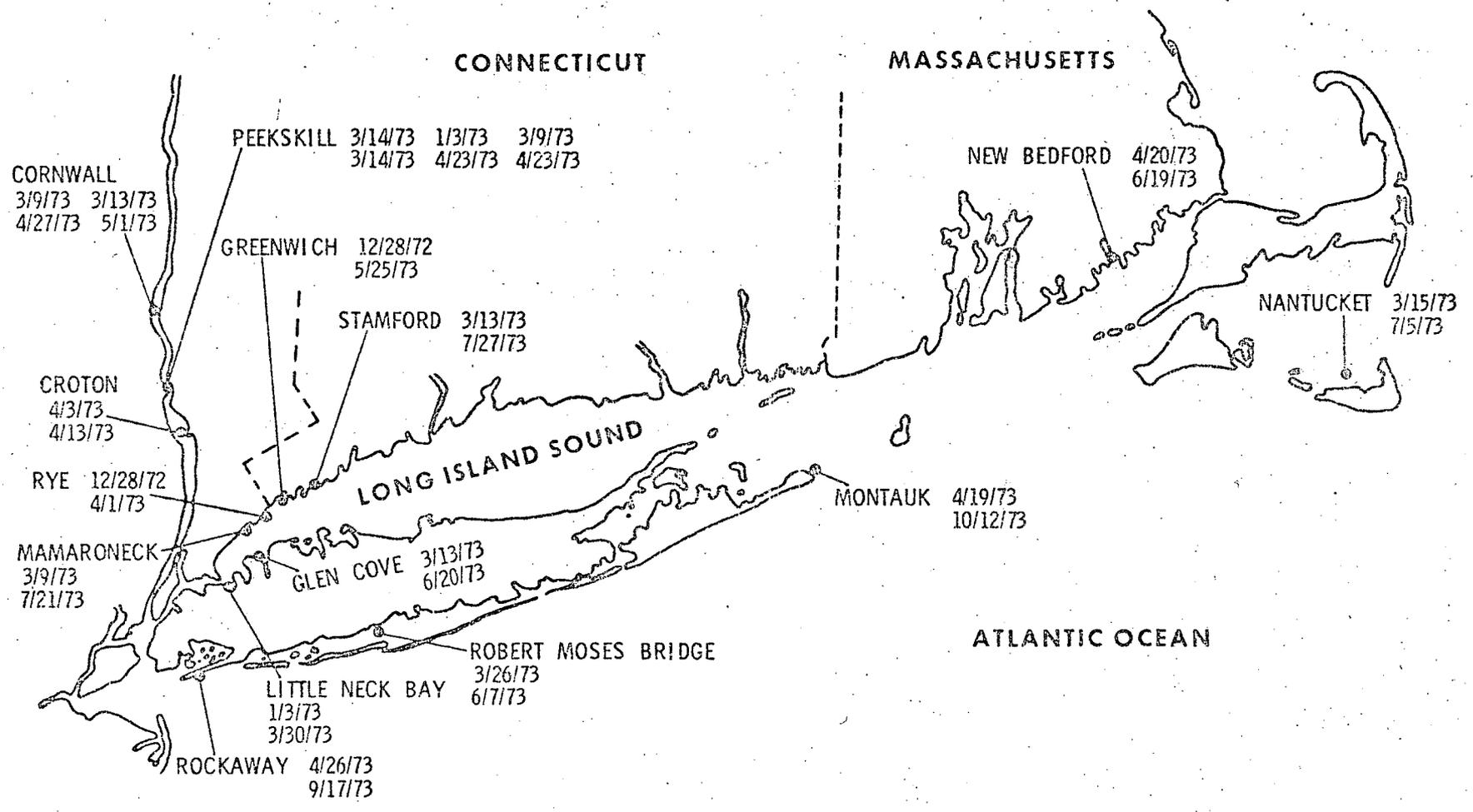


Figure III-9. Release (Upper Date Shown) and Recovery Location (Lower Date Shown) of Striped Bass > 400 mm Tagged in Hudson River



Three recoveries (17.6%) were tagged in the Beacon area, Group B (RM 59-60 [94-96 km]), during late April 1973 (Tables III-23 and III-24); this area is a reported spawning ground for striped bass (Rathjen and Miller, 1957; Clark, 1968; Carlson and McCann, 1969; Raney, 1972; and Texas Instruments, 1974), which suggests that these large older fish (Table III-23) were mature adults participating in spawning activity. All three fish were recovered outside the Hudson River (Figure III-9): one in Lower New York Bay near Rockaway Point, New York; one in eastern Long Island Sound near Montauk Point, New York; and one in Buzzards Bay, New Bedford, Massachusetts.

Although the number of tag releases and recoveries from the present study is insufficient for any definitive statements concerning the migration patterns of striped bass from the Hudson River, the recovery of 11 fish > 490 mm (TL) is a significant addition to the body of existing data. Interpretation of previous tagging data for striped bass in the Hudson River (summarized by Raney et al, 1954, and Raney, 1972) was based almost solely on the recovery of fish < 400 mm; several investigators (Schaefer, 1968; Raney, 1972) pointed out, however, that small striped bass, particularly those < 2 years old, are thought to be relatively nonmigratory. Thus, tag returns from small striped bass may provide information on local and seasonal movements but not on long-range migrations.

Clark (1968) analyzed the distribution patterns of striped bass (about 70% were 330 to 457 mm FL) tagged along the Northeast's Atlantic coast from 1959 to 1963; his findings with regard to Hudson River fish confirmed and extended a previous report by Raney, Wolcott, and Mehring (1954). Clark concluded that the striped-bass population contains three "contingents," or groups, of fish exhibiting similar migration patterns between feeding areas, wintering areas, and spawning areas. The following contingents occurred in the Hudson during the spring and were presumed to spawn there:



• *Hudson-West Sound Contingent*

Found in Western Long Island Sound during the summer and fall, these overwinter and spawn in the Hudson River and then return to the sound in summer, apparently via the Hudson River and East River or around Manhattan Island and up the East River but not via an oceanic route around Long Island.

• *Hudson Estuary Contingent*

These confine their seasonal movements to within the Hudson estuary system, overwinter and spawn in the Hudson, and then move down into the bays (Upper New York Bay, Lower New York Bay, Jamaica Bay), along the northeastern coast of New Jersey, and along the south shore of Long Island, at least as far east as Jones Beach.

• *Hudson-Atlantic Contingent*

These use the Hudson River for spawning in the spring and then depart and presumably spend summer in the New York Bight area and in southern New England and perhaps overwinter in South Atlantic coast rivers or offshore.

In addition to those Atlantic striped bass that apparently spawn and/or overwinter in the Hudson River, some Chesapeake Bay-Delaware Bay striped bass may also overwinter in several areas of the Hudson downriver from Stony Point (RM 40); these fish, called the *Southern Contingent* by Clark (1968) may be returning from their late spring-summer migrations along the coast of southern New England (Raney, 1952; Raney et al, 1954; Merriman, 1941; Vladykov and Wallace, 1952; Clark, 1968).

In light of these previous findings, it is apparent that the 14 recovered striped bass tagged during the winter and early spring in the Croton Bay area (Group A) could have been:

- (1) Mature fish from either the *Hudson-West Sound*, *Hudson Estuary*, or *Hudson-Atlantic Contingent* overwintering or enroute to upstream spawning areas
- (2) Mature Chesapeake Bay-Delaware Bay fish overwintering
- (3) Immature fish



Based on age and size criteria (see page III-37), it appears that at least one fish in Group A (age VIII, 870 mm) was mature when tagged; the recapture of this fish off Nantucket, Massachusetts, 112 days after release suggests that it belonged to Clark's *Hudson-Atlantic Contingent*. Time at large, however, was probably sufficient to allow for the possibility that this fish was an overwintering Chesapeake Bay-Delaware Bay fish; between the date on which it was tagged (March 15) and the date on which it was caught off Nantucket (July 15), it could have migrated south to spawn and then returned north in early summer. The majority of Group-A recoveries, however, came from the Hudson River and the western part of Long Island Sound, with one return from Great South Bay, supporting conclusions of previous studies (Raney et al, 1954; Raney, 1972; Alperin, 1966) that most of the striped bass tagged in the Hudson belong to Clark's *Hudson-West Sound* or *Hudson Estuary Contingents*.

The three striped-bass recoveries tagged near Beacon (Group B) in late April in a known spawning area far upstream from any reported overwintering areas were undoubtedly mature (based on age and length) and very likely were part of the spawning population. Returns from the eastern part of Long Island Sound, Montauk Point, New York (October 12) and Buzzards Bay, Massachusetts (June 19) qualify for inclusion in the *Hudson-Atlantic Contingent* (Clark, 1968). The third Group-B tag return (from Lower New York Bay, Rockaway, New York, September 17) qualifies for the *Hudson-Estuary Contingent*.

To our knowledge, only three striped bass tagged in the Hudson River have ever been recovered (and reported) north of Buzzards Bay, Massachusetts. Clark and Smith (1969) tagged and released 319 striped bass on March 6 and 7, 1968, in Haverstraw Bay, recovering 22 including two off Newburyport, Northern Massachusetts. Lengths and ages for these two recoveries were not given, so it is impossible to conclude that they were mature fish; furthermore, if they were mature, it is possible that they were overwintering Chesapeake Bay-Delaware Bay fish since they were tagged during late winter in a suspected overwintering area. Raney (1972) analyzed data



from the American Littoral Society's Atlantic Coast striped-bass tagging program beginning in 1967; of 13 fish tagged in the Hudson River (Westchester County, New York), one tagged in May 1970 was recovered in August 1970 in Plymouth Bay, Massachusetts, but, since no length and age information was given, the degree of maturity is unknown. Our tag return from Buzzards Bay, Massachusetts, therefore, appears to be the most northern tag recovery reported to date for a striped bass known almost definitely to have been mature and spawning in the Hudson River when tagged.

### 3) Value of Adult Tagging Studies

A tagging program of adult striped bass can provide valuable information concerning migration ranges. Often, too, a description of migration ranges based on distribution of tagged adult recoveries is suggested as a method of determining the origin of Atlantic Coast striped-bass populations and assessing the relative contribution of the various spawning rivers to the coastal migratory stock. However, implementation of a sound tagging program in the Hudson River and interpretation of tag-return data regarding origins and relative contribution is riddled with pitfalls:

- A large number of fish from each stock which contributes to the Atlantic fishery must be tagged for several years at considerable expense before definitive statements about migration routes can be made. Also, one must know the proportion of each stock tagged.
- In a large tagging program, fish mortality due to capture, handling, and tagging could be significant.
- Tag loss tends to operate differentially by age group and method of capture.
- In all tagging studies, the recovery rate of tagged fish is a function of catch rate; the absence of returns at any time or place may mean either that no fish are there, that no one is fishing there, that no fish are being taken, or that no tags are being returned.



- ⊙ Age selectivity by commercial and sport fishing may vary, depending on current regulations, consumer size preferences, etc., thus complicating the interpretation of tag-recovery data.
- ⊙ It is very likely that some adult fish from non-Hudson contingents overwinter in the lower river but do not spawn there (Raney et al, 1954).
- ⊙ It is possible that within the Hudson different waves of spawning fish may represent separate components of a Hudson River stock which migrate to different locations; if so, proper stratification of tagging effort over time would be difficult.
- ⊙ Any differences in year-class strength, both within and between stocks, would complicate interpretation of tagging data.

Even if one could avoid these pitfalls, there would be two difficult questions to answer before an adult tagging program could assess the relative contribution of the Hudson River to the Atlantic striped-bass fishery:

- (1) What portion of those stocks (including those of the Hudson) which contribute to the Atlantic fishery were tagged?
- (2) Do striped bass return to their native streams to spawn?

Clark (1968) summarized the situation when he stated that "Improved tagging strategy may help, but entirely new approaches should also be attempted." Electrophoretic, meristic, and morphometric studies of fish from the major striped-bass producing rivers of the Atlantic coast as well as from the Atlantic fishery are currently being conducted by Texas Instruments Incorporated and others.

Conclusions. Based on the 1973 recovery of 17 large striped bass tagged in the Hudson River during 1972-73, the following points can be made:



- No fish < 400 mm in total length were recovered.
- The 17 tag returns from 149 fish > 400 mm (TL) represent a recovery of 11.4%.
- Fourteen of the 17 returns were tagged in the Croton Bay area (RM 32-34 [51-54 km]) and three near Beacon (RM 59-60 [94-96 km]).
- Six tag returns were within the Hudson River; six came from the western end of Long Island Sound; one from Lower New York Bay, Rockaway Point, New York; one from Great South Bay near Robert Moses Bridge, New York; and three from other localities -- Montauk Point, New York (eastern Long Island Sound); Nantucket, Massachusetts (Nantucket Sound); and New Bedford, Massachusetts (Buzzards Bay).
- Sport fishermen yielded 70.6% of all tag returns and commercial fishermen yielded 17.6%, with project sampling yielding the remaining 11.8%.
- Time at large ranged from 0.5 to 174 days.
- Tag return from Buzzards Bay, New Bedford, Massachusetts, is apparently the most northern tag recovery reported to date for a mature striped-bass spawning in the Hudson River.
- An adult tagging program will add little to an estimate of the relative contribution of the Hudson to the Atlantic Coast striped-bass fishery.

## POPULATION ESTIMATES

### Introduction

The objective of this section is to make population estimates of white perch and striped bass using mark/recapture techniques and to evaluate their applicability in the Hudson River. Once adequate population estimates