Returns from the 1965 Schlitz tagging program including a cumulative analysis of previous results

Dale S. Beaumariage

SEDAR51-RD-09

October 2016

STATE OF FLORIDA

DEPARTMENT OF NATURAL RESOURCES

RANDOLPH HODGES

Executive Director

TECHNICAL SERIES

NO. 59

RETURNS FROM THE 1965 SCHLITZ TAGGING PROGRAM INCLUDING A CUMULATIVE ANALYSIS OF PREVIOUS RESULTS

Dale S. Beaumariage

August, 1969

Marine Research Laboratory

Florida Department of Natural Resources

Division of Marine Resources

St. Petersburg, Florida

Effective July 1, 1969, agencies of the State of Florida underwent legislative reorganization and the Florida Board of Conservation was renamed the Florida Department of Natural Resources. Similarly, the former Division of Salt Water Fisheries became the Division of Marine Resources. These names should consequently be considered synonymous in this publication.

FLORIDA DEPARTMENT OF NATURAL RESOURCES

CLAUDE R. KIRK, JR.
Governor

TOM ADAMS
Secretary of State

BROWARD WILLIAMS
Treasurer

FRED O. DICKINSON, JR.
Comptroller

DOYLE CONNER
Commissioner of Agriculture

FLOYD CHRISTIAN
Supt. of Public Instruction

EARL FAIRCLOTH
Attorney General

RANDOLPH HODGES
Executive Director

SCIENTIFIC BOARD OF ADVISORS

Marine Research Laboratory

Division of Marine Resources

Florida Department of Natural Resources

Marine Research Laboratory
Florida Department of Natural Resources
P. O. Drawer F, St. Petersburg, Florida 33731

ROBERT M. INGLE
Director of Research

EDWIN A. JOYCE JR.
Assistant Director, Marine Laboratory

Laboratory Staff

ICHTHYLOGY

Robert W. Topp, M. S. ..... *Senior Fisheries Biologist*
Frank H. Hoff, Jr., B. A. ..... *Marine Biologist*
Alice C. Gennette ..... *Marine Sciences Technician*
Carlton F. Rowell, B. A. ..... *Marine Sciences Technician*
Dion Powell ..... *Student Research Assistant*

LARVAL FISHES

Bonnie M. Elred ..... *Marine Biologist*
Michael B. Wollam, B. S. ..... *Marine Biologist*
Robert F. Presley, B. S. ..... *Marine Biologist*
Rena Barco ..... *Student Research Assistant*

PELAGIC FISHES

Dale S. Beaumariage, B. S. ..... *Marine Biologist*
David L. Girardin, B. S. ..... *Marine Biologist*

INVERTEBRATES

William G. Lyons ..... *Marine Sciences Technician*
Thomas Savage, M. S. ..... *Marine Biologist*
David K. Camp, B. S. ..... *Marine Biologist*
Stephen P. Cobb, B. S. ..... *Marine Biologist*
D. Keith Serafy ..... *Student Research Assistant*

PHYSALIA

F. Stuart Kennedy, Jr., B. S. ..... *Marine Biology*

OYSTER BIOLOGY

Stanley W. Morey, M. A. ..... *Marine Biology*
Walter K. Havens, B. S. ..... *Marine Sciences Technician*

OYSTER PARASITES AND ARTIFICIAL CULTURE

Joe A. Quick, Jr., B. S. ..... *Marine Biologist*
Andrew Kaloski, B. S. ..... *Marine Biologist*

CLAM BIOLOGY

Mark F. Godcharles, B. A. ..... *Marine Biologist*
Arthur S. Butler, B. A. ..... *Marine Biologist*

DINOFLAGELLATES

Karen A. Steidinger, B. A. ..... *Marine Sciences Technician*
Jean Williams ..... *Marine Sciences Technician*
Linda H. Lyons ..... *Marine Sciences Technician*

DIATOMS

Richard P. Saunders, M. S. ..... *Marine Biologist*

CHEMISTRY AND ALGOLOGY

Jack F. Van Breedveld ..... *Marine Sciences Technician*

ORGANIC CHEMISTRY

Mary Ann Burklew, B. A. ..... *Marine Biologist*
Rose Ann Morton, B. A. ..... *Marine Biologist*

STUART FIELD LABORATORY

Ross Witham ..... *Marine Sciences Technician*

KEY WEST FIELD LABORATORY

Thomas F. Maloney, B. S. ..... *Marine Biologist*
Donald L. Lockard ..... *Marine Sciences Technician*

ST. JOHNS FIELD LABORATORY (Sanford)

Roy O. Williams, B. S. ..... *Marine Biologist*
Howard W. Suber ..... *Biological Aide*

APALACHICOLA FIELD LABORATORY

James G. Mills, Jr., B. S. ..... *Marine Biologist*

FERNANDINA BEACH FIELD LABORATORY

Sean J. Bollar, B. S. ..... *Marine Biologist*

THERMAL ADDITION STUDIES (Crystal River)

Patrick R. Parrish, M. S. ..... *Marine Biologist*
Edward R. McGrath, B. S. ..... *Marine Sciences Technician*

RESEARCH VESSEL

Earl Girard ..... *Marine Captain*
John W. Jolley, Jr., B. S. ..... *Marine Biologist*
William J. Millis, Jr. ..... *Marine Sciences Technician*

ADMINISTRATION

Alan S. Sellen ..... *Director of Administration*
Betty Accurso ..... *Records*
Jane F. Biggs ..... *Publications*
Evelyn M. Harper ..... *Personnel*
Eileen M. Kahle ..... *Accounting*
Marion Stancell ..... *Purchasing*
Claudia T. Leduc ..... *Library*
Margaret T. Cobb ..... *Library Assistant*
Katherine Stoelzel ..... *Library Assistant*
Lynn Simms ..... *Student Research Assistant*

ENGINEERING

Norman C. Cameron
Marco Omeechevarria
George Omeechevarria ..... *Student Assistant*

TALLAHASSEE OFFICE

William K. Whitfield, Jr. ..... *Shellfish Industry Coordinator*
Hazel Jones ..... *Administrative Assistant*
Marjorie Core ..... *Records*
June Smith ..... *Statistics*

APALACHICOLA

Joseph Martina, Jr. ..... *Field Supervisor (Div. Oyster Culture)*

TABLE OF CONTENTS

RETURNS FROM THE 1965 SCHLITZ TAGGING PROGRAM INCLUDING A CUMULATIVE ANALYSIS OF PREVIOUS RESULTS

DALE S. BEAUMARIAGE

Florida Department of Natural Resources Marine Research Laboratory*
St. Petersburg, Florida

ABSTRACT

Data received from the return of tagged individuals representing 26 of the 58 species of marine fishes released throughout Florida waters during 1965 is presented in this final report concerning these annual cooperative fish-tagging programs. Movement and growth information is recapitulated for 12 principal species of the families: Serranidae, Pomatomidae, Lutjanidae, Pomadasyidae, Sparidae, and Sciaenidae, which were tagged during the 1961-65 Schlitz and the 1963 State sponsored programs.

INTRODUCTION

During the first seven months of 1965 a total of 3,413 marine fishes representing 20 families and 58 species of sports or commercial importance were tagged and released throughout Florida's coastal waters. The release of these fishes culminated a five-year cooperative fish-tagging program between the Jos. Schlitz Brewing Company and the Florida Board of Conservation Marine Laboratory.

Ingle *et al.* (1962) reported the results of the initial tagging program conducted in 1961. Topp (1963) included with the results of the 1962 program a summary of the extent of the brewery's participation in promoting tag returns and an explanation of the procurement and tagging methods used during that and subsequent programs. Beaumariage (1964) presented data received during the 1963 program. Beaumariage and Wittich (1966), in their presentation of returns from the 1964 program, discussed the merits of a tagging program which emphasizes high monetary rewards, divided the state into four specific oceanogeographical areas to facilitate analysis of tagging data, and discussed the relative merits of Petersen, internal anchor, and California spaghetti fish tags.

Although no tagging was carried out in 1966, Schlitz offered smaller rewards throughout the calendar year to encourage the return of as many tags as possible. The preparation of this paper has been deferred in order to present the final information from the Schlitz programs and to include a few late returns from the 1963 State tagging program.

*Contribution No. 130

The release of tagged fishes always coincided with the dates of the brewery's sponsorship within specific areas of the state during these annual programs. Therefore, it was impossible for tagging emphasis to accurately correspond with the optimal seasonal abundance of several species throughout the state. Generally, tagging was initiated in southern Florida during January, progressed northward along each coast throughout the spring, and terminated in northern Florida during July.

The contest dates of the four release zones arbitrarily assigned by the brewing company in 1965 were:

Zone I —February 1 through April 30
Northern Indian River County line to Everglades City
Zone II —March 1 through May 30
Northern Hernando County line to Everglades City
Zone III —April 1 through June 31
West coast — Waccasassa River to the northern Hernando County line
East coast — northern Flagler County line to the northern Indian River County line
Zone IV—June 1 through August 31
West coast — Escambia County line to the Waccasassa River
East coast — northern Nassau County line to the northern Flagler County line

Figure 1 shows the relationship of these release zones with the areas used in categorizing the returns. The description of these areas essentially follows Beaumariage and Wittich (1966):

AREA A — Southwest coast from Hernando County to Everglades City

The offshore fishing grounds are characterized by a broad, gradually sloping continental shelf composed principally of limestone outcroppings and reefs.

The inshore fishing grounds are characterized by sheltered natural estuaries consisting of mangroves islands, oyster bars, and submerged grass flats. Fishes were often transported from remote capture areas to be released at piers and bridges near population centers.

AREA B — Southeast coast from Cape Canaveral to Key West, including Florida Bay

The offshore fishing grounds are characterized by a restricted, moderately sloping continental shelf which narrows from 35 miles offshore at Cape Canaveral to only four miles offshore at Miami Beach.

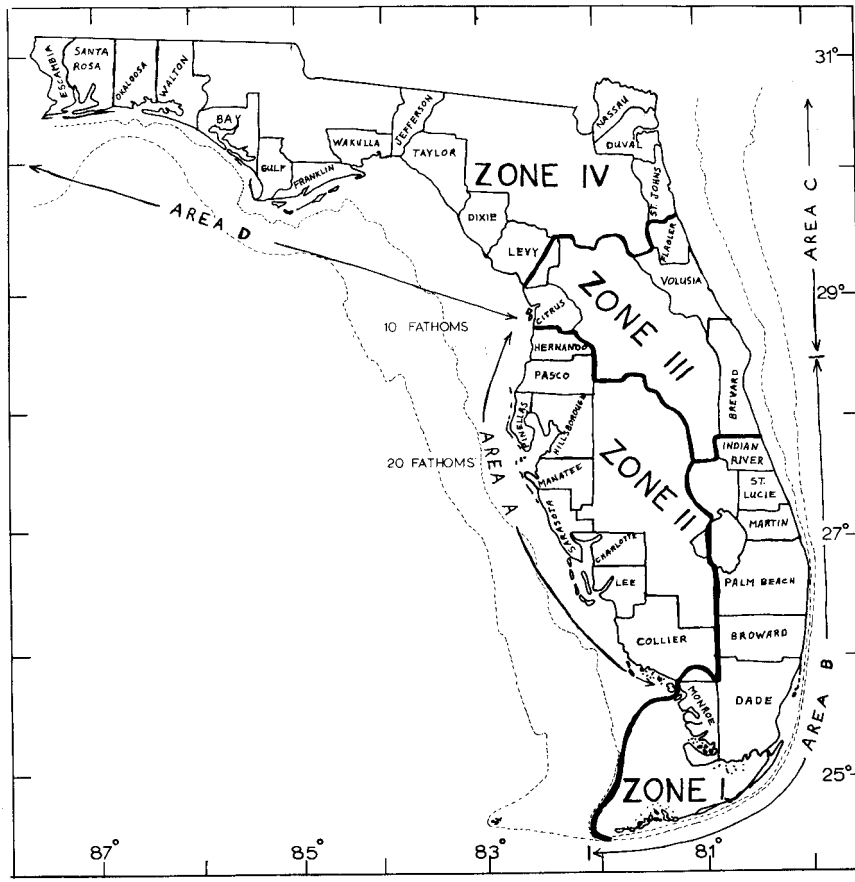

Figure 1. Florida coastal counties divided into contest zones and geo-oceanographic evaluation areas.

The inshore fishing grounds in the northernmost section consist of the pristine Indian and Banana Rivers leading into the urbanized Intracoastal Waterway south through Miami. Here, again, fishes were often transported into the more metropolitan areas.

The Florida Keys consist of abundant coral reefs and clear water typical of a teeming tropical habitat.

AREA C — Northeast coast from Fernandina Beach to Cape Canaveral

The offshore fishing grounds are characterized by a relatively restricted continental shelf varying in width from 35 miles off Cape Canaveral to 80 miles off Fernandina Beach. This shelf has the irregular topography of numerous rocky reefs interspersed with local areas of coarse sand and gravel. These reefs generally lie parallel to the 100 fathom contour. Although they are usually obscured by sediments near shore, they are more pronounced offshore, having 30 to 75 foot ledges.

The inshore fishing grounds consist of the Indian, Halifax, and Matanzas Rivers which comprise the protected Intracoastal Waterway. Transported fishes were released in this waterway near piers and bridges in the southern half of this area. Fishes were released directly into the ocean from beach seines in the northern half of this area.

AREA D — Northwest coast from Pensacola to Citrus County

The offshore fishing grounds vary from the shallow depths of the gently sloping continental shelf off Crystal River and Carrabelle to much greater depths nearer shore along the restricted continental shelf off Panama City and Pensacola.

Fishes were tagged inshore only in Citrus, Levy, Dixie, and Taylor Counties. These estuaries are much like those described for Area A. From upper Apalachee Bay, around Cape St. George westward to Pensacola, tagging of offshore fishes was emphasized.

The term "inshore" refers to waters adjacent to shore as well as protected waters. "Offshore" refers to waters some distance from land and/or ranging in depth from 9.1 to 54.9 meters (5 to 30 fathoms). Movement in excess of five nautical miles is considered significant for tagged reef fishes. Movement in excess of 10 to 15 nautical miles is considered significant for others. Usually, only those fishes free for a year or more yield valid growth data. Data pertaining to movement of offshore fishes has been generally considered invalid unless recapture locations were received as an azimuth and depth, or as LORAN. Phyletic order follows Briggs (1958) for elasmobranchs, and Greenwood *et al.* (1966) for teleosts.

ACKNOWLEDGMENTS

The continuing cooperation received from sport fishing captains and guides and from commercial fishermen throughout Florida has been invaluable in the successful release of so many fishes throughout such a wide-ranging area within so short a time. The interest shown by several Schlitz distributors and their employees has also aided in the accurate recording of most of the return information.

I am again indebted to several of my colleagues at this laboratory for their assistance and understanding during the compilation of this summary. Foremost are M. A. Moe, Jr. for his consultation, R. M. Ingle for his patience, E. A. Joyce, Jr. for his editorial assistance, and R. W. Topp for his critical review of the manuscript.

RESULTS AND DISCUSSION

All the fishes released during the 1965 program are listed in Table 1. Those species for which returns were received are listed by area in Table 2.

Although no returns were received from 36 of 67 species (54%) tagged during 1965, there were generally fewer than a dozen fish released for each of these 36 species (Table 1). Over 40 lane snapper *(Lutjanus synagris)* and Spanish mackerel *(Scomberomorus maculatus)* were released with no returns; however, it is likely that absence of returns may be due to the relatively low proportion of fishing effort to population densities in the tagging areas.

CARCHARHINIDAE

SHARK, *Carcharhinus* sp.

One of two requiem sharks released from a beach seine just north of the Matanzas Inlet in St. Johns County was recaptured 43 days later in the same vicinity. Precise identification was not possible at release and the specimen was unavailable when the return was reported. Two other carcharhinids released in Area C were tagged offshore and were not returned.

SPHYRNIDAE

BONNETHEAD SHARK, *Sphyrna tiburo* (Linnaeus)

Twenty-nine bonnethead sharks were released from a gill net just south of the Ft. Pierce Inlet in St. Lucie County. Four (13.8%) were returned, all from the same area, after 14 to 46 days at liberty, with a mean freedom of 35 days.

SERRANIDAE

SOUTHERN SEA BASS, *Centropristes striatus melanus* Ginsburg

Ninety-five southern sea bass were tagged in 1965, 26 in Area A and 69 in Area D. All were released offshore. Nine fish (9.5%) were returned,

TABLE 1. SUMMARY OF FISHES RELEASED AND RETURNED IN 1965 PROGRAM

P—Petersen disc; I Internal anchor (body cavity); S—Spaghetti (Calif. type)

Species	Number Released	Number Returned	Per Cent Returned
ORECTOLOBIDAE			
Nurse shark *Ginglymostoma cirratum* (Bonnaterre)	1-S	0	
CARCHARINIDAE			
Lemon shark *Negaprion brevirostris* (Poey)	1-S	0	
Bull shark *Carcharhinus leucas* (Muller & Henle)	1-S	0	
Blacktip shark *Carcharhinus limbatus* (Muller & Henle)	5-S	0	
Shark *Carcharhinus* sp.	11-S	1-S	9.1
SPHYRNIDAE			
Scalloped hammerhead shark *Sphyrna lewini* (Griffith)	1-S	0	
Bonnethead shark	1-I	0	
Sphyrna tiburo (Linnaeus)	28-S	4-S	
	29	4	13.8
Hammerhead shark *Sphyrna* sp.	1-S	0	
MEGALOPIDAE			
Tarpon *Megalops atlantica* Valenciennes	2-I	0	
CENTROPOMIDAE			
Snook *Centropomus undecimalis* (Bloch)	2-S	0	
SERRANIDAE			
Southern sea bass	50-I	6-I	
Centropristes striatus melanus Ginsburg	45-S	3-S	
	95	9	9.5
Black sea bass	103-P	56-P	
Centropristes striatus striatus (Linnaeus)	112-I	31-I	
	94-S	30-S	
	309	117	37.9

TABLE 1. (Continued)

Species	Number Released	Number Returned	Per Cent Returned
Coney *Cephalopholis fulva* (Linnaeus)	3-I	0	
Red Grouper *Epinephelus morio* (Valenciennes)	95-I 76-S 171	17-I 5-S 22	12.9
Warsaw grouper *Epinephelus nigritas* (Holbrook)	1-I	1-I	100.0
Nassau grouper *Epinephelus striatus* (Bloch)	1-I	0	
Black grouper *Mycteroperca bonaci* (Poey)	1-I	0	
Gag grouper *Mycteroperca microlepis* (Goode & Bean)	108-I 79-S 187	23-I 20-S 43	23.0
Scamp *Mycteroperca phenax* Jordan & Swain	8-I 3-S 11	0	
POMATOMIDAE			
Bluefish Pomatomus saltatrix (Linnaeus)	70-I 67-S 137	12-I 10-S 22	16.1
RACHYCENTRIDAE			
Cobia *Rachycentron canadus* (Linnaeus)	1-S	0	
CARANGIDAE			
Blue runner *Caranx crysos* (Mitchill)	2-S	0	
Crevalle Jack *Caranx hippos* (Linnaeus)	1-S	0	
Great amberjack *Seriola dumerili* (Risso)	3-I 12-S 15	0	
Common pompano *Trachinotus carolinus* (Linnaeus)	2-P 2-I 15-S 19	3-S 3	15.8
Palometa *Trachinotus glaucus* (Bloch)	36-S	10-S	27.8

TABLE 1 (Continued)

Species	Number Released	Number Returned	Per Cent Returned
CORYPHAENIDAE			
Dolphin *Coryphaena hippurus* Linnaeus	15-S	0	
LUTJANIDAE			
Mutton Snapper *Lutjanus analis* (Valenciennes)	3-I 1-S 4	1-S 1	25.0
Red snapper *Lutjanus campechanus* (Poey)	64-P 131-I 117-S 312	14-P 38-I 30-S 82	26.3
Mangrove snapper *Lutjanus griesus* (Linnaeus)	49-P 63-I 64-S 176	3-P 6-I 6-S 15	8.5
Lane snapper *Lutjanus synagris* (Linnaeus)	28-I 21-S 49	0	
Yellowtail snapper *Ocyurus chrysurus* (Bloch)	18-I 18-S 36	2-I 1-S 3	8.3
Vermilion snapper *Rhomboplites auroubens* (Cuvier)	3-I 1-S 4	0	
POMADASYIDAE			
Black margate *Anisostremus surinamensis* (Bloch)	2-P	0	
Sailors choice *Haemulon parrai* (Desmarest)	2-P	0	
White grunt *Haemulon plumieri* (Lacepede)	173-P 3-I 3-S 179	15-P 15	8.4
Bluestriped grunt *Haemulon sciurus* (Shaw)	1-P	0	
Grunt *Haemulon* sp.	1-P	0	
SPARIDAE			
Sheepshead *Archosargus probatocephalus* (Walbaum)	417-P 4-I 17-S 438	107-P 1-S 108	24.7

TABLE 1 (Continued)

Species	Number Released	Number Returned	Per Cent Returned
Grass porgy *Calamus arctifrons* Goode & Bean	10-P 1-I 11	0	
Red porgy *Pagrus sedecim* Ginsburg	32-P 10-I 7-S 49	3-P 2-I 1-S 6	12.2
Porgy *Calamus* sp.	3-P	0	
SCIAENIDAE			
Sand seatrout *Cynoscion arenarius* Ginsburg	5-I 3-S 8	0	
Spotted seatrout *Cynoscion nebulosus* (*Cuvier*)	315-I 281-S 632	35-I 19-S 54	8.5
Weakfish *Cynoscion regalis* (Bloch & Schneider)	6-I 3-S 9	2-I 1-S 3	33.3
Gulf kingfish *Menticirrhus littoralis* (Holbrook)	92-I 41-S 133	20-I 8-S 28	21.1
Southern kingfish *Menticirrhus americanus* (Linnaeus)	3-I 4-S 7	1-S 1	14.3
Black drum *Pogonias cromis* (Linnaeus)	34-P 10-I 6-S 50	15-P 2-I 1-S 18	36.0
Red drum *Sciaenops ocellata* (Linnaeus)	9-I 9-S 18	5-I 5-S 10	55.6
EPHIPPIDAE			
Atlantic spadefish *Chaetodipterus faber* (Broussonet)	14-P	3-P	21.4
SPHYRAENIDAE			
Great barracuda *Sphyraena barracuda* (Walbaum)	10-I 10-S 20	3-I 3-S 6	30.0

TABLE 1 (Continued)

Species	Number Released	Number Returned	Per Cent Returned
LABRIDAE			
Hogfish *Lachnolaimus maximus* (Walbaum)	2-I	0	
SCOMBRIDAE			
Little tuna *Euthynnus alletteratus* (Rafinesque)	4-S	0	
Atlantic bonito *Sarda sarda* (Bloch)	1-S	0	
King mackerel *Scomberomorus cavalla* (Cuvier)	33-I 35-S 68	2-S 2	2.9
Spanish mackerel *Scomberomorus maculatus* (Mitchill)	24-I 20-S 44	0	
Cero mackerel *Scomberomorus regalis* (Bloch)	1-I	0	
BOTHIDAE			
Gulf flounder *Paralichthys albigutta* Jordan & Gilbert	10-P 1-S 11	0	
Summer flounder *Paralichthys dentatus* (Linnaeus)	4-P	0	
Fourspot flounder *Paralichthys oblongus* (Mitchill)	1-P	0	
Flounder *Paralichthys* sp.	1-P	0	
BALISTIDAE			
Gray triggerfish *Balistes capriscus* Gmelin	58-P	6-P	10.3
Queen triggerfish *Balistes vetula* Linnaeus	1-P	0	
Statewide total, inshore	1,722	287	16.7
Statewide total, offshore	1,691	306	18.1
Statewide total, inclusive	3,413	593	17.4

TABLE 2. SUMMARY OF FISHES RELEASED AND RETURNED BY AREA1

	AREA A			AREA B			AREA C			AREA D			STATEWIDE		
	No. Rel.	No. Ret.	% Tot. Ret.	No. Rel.	No. Ret.	% Tot. Ret.	No. Rel.	No. Ret.	% Tot. Ret.	No. Rel.	No. Ret.	% Tot. Ret.	No. Rel.	No. Ret.	% Ret.
CARCHARHINIDAE															
Shark							4	1	100.0	7			11	1	9.1
SPHYRNIDAE															
Bonnethead shark				29	4	100.0							29	4	13.8
SERRANIDAE															
Southern sea bass	26	6	66.6							69	3	33.3	95	9	9.5
Black sea bass				24	3	2.6	285	114	97.4				309	117	37.9
Red grouper	118	21	95.5	6						47	1	4.5	171	22	12.9
Warsaw grouper							1	1	100.0				1	1	100.0
Gag grouper	97	35	81.4	20	3	6.9	26	2	4.7	44	3	6.9	187	43	23.0
POMATOMIDAE															
Bluefish	3			116	20	90.9	17	2	9.1	1			137	22	16.1
CARANGIDAE															
Common pompano	4	1	33.3	9	2	66.7	6						19	3	15.8
Palometa							36	10	100.0				36	10	27.8
LUTJANIDAE															
Mutton snapper				4	1	100.0							4	1	25.0
Red snapper	3	1	1.2	14	3	3.7	54	15	18.3	241	63	76.8	312	82	26.3
Mangrove snapper	50	4	26.6	119	9	60.0	4	1	6.7	3	1	6.7	176	15	8.5
Yellowtail snapper				36	3	100.0							36	3	8.3
POMADASYIDAE															
White grunt	144	15	100.0	9						26			179	15	8.5

TABLE 2. SUMMARY OF FISHES RELEASED AND RETURNED BY AREA[1] (Continued)

	AREA A			AREA B			AREA C			AREA D			STATEWIDE		
	No. Rel.	No. Ret.	% Tot. Ret.	No. Rel.	No. Ret.	% Tot. Ret.	No. Rel.	No. Ret.	% Tot. Ret.	No. Rel.	No. Ret.	% Tot. Ret.	No. Rel.	No. Ret.	% Ret.
SPARIDAE															
Sheepshead	70	4	3.7	280	55	50.9	87	49	45.4	1			438	108	24.7
Red porgy	15	1	16.7	3			10	1	16.7	21	4	66.6	49	6	12.2
SCIAENIDAE															
Spotted seatrout	205	20	37.0	154	13	24.1	96	14	25.9	177	7	13.0	632	54	8.5
Weakfish	1	1	33.3	8	2	66.7							9	3	33.3
Gulf kingfish	1						132	28	100.0				133	28	21.1
Southern kingfish				7	1	100.0							7	1	14.3
Black drum	8	1	5.5	11	4	22.2	24	12	66.7	7	1	5.5	50	18	36.0
Red drum				1	1	10.0	15	9	90.0	2			18	10	55.6
EPHIPPIDAE															
Atlantic spadefish	1			1			12	3	100.0				14	3	21.4
SPHYRAENIDAE															
Great barracuda				19	6	100.0	1						20	6	30.0
SCOMBRIDAE															
King mackerel				49	2	100.0	1			18			68	2	2.9
BALISTIDAE															
Gray triggerfish	2			3			3			50	6	100.0	58	6	10.3
Offshore	418	79	25.8	195	13	4.2	378	133	43.5	525	81	26.5	1516	306	20.2
Inshore	330	31	10.8	727	119	41.5	436	129	44.9	189	8	2.8	1682	287	17.1
Total	748	110	18.5	922	132	22.3	814	262	44.2	714	89	15.0	3198	593	18.5

% Tot. Ret.—refers to the percentage of returns from that area with regard to the total returned statewide.

all from their respective release locations after 8 to 85 days at liberty, with a mean freedom of 34 days.

A total of 579 southern sea bass were released in offshore Gulf waters during the five annual Schlitz programs. One hundred nineteen (20.6%) were returned and showed no significant growth or movement during their 32.2 mean days at liberty. This rate of recovery was five times the 4.1 per cent recovery from the 1,046 individuals tagged during the State program (Moe, 1966). The return of 59.5 per cent of all the Schlitz tagged southern sea bass within 30 days of release, and 93.1 per cent within 60 days shows the ease with which they may be taken from their populous shallow-water, rocky habitats. The high monetary rewards offered for the return of Schlitz tags obviously increased the fishing pressure and rate of return of this highly residential species. These results augment Moe's (1966) findings that southern sea bass are specific year-round inhabitants of the 3 to 15 fathom (5.5 to 27.4 meters) reefs offshore of Florida's middle and upper west coast.

BLACK SEA BASS, *Centropristes striatus striatus* (Linnaeus)

Three hundred nine black sea bass were tagged in 1965, 24 in Area B and 285 in Area C. Four fish were brought in alive from the offshore reefs by a Daytona Beach party fishing boat and released inshore in Area C; however, none were ever recaptured. One hundred seventeen fish (37.9%) were returned, all from their respective offshore release locations, after 2 to 341 days at liberty, with a mean freedom of 39.9 days.

A total of 788 black sea bass were released offshore along Florida's upper east coast during the five annual Schlitz programs. Two hundred ninety-four fish (37.3%) were returned and showed no significant movement during their 41.3 mean days at liberty. This subspecies is also easily taken from well-defined offshore habitats since 66.4 per cent of all the Schlitz tagged black sea bass were returned within 30 days of release, and 86.5 per cent within 60 days.

Moe (1966) reports a 24.7 per cent recovery from 89 black sea bass released with state tags offshore of St. Johns County during 1963. Although Moe suspected that black sea bass persist on their home reefs throughout the year, lack of returns from the State program during winter months failed to verify this. However, the Schlitz rewards offered throughout the entire year during 1966 apparently provided incentive for winter fishing since one black sea bass was returned from its original release location offshore of Daytona Beach during January (free 259 days), and two others were returned from the same area during February (free 263 and 287 days).

RED GROUPER, *Epinephelus morio* (Valenciennes)

One hundred seventy-one red grouper were tagged offshore in 1965, 118

in Area A, 6 in Area B, and 47 in Area D. Twenty-two fish (12.9%) were returned, all but one from their respective release locations, after 2 to 289 days at liberty, with a mean freedom of 46 days. Returns were also received from one red grouper released during the 1964 Schlitz program and one released in 1963 during the State tagging program.

One fish, 338 mm TL, released on 12 April 1965 in 12.8 meters (7 fathoms) 12½ nautical miles on a heading of 205° from Gordon Pass, was reportedly recaptured on 6 March 1966 (329 days later) in 12.3 meters offshore of Tarpon Springs (155 nautical miles to the north). This return is atypical in that younger red grouper commonly taken by party boats in relatively shallow offshore fishing grounds do not show extensive movement. Such movement has previously been observed only among members of the older commercial stocks in deeper waters of the Gulf of Mexico (Moe, 1966; 1967).

During all the Schlitz tagging programs 390 red grouper were released in relatively nearshore fishing grounds. Fifty-one (13.1%) were returned and showed a mean freedom of 50.1 days. This unusual 1965 return is the only one reporting any significant movement from the original release location.

The red grouper tagged in the State program measured 295 mm TL when released on 16 July 1963 in 12.3 meters (6¾ fathoms) on a heading of 195° from Buoy 18 near Egmont Key. It was returned approximately 1,635 days later by a grouper boat fishing out of Cortez, Florida. Specific recapture information was obscured since the internal tag was not noticed until the fish reached a retail market in Opa-Locka, Florida. This fish increased approximately nine pounds, corresponding to a recapture measurement of 650 mm TL (Moe, personal communication). It moved about 40 nautical miles west since the vessel was fishing between 43.9 and 73.2 meters (24 and 40 fathoms) west of Egmont Key on or about 5 January 1968.

TABLE 3. INDICATIONS OF GROWTH IN RED GROUPER

Date Released	Measurements (mm) TL	SL	Date Recaptured	No. Days Free	Incr. in TL (mm) Total	Per Mo.	Incr. in SL (mm) Total	Per Mo.
4-23-65	334	275	2-5-66	289	51	5.3	40	4.2
2-19-64	488	410	2-3-66	716	172	7.2	137	5.8
7-16-63	295	240	1-5-68	1,635	355	6.5	305	5.6

Table 3 presents estimated recapture measurements from this return along with growth data available from one of the 1965 Schlitz returns and the 1964 Schlitz return.

WARSAW GROUPER, *Epinephelus nigritus* (Holbrook)

One Warsaw grouper, 485 mm TL, was released on 7 May 1965 in 22.8 meters (12½ fathoms) 26 nautical miles on a heading of 105° from the Ponce de Leon Inlet. It was recaptured 43 days later at this same location. Recapture measurements were not taken.

TABLE 4. GAG GROUPER MOVEMENT

Date Released	Measurements (mm) TL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
6-25-64	464	390	190° - 7 mi. from Dog Is. Bell Buoy, 15.5 m (8 1/3 fathoms) (Carrabelle)	5-29-66	704	4 hrs. (est. 40 mi.) S of Panama City Beach	55	255° (WSW)
7-12-63	540	460	"A 5-mi strip of bottom 215° from the Panama City Sea Buoy in 150 ft" (45.7m, 25 fathoms)	11-17-66	1,225	12 mi. SW of St. Andrew Bay Jetty	15	10° (NNE)
3-24-65	410	350	230° - 18 mi. from Johns Pass Sea Buoy, 18.3 m (10 fathoms)	6-10-65	79	250° off Johns Pass 12.3 m (6¾ fathoms)	7	N
4-21-65	640	535	295° - 34 mi. from Clearwater Bell Buoy, 22.8 m (12½ fathoms)	1-22-68	1,007	LORAN: 3HO 1993.6 3HI 3274.0	7	115° (ESE)

GAG GROUPER, *Mycteroperca microlepis* (Goode & Bean)

One hundred eighty-seven gag grouper were tagged in 1965, 97 in Area A, 20 in Area B, 26 in Area C and 44 in Area D. This includes 11 released inshore, one in Area A, and ten in Area B. Forty-three (23.0%) were returned after 4 to 1,007 days at liberty, with a mean freedom of 158.2 days. This includes the return of two gag grouper released inshore in Area B. Three gag grouper released during the 1963 program and two during the 1964 program were also returned.

One of these 1963 fish was at liberty over six years (2,307 days) before it was recaptured within two miles of its release site, 32.9 meters (18 fathoms) offshore of Manatee County. This grouper measured 670 mm TL and 569 mm SL at release and weighed about eight pounds. It weighed 35 pounds at recapture but unfortunately was cleaned before further measurements could be obtained. However, Moe *et al.* (in manuscript) estimate from otolith examination that it probably grew to about 1,000 mm TL and 870 mm SL (an increase of 4.4 mm TL and 4.0 mm SL per month).

Significant movement (Table 4) was shown by only two returns from the 1965 program and by two from the previous programs. Five returns received since 1965 had recapture measurements adequate for obtaining growth data. (Table 5).

TABLE 5. INDICATIONS OF GROWTH IN GAG GROUPER

Date Released	Measurements (mm) TL	SL	Date Recaptured	No. Days Free	Incr. in TL (mm) Total	Per Mo.	Incr. in SL (mm) Total	Per Mo.
4-13-65	449	380	2-5-66	322	41	3.8	20	1.8
5- 6-65	600	575	7-2-66	423	90	6.4	15	1.1
3-24-65	364	305	12-17-66	634	223	10.6	195	9.2
6-25-64	464	390	5-29-66	704	204	8.7	175	7.4
5-16-63	890	770	6-18-66	1,130	162	4.3	162	4.3

Of the 811 gag grouper released during the annual Schlitz programs, 131 were released in inshore waters. To date 216 fish (26.6%) have been recovered (including 23 inshore returns) which all exhibited a mean freedom of 105 days. Topp (1963) reported movement in two gag grouper one of which was tagged inshore. Table 4 shows movement of four tagged gag grouper received since that report.

Moe (1966) notes a more obvious depth/size relationship in gag grouper than in red grouper, specifically: juveniles in inshore waters; young adults on

nearshore reefs; older adults on deeper, offshore commercial grounds. Schlitz tagging results indicate that those young adults inhabiting the nearshore reefs show residence specificity typical of other serranids studied.

POMATOMIDAE

BLUEFISH, *Pomatomus saltatrix* (Linnaeus)

One hundred thirty-seven bluefish were tagged inshore in 1965, 3 in Area A, 116 in Area B, 17 in Area C, and 1 in Area D. Twenty-two fish (16.1%) were returned, principally from Area B (Table 2) after 8 to 190 days at liberty, with an overall mean freedom of 47.8 days.

Thirteen fish moved significantly (Table 6), predominantly northward along Florida's east coast during spring and summer. None of the returns yielded growth data.

A total of 391 bluefish were released during the five annual Schlitz programs. Forty-five (11.5%) were recovered and showed a mean freedom of 42.6 days. Most were tagged on Florida's east coast, in St. Lucie County during January and February, and during May, June, and July in St. Johns and Duval Counties. Similar northerly movement by earlier Schlitz returns (Beaumariage, 1964) is consistent with several observations of the seasonal fluctuation of bluefish along the eastern coast of the United States. Deuel *et al.* (1966) describe the departure of bluefish from Florida waters in the spring, coinciding with their arrival along the Carolina coasts in mid-spring. Richards (1965) reports that bluefish were the most abundant species in the charter boat fishery operating offshore of Virginia, peaking during May and June and again in September or October. He discusses availability patterns of bluefish along the eastern seaboard from landing statistics and theorizes that there is a northward drift of the adults during midsummer followed by a southward drift during the fall. This apparently accounts for our primarily winter bluefishery in Florida.

CARANGIDAE

POMPANO, *Trachinotus carolinus* (Linnnaeus)

Nineteen pompano were tagged inshore during the 1965 program (Table 2). Three fish (1.6%) were returned after 7 to 40 days at liberty with a mean freedom of 27.3 days.

The only return to show significant movement was from one of four fish released on 15 March 1965 at New Pass in Sarasota. It was recaptured 35 days later at Cortez (Manatee County), having moved approximately ten nautical miles north. None of the returns yielded growth data.

TABLE 6. BLUEFISH MOVEMENT

Date Released	Measurements (mm) FL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
2- 1-65	396	356	Off Hobe Sound Point (7 mi. N of Jupiter Inlet)	5- 8-65	97	Sebastian Inlet, Eau Gallie	50	N
1-19-65	373	336	¼ mi. S of Ft. Pierce Inlet	3-31-65	72	5 mi. S of Melbourne Beach in surf	34	N
1-15-65	397	359	1 mi. S of Ft. Pierce Inlet	3- 7-65	52	Loxahatchee Inlet, Jupiter	33	S
1-15-65	423	383	¼ mi. S of Ft. Pierce Inlet	2-13-65	30	S end Sebastian Inlet	22	N
1-19-65	372	335	¼ mi. S of Ft. Pierce Inlet	7-27-65	190	Sebastian Inlet	22	N
1-15-65	389	350	¼ mi. S of Ft. Pierce Inlet	2-14-65	31	Salerno Inlet	19	S
1-20-65	377	340	½ mi. S of Ft. Pierce Inlet	3- 5-65	45	Wabasso Beach	19	N
1-15-65	395	357	¼ mi. S of Ft. Pierce Inlet	3- 1-65	46	Wabasso Beach	19	N
7-17-65	263	291	South Jetty, Mayport Naval Base	7-30-65	14	Mickler Pier, Palm Valley	12	S
1-19-65	353	320	¼ mi. S of Ft. Pierce Inlet	3-10-65	51	¼ mi. S of Vero Beach Pier	11	N
1-20-65	353	320	½ mi. S of Ft. Pierce Inlet	2-10-65	22	Walden Rocks, Jensen Beach	10	S
1-15-65	390	356	¼ mi. S of Ft. Pierce Inlet	2-28-65	45	2 mi. S of Vero Beach Pier	10	N
1-19-65	360	325	¼ mi. S of Ft. Pierce Inlet	3-11-65	52	2 mi. S of Vero Beach Pier	10	N

PALOMETA, *Trachinotus goodei* Jordan & Evermann

Thirty-six palometa were tagged inshore in Area C in 1965. Ten fish (27.8%) were returned after 11 to 130 days at liberty, with a mean freedom of 38.0 days.

One of four fish showing significant movement (Table 7) was the first Schlitz tagged fish to be returned from the coastal waters of another state. The estimated movement of 385 nautical miles was obtained by measuring the length of the meandering five-fathom contour line from St. Marys Inlet at the Florida/Georgia boundary to Virginia Beach, North Carolina.

LUTJANIDAE

MUTTON SNAPPER, *Lutjanus analis* (Cuvier)

Four mutton snapper were tagged in 5.9 to 9.1 meters (3¼ to 5 fathoms) in Hawk Channel off Key Colony Beach (Key Largo) in 1965. One (25.0%) was returned from that location. It measured 265 mm TL 225 mm SL at release on 23 February 1965. Recapture measurements of 275 mm TL and 238 mm SL taken 300 days later on 19 December 1965 indicated a growth of approximately 1 mm per month.

RED SNAPPER, *Lutjanus campechanus* (Poey)

Three hundred twelve red snapper were tagged in 1965, 3 in Area A 14 in Area B, 54 in Area C, and 241 in Area D. One fish was brought in alive from the offshore reefs by a Daytona Beach party fishing boat and released inshore in Area C, but was never recaptured. Eighty-two fish (26.3%) were returned, all but eight from their release locations after 3 to 1,180 days at liberty, with a mean freedom of 113.0 days. Six additional returns were received from red snapper released during the 1963 and 1964 Schlitz programs and from one fish released in a holding pen at Marineland during the 1963 State tagging program.

This individual was among several held during that program for tag type evaluation (Moe, 1966) and constitutes the second return from captive fish which escaped the enclosure subsequent to the last examination on 28 September 1963. It was recaptured on 7 May 1969 (2,049 days later) in 22 fathoms (40.3 meters) about 60 miles on a heading of 70° from Mayport (Jacksonville). The reported recapture length (30 inches) indicates an estimated growth of 6.0 mm per month from 370 mm TL at release to the approximated 765 mm TL at recapture. Moe *et al.* (in manuscript) estimated that this fish moved about 80 nautical miles northeast.

From 1962 through 1965 a total of 1,372 red snapper were released throughout Florida's offshore waters; 384 (28.0%) were recovered after a mean freedom of 130.7 days. The greatest tagging effort (82.1%) was ex-

TABLE 7. PALOMETA MOVEMENT

Date Released	Measurements (mm) FL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
7-19-65	240	St. Marys Inlet Jetty	9-23-65	66	Atlantic Bch. Pier North Carolina	385	N
7- 7-65	218	¼ mi. N of Matanzas Inlet	11-13-65	130	Hutchinson Island, Jensen Beach	160	S
7- 8-65	235	¼ mi. N of Matanzas Inlet	7-23-65	16	North River - St. Augustine	13	N
7- 7-65	215	¼ mi. N of Matanzas Inlet	7-25-65	19	½ mi. S of Bridge of Lions - St. Augustine	11	N

pended in Area D with the release of 1,126 fish. Over half (651) were released at the three specific offshore locations shown in Figure 2.

Although a clear pattern of red snapper movement has yet to be established, these programs have contributed significantly to our present understanding. Topp (1963) for example, reported limited collective movement among red snapper released in less than 27.4 meters (15 fathoms) off Panama City during the 1962 program. Beaumariage (1964) and Topp (1964a) presented further evidence that red snapper released in similar depths off Carabelle in 1963 showed little or no movement. Appreciable movement was shown, however, by tagged individuals released in depths greater than 15 fathoms in 1964 (Beaumariage and Wittich, 1966). Movement shown in Table 8 by two returns from earlier programs and by eight returns from the 1965 program is the most extensive observed during the four years that we have tagged this species.

The seven red snapper which moved eastward (Figure 2) during their average 331.4 days of freedom ranged from 186 to 350 mm in standard length at release. The two available for measurement upon recapture increased 5.3 mm and 8.1 mm per month during 474 and 240 days at liberty (an average of 81.8 mm per year). According to Moseley (1966) these two fish would be in spawning class I and would be expected to grow 80 to 90 mm in standard length each year up to spawning class III. Consequently, movement of red snapper released in depths greater than 15 fathoms may be related to seasonality, size, or maturation.

Growth data (Table 9) is available from the return of two fish from the 1965 program and three from earlier programs.

MANGROVE SNAPPER, *Lutjanus griseus* (Linnaeus)

One hundred seventy-six mangrove snapper were tagged in 1965, 50 in Area A, 119 in Area B, 4 in Area C, and 3 in Area D. This includes 54 released offshore, 14 in Area A, 37 in Area B, and 3 in Area D. Fifteen fish (8.5%) were returned after 7 to 385 days at liberty, with a mean freedom of 94.2 days. The only offshore return was one fish released in 36.6 meters (20 fathoms) on the "Trisler Grounds" offshore of Pensacola (Figure 2). A return was also received from a mangrove snapper released offshore of St. Petersburg in 1963 during the State tagging program.

The only individual moving significantly from its release site was one of nine returns from fish transported into the Miami area from Rose Harbor, a fish camp 15 miles to the south. When released on 14 February 1965 at the MacArthur Causeway in Miami it measured 252 mm TL and 209 mm SL. It was recaptured on 5 March 1966 (385 days later) in a canal on the east side of Card Sound Road (Barnes Sound), 30 nautical miles south. Growth data presented in Table 10 is from this fish, a nontransported mangrove snapper released in 1965, and from the one tagged during the State program.

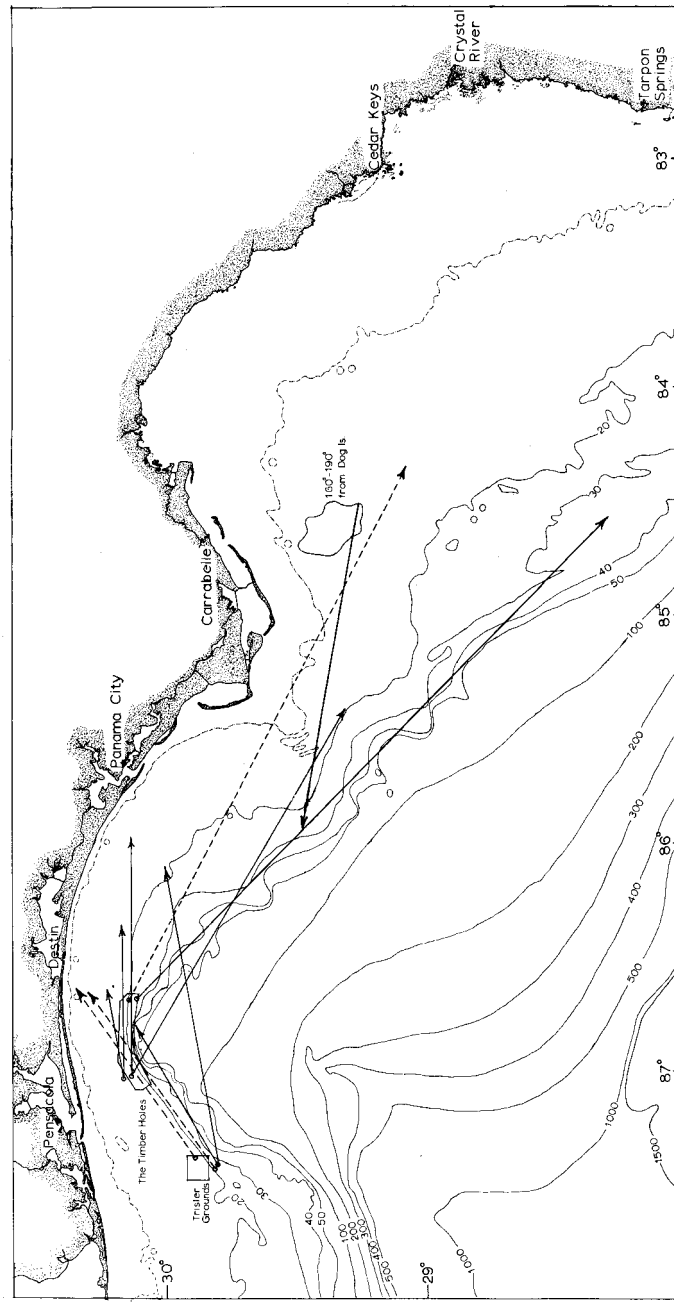

Figure 2. Movement of red snapper offshore of Area D. Broken lines represent significant movement shown in this area by red snapper from the 1964 program (Beaumariage and Wittich, 1966).

TABLE 8. RED SNAPPER MOVEMENT

Date Released	Measurements (mm) TL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
AREA C								
4-19-64	314	260	South end of "Turtle Mound Grounds" (off Daytona Beach)	5-27-66	769	Offshore of Mayport (near Jacksonville)	90	N
4-11-65	359	300	87° - 42 mi. from Ponce de Leon Inlet, 45.7-47.6 m (25-26 fathoms)	5- 2-66	357	6 mi. NE Cape Canaveral	25	S
AREA D								
6-23-65	242	200	186° from Destin Sea Buoy, 36.6 m (20 fathoms)	8-20-66	424	80 mi. SSE Cape St. George, 59.5 m (32½ fathoms) 28° 19' N, 84°35' W	150	135° (SSE)
6-27-65	232	195	120° from Pensacola Sea Buoy, 32.9 m (18 fathoms)	7-4-66	373	20 mi. S of Cape San Blas, 27.4 m (15 fathoms)	95	120° (ESE)
5-5-63	486	405	165° from Carrabelle, 27.4 m (15 fathoms)	7-10-66	1,163	35-40 mi. SWxS from Panama City, 54.9 m (30 fathoms)	75	280° (W)

TABLE 8. (Continued)

Date Released	Measurements (mm) TL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
6-26-65	260	215	190° from Pensacola Sea Buoy, 36.6 m (20 fathoms)	2-20-66	240	Offshore of Panama City	70	80° (E)
6-27-65	226	186	120° from Pensacola Sea Buoy, 32.9 m	8-13-66	474	10 mi. from Long Bch. (near Panama City)	55	E
6-27-65	281	232	120° from Pensacola Sea Buoy, 32.9 m	5-15-66	323	Approx. 30 mi. from Panama City Beach	35	E
6-26-65	415	350	190° from Pensacola Sea Buoy, 36.6 m	7-26-66	457	20 mi. offshore of Destin	35	60° (ENE)
6-27-65	295	245	120° from Pensacola Sea Buoy, 32.9 m	7-25-65	29	9 mi. off Cinco (near Destin)	20	80° (E)

Three hundred four mangrove snapper (18.3%) were recovered from the 1,663 tagged fish released since 1961. Only 13 (4.3%) have shown movement away from their respective release locations, this usually being less than 20 nautical miles. Eleven of the 13 had been transported from their original capture location to a distant release site.

TABLE 9. INDICATIONS OF GROWTH IN RED SNAPPER

Date Released	Measurements (mm) TL	SL	Date Recaptured	No. Days Free	Incr. in TL (mm) Total	Per Mo.	Incr. in SL (mm) Total	Per Mo.
6-25-65	260	215	2-20-66	240	105	13.1	65	8.1
6-25-64	419	350	8-23-65	425	146	10.3	88	6.2
6-27-65	226	186	8-13-66	474	104	6.6	84	5.3
5-15-63	262	217	9-20-64	494	126	7.6	105	6.4
4-19-64	314	260	5-27-66	769	200	7.8	174	6.8

The majority of transported fish, however, showed no movement. Since mangrove snapper have rather generalized ecological requirements, it was unlikely that transported fish were drastically displaced from an acceptable environment. Consequently, movement of displaced mangrove snapper is probably random.

TABLE 10.
INDICATIONS OF GROWTH IN MANGROVE SNAPPER

Date Released	Measurements (mm) TL	SL	Date Recaptured	No. Days Free	Incr. in TL (mm) Total	Per Mo.	Incr. in SL (mm) Total	Per Mo.
3- 8-65	188	150	11-6-66	244	28	3.5	15	1.9
2-14-65	252	209	3-5-66	385	91	7.1	57	4.5
6- 7-63	373	—	12-7-66	1,280	107	2.5	—	—

YELLOWTAIL SNAPPER, *Ocyurus chrysurus* (Bloch)

Thirty-six yellowtail snapper were tagged offshore in Area B in 1965. Three fish (8.3%) were recovered at their respective release locations 18, 21, and 262 days later.

The latter return measured 220 mm FL and 192 mm SL when released on 18 February 1965. Measurements taken at recapture on 6 November 1965 indicated a growth of 1.2 mm FL and 0.5 mm SL per month.

POMADASYIDAE

WHITE GRUNT, *Haemulon plumieri* (Lacepede)

One hundred seventy-nine white grunt were tagged offshore in 1965, 144 in Area A, 9 in Area B, and 26 in Area D. Fifteen (8.5%) were returned from their respective release locations in Area A after 3 to 324 days at liberty, with a mean freedom of 30.5 days. Three white grunt tagged in 1963 during the State program were also returned from their respective release locations offshore of Clearwater and St. Petersburg after 1,420 to 1,678 days at liberty. Growth data was unavailable.

During the Schlitz tagging programs 485 white grunt were released offshore (primarily in Areas A and D). Thirty-four (7.4%) were returned showing no significant growth or movement during their 52.2 mean days at liberty.

Two independent biases may account for the disparity in mean days at liberty and the number of returns between State tagged fish (Moe, 1966) and Schlitz tagged fish. The State tagging program utilized internal tags for their retentive qualities while the Schlitz program used the shorter term, more obvious, Petersen tag. In addition, there was an apparent increase in fishing pressure for Schlitz tagged fish because of the high monetary rewards. In one instance, over 60 per cent of one day's releases were returned within that week.

SPARIDAE

SHEEPSHEAD, *Archosargus probatocephalus* (Walbaum)

Four hundred thirty-eight sheepshead were tagged inshore in 1965, 70 in Area A, 280 in Area B, 87 in Area C, and 1 in Area D. One hundred eight fish (24.7%) were returned (Table 2) after 1 to 401 days at liberty, with mean freedom of 67.3 days. A return was also received from a sheepshead released during the 1964 program.

Only eight (7.4%) of those fish returned from the 1965 program moved significantly from their respective release locations (Table 11). Four of these were transported fish. The fish returned from the 1964 program was also a transported one. Growth data is presented in Table 12.

A total of 2,640 sheepshead were released during the Schlitz tagging programs and 917 (34.7%) were returned. One hundred seven (11.7%) moved significantly from their release sites. This movement has been mostly random (Topp, 1963) and often extensive (Beaumariage and Wittich, 1966).

Since sheepshead are an extremely hardy fish and survive tagging and excess handling quite well, they were often transported long distances and released at heavily fished locations to obtain a more even distribution of tagged fish with respect to fishing pressure.

Most release locations were well suited to the normal ecological requirements, and recaptures were usually made in the same area. Extensive movement was apparently associated with drastic changes in habitat, such as the transport of specimens from sheltered or brackish waters to open surf (Topp, 1964b).

RED PORGY, *Pagrus sedecim* Ginsburg

Forty-nine red porgy were tagged offshore in 1965, 15 in Area A, 3 in Area B, 10 in Area C, and 21 in Area D. Six fish (12.2%) were returned after 21 to 81 days at liberty, with a mean freedom of 46.2 days. No movement or growth were observed.

TABLE 11. SHEEPSHEAD MOVEMENT

Date Released	Measurements (mm) FL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
AREA C								
5-11-65	187	157	Allenhurst Canal (Titusville)	8-14-65	96	Matanzas River - N of Bridge of Lions (St. Augustine)	75	N
*5- 8-65	175	145	Ormond Beach Bridge - Halifax River	5-30-65	23	Bridge N of Flagler Beach	14	N
7-16-65	385	330	Talbot Island Pier	8-10-65	26	Jetty at Atlantic Bch	6	S
7-16-65	405	350	Talbot Island Pier	8-10-65	26	Jetty at Atlantic Bch	6	S
AREA B								
*4-30-65	265	225	Mather's Bridge - Banana River	3-18-66	323	Salerno Inlet	62	S
5- 2-65	195	165	Barge Canal Fish Camp - Merritt Is.	2-16-66	291	Sebastian Inlet	38	S
*4-30-65	232	200	Mather's Bridge - Banana River	6- 9-65	41	Buoy # 38 - Indian River	14	S
AREA A								
*4- 9-65	267	230	Bayport Park	3-25-66	351	Mouth of Homosassa River	15	N
1964 RETURN								
*2-10-64	252	215	Aripeka	2-13-66	735	Hudson	5	S

*Transported fish

TABLE 12. INDICATIONS OF GROWTH IN SHEEPSHEAD

Date Released	Measurements (mm) FL	SL	Date Recaptured	No. Days Free	Incr. in FL (mm) Total	Per Mo.	Incr. in SL (mm) Total	Per Mo.
5- 2-65	239	205	2-3-66	278	58	6.2	27	2.9
5- 2-65	195	165	2-16-66	291	57	5.9	53	5.5
4-30-65	265	225	3-18-66	323	90	8.3	51	4.7
5- 2-65	264	228	3-20-66	323	100	9.3	73	6.8
4- 9-65	267	230	3-25-66	351	85	7.3	67	5.7
1-17-65	227	194	2-2-66	383	60	4.7	38	3.0
2-10-64	252	215	2-13-66	735	96	3.9	75	3.1

SCIAENIDAE

SPOTTED SEATROUT, *Cynoscion nebulosus* (Cuvier)

Six hundred thirty-two spotted seatrout were tagged inshore in 1965, 205 in Area A, 154 in Area B, 96 in Area C, and 177 in Area D. Fifty-four (8.5%) were returned (Table 2) after 5 to 343 days at liberty, with a mean freedom of 88.7 days. Six additional spotted seatrout returns were received from the 1961, 1963, and 1964 programs.

Ten (18.5%) fish returned from the 1965 program moved significantly from their release locations (Table 13). Two of these fish were transported fish. Growth data from the return of six spotted seatrout tagged during 1965 and one during 1963 is presented in Table 14.

A total of 3,957 spotted seatrout were released since the first Schlitz tagging program in 1961. Fifty-nine per cent were released during the first two programs when more emphasis was placed on inshore species. Five hundred thirty-seven (13.6%) were recovered; 145 (27.0%) moved significantly while at large. Our observations agree with those of Moffett (1961) and Iversen and Tabb (1962) in that spotted seatrout rarely move over 20 or 30 miles from the immediate release site. Although this species was among those transported for release elsewhere, it is doubtful that any were released outside their usual range (Beaumariage and Wittich, 1966). Tabb (1966) emphasizes the dependency of spotted seatrout upon various estuarine areas throughout Florida, and infers that the environment of each area imparts an identity in the form of relative growth rates and abundance to the subpopulation which it supports.

WEAKFISH, *Cynoscion regalis* (Block and Schneider)

Nine weakfish were tagged inshore in 1965, most in Area B (Table 2). Three (33.3%) were returned after 22 to 42 days at liberty, with a mean freedom of 29.3 days. No movement or growth were observed.

GULF KINGFISH, *Menticirrhus littoralis* (Holbrook)

One hundred thirty-three Gulf kingfish were tagged inshore in 1965, mostly in Area C (Table 2). Twenty-eight (21.1%) were returned after 2 to 214 days at liberty, with a mean freedom of 24.7 days. One tagged fish which

TABLE 13. SPOTTED SEATROUT MOVEMENT

Date Released	Measurements (mm) TL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
AREA C								
7-19-65	372	320	Fernandina Pier	8-23-65	36	South Ponte Vedra in surf	45	S
7-20-65	395	342	N end of Little Talbot Island	3-12-66	236	S of Lighthouse Park Pier	35	S
7-19-65	429	367	Fernandina Pier	2-19-66	216	White Street Camp, Heckscher Dr. (Jacksonville)	20	S
7-17-65	31	264	South Mayport Jetty (U. S. Naval Base)	8-23-65	38	Coon Point near Fulton, Fla.	8	E
AREA B								
5-3-65	343	292	Eau Gallie Causeway	7-16-65	75	South Bennett Causeway, N Banana River	15	N
AREA A								
*3-15-65	358	305	Robert's Bay, Nokomis	6- 5-65	83	City Island, Sarasota	16	N
*3-20-65	348	300	Terra Ceia Bay at Highway 19	5- 2-65	44	Little Manatee River, Ruskin	10	N

*Transported fish

TABLE 13. (Continued)

Date Released	Measurements (mm) TL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
AREA D								
5-20-65	402	340	One mile W of Turtle Point, Yankeetown	4- 66	324	Deadman Key S of Withlacoochee River	15	S
5-20-65	315	270	"Bombing Stake" 1 mi. W of Porpoise Pt., Yankeetown	7-29-65	71	Waccasassa Bay, Cedar Key	10	N
6-10-65	364	312	Off Shired Is., halfway between Suwannee R. & Horseshoe Pt.	6-19-65	10	7 mi. S of Shired Island	7	S
PREVIOUS PROGRAMS								
4- 5-63	378	325	Mouth of Chassahowitzka R. near Buckhorn Key	9- 7-67	1,626	Mangrove Pt. S shore Crystal Bay	12	N
1-11-63	351	299	Terra Ceia Bay at Highway 19	2-8-66	1,125	Crane's Bayou, Sarasota Bay	10	S
*1- 8-64	310	265	Floramar Basin, New Port Richey	2-26-66	781	Canal at Hudson Beach	10	N

*Transported fish

had been kept frozen by the fisherman since "sometime during the fall of 1967" was returned during July 1968. No movement was apparent and recapture measurements appeared invalid due to the length of time the fish remained frozen. The estimated 800 days at liberty were not included in calculating mean freedom. A return was also received from the 1964 program.

Seven fish (25.0%) returned from the 1965 program moved more than five miles from their release locations (Table 15).

Two fish contributed growth data. One measured 350 mm TL and 295 mm SL when released on 7 July 1965. Recapture measurements taken 214 days later on 5 February 1966, indicated growth of 0.3 mm TL and 0.8 mm SL per month. The other measured 315 mm TL and 260 mm SL when released on 11 May 1964. Recapture measurements taken 403 days later on 17 June 1965 indicated growth of 4.4 mm TL and 3.1 mm SL per month.

TABLE 14.
INDICATIONS OF GROWTH IN SPOTTED SEATROUT

Date Released	Measurements (mm) TL	SL	Date Recaptured	No. Days Free	Incr. in TL (mm) Total	Per Mo.	Incr. in SL (mm) Total	Per Mo.
7-19-65	429	367	2-19-66	216	15	2.1	16	2.2
7-20-65	395	342	3-12-66	236	4	0.5	5	0.6
4-29-65	365	310	3-2-66	308	63	6.1	45	4.4
5-20-65	402	340	4- 66	324*	83	7.7	80	7.4
5- 1-65	390	332	3-24-66	328	30	2.8	33	3.0
3-11-65	336	289	2-7-66	334	8	0.7	3	0.3
1-11-63	351	299	2-8-66	1,125	155	4.1	129	3.4

*Estimated minimum

SOUTHERN KINGFISH, *Menticirrhus americanus* (Linnaeus)

Seven southern kingfish were tagged inshore in Area B in 1965; one (14.3%) was returned. This fish had been transported from the Barge Canal Fish Camp on Merritt Island to the Eau Gallie Causeway for release on 30 April 1965, and was recaptured there 12 days later.

BLACK DRUM, *Pogonias cromis* (Linnaeus)

Fifty black drum were tagged inshore in 1965, 8 in Area A, 11 in Area B, 24 in Area C, and 7 in Area D. Eighteen (36.0%) were returned from their release locations after 2 to 389 days at liberty, with a mean freedom of 58.3 days. Two of these were transported fish.

Two fish contributed growth data. One measured 286 mm TL and 232 mm SL when released on 8 March 1965. Recapture measurements taken 318 days later on 19 January 1966 indicated growth of 2.3 mm TL and 1.7 mm SL per month. The other measured 280 mm TL and 225 mm SL when released on 19 January 1965. Recapture measurements taken 389 days later on 11 February 1966 indicated growth of 2.8 mm TL and 2.9 mm SL per month.

TABLE 15. GULF KINGFISH MOVEMENT

Date Released	Measurements (mm) TL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
7-16-65	347	289	Talbot Island Pier	8-23-65	39	South Ponte Vedra	25	S
7-17-65	305	255	South Mayport Jetty near Naval Base	7-30-65	14	Mickler Pier, Palm Valley, ocean front	12	S
7-17-65	394	332	South Mayport Jetty near Naval Base	7-30-65	14	Mickler Pier, Palm Valley, ocean front	12	S
7-17-65	290	240	South Mayport Jetty near Naval Base	8-23-65	32	Mickler Pier, Palm Valley, ocean front	12	S
7- 8-65	350	292	1 mile N of Matanzas Inlet	7-23-65	16	St. Augustine Pier	8	N
7-22-65	332	280	South Mayport Jetty	8- 2-65	12	Jacksonville Beach near Pier	6	S
7-17-65	360	300	South Mayport Jetty near Naval Base	8- 2-65	17	Jacksonville Beach near Pier	6	S

TABLE 16. RED DRUM MOVEMENT

Date Released	Measurements (mm) TL	SL	Release Location	Date Recaptured	No. Days Free	Recapture Location	Movement Naut. Mi.	Direction
7-19-65	302	250	St. Marys Inlet	7-29-65	11	Nassau Sound Bridge	12	S
7- 9-65	635	550	St. Augustine Inlet	2-26-66	233	Matanzas Inlet	12	S
1963 RETURN								
4-10-63	372	311	Barge Canal Fish Camp, Merritt Island	2-13-66	1,041	2 miles N of Vilano Bridge, North River	95	N

A total of 538 black drum have been released since 1961. One hundred ninety-nine (37.0%) were recovered, only five per cent having moved significantly. Black drum are hardy and were often transported to release sites. Like sheepshead, they were usually recaptured shortly after release and showed little movement. Some relatively extensive movement, however, has been shown by black drum released from beach seines in the open surf of northeast Florida (Topp, 1963; Beaumariage and Wittich, 1966).

RED DRUM, *Sciaenops ocellata* (Linnaeus)

Eighteen red drum were tagged inshore in 1965, 1 in Area B, 15 in Area C, and 2 in Area D. Ten fish (55.6%) were returned (Table 2) after 10 to 243 days at liberty, with a mean freedom of 74.6 days. A return was also received from the 1963 program.

Significant movement was shown by the 1963 return and two fish from the 1965 program (Table 16). Growth data was available from a single 1965 return free 243 days and measuring 655 mm TL and 560 mm SL when released on 9 July 1965. An increase of 2.5 mm TL and 1.4 mm SL per month was indicated by recapture measurements taken on 8 March 1966.

A total of 690 red drum were released during the five Schlitz tagging programs. Three hundred twenty-eight (47.5%) were recovered; 91.2 per cent did not move significantly from their release locations. A few individuals have shown some extensive movement but it has been infrequent and generally among transported fish (Ingle *et al.*, 1962; Beaumariage, 1964; Beaumariage and Wittich, 1966).

EPHIPPIDAE

ATLANTIC SPADEFISH, *Chaetodipterus faber* (Broussonet)

Fourteen Atlantic spadefish were tagged inshore in 1965, mostly in Area C (Table 2). Three (21.4%) were returned after 6 to 42 days at liberty, with a mean freedom of 20.0 days.

One fish, free 42 days, was released on 20 July 1965 at the north end of Little Talbot Island (near Jacksonville) and was recaptured 12 nautical miles south on 30 August 1965. It measured 205 mm TL and 170 mm SL at release and grew 13.6 mm TL and 5.7 mm SL per month.

SPHYRAENIDAE

GREAT BARRACUDA, *Sphyraena barracuda* (Walbaum)

Twenty great barracuda were tagged in 1965, 19 inshore in Area B, and 1 offshore in Area C. Six (30.0%) were returned from Area B after 43 to 92 days at liberty, with a mean freedom of 64.8 days.

None of these fish moved from Manatee Bay (just north of Key Largo) where they were released. Growth data is available from four fish (Table 17).

The rate of returns obtained from Schlitz tagged barracuda was considerably higher than the 8.0 per cent received from the 372 fish released by Springer and McErlean (1961). This may have been due to increased fishing pressure for the Schlitz tags. Moreover, the internal and spaghetti tags which we used were probably better suited to these swift predators than were the more easily shed Petersen or dart tags used during the earlier study.

TABLE 17.

INDICATIONS OF GROWTH IN GREAT BARRACUDA

Date Released	Measurements (mm) FL	SL	Date Recaptured	No. Days Free	Incr. in FL (mm) Total	Per Mo.	Incr. in SL (mm) Total	Per Mo.
2-15-65	399	364	4-11-65	56	11	5.8	6	3.2
2-15-65	445	410	4-20-65	65	15	6.8	10	4.5
2-15-65	340	310	5-9-65	84	18	6.4	15	5.4
2-13-65	392	356	5-15-65	92	30	9.7	29	9.4

Our tagging supports Springer and McErlean (1961) who found that small barracuda exhibited little movement from mangrove-lined grassy flats in the Florida Keys. However, two larger barracuda released near offshore reefs in the Florida Keys moved significantly during their ten months at liberty (Topp, 1963).

SCOMBRIDAE

KING MACKEREL, *Scomberomorus cavalla* (Cuvier)

Sixty-eight king mackerel were tagged in 1965, 49 in Area B, 1 in Area C, and 18 in Area D. Two (2.9%) were returned from Area B after 58 and 67 days at liberty.

Both were released in 15 fathoms (27.4 meters) due east of Jupiter Inlet on 30 January 1965. One (630 mm FL) was returned from that location on 28 March 1965; the other (655 mm TL) was recaptured on 6 April 1965 off Sebastian Inlet (58 nautical miles north). Growth information was not available.

King mackerel are extremely difficult to catch, tag, and release without injury. Tagging techniques developed during the Schlitz and State tagging programs have been used successfully (Moe, 1966), and previous Schlitz recoveries have been reported by Beaumariage (1964).

BALISTIDAE

GRAY TRIGGERFISH, *Balistes capriscus* Gmelin

Fifty-eight gray triggerfish were tagged in 1965, mostly in Area D (Table 2). Six (10.3%) were returned from Area D after 48 to 380 days at liberty, with a mean freedom of 201.8 days. None moved significantly, but three contributed growth information (Table 18).

TABLE 18

INDICATIONS OF GROWTH IN GRAY TRIGGERFISH

Date Released	Measurements (mm) TL	SL	Date Recaptured	No. Days Free	Incr. in TL (mm) Total	Per Mo.	Incr. in SL (mm) Total	Per Mo.
6-23-65	250	207	8-9-65	48	25	15.6	17	10.6
6-23-65	270	222	8-14-65	53	23	12.8	22	12.2
6-20-65	332	285	5-31-66	346	50	4.3	41	3.6

SUMMARY

A total of 3,413 marine fishes representing 20 families and 58 species of sport or commercial importance were released throughout Florida's coastal waters during the 1965 Schlitz tagging program. A total of 593 (17.4%) were returned, comprising 13 families and 26 species. Information pertaining to movement or growth is presented for each species when available from various tag returns.

A cumulative analysis of all the tagging data is presented for twelve species (14,304 fishes) which have been repeatedly encountered among the more than 18,000 individuals released during the five annual programs (1961-1965): southern sea bass, *Centropristes striatus melanus;* black sea bass, *C. striatus striatus;* red grouper, *Epinephelus morio;* gag grouper, *Mycteroperca microlepis*; bluefish, *Pomatomus saltatrix;* red snapper, *Lutjanus campechanus;* mangrove snapper, *L. griseus;* white grunt, *Haemulon plumieri;* sheepshead, *Archosargus probatocephalus;* spotted seatrout, *Cynoscion nebulosus;* black drum, *Pogonias cromis; and* red drum, *Sciaenops ocellata.*

BEAUMARIAGE, D. S.
1964. Returns from the 1963 Schlitz tagging program, *Fla. Bd. Conserv. Mar. Lab.*, Tech. Ser. No. 43: 34 pp.

BEAUMARIAGE, D. S. and A. C. WITTICH
1966. Returns from the 1964 Schlitz tagging program. *Fla. Bd. Conserv. Mar. Lab.*, Tech. Ser. No. 47: 50 pp.

BRIGGS, J. C.
1958. A list of Florida fishes and their distribution. *Bull. Fla. St. Mus.*, *2*(8): 318 pp.

DEUEL, D. G., J. R. CLARK, and A. J. MANSUETI
1966. Description of embryonic and early larval stages of bluefish, *Pomatomus saltatrix*. *Trans. Amer. Fish. Soc.*, *95*(3): 264-271.

GREENWOOD, P. H., D. E. ROSEN, S. H. WEITZMAN, and G. S. MYERS
1966. Phyletic studies of teleostean fishes with a provisional classification of living forms. *Bull. Amer. Mus. Nat. Hist.*, *131*(4): 393-403.

INGLE, R. M., R. F. HUTTON, and R. W. TOPP
1962. Results of the tagging of salt water fishes in Florida. *Fla. Bd. Conserv. Mar. Lab.*, Tech. Ser. No. 38: 57 pp.

IVERSEN, E. S. and D. C. TABB
1962. Subpopulations based on growth and tagging studies of spotted seatrout in Florida. *Copeia*, *1962*(3): 544-548.

MOE, M. A., JR.
1966. Tagging fishes in Florida offshore waters. *Fla. Bd. Conserv. Mar. Lab.*, Tech. Ser. No. 49: 40 pp.

MOE, M. A., JR.
1967. Prolonged survival and migration of three tagged reef fishes in the Gulf of Mexico. *Trans. Amer. Fish. Soc.*, *96*(2): 228-229.

MOE, M. A., JR., D. S. BEAUMARIAGE, and R. W. TOPP
1969. Tag returns from gag grouper, *Mycteroperca microlepis*, and Caribbean red snapper, *Lutjanus campechanus*, after six years of freedom. (In manuscript)

MOFFETT, A. W.
1961. Movements and growth of spotted seatrout in west Florida. *Fla. Bd. Conserv.*, Tech. Ser. No. 36: 35 pp.

MOSELEY, F. N.
1966. Biology of the red snapper, *Lutjanus aya* Bloch, of the northwestern Gulf of Mexico. *Publ. Inst. Mar. Sci.*, *11*: 90-101.

RICHARDS, C. E.
1965. Availability pattern of marine fishes caught by charter boats operating off Virginia's eastern shore, 1955-1962. *Chesapeake Sci.*, *6*(2): 96-108.

SPRINGER, V. G. and A. J. McERLEAN
1961. Tagging of great barracuda, *Sphyraena barracuda* (Walbaum). *Trans. Amer. Fish. Soc.*, *90*(4): 497-500.

TABB, D. C.
1966. The estuary as a habitat for spotted seatrout. *In* A symposium on estuarine fisheries. *Amer. Fish Soc.*, Sept. 1964, Spec. Publ. No. 3.

TOPP, R. W.
1963. The tagging of fishes in Florida 1962 program. *Fla. Bd. Conserv. Mar. Lab.*, Prof. Pap. Ser. No. 5: 76 pp.

TOPP, R. W.
1964a. Residence habits of the red snapper. *Underw. Nat.*, *2*(3): 15-17.

TOPP, R. W.
1964b. Movements of a group of displaced sheepshead.. *Underw. Nat.*, *2*(2): 21.