Gulf Thread Herring: Aspects of the Developing Fishery and Biological Research [1]

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Abstract

Development of an industrial fishery for thread herring *(Opisthonema oglinum)* in its first year on the Florida west coast is described, including information on fishing areas, legal problems, vessels and gear, landings, catch per set, processing and yield. A brief outline of the biological program is given. Preliminary results of research are discussed, including seasonal distribution, length frequency, age composition, feeding habits, gonad development and occurrence of juveniles.

INTRODUCTION

THIS REPORT describes the development of the thread herring fishery in its first year and briefly outlines the biological research program and presents some of the preliminary results.

The thread herring, *Opisthonema oglinum* (LeSueur), is a marine fish of the family Clupeidae that occurs in tropical and subtropical waters of the western Atlantic Ocean and throughout the Gulf of Mexico (Butler, 1961; Berry and Barrett, 1963; Hildebrand, 1963). Bullis and Thompson (1967) have estimated that the Gulf stock is about 1 million tons. Thread herring are found in great numbers along the west coast of Florida, particularly from October to April in the Fort Myers area.

Commercial fishing for thread herring was first attempted in the St. Petersburg, Florida area in 1958. Lampara and single-boat-rig purse seining produced good catches but adequate reduction facilities were not available, and operations were discontinued in 1960 (Butler, 1961). In August 1967, the industrial thread herring fishery was revived with the opening of a reduction plant on Charlotte Harbor near Fort Myers. Fishing by local vessels has continued since August, and a number of Louisiana-based menhaden vessels entered the fishery in November and December and again in February 1968. The continuing decline of Atlantic menhaden stocks and increasing demand for animal protein have prompted the development of the current fishery (Fuss, 1968).

In recognition of the need for biological studies in the early stages of a new fishery, the Bureau of Commercial Fisheries Biological Laboratory at St. Petersburg Beach initiated preliminary studies on the life history and distribution of thread herring in April 1967. The project was expanded on July 1, 1967.

THE FISHERY

Fishing area

Fishing has been confined to a relatively small area off Fort Myers in near-

[1] Contribution No. 50, Bureau of Commercial Fisheries Biological Laboratory, St. Petersburg Beach, Florida 33706.

shore waters less than 10 fathoms deep (Fig. 1). Rough bottom (coral and rock outcrops) to the north and south and a scarcity of fish in offshore waters restrict the area of fishing. Good bottom conditions exist in the St. Petersburg area but a Florida law prohibits purse seining for industrial fish in territorial waters adjacent to Pinellas County.

Catches in the fishery varied seasonally. Fishery statistics collected from the crews of commercial vessels revealed that most catches were in two areas—off Gasparilla Island in the north and off Sanibel Island in the south. The seasonal distribution of fishing effort in these two areas differed during the fall and winter. The number of sets in the north reached a maximum in the fall

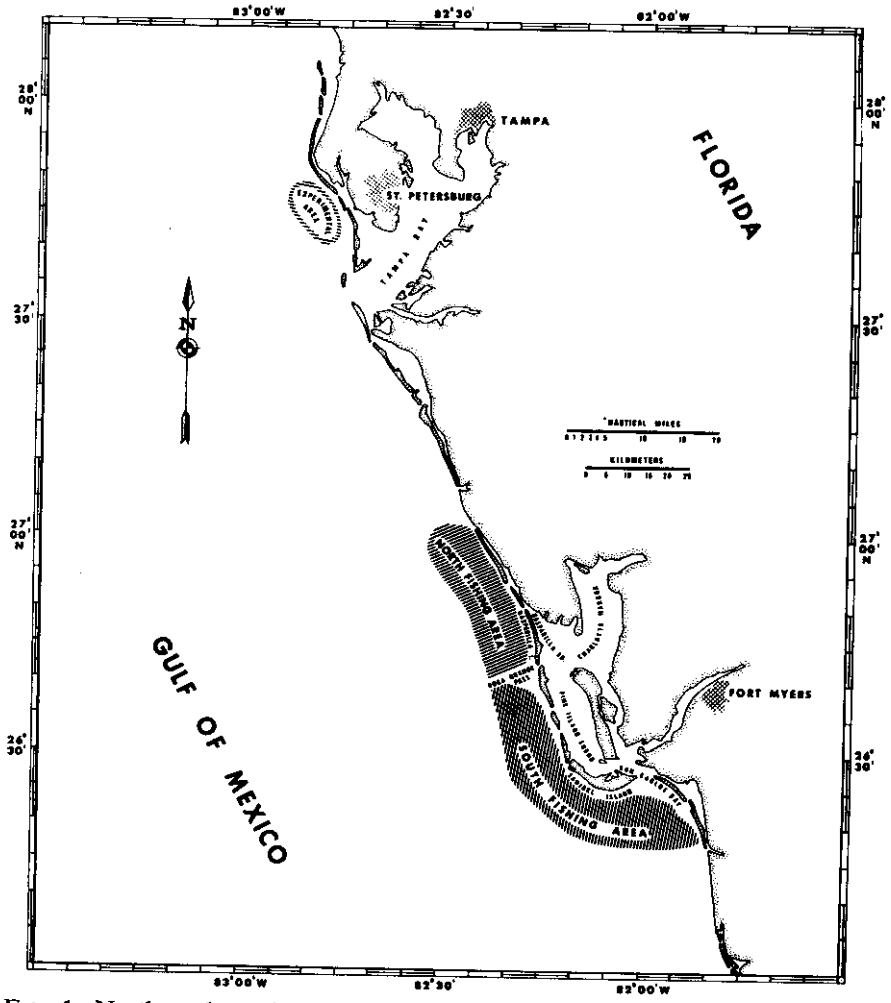

FIG. 1. North and south commercial fishing areas off Fort Myers, Florida, and experimental thread herring fishing area off St. Petersburg Beach, Florida.

and declined to a minimum in the winter, but the number in the south rose from a minimum in the fall to a maximum in the winter. The percentage of total sets made during the summer was about the same in the two areas (Fig. 2).

Legal problems

The new fishery was initially beset with a series of legal conflicts over the taking of food fish by purse seines. Florida does not allow purse seining for food fish in territorial waters (out to 10.5 miles on the Gulf coast), and the law was interpreted to include incidental food fish captured in thread herring sets. From late November 1967 to February 1968, enforcement of the statute caused a reduction in local fishing and the withdrawal of out-of-state vessels from the fishery. We immediately began to analyze catch data and were able to testify at court hearings that food fish accounted for less than 1% of the industrial catches. As a result, a court decision was delivered on February 5, 1968, that included an interpretation allowing a small percentage of food fish in thread herring catches, subject to administrative regulation by the Florida State Board of Conservation.

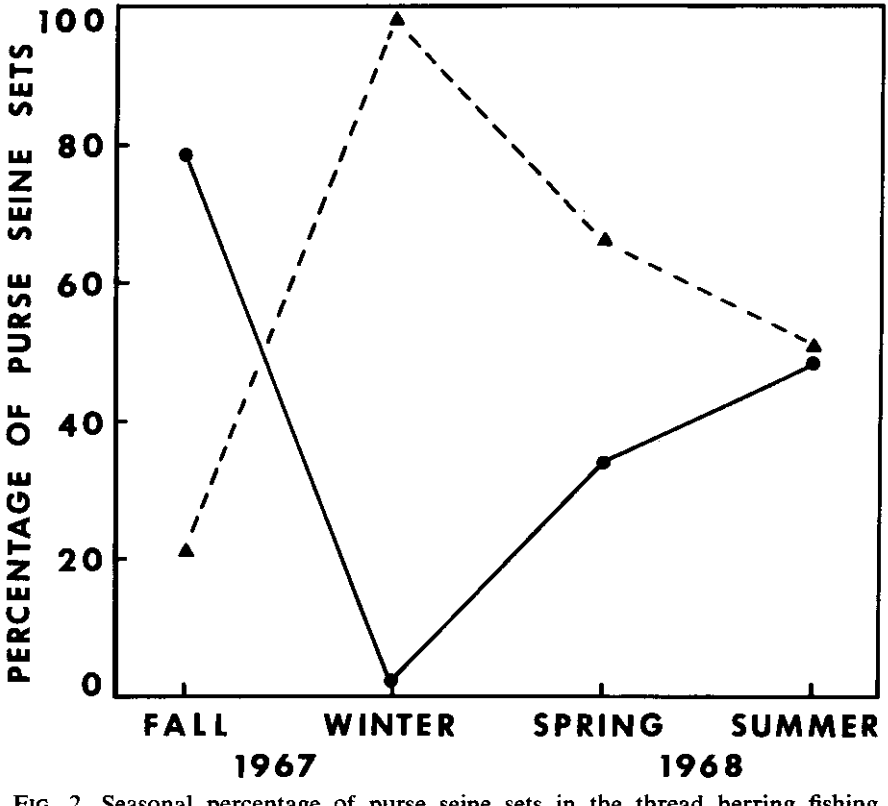

FIG. 2. Seasonal percentage of purse seine sets in the thread herring fishing areas off Fort Myers, Florida, 1967-68; north, solid line, and south, dashed line.

Vessels and gear

Vessels based at the plant in Charlotte Harbor and from Dulac, Louisiana, have been active in the thread herring fishery. These craft were either single-boat purse seiners or typical two-boat-rig menhaden vessels.

The first vessel in the fishery began operating from the Charlotte Harbor plant in late August 1967. It was a converted 78-foot shrimp trawler (Fig. 3) rigged to fish a single-boat purse seine of 1¼-inch stretched mesh (about 265 fathoms long by 800 meshes deep). A crew of 4 to 7 was required—somewhat less than one-half the number of men needed to fish a typical two-boat menhaden rig. The vessel fished for 10 months; fish were landed on the day they were caught because the hold was not refrigerated.

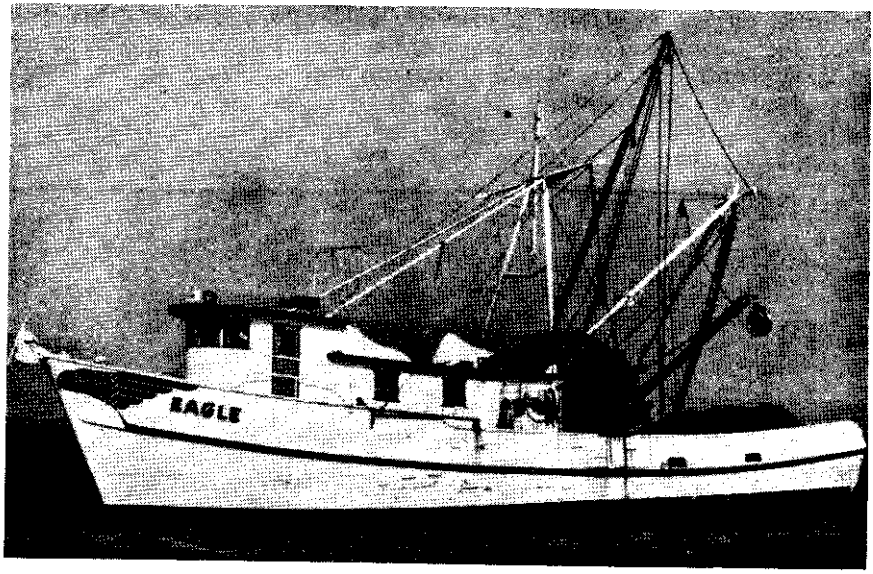

FIG. 3. Single-boat-rig purse seiner used in the Florida thread herring fishery.

From October to December 1967 and again in February 1968 a refrigerated menhaden vessel measuring 120 feet (two-boat rig) joined the operation, fishing a 1¼-inch stretched mesh purse seine (about 250 fathoms long by 1,200 meshes deep). In April 1968, a second converted shrimp trawler rigged to fish a single-boat purse seine began operations from the Charlotte Harbor plant. This vessel landed a relatively small volume of thread herring and was used primarily for the evaluation of sonar equipment. In May, the single-boat purse seiners were withdrawn from the fishery. At the end of May the plant acquired a 129-foot refrigerated menhaden vessel rigged to fish a 1½-inch stretched mesh menhaden purse seine (about 170 fathoms long by 1,200 meshes deep). This was the only vessel that continued to fish during the summer.

The Louisiana-based vessels fished off Fort Myers in November and December 1967 and for a short time in February 1968. These were modern, 500-ton capacity vessels with refrigerated holds. They fished standard 1½-inch

stretched mesh menhaden seines (about 250 fathoms long by 1,200 meshes deep). Not over three vessels fished at any one time but others were used for freighting catches to Dulac.

The only gear problem encountered, other than fouling on bad bottom, was the sinking of the cork-line in single-boat-rig operations when the catch was hardened (fish concentrated in the bag of the net). The problem was solved by attaching drop-lines from the cork-line to the lead-line at about 36-foot intervals. When the seine was pursed and the lead-line brought up to the vessel, the drop-lines were raised with the lead-line to support the cork-line and prevent it from sinking.

Landings and catch per set

Landings at the Charlotte Harbor plant through August 1968 totaled 5,689 tons. Most of the fish landed were thread herring, but occasionally schools of menhaden were caught. Florida-caught thread herring landed in Louisiana during the winter amounted to 1,270 tons. These catches, plus the Florida

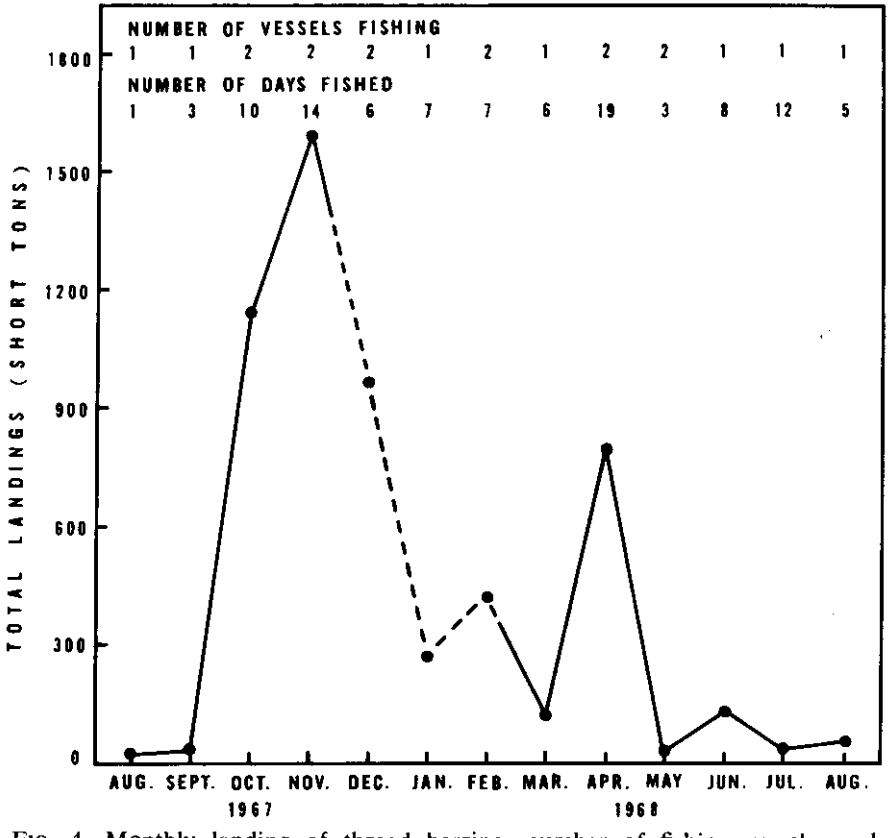

FIG. 4. Monthly landing of thread herring, number of fishing vessels, and number of days fished for the Charlotte Harbor plant in 1967-68. Dashed line designates period of controversy over legality of the thread herring fishery.

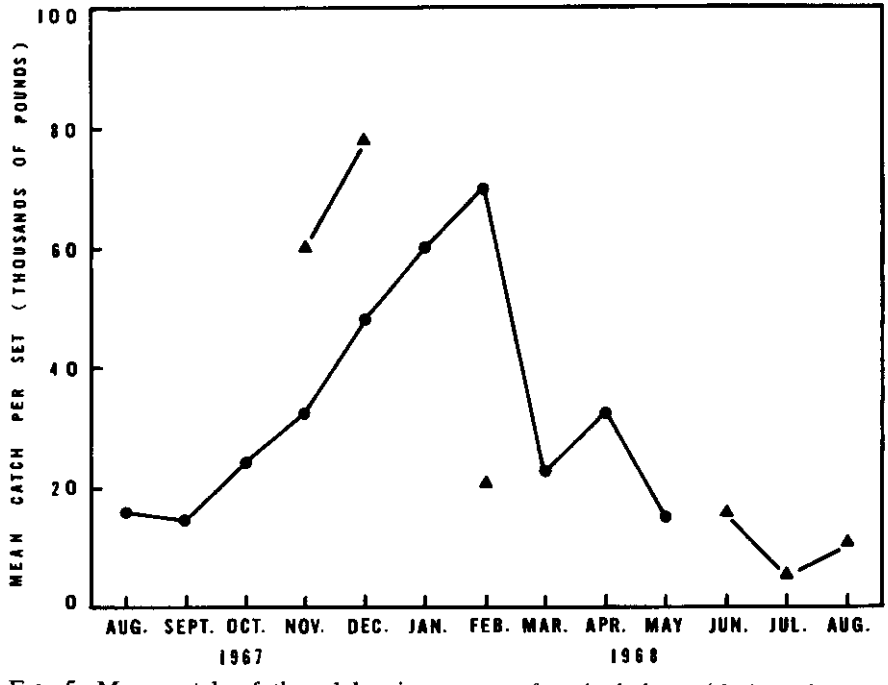

FIG. 5. Mean catch of thread herring per set for single-boat (dot) and two-boat rigs (triangle) on the grounds off Fort Myers, Florida, 1967-68.

landings, totaled almost 7,000 tons (6,355 metric tons) for the first year of the fishery.

Monthly landings at the Charlotte Harbor plant (unpublished data[2]) showed a primary peak in November and a secondary peak in April. Landings dropped off in May and remained low through the summer (Fig. 4). Observations indicated the fish to be scattered in small schools during the warm weather. Spawning or other factors may have caused the scattering and reduction in school size.

Data on catch per set show that schools of thread herring were larger in the winter than in other seasons (Fig. 5 and Table 1). These catches reflect school size but do not necessarily indicate seasonal differences in the abundance of fish, because the time spent locating schools of fish was not included. The large winter schools might have brought greater landings if fishing effort had not been reduced because of legal problems and inclement weather (northers). Winter cold fronts not only restrict fishing but apparently cause the temporary dispersal of fish schools.

In periods of relatively good fishing (October-April) the single-boat rig caught about 61% of the catch per set reported by the two-boat rig (Table 1). The smaller single-boat rig can be used efficiently when the fishing grounds are

[2]Statistical data on file at Bureau of Commercial Fisheries Statistical Office, Miami, Florida 33149.

close to a processing plant, and may prove to be more economical than a two-boat rig in the fishery near Charlotte Harbor.

Plants and processing

The reduction plant at Charlotte Harbor has a daily capacity of about 200 tons (182 metric tons) of fish and is equipped with modern facilities for production of meal, oil and solubles. The only problems encountered in the processing of thread herring were the accumulation of scales (thread herring shed scales easily) in the recirculating water of the plant's rotary fish pump and the formation of a suspension of extremely fine particles in the press water. The scale problem was solved by using a screen of smaller mesh in the pumping system. A method was developed for finer screening and centrifuging of the press water to remove suspended particles. Processing of thread herring is now routine.

TABLE 1

CATCH OF THREAD HERRING PER SET BY COMMERCIAL VESSELS FISHING OFF FORT MYERS, FLORIDA, 1967-68[1]

	Single-boat rig			Two-boat rigs		
Month	Number sets	Catch (1000 lbs.)	Catch per set (1000 lbs.)	Number sets	Catch (1000 lbs.)	Catch per set (1000 lbs.)
Aug. 1967	1	16	16	—	—	—
Sept.	4	60	15	—	—	—
Oct.	21	525	25	—	—	—
Nov.	32	1,063	33	39	2,352	60
Dec.	13	622	48	13	1,020	78
Jan.	11	661	60	—	—	—
Feb.	11	776	71	5	103	21
March	11	252	23	—	—	—
April	45	1,491	33	—	—	—
May	2	29	15	—	—	—
June	—	—	—	18	292	16
July	—	—	—	21	101	5
Aug. 1968	—	—	—	11	139	13
Mean						
Oct.-April	144	5,390	37	57	3,475	61
May-Sept.	7	105	15	50	532	11
All months	151	5,495	36	107	4,007	37

[1]Only landings accompanied by logbook information.

The Louisiana plant reported no difficulties in processing thread herring. The only difficulty encountered was that scales clogged the refrigerated sea water system in the fish holds of transport vessels.

Yield and quality of products

The yield of fish meal is higher from thread herring than from menhaden. Fish landed in Louisiana during the winter yielded 86 tons of meal per

million standard fish[3] (about 333 tons). The yearly average for fish landed at Charlotte Harbor was about 79 tons per million. This ratio of meal to fish is about 1:4. For menhaden the ratio is about 70 tons of meal per million fish, or about 1:5.

Protein content of thread herring meal is reported to be 65% to 68%. Sixty percent protein is usually guaranteed for menhaden meal. Plant operators also state that thread herring yield a meal of finer texture than menhaden.

The yield of oil from thread herring is considerably below that from menhaden, particularly in the summer. Thread herring landed at Charlotte Harbor in the winter yielded 3,300 gallons of oil per million fish, but summer landings yielded less than 1,000 gallons per million fish. Menhaden generally give more than 10,000 gallons per million fish or at least three times the best yield from thread herring at Charlotte Harbor.

Solubles from thread herring have varied from 15 to 25 tons per million fish. The production of oil and solubles, however, has been small.

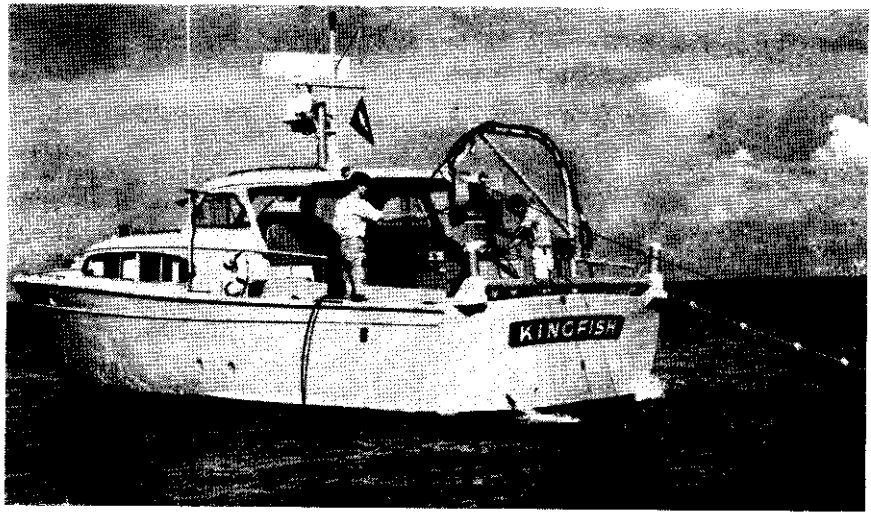

FIG. 6. Bureau of Commercial Fisheries R/V KINGFISH rigged with a power block for sampling thread herring with monofilament gill nets.

BIOLOGICAL RESEARCH

Fishery scientists seldom have an opportunity to begin studies on a substantial and underutilized stock before significant commercial exploitation. Information gained during the early stages of the fishery, such as age and size of the fish and catch per unit of effort, will serve as a basis for assessing the possible future effects of fishing pressures on the resource. By gathering environmental data along with catch data we may be able to detect possible changes in the population traceable to factors other than fishing.

[3]Menhaden industry terminology referring to the volumetric method of counting fish. A standard plant counting hopper holds about 1,000 standard fish (menhaden). Three hoppers (3,000 standard fish) are equal to approximately 1 ton.

The broad objectives of the research called for long-range studies that could contribute to the management of the fishery and the prediction of year class strength (Fuss, 1968). Immediate objectives, however, are directed to collection of timely information on the new fishery. Emphasis has been placed on distribution, age and growth, catch analysis and some aspects of behavior.

Field data for the fishery were obtained from log book records that included fishing location, depth, time of set, estimated catch per set (number of fish) and general meteorological conditions. Fish samples for laboratory analysis were obtained from the commercial catches. Information on daily landings was provided by plant personnel.

Additional samples of adult fish have been collected with monofilament gill nets of various mesh sizes set from the Laboratory's R/V KINGFISH (Fig. 6). Gill net sampling was conducted monthly in Tampa Bay and Gulf waters off St. Petersburg Beach. Limited sampling was done in Charlotte Harbor-Pine Island Sound and in nearshore Gulf waters between St. Petersburg Beach and Fort Myers Beach. Plankton tows (No. 0, ½-m net) were made at each gill net station and oceanographic data including temperature and salinity were recorded. Beach seines and lift nets were used to collect juvenile thread herring in shallow areas and near docks and bridges.

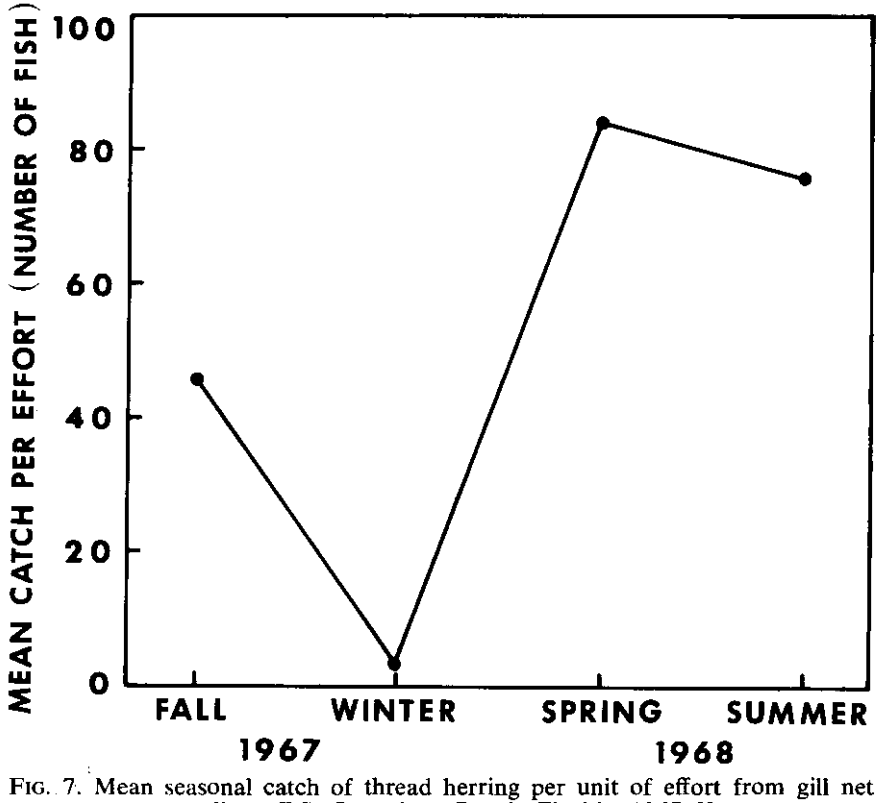

FIG. 7. Mean seasonal catch of thread herring per unit of effort from gill net sampling off St. Petersburg Beach, Florida, 1967-68.

Laboratory processing on fish samples included measurements of fork length, body depth, body weight and gonad weight. Sex was determined and scales, stomach and gonad samples were preserved for analysis.

Conclusions from the first year of study are highly tentative, but certain aspects of thread herring biology are apparent. Selected data are presented here to illustrate the type of work currently in progress.

Seasonal distribution

Gill net sampling off St. Petersburg Beach and data from commercial fishing off Fort Myers indicate a seasonal population shift along the Florida west coast. Thread herring catches per unit of effort (30-minute set with 2-inch-mesh

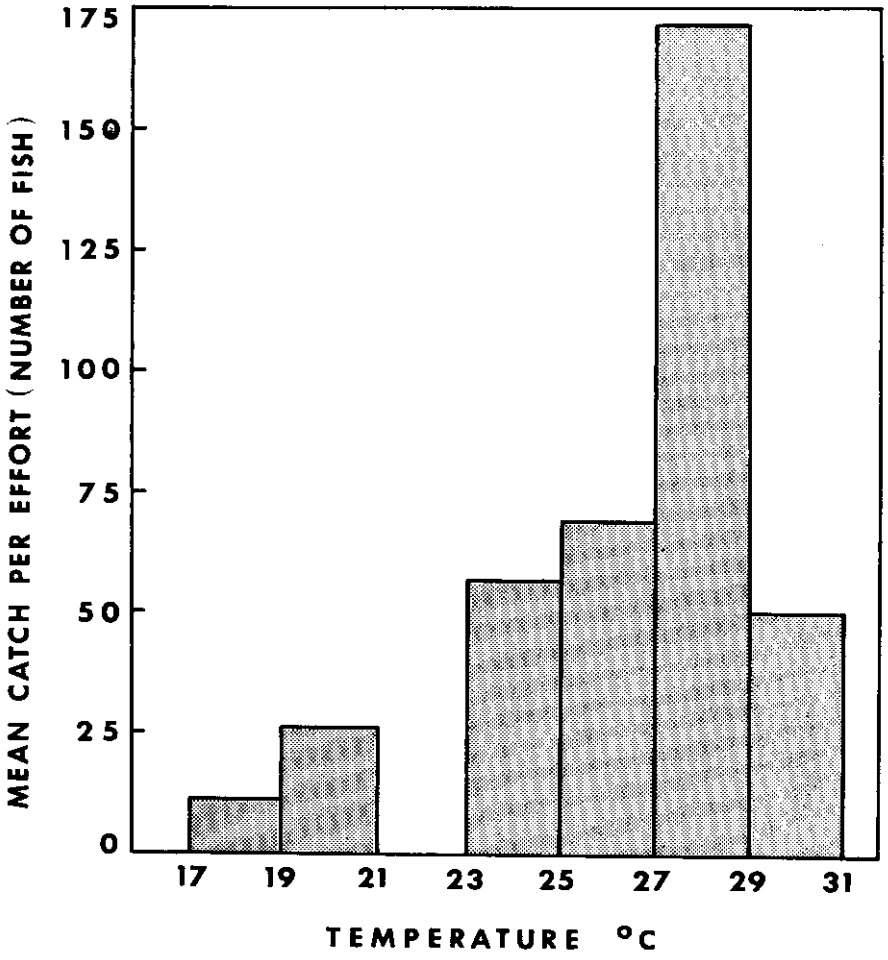

FIG. 8. Mean catch of thread herring per unit of effort from gill net sampling, in relation to surface water temperature off St. Petersburg Beach, Florida, 1967-68.

300- x 10-foot surface monofilament gill net) in the Gulf off St. Petersburg Beach (Fig. 1) were greatest in the spring and summer and least in the winter (Fig. 7). Commercial landings at Charlotte Harbor showed high peaks in the fall and spring and data on catch per set indicated the presence of large schools throughout the winter. Summer catches off Fort Myers were greatly reduced (Figs. 4 and 5).

Thread herring were not taken in the St. Petersburg area when surface water temperature fell below 17°C. (63°F.). Surface temperature in the fishing area off Fort Myers generally does not drop below 17°C. (unpublished data[4]). Schools appear to move south in the fall and in the winter concentrate generally within 10 miles of shore along the lower west coast of Florida. The north-south distribution of purse seine catches on the fishing grounds substantiates this observation (Fig. 2). Turner (personal communication[5]) noted a similar southward movement of thread herring in the eastern Gulf.

As water warmed in the spring, a northward movement and possibly an offshore dispersal were indicated. Gill net catches per unit of effort off St. Petersburg Beach showed a substantial peak when water temperature was between 27° and 29°C. (81° and 84°F.) in late spring and early summer and declined as surface waters continued to warm (Fig. 8). Observations of schools in the northern Gulf in August and September (Butler, personal communication[6]) indicate that thread herring may move northward, and perhaps offshore, when surface water temperature exceeds 29°C. in the St. Petersburg area.

TABLE 2

FORK LENGTH (IN MM) OF THREAD HERRING TAKEN IN DIFFERENT SEASONS FROM PURSE SEINE CATCHES OFF FORT MYERS, FLORIDA, 1967-68

Season	Mean	Mode	Min.	Max.	Standard deviation	Range
1967						
Fall	146	148	100	167	2.2	67
Winter	150	149	122	180	1.8	58
1968						
Spring	148	146	122	180	1.4	58
Summer	147	148	128	160	1.4	32
1967-68						
Summary	148	148	100	180	1.7	80

Length frequencies of commercial catches

The mean size of thread herring (fork length) from the 1967-68 purse seine catches off Fort Myers showed little seasonal variation. Fall catches contained the smallest fish—mean size 146 mm—and had the greatest spread in size. Winter catches contained fish with the largest mean size—150 mm; thread

[4]Data on file at the Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi 39567.

[5]William R. Turner, Bureau of Commercial Fisheries, Biological Laboratory, Beaufort, North Carolina 28516.

[6]Johnny A. Butler, Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi 39567.

herring in spring and summer catches had mean sizes of 148 and 147 mm respectively (Table 2).

Age determination

Thread herring scales taken in monthly samples from commercial catches were examined with an Eberbach[7] scale projector. The validity of apparent annuli (correlation with size of fish) has yet to be definitely established and we are not certain as to the time of year the apparent year marks are formed. It is therefore impossible to make accurate assignments to age groups but a tentative determination has been made (Table 3).

TABLE 3

PRELIMINARY ESTIMATES OF AGE GROUP LENGTHS OF THREAD HERRING FROM COMMERCIAL CATCHES OFF FORT MYERS, FLORIDA, 1967-68

Item	Fall	Winter	Spring	Summer	12 months
Age composition			Percent		
Age group I	36	13	28	32	27
Age group II	64	80	70	66	70
Age group III	0	7	2	2	3
Size of age groups			Millimeters		
Age group I					
Mean fork length	142	155	146	146	146
Mode	147	161	150	147	147
Age group II					
Mean fork length	148	152	150	147	149
Mode	150	150	148	151	150
Age group III					
Mean fork length	—	147	[1]152	[1]147	148
Mode	—	147	—	—	148

[1]One fish only.

Most of the scales examined (70%) indicated the fish were in age group II but only 3% could be placed in age group III. The mean size (fork length) of fish of age group II (149 mm) exceeds that of age group I (146 mm) but the mean size of age group III (148 mm) does not show the expected increase of size with age. The data also indicate that winter catches off Fort Myers contained the highest percentage of older fish.

Little is known about the growth rate of thread herring. Hildebrand (1963) stated that some measurements made at Beaufort, North Carolina, indicate that thread herring attain a length of about 35-60 mm at the age of 1 year and 90-120 mm by the end of their second summer. Our data suggest a faster growth rate.

Feeding habits

Thirty-four stomachs were examined from fish taken by commercial purse

[7]References to trade names in this publication do not imply endorsement of commercial products.

seiners in the first year of the fishery. Generally, the contents had disintegrated so much by the time of preservation that identification was limited largely to the forms with chitinous or calcareous exoskeletons. The identification of phytoplankters was particularly difficult.

Copepods predominated in samples from 7 months of the year, and pelecypods, gastropods and "cypris" stage barnacles were generally common. The frequency of finely-graded sediments indicated some bottom feeding. The presence of minute fish scales (unidentified) in the pyloric stomachs of some thread herring suggested the possibility of carnivorous feeding habits (Table 4).

Hildebrand (1963) stated that thread herring feed largely on small organisms which they strain from the water with numerous closely spaced gill rakers. He

TABLE 4

MEAN PERCENTAGE OF FOOD ORGANISMS IN THE STOMACHS OF THREAD HERRING FROM THE COMMERCIAL CATCH OFF FORT MYERS, FLORIDA, 1967-68
(In addition to plankters listed below, most samples contained plant detritus, fish scales and sediment.)

Date[1]	Number of stomachs	> 50%	10 to 50%	< 10%
1967				
Sept.	2	Copepods	Cypris larvae Pelecypods	—
Oct.	3	Pelecypods	—	Copepods Gastropods
Nov.	5	Copepods	Gastropods Pelecypods Centric diatoms	Cypris larvae
Dec.	3	Sergestids	Copepods	Pelecypods
1968				
Jan.	4	Copepods	Cypris larvae	Gastropods Annelid larvae Pelecypods Centric diatoms Eggs (unidentified)
Feb.	3	Copepods	Gastropods	Sergestids Cypris larvae Annelid larvae Pelecypods Brachyurans
March	4	Cypris larvae	—	Annelid larvae Copepods Pelecypods Centric diatoms
Apr.	3	Copepods	Cypris larvae Porcellanids	Annelid larvae Brachyurans
May	4	Copepods	Cypris larvae	Gastropods
July	3	Copepods	—	Cypris larvae Gastropods Sergestids Pelecypods Centric diatoms

[1]No samples in June or August 1968.

noted that copepods constituted the chief food of specimens from Chesapeake Bay, but that small fish, crabs and shrimp were also found in the stomachs of fish from Port-au-Prince, Haiti. Springer and Woodburn (1960) examined the stomachs of three fish which contained copepods, tiny mollusks and bits of algae.

Spawning

Studies of gonad development permit separation of immature, ripe, and spent fish and thereby indicate spawning peaks along the Gulf coast. The ratio of gonad weight to whole body weight (gonad index) plotted against time produces a graph of seasonal spawning activity. The gonad index curve of thread herring taken from commercial catches off Fort Myers showed rapid gonad development of both males and females beginning in March and reaching a peak in June (Fig. 9). Females appear to be ripe when the gonad index is 0.04 or greater. The percentage of the females with an index of 0.04 or greater was 17% in March and 75% in June. We can assume that spawning in the Fort Myers area extends from about March through August and peaks in June. Hildebrand (1963) stated that thread herring spawn during May and June in the vicinity of Beaufort, North Carolina. William R. Turner (personal communication) found ripe males and nearly ripe females at a station 25 miles NNE of Key West in March 1966.

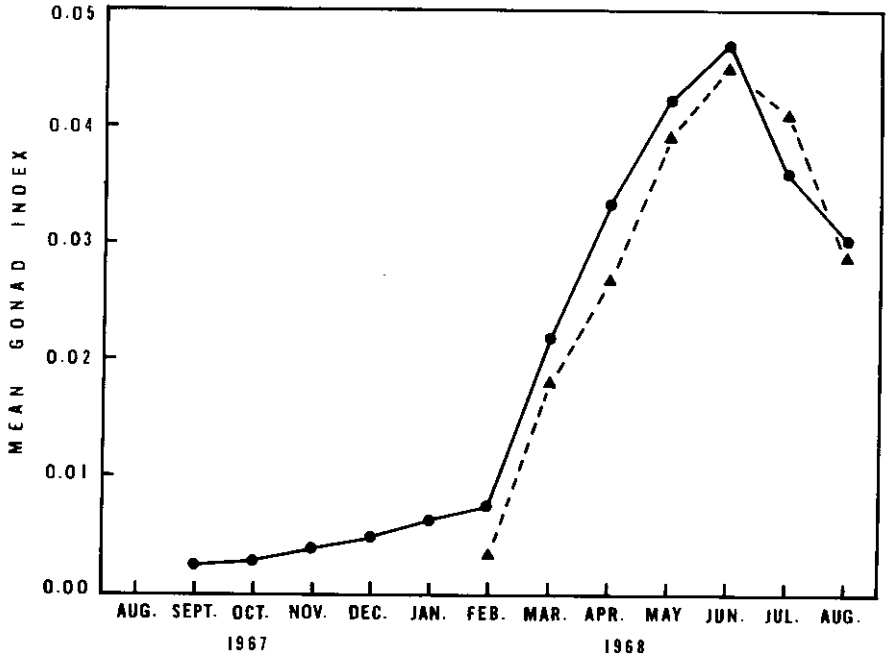

FIG. 9. Gonad index (mean monthly weight of thread herring gonads divided by whole body weight) for male (dashed line) and female (solid line) fish from the commercial catch off Fort Myers, Florida, 1967-68.

Occurrence of juveniles

Young thread herring have not been found in large numbers in nearshore shallow areas. One large school of juveniles (50 mm to 67 mm fork length) was observed in an arm of lower Boca Ciega Bay on October 15, 1968. Very few were taken in other bay areas. Juveniles (25 mm to 100 mm fork length) first appeared on the Gulf beaches near Tampa Bay in July and none were caught after October. They were generally mixed with schools of juvenile scaled sardines *(Harengula pensacolae)*. Young thread herring apparently prefer offshore waters.

A few records of juvenile thread herring have been reported from nearshore and estuarine areas on the Florida gulf coast. Springer and Woodburn (1960) noted juveniles (36-83 mm standard length) at St. Petersburg Beach from August to December; the concentration was greatest in October. Reid (1954) took juveniles (61-77 mm) at Cedar Key in September and Finucane (personal communication[8]) reported some juveniles (27-105 mm standard length) in Tampa Bay from June to December. Gunter and Hall (1965) found a few juveniles (58-102 mm) in San Carlos Bay (Fort Myers, Florida) at a salinity of 17.5‰.

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