SPECIES DIVERSITY AND CHANGES WITH TIME IN THE FINFISH POPULATION IN NARRAGANSETT BAY, 1969 - 1977.

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INTRODUCTION:

In 1910, Henry C. Tracy prepared a list of Fishes of Rhode Island for the Fortieth annual report of the Commissioners of Inland Fisheries. The list included twenty from fresh water, 175 salt water, 13 anadromous, and one katadromous species.

Of the marine species, 113 were reported from Narragansett Bay and most were caught in floating fish traps.

During the past several years, data has been gathered to qualitatively and quantitatively characterize the finfish populations of Narragansett Bay. Oviatt and Nixon in 1973 descibed community structure, distribution and abundance of demersal fish at 22 stations in Narragansett Bay. In 1974, Jeffries and Johnson described the seasonal distribution of bottom fishes collected at weekly intervals for seven years at two stations - one in Narragansett Bay, and another in Rhode Island Sound. They characterized variations in the abundance of winter flounder (Pseudopleuronectes americanus) between the year of 1966 and 1972. Since 1975, New England Power Company has recorded the species and numbers of finfish trapped on rotating trash screens at the cooling water intakes of the Manchester Street and South Street power generating stations located at the Fox Point hurricane barrier in the Providence River.

Cognizant that long term monitoring of fish population was necessary to development of rational fisheries management programs, the Rhode Island Department of Natural Resources, now the Department of Environmental Management, in 1969, began a finfish monitoring program at four stations within Narragansett Bay.

From survey data collected between 1969 and 1977 trends in species abundance and diversity can be identified and in some cases

may be attributed to fishing pressure, climatic trends, changes in water quality or combinations of these and other factors which are difficult to identify positively.

The data collected allow only generalized statements on species diversity and abundance because of limitations imposed by the sampling gear, and by the permanance of the sample trawl sites. They do however show trends at the chosen sample stations irregardless of whether the stations are considered to have commercially valuable quantities of finfish.

METHODS:

Monthly samples were collected at four stations within Narragansett Bay using a 3/4 scale "Yankee" otter trawl (Figure 1) towed at an average speed of 2.5 knots (4.2feet/second) by a 34 foot western rigged dragger.

The net had a 48 foot (14.63 meters) ground rope with an average opening of 8 feet (2.438 meters) to the headrope. The net was spread by 2 foot by 4 foot (.63m x 1.2m) trawl doors running 45 feet (13.72m) ahead of the wings. The mesh sizes are those generally used in the Narragansett Bay commercial fishery, and are chosen to capture fish of a processable size. The wings and top square are of 3 inch (7.6 centimeters) stretch mesh, the top and bottom belly are of 2 inch (5.1cm) stretch mesh, and the cod end is 1.5 inch (3.8cm) stretch mesh.

One day each month from 1969 to 1977, thirty (30) minute tows were made at the four stations, Dutch Island, Jamestown Hole, Davisville, and Poppasquash (Figure 2). After haul-back, the contents of the net were released onto the deck of the vessel, species identified and numbers of each were recorded. Intermittant temperature readings were obtained at each trawl station.

figure 1

YANKEE OTTER TRAWL

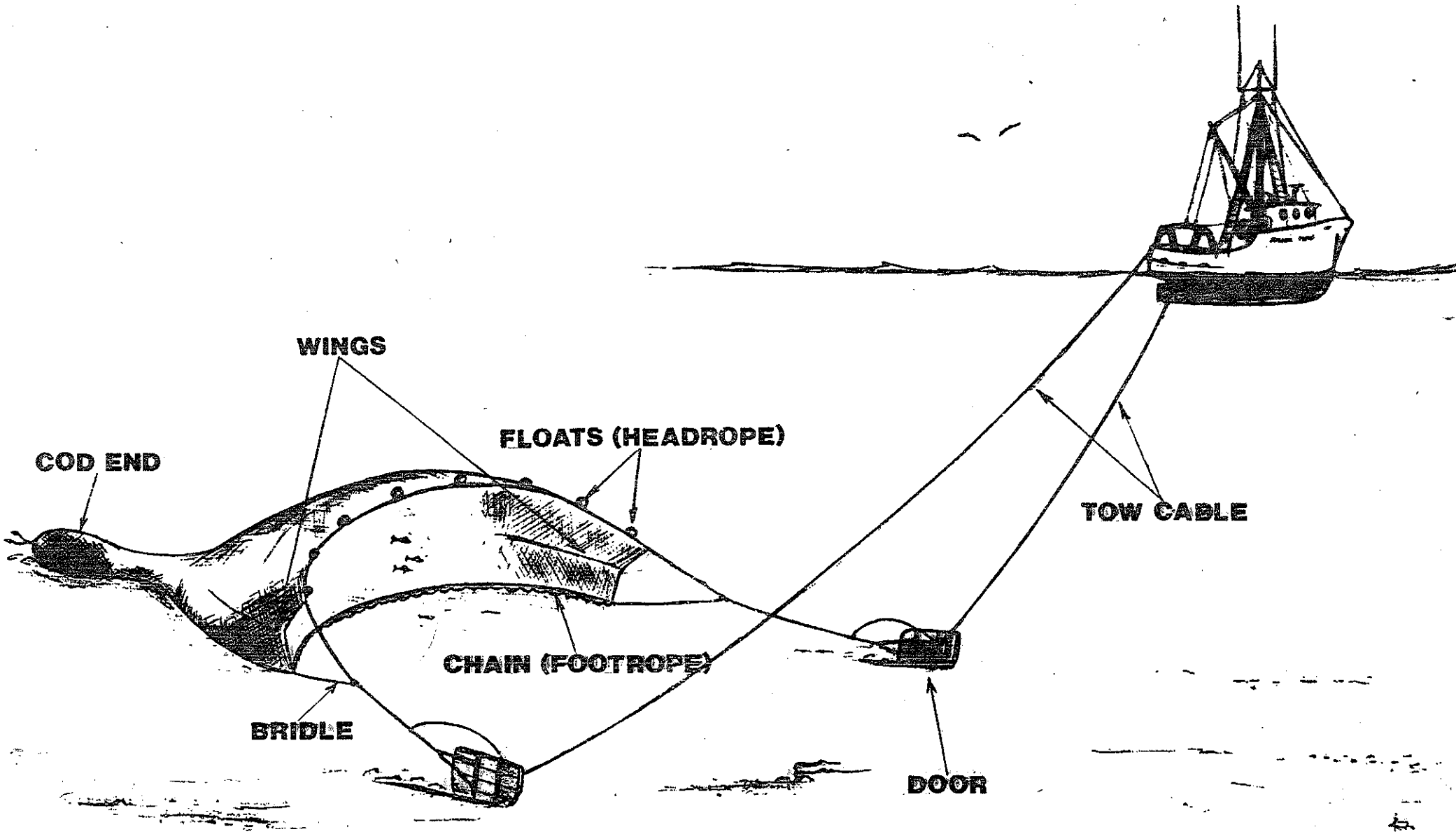
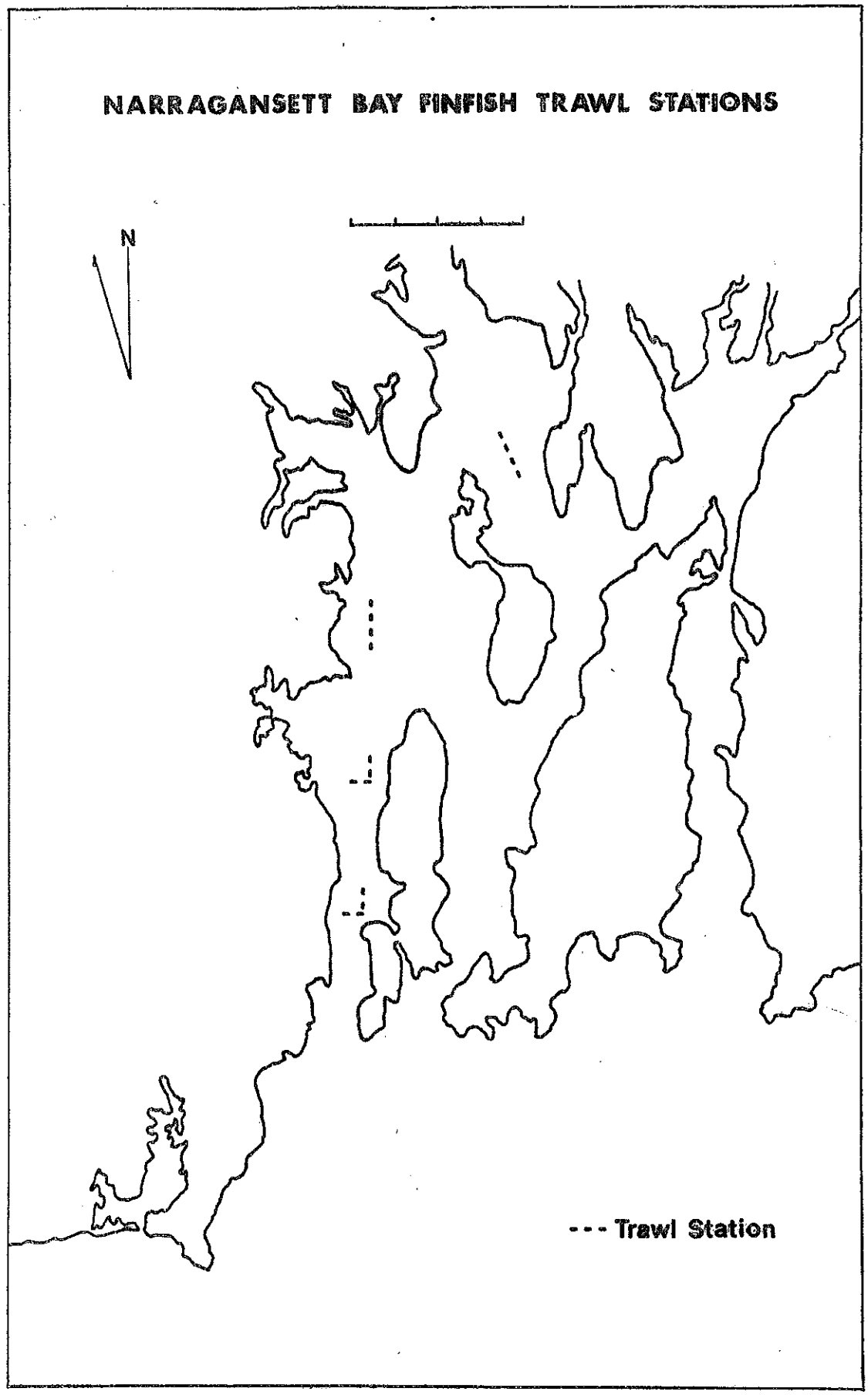


figure 2



RESULTS and DISCUSSION

236 tows, each sweeping 4.8 acres, were made during the nine year study. 31,537 individual fish were captured representing 46 species, many of which are seasonal in abundance (Table 1).

The four most common species determined from mean catch per tow (weighted) for the entire study period were winter flounder, scup (Stenotomous chrysops), butterfish (Peprilus burti) and sand flounder (Scopthalmous aquosus), together they accounted for 62.9% of the total catch. The four most frequently appearing species agree with those reported by Oviatt and Nixon (1973), and three agree with those reported by Jeffries and Johnson, (1974). Species rank does differ however. Oviatt and Nixon's ranking lists winter flounder, summer flounder, and scup, while Jeffries and Johnson list winter flounder, and summer flounder as the two dominant year round residents. Mean catch per tow for all species was greatest (172.5) at Dutch Island. The greatest number of fish per acre (34.9) was also recorded there. The lowest mean catch per tow (10.6 fish) and number of fish per acre (18.8) was recorded at the Poppasquash Station. Table 2 presents catch data for all sample stations.

Although these data do not agree with those presented by Oviatt and Nixon (1973) they are probably representatives of the catch for the number of samples taken and the selectivity of the fishing gear.

Mean catch per tow (weighted) for each of the four most commonly captured species fluctuated widely about the respective yearly mean (weighted) catch for all years 1969 to 1977. Table 3 presents mean catch per tow (weighted) and illustrates the range in weighted mean catch per tow for winter flounder, scup, butterfish, and sand flounder.

Two of the most commercially exploited species in Narragansett

TABLE 1

SPECIES CAPTURED BY OTTER TRAWL

IN NARRAGANSETT BAY, R.I.

1969-1977

SPECIES NAMES

Winter Flounder (Pseudopleuronectes americanus)
Sand Flounder (Scopthalmous aquosus)
Cod (Gadus moruha)
Ocean Pout (Macrozoarces americanus)
Cunner (Tautogolabrus adspersus)
Tautog (Tautoga onitis)
Red Hake (Urophycis chuss)
Butterfish (Peprilus burti)
Smooth Dogfish (Mustelus canis)
Scup (Stenotomus chrysops)
Weakfish (Cynoscion regalis)
Silver Hake (Merluccius bilinearis)
Bluefish (Pomatomus saltatrix)
Blueback Herring (Pomolobus aestivalis)
Sea Herring (Clupea harengus)
Menhaden (Brevootia tyrannus)
Summer Flounder (Paralichthys dentatus)
Little Skate (Raja erinacea)
American Conger (Conger oceanica)
Grubby Sculpin (Myoxocephalus aeneus)
Silverside (Menidia menidia)
Striped Bass (Morone saxatilus)
Haddock (Melanogrammus aeglefinus)
Barndoor Skate (Raja laevis)
Common Sea Robin (Prionotus carolinus)
Striped Sea Robin (Prionotus evolans)
Summer Squid (Ilex illecebrosus)
Winter Squid (Loligo paelei)
4-spot Flounder (Paralichthys oblongus)
Toadfish (Opsanus tau)
Alewife (Alosa pseudoharengus)
Atlantic Mackeral (Scomber scombrus)
Kingfish (Menticirrhus saxatilis)
Moonfish (Vomer setapinnis)
Smelt (Osmerus mordax)
Atlantic Sturgeon (Acipenser sturio)
Cusk (Brosme brosme)
Black Sea Bass (Centropristes striatus)
Common Mummuchaug (Fundulus heteroclitus)
American Eel (Anguilla rostrata)
Hogchocker (Achirus fasciatus)
Striped Mummuchaug (Fundulus majalis)
White Perch (Morone americana)
4-Beard Rockling (Enchelyopus cimbrius)
Lumpfish (Cyclopterus lumpus)
Puffer (Sphaeroides maculatus)

TABLE 2

Finfish catch data for four trawl stations in Narragansett Bay, 1969-1977.

Station	$\bar{X}$ Catch/tow	$\bar{X}$ Fish/acre
Dutch Island	172.5	34.9
Jamestown	88.8	26.5
Davisville	143.5	24.2
Poppasquash	10.6	18.8

TABLE 3

Mean catch per tow (weighted) and range
for the four most commonly caught species
in Narragansett Bay, 1969-1977

SPECIES	$\bar{X}$ Catch/tow (weighted)	Range in annual $\bar{X}$ Catch/tow (weighted)
Winter Flounder	35.5/tow	13.5 - 61.9/tow
Scup	25.7/tow	2.0 - 68.2/tow
Butterfish	14.6/tow	0 - 21.3/tow
Sand Flounder	13.3/tow	4.5 - 36.8/tow

Bay are winter flounder and scup. Catches of winter flounder were greatest at Dutch Island and lowest at Jamestown Hole. Scup were caught in greatest abundance at the Jamestown station and were least abundant at Poppasquash.

Sorenson's index of similarity (Odum, 1971) was used to compare sample locations. A value of 1.0 is indicative of communities with identical species composition. The index of similarity is calculated using the expression $S = \frac{2C}{A+B}$ where S = index of similarity

A = number of species in sample A

B = number of species in sample B

C = number of species common in both samples

Some rather meaningful observations may be made from this fairly simplistic approach (Table 4).

Data provided by the New England Electric Company reveals a great similarity between there Manchester Street and South Street power station. Comparisons of the four trawl stations show the greatest species composition similarity between Jamestown and Poppasquash (.81). The least similarity was found between Dutch Island and Davisville (.74) and between Dutch Island and Poppasquash (.74). The index for comparisons between Jamestown Hole and Davisville and Dutch Island and Jamestown Hole were most likely similar, and not different from the preceeding two station comparisons. No attempt was made to statistically test for significant differences between stations.

When Manchester Street data are compared to Dutch Island data a low S of .448 is obtained, but when a comparison is made between Manchester Street and Poppasquash a much higher similarity in composition (.656) is revealed. Differences between Manchester Street and Dutch Island are attributable to sampling gear i.e. trash racks is otter trawl, and the salinity differences from the Providence River to the

TABLE 4

Indices of similarity for Narragansett Bay Finfish Sampling Stations

Dutch Island - Jamestown
S = .77

Dutch Island - Davisville
S = .74

Dutch Island - Poppasquash
S = .74

Jamestown - Davisville
S = .75

Jamestown - Poppasquash
S = .81

Davisville - Poppasquash
S = .81

Manchester Street - South Street
S = .918

Manchester Street - Dutch Island
S = .45

Manchester Street - Poppasquash
S = .66

figure 3

TRAWL STATION TEMPERATURE DATA

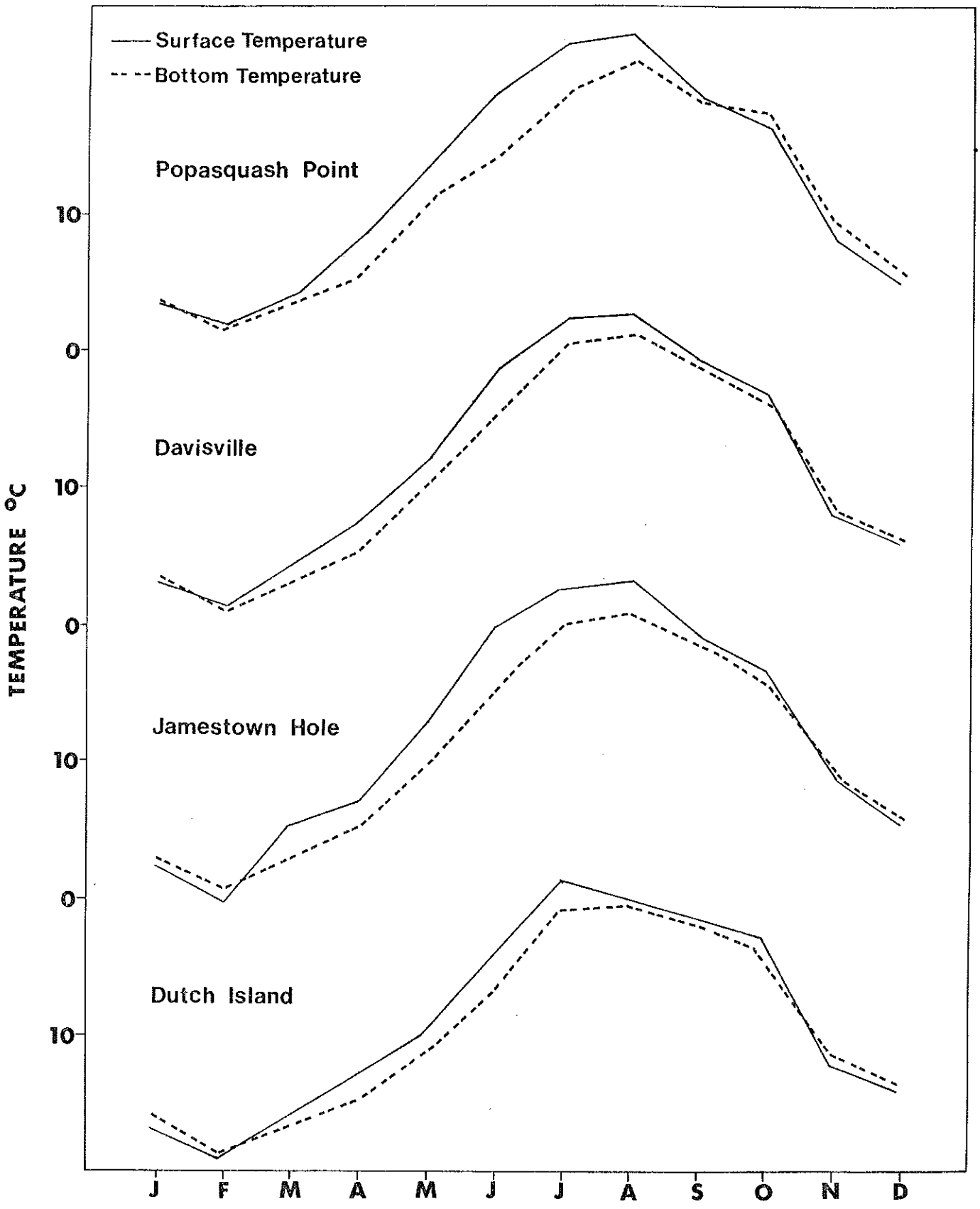


Figure 4

SEASONAL CATCH OF WINTER FLOUNDER AND SCUP – DUTCH ISLAND STATION

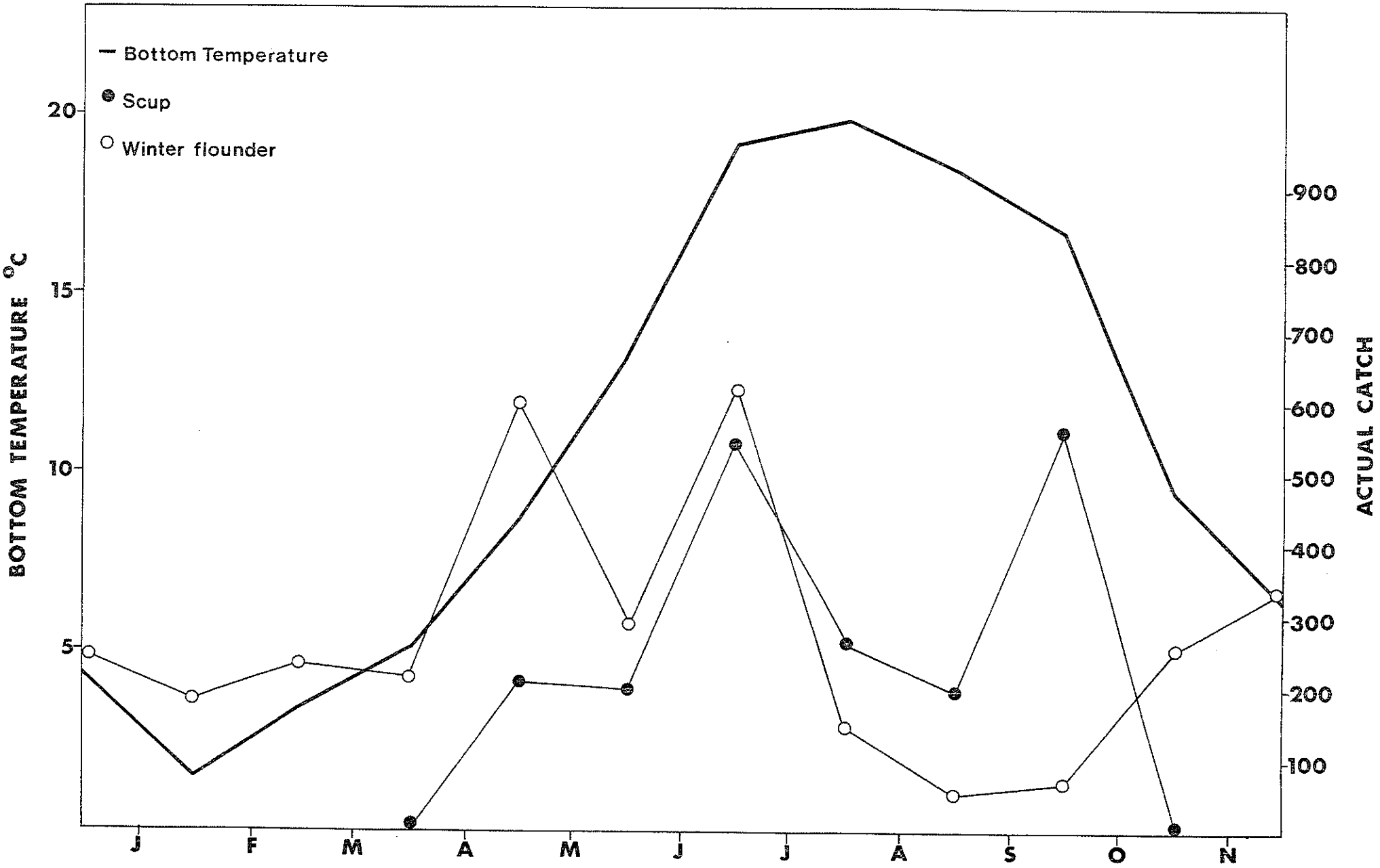


Figure 3

SEASONAL CATCH OF WINTER FLOUNDER AND SCUP - JAMESTOWN STATION

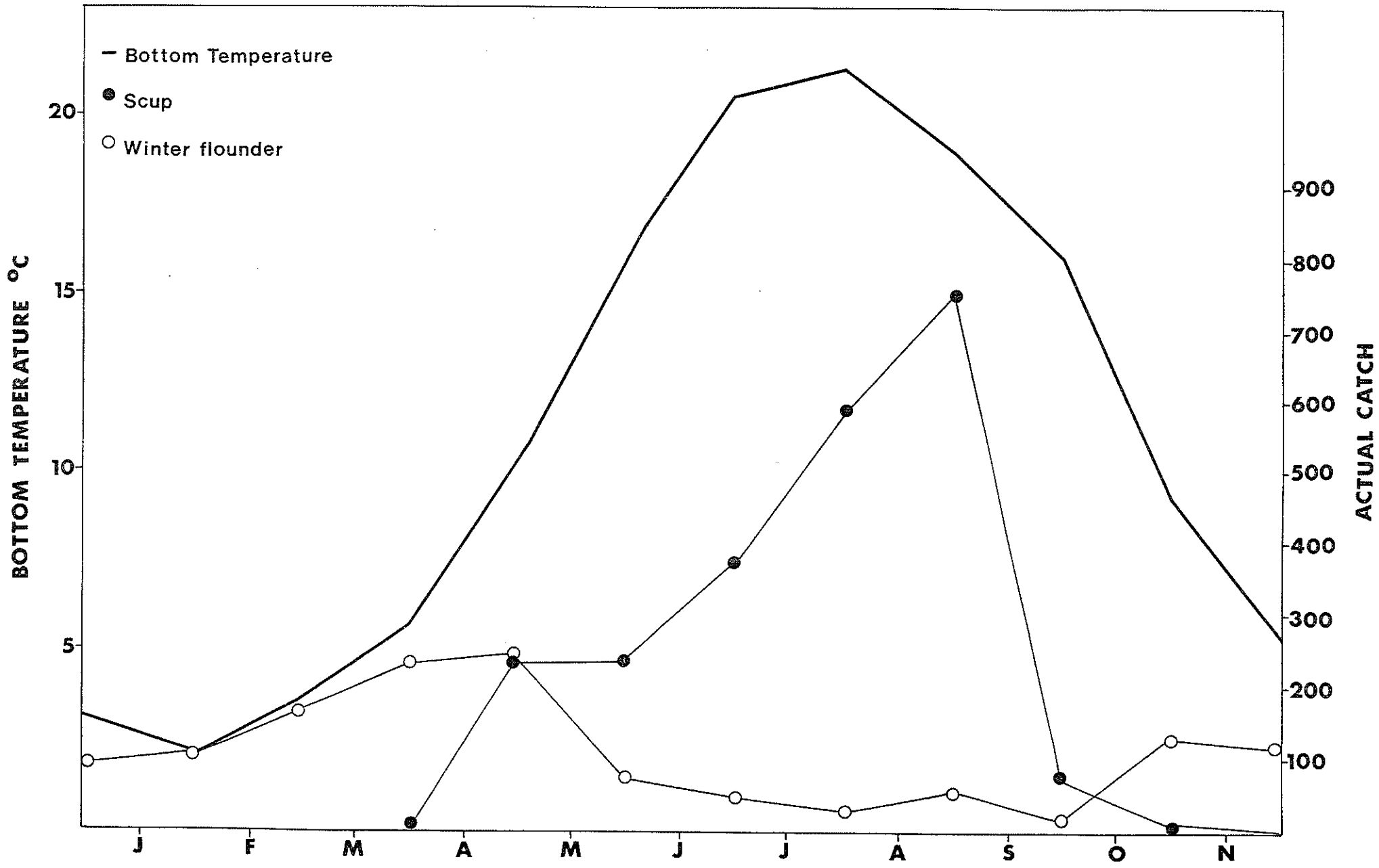


Figure 6

SEASONAL CATCH OF WINTER FLOUNDER AND SCUP - DAVISVILLE STATION

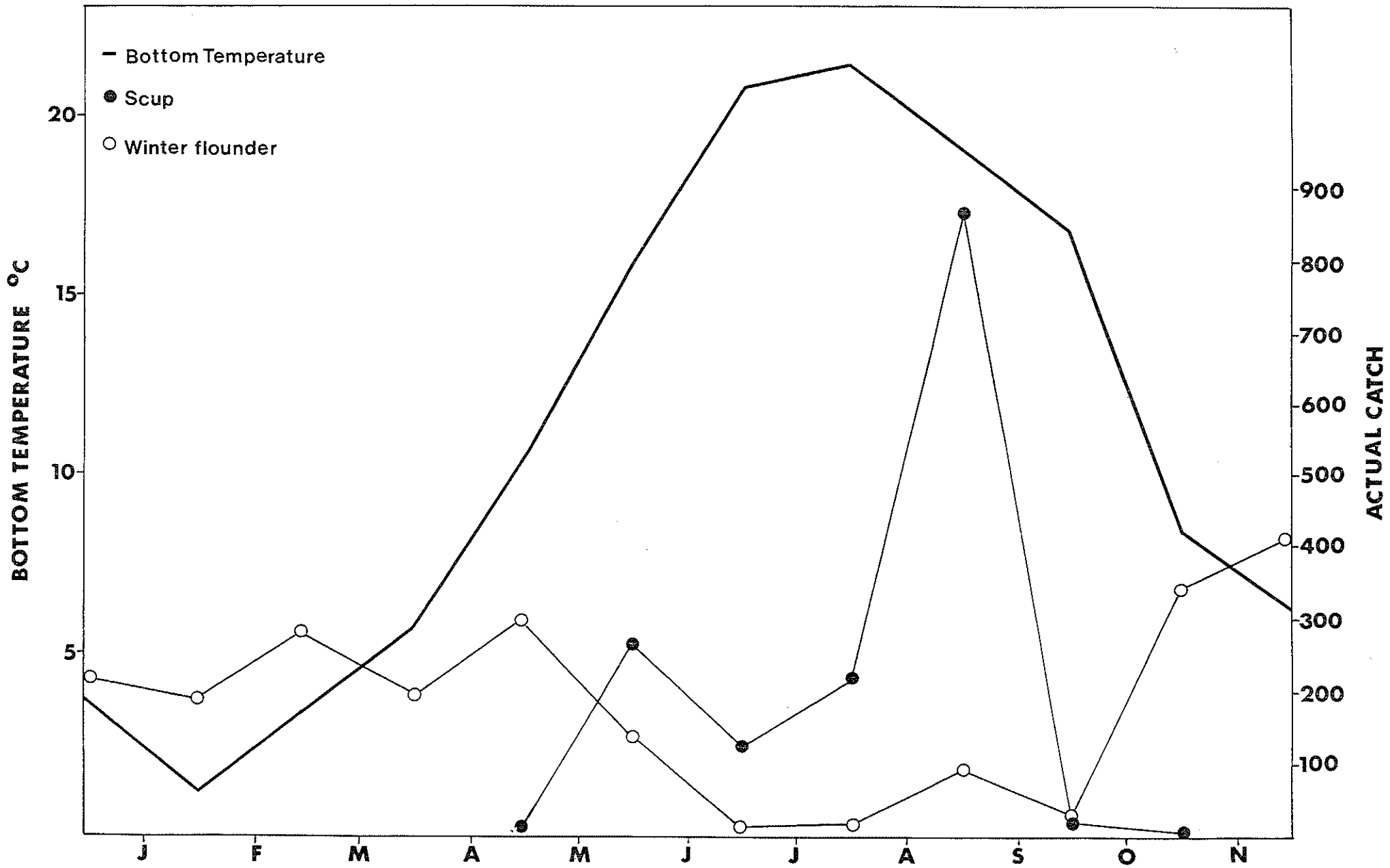
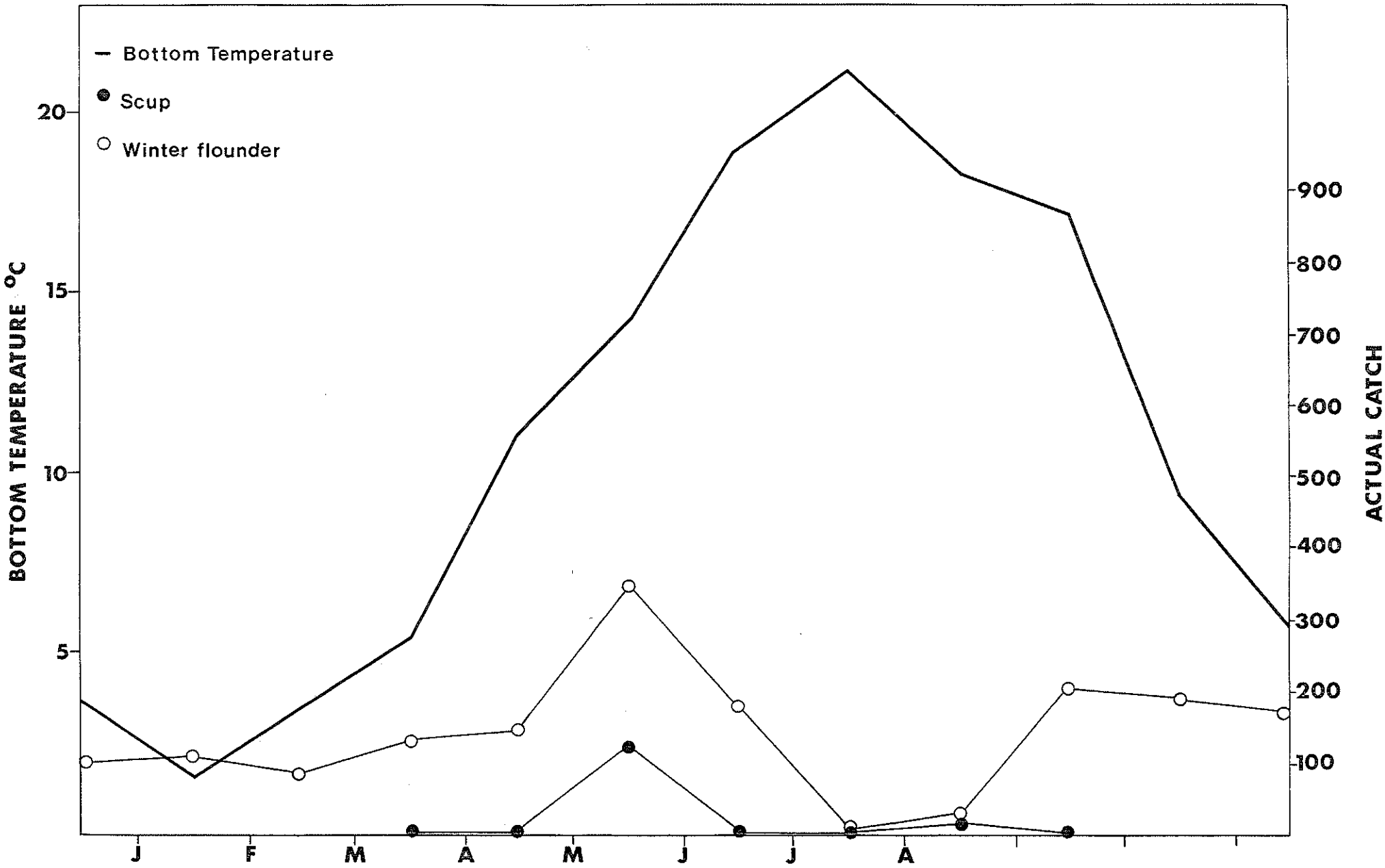


Figure 7

SEASONAL CATCH OF WINTER FLOUNDER AND SCUP - POPPASQUASH STATION



mouth of the bay. Dutch Island and Providence River salinities are at opposite extremes of the range expected in an estuary. Comparisons of species with Oviatt and Nixon(1973)yields an S of .75 for Narragansett Bay. An interesting exercise compared all species from this study with all species which Tracy identified in 1910 as inhabitants of Narragansett Bay (S = .52). The result may be attributed to a difference in sampling gear and the fact that all species were not collected by Tracy, but were reported to him by sources whose gear is not identified. Tracy reported 41 of the 44 finfish species which we have identified. His list includes many fish found in brackish waters, and many species found only in the juvenile stages, and for this reason our sampling gear would select against these species. By eliminating these species, a number closer to that reported by this study and Oviatt and Nixon (1973) would be obtained allowing a higher similarity index and presenting evidence that species composition has not changed drastically since 1910, even though yearly data indicate that fluctuations are common, and are probably due to such variables as temperature, year class strength and fishing pressure.

Bottom temperature fluctuations between stations are seasonal and exhibit little variability on any given sampling data (Figure 3). There is no evidence of stratification at any of our sample locations. Movement and availability of winter flounder and scup do coincide with flustuations in bottom temperature (Figures 4&5). Winter flounder catch at Dutch Island peaked in April and showed a definite decrease when temperature approached 12^{o}C. The fall increase in catch occurred when temperatures dropped to approximately 6.5^{o}C. Scup catches at Jamestown peaked in August at 15^{o}C and declined rapidly, disappearing almost completely when the temperature reached 5^{o}C.

From the data collected and that reported by Oviatt and Nixon (1973), and Jeffries and Johnson (1974) it is clear that continued monitoring of the finfish resources and related hydrographic parameters are necessary. Should drastic changes in the physical and chemical characteristics of Narragansett Bay occur, they could immediately be recognized.

The Department of Environmental Management has begun an expanded fish monitoring program. Spring and fall surveys are now conducted annually at randomly selected sites within the territorial waters of Rhode Island. Total catch in numbers, length frequencies and weights are recorded along with temperature and salinity readings. It is expected that minimum biomass estimates will be derived from the data collected. In addition, recruitment indices will be constructed for species of commercial importance, and length frequency data will be used to assess age class composition and mortality rates for principle groundfish species.

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