LABORATORY REFERENCE DOCUMENT NO. 82 - 05

POTENTIAL IMPACT OF THE STATE/FEDERAL RECOMMENDATIONS FOR STRIPED BASS MANAGEMENT ON THE COMMERCIAL FISHERIES IN RHODE ISLAND

by

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Date 3/14/82

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PREFACE

On December 17, 1982, the Chief of the Division of Fish and Wildlife, State of Rhode Island and Providence Plantations, sent a letter to the Chief, Resource Assessment Division, Northeast Fisheries Center, National Marine Fisheries Service, asking assistance in taking a more critical look at the commercial fishery for striped bass in Rhode Island. Specifically, assuming that the State of Rhode Island adopts the management measures proposed by the State/Federal Striped Bass Management Program, is it possible to measure the effect on the commercial fishery in Rhode Island and on the population itself? This document was prepared in response to the request from Rhode Island.

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INTRODUCTION

Since 1974 the reported commercial landings of striped bass in the Atlantic coastal states have dramatically declined. The 1979 reported landings of 2.9 million pounds was the lowest coastal total since 1940. The commercial catch reported for Rhode Island in 1980 (20,000 pounds) was the lowest since 1935. The decline in abundance of the coastal stocks perceived by sport and commercial fishermen stimulated passage of an amendment to the Anadromous Fish Conservation Act (Emergency Striped Bass Study) and the development of a coastwide management plan.

The coastal fishery for striped bass has traditionally been supported by dominant year classes. The last dominant year class occurred in 1970 and resulted in the highest reported commercial landings on record for the Atlantic coastal states in 1973. With the objectives of distributing the catch from a dominant year class over a greater number of years and increasing the number of mature fish that return to the spawning ground to increase the chances for dominant year class formation, the Atlantic States Marine Fisheries Commission has developed a set of recommended management measures for the coastal striped bass stocks.

The recommended management measures include size limitations of 14 inches TL in Albemarle Sound, Chesapeake Bay, Delaware Bay,

and their tributaries, and the Hudson River, and 24 inches TL in other coastal waters. Furthermore, no more than four fish between 14 inches TL and 24 inches TL may be retained by each fisherman daily if the fish are caught by hook and line, or no more than five percent by-catch of 14 to 24 inch TL striped bass if the catch is made by net. The Commission also recommended that major spawning areas or rivers be closed to fishing during the period of striped bass spawning activity to prevent excessive exploitation of mature fish on the spawning grounds.

The purpose of this report is to assess the potential impact on the Rhode Island commercial fishery if the state chooses to adopt the recommendations of the Atlantic States Marine Fisheries Commission. The assessment will consist of determining the current status of the commercial fishery and how that status might change if the management measures are adopted. This report is not intended to make any management recommendations to the State of Rhode Island, nor is it intended to pass judgement on the appropriateness of the measures suggested by the Commission.

IMPLICATIONS OF THE STATE/FEDERAL MANAGEMENT PLAN

An important biological basis for the proposed management measures is a study conducted by Kohlenstein (1980) on the mortality and migration processes that influence reproductive success and population structure of striped bass spawned in the Maryland tributaries of Chesapeake Bay (actually the Potomac River). The population model developed by Kohlenstein was used to

examine the possible effects of a change in Maryland minimum size limits from 12 inches TL to 14 inches TL. To quote the management plan: "On the basis of this analysis of Maryland catch, it is highly probable that a 14 inch TL minimum size limit in all producing areas will result in an increase in yield by weight in both producing areas and coastal areas, and substantially increase the numbers of females surviving to maturity"(ASMFC 1981).

The Commission also recognized that raising the minimum size limit in the producing areas would likely result in greater exploitation of the immature fish by coastal fisheries. Therefore, they recommended raising the minimum size limit of coastal fisheries to 24 inches TL. Several assumptions that underly this reasoning are worth discussion.

1. Other stocks exhibit Potomac stock characteristics: The principal assumption underlying the proposed management measures is that stocks originating in other parts of Chesapeake Bay, Albemarle Sound, and the Hudson River exhibit similar population dynamics, migration habits, and fishery experiences as the Potomac River stock.

Migration habits, and thus fishery experiences, differ among the Atlantic coast stocks. Extensive tagging evidence indicates that few striped bass from Albemarle Sound partake in coastal migrations. Chesapeake (principally Potomac River) striped bass migrate from North Carolina to Nova Scotia, and Hudson River striped bass have a coastal range that is concentrated between

Cape May and Massachusetts. Winter fisheries currently exist in Chesapeake Bay and off the North Carolina coast, so only the Chesapeake stocks would likely be subjected to exploitation during this season. The yearly patterns of commercial landings in the Atlantic coastal states, based on the 1960-1978 average, are listed in Table 1. Fisheries in states other than the producer states are dependent upon migration habits of the various stocks.

2. The proposed management measures will be enforced. There is no guarantee, if all the states adopt the management measures, that strict adherence to the size and creel limits can be maintained.

3. Reducing exploitation is the key to acheiving the objectives of the Plan: Will a reduction in the exploitation rate of pre-spawning striped bass achieve the objectives of the management plan and help to restore the depleted coastal population? Preliminary analysis of tag return data indicates that the fishing mortality rate on the coastal population may be as high as 40 to 60 percent (Appendix A). Estimates of natural mortality are on the order of 10 to 20 percent (Kohlenstein 1980), indicating that elimination of fishing mortality will not be rendered ineffective by natural mortality. For example, if the rate of exploitation is 50 percent and the rate of natural mortality is 20 percent, then the total annual mortality rate would be 60 percent. Eliminate fishing and the total rate drops to 20 percent (survival doubles). Reverse the situation, however, by setting the rate of exploitation to 20 percent and the rate of natural mortality to 50 percent and then eliminate fishing; the total mortality rate

will change from 60 percent to 50 percent (survival increases only 1.25 times). As long as natural mortality is much less than fishing mortality elimination of fishing mortality will significantly increase the total survival rate.

According to Goodyear (1981), in addition to an increase in numbers reaching maturity if minimum size limits are raised, an increase in biomass will also occur (assuming a natural mortality rate of 15 percent and a fishing mortality rate of 15-75 percent). Goodyear acknowledges, however, that his analysis does not address the effect of reducing mortality on young fish on the allocation of yield among the various users of the resource. Kohlenstein (1981), Polgar (1980), and Cooper and Polgar (1981) agree that decreasing the mortality of young fish in Chesapeake Bay would increase yield in the Bay and ocean, but would have little affect on the allocation.

Since the recommended minimum size limit for the Hudson River is 14 inches TL, an increase in the exploitation rate on young fish may result if the proposed measures are adopted by New York. Although the commercial fishery for striped bass in the Hudson River has been closed since 1976 due to PCB contamination, the current minimum size limit for striped bass in New York is 16 inches TL. Large numbers of "schoolies" congregate in the Hudson River in early spring (McFadden et al. 1978), and would be vulnerable to exploitation if the fishing season reopened with the new size limit. The extent to which an increase in exploitation of young fish in the Hudson River influences landings in Rhode Island depends on the relative contribution of the Hudson River

stock to the Rhode Island fishery, a subject that will be addressed in the following section.

THE COMMERCIAL FISHERY FOR STRIPED BASS IN RHODE ISLAND

Data collected by the State of Rhode Island in 1981 as part of the Emergency Striped Bass Study provide the ability to estimate the age, size, and sex composition of the landings reported for gill nets, trap nets, and rod and reel(handlines). From these data, the potential impact of the recommended management measures on the commercial fishery for striped bass in Rhode Island can be determined.

The 1981 Commercial Fishery

Three types of gear accounted for the majority of the commercial landings of striped bass in Rhode Island during 1981: gill nets, trap nets, and handlines. Statistics available from the National Marine Fisheries Service for the 1980 commercial fishery in Rhode Island indicate that trap nets and handlines accounted for 85 percent of the reported landings. The remaining catch was from gill nets and draggers. Similar data have not yet been published for 1981; however, gill nets appear to be gaining in their relative contribution to the total state landings (John O'Brien, pers. comm.).

Size and sex composition by gear: The length frequencies of striped bass caught in trap nets, gill nets, and handlines in Rhode Island during 1981 are listed in Table 2. As expected, gill

nets and trap nets were more size-selective than handlines, concentrating on the 41-60 cm (16-24 inch) size range. Handlines exhibited a peak catch in the same size range and an additional peak in the 90-120 cm (35-47 inch) size range. According to the size per age chart developed by Mansueti (1961) for Chesapeake Bay striped bass, the 40-60 cm size range corresponds to the 1976 and 1977 year classes, and the 90-120 cm size range corresponds to the 1966-1971 year classes. The relatively strong 1973 year class produced in the Hudson River (Table 2), which tracked through the Hudson River fisheries of the late 1970's (TI 1981), did not produce a noticeable peak in the handline length frequency data. The 1973 year class would have been in the 77-82 cm size range in 1981, based on Mansueti's chart.

Sex ratios by fork length categories (all gear combined) are listed in Table 4. The proportions of males in the 45 and 55 cm length categories (40 percent and 35 percent, respectively) are much higher than Young (1981) observed during 1979 and 1980 for the same length categories of striped bass sampled in eastern Long Island. According to Kohlenstein (1981), young adult males do not migrate into coastal waters from the Chesapeake Bay to any great extent. As such, the unusually high proportion of males in the length categories corresponding to ages 4 and 5 (Mansueti 1961) may reflect abnormal migration behavior of Chesapeake Bay fish or an influx and domination by fish from the Hudson River stock.

Age frequency: The age frequency of the 1981 commercial landings in Rhode Island can be estimated from the length frequency

of the catch (Table 3), the sex ratios by length category (Table 4), and the probable age of males and females in each length category. Since actual age data have yet to be analyzed for the 1981 study, I assumed that the age-length relationship for striped bass in Rhode Island is similar to the relationship described by Mansueti (1961) for striped bass in Chesapeake Bay.

To derive the probable age of male and female striped bass in each 1 cm length category, the data presented by Mansueti (1961) was fit to a von Bertalanffy growth model using a nonlinear least squares fitting routine. The form of the growth model is:

$$Lt = Linf(1 - exp(-k(t - to))$$

where Lt equals the length at age t, Linf equals the length asymptote (maximum acheivable length in mm), k equals the Brody growth coefficient, and to equals the hypothetical age at which the fish would have been zero length. For males, the fitted model values are: Linf = 1507.87 mm, k = 0.0838, to = 0.237; for females, the values are: Linf = 1349.49 mm, k = 0.1102, to = 0.065.

The resultant age-frequencies for each gear type and all gear types combined are listed in Table 5. The most abundant age for all gear types was age 4; age 3 fish appeared to have been only partially recruited into the Rhode Island commercial fishery. The secondary peak in the handline fishery corresponds to the 1967-1970 year classes.

Stock composition: Juvenile abundance data collected on the Hudson River stock has not indicated the decline in recruitment that is evident in the Chesapeake Bay stocks. Therefore, the stock composition of the Rhode Island commercial landings becomes an important factor in determining the potential impact of the recommended management measures.

Berggren and Lieberman (1978) conducted a stock composition study of the striped bass fishery from Maine to North Carolina in 1975. Based on 159 samples from the Rhode Island fishery, they initially classified 28 percent as Hudson River stock, 61 percent as Chesapeake Bay stock, and the remaining 11 percent as Roanoke River stock. After accounting for classification errors, they identified 11 percent Hudson River stock, 85 percent Chesapeake Bay stock, and 4 percent Roanoke River stock.

These values, however, cannot be assumed accurate for two reasons: (1) the iterative technique used to adjust the classification to account for error was determined invalid by Robson (1979) because any stock that was classified greater than 50 percent on the first iteration would continually gain in percentage each successive iteration at the expense of the other stocks; and (2) the 1975 study focused on the 1970 year class, which was the most abundant on record for Chesapeake Bay, while only moderately abundant in the Hudson River. Thus, for years when Chesapeake production is relatively poor and Hudson production is relatively good (such as in the late 1970's), the classification scheme for Rhode Island may exhibit a higher proportion of Hudson River stock.

Tagging data allows examination of movement patterns of the various stocks, and estimation of the proportion of each stock that is caught in each geographical area. Although tagging data on striped bass stocks is extensive, it is also piecemeal, not allowing examination of stock composition in coastal landings. Designing a tagging program to determine stock composition would involve tagging members of each stock prior to recruitment into the coastal fisheries and following the tagged fish through their entire existance. Since relative year class abundance may affect composition, several years of tagging would be required.

Four tagging studies provide evidence related to the proportion of the total coastal fishing mortality on the Chesapeake Bay stock that is represented by Rhode Island. Nichols and Miller (1967) reported 52 coastal recaptures of striped bass tagged in the Potomac River. Vladykov and Wallace (1952) reported 30 coastal recaptures from striped bass tagged in the Maryland portion of Chesapeake Bay, Massman and Pacheco (1961) reported 12 recaptures from striped bass tagged in Virginia rivers, and Florence (pers. comm.) reported 123 recaptures from tagged striped bass released in Maryland waters in the 1970's. The distribution of the coastal recaptures from these programs are listed in Table 6. The number of tags returned from Rhode Island fishermen accounted for 16 percent of all the tags returned from the coastal region, suggesting that Rhode Island contributes to approximately one-sixth of the coastal fishing mortality on the Chesapeake Bay stock.

Also listed in Table 6 are the 1977 and 1978 coastal recaptures of striped bass tagged by Texas Instruments, Inc. (TI 1980, 1981) and released in the Hudson River. Nine percent of the coastal recaptures were in Rhode Island. Of the 38 tags returned from Rhode Island, 9 (24 percent) were returned by commercial fishermen.

Potential Impact of the Proposed Management Measures

Since 1981 is the only year for which data pertaining to the length frequencies and sex ratios of the Rhode Island commercial fisheries are available, my analysis of the potential impact of the proposed management measures will use 1981 as a "representative" year. My analysis is intended to answer the following questions: (1) What will be the relative change in yield (in terms of numbers and biomass) if all coastal states adopted the proposed management measures? (2) What will be the relative change in yield if only Rhode Island adopts the management measures? Since striped bass take approximately two years to grow from 16 inches FL to 24 inches TL, the changes in yield that would accompany adoption of the proposed management measures would not be fully realized until several years after adoption of the measures.

Change in relative yield if all states participated: Based on an analysis of tag return data (Appendix A), the conditional rate of fishing mortality on the coastal migratory stock appears to be in the range of 30-60 percent. Assuming an annual rate of natural mortality of 15 percent (Kohlenstein 1980), the total annual mortality rate of the coastal migratory population would be

approximately 40-66 percent. This range is compatible with the range determined by TI (1981) and Young (1981) for striped bass sampled in the Hudson River and eastern Long Island, respectively.

If all the coastal states adopted the management measures and virtually eliminated fishing mortality on striped bass between 16 inches FL and 24 inches TL, then the annual mortality rate would drop to 15 percent (equal to the natural mortality rate only) for the period it took to grow through that size range. Since a striped bass takes about two years to grow from 16 inches FL to 24 inches TL (Mansueti 1961), the total mortality during that time period would drop from 65-88 percent to 28 percent (= 1 - (1 - 0.15)(1 - 0.15)). The number of recruits to the 24 inch TL size would increase 2-6 times, reflecting the change in the two year survival rate. If the annual mortality rate remains constant after 24 inches TL is acheived, then the resultant change in the frequency in each length category above 24 inches TL would be a two- to sixfold increase in the number of fish. The assumption that the annual mortality rate of fish greater than 24 inches TL will remain constant after the minimum size limit is increased is critical to thee analysis presented in this paper. Fishing effort directed towards the larger fish may increase, thus raising the fishing and total mortality rates. Lack of information, however, necessitates use of the constant mortality rate assumption in the analysis.

Upon this premise, the analysis for each gear type was conducted by first eliminating the catch between 16 inches FL and 24

inches TL in the frequency distribution, increasing the number in each length category above 24 inches TL by 2-6 times, and re-calculating the total number of fish caught and their total biomass. The re-calculated totals were then compared to the original totals to determine the relative change in yield. Total bimass was estimated by converting the number of males or females in each length category to biomass by the respective length-weight relationships reported by Mansueti (1961), and then summing across all length categories. Total length was converted to fork length by multiplying the total length by 0.93 (Mansueti 1961). Thus, 24 inches TL equals 22.3 inches FL.

The potential impact on the Rhode Island commercial fisheries if all the coastal states adopted the proposed management measures is shown in Case 1 in Table 7. The only fishery that would benefit from the proposed change would be the handline fishery. The results presented in Table 7 assume that the gill netters would not alter their mesh size to exclude the 16-24 inch fish from their catch and that the trap net fishery is most efficient in catching the size range reflected in Table 3.

Inclusion of the measure allowing four fish or five percent by-catch between 16 inches FL and 24 inches TL would increase the mortality of fish between those sizes. However, the extent to which the mortality would be increased cannot be judged from the available information. The total change in the calculated yield values listed in Table 7 may not be affected to a significant extent because, although yield may increase from a five percent or four-fish allowance in the 16-24 inch size range, the number of

recruits to the 24 inch TL size would be reduced.

Change in relative yield if only Rhode Island participates: Based on tag return data (Table 6), Rhode Island contributes between 9 and 16 percent to the total coastal fishing mortality of striped bass, depending on stock origin (Hudson River or Chesapeake Bay). Thus, if Rhode Island is the only state to adopt the proposed management measures, the fishing mortality rate on fish in the 16 inch FL to 24 inch TL size range would be reduced by 9-16 percent. A conditional fishing mortality rate of 30 percent would be reduced to 25-27 percent, and a rate of 60 percent would be reduced to 50-55 percent.

The change in yield to the commercial fisheries, expressed as a change in numbers or biomass landed, is shown in Case 2 of Table 7. Once again, the only fishery that would show some benefit from the adoption of the proposed management measures would be the handline fishery. The total number caught in the handline fishery would be reduced, but the total biomass would increase (reflecting an increase in the average size of a landed fish).

DISCUSSION

The results of the analyses assume, among other factors, that the commercial net fisheries in Rhode Island will not "adjust" to the new minimum size limit if the proposed management measures are adopted. Trent and Hassler (1968) determined that the most efficient gill net mesh size for catching a given size of striped

bass can be calculated from the following linear equation:

$$Y = (X - 2.24)/3.41$$

where Y is equal to the stretched mesh size in inches and X is equal to FL in inches. Based on their equation, the current gill net fishery in Rhode Island is fishing approximately 4.75-5 inch stretch mesh nets, corresponding to a fish length of 18.5-19.5 inches FL. In order to exclude all but five percent of the catch below 24 inches TL, the mesh size of the gill nets would probably have to be greater than 7 inches stretch mesh.

Trap nets are probably fishing the most vulnerable size range at present. The gear functions by trapping fish that move into the gear and stay, rather than snaring them as they try to swim through. As such, catching proportionately more older fish would be difficult. Of the three Rhode Island commercial fisheries examined, this fishery would be the least able to adjust to a larger size range.

Another assumption in the analyses that needs discussion is the use of Mansueti's (1961) age and size keys for male and female striped bass in the Rhode Island fishery. Mansueti's keys were based on back-calculated lengths at the size of annulus formation; hence, they probably underestimate the size of a fish for a given age that appeared in the Rhode Island landings (the majority of the fish are landed in the fall in Rhode Island and annulus formation occurs the previous spring). The age-

frequencies in Table 5 would be affected by this assumption, but not the calculations of the change in yield to the fisheries, since the calculations rely on size frequencies rather than age frequencies.

Finally, how respresentative is the 1981 data base upon which the analyses were based? For purposes of examining the size-selectivity of the various gear it probably is representative. The modal fish size in the gill net fishery in Rhode Island during 1981 was larger than either the handline or the trap net fishery, indicating smaller fish were excluded from the gill nets to a greater extent. Furthermore, the handline fishery exhibited a peak in landings in the 90-110 cm size category of about equal magnitude to its peak in the 41-55 cm size category. A similar peak in the larger category was not evident in the gill net and trap net landings.

Continuation of the 1981 data collection method for several more years will enable more accurate estimation of the total mortality rate of the exploited age groups. Other ongoing studies under the Emergency Striped Bass Study complement the information collected in Rhode Island and eventually will allow more accurate estimates of exploitation. With the additional information at hand, the impact of the proposed management measures on the commercial fishery in Rhode Island can be more accurately and precisely defined. Additional information can be used to better define an equilibrium situation. Use of one year's age composition data will less accurately project long-term trends because of the overwhelming influence of year class strength on the

population dynamics of striped bass. As such, the numbers presented in the current analyses should only be accepted as indicators of trends.

ACKNOWLEDGMENTS

Data pertaining to the 1981 commercial catch of striped bass in Rhode Island were provided by John O'Brien, Division of Fish and Wildlife, State of Rhode Island. Fishing mortality estimates for striped bass tagged and released off eastern Long Island and parameter values for the von Bertalanffy growth models were provided by Phil Goodyear, National Fisheries Center, U.S. Fish and Wildlife Service. Phil Goodyear, Brad Brown, and Mike Sissenwine provided useful suggestions on an earlier version of this report.

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trict of New York. Annual Progress Report. New York Division of Marine Resources.

Table 1. Average Monthly Proportions, Expressed as Percentages, of Annual Commercial Landings of Striped Bass in the Atlantic Coastal States

Month	MA	RI	NY	NJ	MD	VA	NC
JAN	0	0.09	0.08	9.10	6.90	5.62	18.49
FEB	0	0.05	0.01	8.43	9.43	6.90	16.04
MAR	0	0.03	0.08	6.73	27.88	25.95	12.53
APR	0.02	1.58	1.27	4.99	27.88	18.05	7.31
MAY	4.24	9.52	6.41	4.43	5.39	4.15	1.99
JUN	15.34	11.17	11.64	2.51	1.01	2.62	1.38
JUL	22.58	10.90	9.32	2.21	2.41	3.16	1.24
AUG	22.13	10.90	7.26	3.62	4.47	2.16	1.94
SEP	19.17	9.35	8.30	1.13	3.18	2.30	6.52
OCT	14.19	28.75	29.29	3.44	3.55	8.78	5.56
NOV	2.32	18.23	25.09	39.46	2.84	13.04	9.24
DEC	0.02	0.26	1.25	13.97	5.04	7.28	17.77
YEARS	63-79	60-80	60-79	60-80	60-77	60-77	60-78

Table 2. Striped Bass Juvenile Abundance Indices for the Maryland Waters of Chesapeake Bay and the Hudson River

Year	Chesapeake	Hudson(TI)	Hudson(DEC)
1954	5.2	-	-
1955	5.5	-	-
1956	15.2	-	-
1957	3.2	-	-
1958	19.2	-	-
1959	1.6	-	-
1960	7.1	-	-
1961	16.9	-	-
1962	12.2	-	-
1963	4.0	-	-
1964	23.5	-	-
1965	7.4	-	-
1966	22.1	-	-
1967	7.8	-	-
1968	7.2	-	-
1969	10.2	49.1	-
1970	30.4	28.8	-
1971	11.8	-	-
1972	8.5	16.7	-
1973	9.0	79.2	-
1974	10.1	15.1	-
1975	6.7	21.3	-
1976	4.9	15.5	16.5
1977	4.9	22.8	39.7
1978	8.4	31.4	41.8
1979	4.2	-	5.0
1980	1.9	-	24.2

Sources: Chesapeake - Benjamin Florence, Md DNR, pers. comm.

Hudson(TI) - TI (1980), Table B-27.

Hudson(DEC) - Young (1981), Table 16.

Table 3. Length Frequencies of Striped Bass Caught in Trap Nets, Gill Nets, and by Handlines in Rhode Island during 1981

Length (cm)	Trap Net	Gill Net	Handline
41	21	13	12
42	15	22	8
43	24	29	14
44	35	22	19
45	25	26	12
46	15	19	7
47	19	29	8
48	25	31	14
49	18	38	10
50	16	21	10
51	12	59	14
52	20	35	11
53	13	27	11
54	7	26	12
55	4	20	5
56	5	20	9
57	7	12	1
58	3	10	3
59	5	9	1
60	5	5	2
61	1	1	5
62	1	4	3
63	1	2	1
64	3	1	1
65	0	4	0
66	1	2	0
67	1	1	0
68	0	3	1
69	1	0	3
70	1	1	0
71	0	1	1
72	0	0	1
73	0	0	2
74	0	0	5
75	0	1	4
76	1	0	3
77	0	0	4
78	0	0	0
79	0	0	0
80	0	0	3

Table 3 (cont'd).

Length (cm)	Trap Net	Gill Net	Handline
81	0	0	3
82	0	0	4
83	0	0	5
84	0	0	1
85	0	0	3
86	0	1	3
87	0	0	5
88	0	0	0
89	0	0	5
90	0	0	3
91	0	0	0
92	0	0	5
93	0	0	6
94	0	0	8
95	0	0	6
96	0	0	8
97	0	0	8
98	0	0	10
99	0	0	17
100	0	0	11
101	0	0	17
102	0	0	9
103	0	0	11
104	0	0	15
105	0	0	13
106	0	0	8
107	0	0	13
108	0	0	7
109	0	0	8
110	0	0	3
111	0	0	6
112	0	0	4
113	0	0	2
114	0	0	3
115	0	0	6
116	0	0	0
117	0	0	0
118	0	0	1
119	0	0	3
120	0	0	0
121	0	0	2
122	0	0	0
123	0	0	0
124	0	0	0

Table 3 (cont'd).

Length (cm)	Trap Net	Gill Net	Handline
125	0	0	2
126	0	0	1
127	0	0	0
128	0	0	0
129	0	0	0
130	0	0	0
131	0	0	0
132	0	0	0
133	0	0	1
134	0	0	0
135	0	0	0
136	0	0	0
137	0	0	0
138	0	0	0
139	0	0	0
140	0	0	1
Total	305	495	467

Source: J. O'Brien, pers. comm.

Table 4. Sex Ratios, by Length Category, of Striped Bass Sampled in the Rhode Island Commercial Fishery during 1981, Gear Combined

Length (cm)	No. Males	No. Females	% Males
35-44	16	69	19
45-54	95	145	40
55-64	24	44	35
65-74	2	11	15
75-84	1	12	8
85-94	0	19	0
95-104	1	35	3
105-114	0	47	0
115-124	0	8	0
125-134	0	3	0
Total	139	393	-

Table 5. Estimated Age Frequencies of Male and Female Striped Bass Sampled from the Rhode Island Commercial Fishery during 1981

Age	Trap Net			Gill Net			Handline			Combined		
(yrs)	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F
3	0	48	48	0	70	70	0	27	27	0	145	145
4	60	118	178	73	171	244	32	66	98	165	355	520
5	32	32	64	85	69	154	28	31	59	145	132	277
6	6	7	13	12	11	23	5	8	13	23	26	49
7	0	2	2	0	3	3	0	15	15	0	20	20
8	0	0	0	0	0	0	1	14	15	1	14	15
9	0	0	0	0	1	1	0	17	17	0	18	18
10	0	0	0	0	0	0	0	19	19	0	19	19
11	0	0	0	0	0	0	0	30	30	0	30	30
12	0	0	0	0	0	0	0	53	53	0	53	53
13	0	0	0	0	0	0	2	48	50	2	48	50
14	0	0	0	0	0	0	0	28	28	0	28	28
15	0	0	0	0	0	0	0	11	11	0	11	11
16	0	0	0	0	0	0	0	12	12	0	12	12
17	0	0	0	0	0	0	0	9	9	0	9	9
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	4	4	0	4	4
20+	0	0	0	0	0	0	0	7	7	0	7	7
Total	98	207	305	170	325	495	68	399	467	336	931	1267

M = males

F = females

Table 6. Coastal Recaptures of Tagged Striped Bass Released in Chesapeake Bay and the Hudson River

Release Location	Recapture Location*											
	NC	VA	MD	DE	NJ	NY	CT	RI	MA	NH	ME	CA
Chesapeake Bay												
Nichols and Miller (1967)	0	0	0	3	5	14	3	7	13	1	3	3
Vladykov and Wallace (1952)	0	0	1	1	7	4	3	8	6	0	0	0
Massman and Pacheco (1961)	2	0	0	1	3	2	0	3	0	0	1	0
Florence (pers. comm.)	2	2	0	0	14	21	14	16	53	0	0	1
Total No.	4	2	1	5	19	41	20	34	72	1	4	4
%	2	1	0	2	9	20	10	16	35	0	2	2
Hudson River												
TI(1980)	0	0	0	1	11	161	25	14	6	0	1	0
TI(1981)	0	1	0	1	6	150	26	24	10	0	0	0
Total No.	0	1	0	2	17	311	51	38	16	0	1	0
%	0	0	0	0	4	71	12	9	4	0	0	0

*Only ocean recaptures in Virginia, Maryland, and New York

Table 7. Estimated Potential Impact on the Commercial Fishery for Striped Bass in Rhode Island with the Proposed ASMFC Management Measures

Condition	Trap Net		Gill Net		Handline	
	No.	Wt.(kg)	No.	Wt.(kg)	No.	Wt.(kg)
Case 1: All Coastal States Comply						
Base	305	548	495	1002	460	4932
m=30%	62(20)	227(41)	116(23)	435(43)	568(123)	9260(188)
m = 60%	186(61)	680(124)	348(70)	1305(130)	1704(370)	27780(563)
Case 2: Only Rhode Island Complies						
Base	305	548	495	1002	460	4932
m = 30%	33(11)	122(22)	63(13)	235(23)	307(67)	5000(101)
	-40(13)	-146(27)	-75(15)	-281(28)	-366(80)	-5973(121)
m = 60%	35(11)	129(24)	66(13)	248(25)	324(70)	5278(107)
	-47(15)	-173(32)	-89(18)	-333(33)	-435(95)	-7084(144)

Percentages of base values are in parentheses

m = conditional fishing mortality rate between 16 inches FL and 24 inches TL

Appendix A. Estimation of the Fishing Mortality Rate for the Coastal Migratory Population of Striped Bass

METHOD

The total rate of mortality, Z, is the sum of the rate of fishing mortality, F, and the rate of natural mortality M; i.e.,

$$Z = F + M$$

If there was no loss of marks from the population other than the loss due to fishing and natural mortality, an estimate of the rate of total mortality can be obtained by the Jackson method:

$$S = (R2 + R3 + \ldots + Rn)/(R1 + R2 + \ldots Rn-1)$$

$$Z = -\ln S$$

where S equals the survival rate and Ri equals the number of recaptures during time interval i.

The rate of exploitation, u, is the ratio of the sum of recaptures over all time intervals to the sum of the number of marked fish at the beginning of each time interval:

$$u = \sum_{i=1}^{n} R_i \Big/ \sum_{i=1}^{n} T S_i^{n-1}$$

where T equals the total number of marked fish released, and S_i^{n-1} equals the survival rate up to time interval i. The corresponding rate of fishing mortality, F, is given as:

$$F = uZ/A = uZ/(1-S),$$

where A is the total annual mortality rate (=1-S). The conditional fishing mortality rate, m, is:

$$m = 1 - \exp(-F).$$

If the rate of tag loss due to tag shedding and tagging mortality (U) is constant over the entire recapture period, then the rate of total disappearance of marks, Z', will equal the sum $F + M + U$. The interval rate of tag disappearance corresponding to Z' will be A', and the apparent rate of exploitation, u', will be:

$$u' = FA'/Z'.$$

The instantaneous rate of fishing mortality remains unbiased and is equal to $u'Z'/A'$.

RESULTS

The above method was appliied to tag/recapture data provided by Byron Young (NYDEC, Stony Brook, NY) from his 1974 and 1975 tagging program conducted in eastern Long Island, New York. The method was also applied to 1977 and 1978 tag/recapture data collected by Texas Instruments, Inc. (TI 1980, 1981) on the Hudson River spawning stock. Returns were sorted by the number of days-at-large and then combined into 30-day intervals. The 1974 and 1975 Young data were combined to give a total number of 269 tag returns during the two-year interval. The TI data was analyzed separately for 1977 and 1978 due to the relatively large number

of tag returns each year (196 and 349, respectively). Incomplete response by fishermen was incorporated into the analysis by dividing the number of tag returns in each 30-day interval by the assumed response rate (0.5 - 1.0).

Results, summarized in Table A-1, indicate that the conditional fishing mortality rate (m) on the striped bass in the New York vicinity is in the range of 0.3 - 0.6. Fishing mortality rates on the Hudson River stock appear to be close to those experienced by the eastern Long Island releases.

Table A-1. Estimated Fishing Mortality Rates for Striped Bass Tagged and Released in New York Waters

Release Site	Year	No. Released	Angler Response Rate(%)	·F 30 days	F Season*	m
Eastern L.I.	1974 and 1975	2678	50	0.0745	0.8936	0.5908
			60	0.0621	0.7447	0.5251
			70	0.0532	0.6383	0.4718
			80	0.0465	0.5585	0.4279
			90	0.0414	0.4965	0.3913
			100	0.0372	0.4468	0.3603
Hudson River	1977	2632	50	0.0701	0.5608	0.4292
			60	0.0584	0.4673	0.3733
			70	0.0501	0.4006	0.3301
			80	0.0438	0.3505	0.2957
			90	0.0389	0.3116	0.2677
			100	0.0350	0.2804	0.2445
Hudson River	1978	3482	50	0.0843	0.6745	0.4906
			60	0.0703	0.5621	0.4300
			70	0.0602	0.4818	0.3823
			80	0.0527	0.4216	0.3440
			90	0.0468	0.3747	0.3125
			100	0.0422	0.3373	0.2863

*Season equals 12 months for Long Island releases and 8 months for Hudson River releases 6