ARTICLE

If you conduct a scallop dredging survey in May 1968--you can expect results similar to this report's.

INCIDENTAL CATCHES OF FINFISH IN SEA SCALLOP DREDGES ON GEORGES BANK

By Roland L. Wigley* and Henry W. Jensen*

Finfish are commonly caught in sea scallop dredges on the Georges Bank fishing grounds. This article analyzes the kinds and number of fish caught in 147 samples collected with a standard commercial scallop dredge from the BCF research vessel "Delaware."

Among the 20 kinds of fish caught, skate accounted for 51% of the total catch. Yellowtail flounder ranked second (11%) and squirrel hake third (8%). Sculpin (7%), goosefish (7%), and haddock (5%) were other common parts of catch.

Highest densities of fish (34 per 10,000 square meters) were near western Georges Bank. Intermediate densities (29 per 10,000 square meters) were found in southern Georges Bank. Lowest densities (16 per 10,000 square meters) were in eastern Georges Bank.

The average number of fish caught per individual dredge haul increased from 8 at the slowest speed to 42 at the fastest speed.

It is estimated that the commercial scallop fleet on Georges Bank catches about 20 million finfish per year.

One of New England's major fisheries, and a rapidly growing one in Nova Scotia, is that for sea scallops, Placopecten magellanicus (Gmelin). A fleet of 40 to 60 vessels, based mainly in New Bedford, Mass., has been fishing for scallops for several decades; in recent years, an equal number of vessels from Nova Scotia have sought them (International Commission for the Northwest Atlantic Fisheries, 1964). The principal fishing grounds in the New England-Nova Scotia region is Georges Bank (Merrill and Posgay, 1964). The most heavily fished areas are in water depths between 50 and 100 meters around the bank's periphery. The gear traditionally used is a large steel dredge 3 to 4 meters wide (Posgay, 1957).

During scallop fishing, a wide variety of bottom-dwelling finfishes that abound on the scallop grounds are caught incidentally in the dredge. The more valuable species, such as yellowtail flounder and haddock, sometimes are brought back to port to be sold. But frequently all species are discarded at sea.

This report is a preliminary account of the incidental catch of finfish.

MATERIALS AND METHODS

The Delaware collected the 147 samples of sea scallops and fish during a survey of the Georges Bank sea scallop stocks in May 1961. The collecting gear was a standard commercial scallop dredge (Posgay, 1957) 3.05 meters wide with 5-cm.-diameter rings in the dredge bag. Each haul lasted 10 minutes. The distance the dredge was towed along the sea bottom was measured with an odometer attached to the dredge. Although the time was the same for each haul, the distance traversed

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Note: All statistics are in the appendix to reprint (Separate No. 795) of this article. For a free copy of the Separate, write to Office of Information, U. S. Department of the Interior, Fish and Wildlife Service, BCF, Washington, D. C. 20240.

U. S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Sep. No. 795

by the dredge varied somewhat due to the effects of water currents and wind on the vessel. To make all tows comparable, the original fish counts were adjusted to a basic area of 10,000 square meters sampled by the dredge. The adjustment factor was based on the distance the dredge was towed, as measured by the odometer. All data in this report refer to the adjusted catch, or to dredge hauls per 10,000 m^2 sampled. Dredge hauls were taken on Georges Bank in a rather narrow depth zone of 51 to 137 meters (fig. 1).

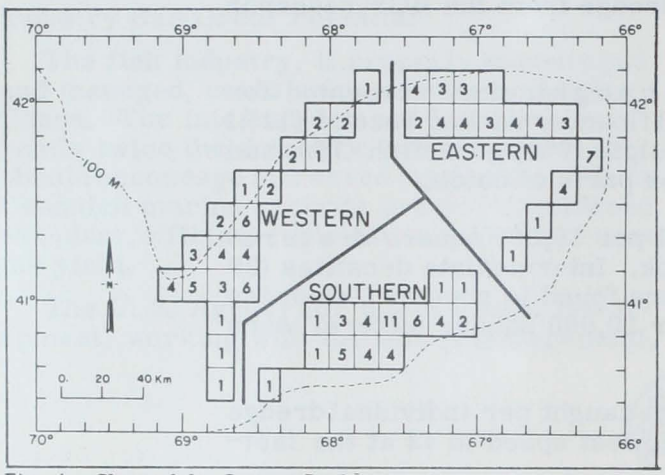

Fig. 1 - Chart of the Georges Bank region showing the three major sectors of the bank (Eastern, Western, and Southern) and the number of dredging stations in each area.

Fish from each dredge haul were identified and counted. Only those longer than about 20 cm. are included in the tabulations. The smaller specimens are omitted, since they were few and were retained in the dredge only accidentally. In reporting these data, we have grouped the samples by the conventional geographical areas (Merrill and Posgay, 1964); dimensions of each unit area are 10 minutes in latitude by 10 minutes in longitude. Samples were taken in 48 areas.

Common names of fishes used in this report are those listed by the American Fisheries Society, Special Publication No. 2, second edition (1960). The scientific and common names are included in table 1 (see note page 63).

KINDS OF FISH AND THEIR RELATIVE DENSITY

Twenty kinds of fish were represented in the collections (table 1). Of these, only 1 was abundant, 5 were common, and 13 were uncommon to rare. The rare species (listed in footnote to table 1) are grouped under "Other." Skate were, by far, the most numerous fish. Their numerical density (number per haul) averaged 14; they accounted for 51% of total number. The second- and third-ranked species were yellowtail flounder and squirrel hake. They averaged 3 and 2 per haul and provided 11% and 8%, respectively. Other fish common in the catch were sculpin, goosefish, and haddock; their average catch-rate ranged from 1 to 2 per haul, and they made up 5% to 7% of total fish caught.

Fish were taken in 140 dredge hauls, 95% of total. The number of specimens per haul averaged 26; the range was 0 to 118 (table 1). The number of fish differed markedly in the 3 sectors (table 1, figs. 2 and 3). Catch was highest in Georges Bank's Western Sector, where the number per haul averaged 34 (unit-area means ranged from 8 to 57). The kinds of fish caught most frequently in this sector were skate, yellowtail flounder, haddock, and goosefish. In the Southern Sector, the catch was moderate, averaging 29 fish per haul (unit-area means ranged from 8 to 51). Principal kinds of fish were skate, squirrel hake, and yellowtail flounder. The Eastern Sector yielded the fewest fish. The number of fish per haul averaged only 16 (unit-area means

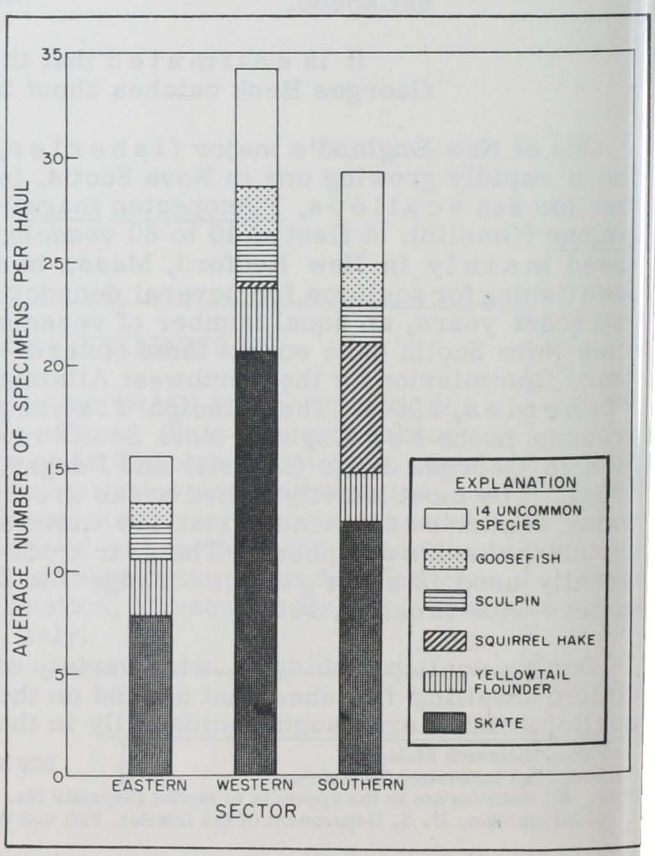

Fig. 2 - Average dredge catch (number per haul) of the major kinds of fishes for each sector of Georges Bank.

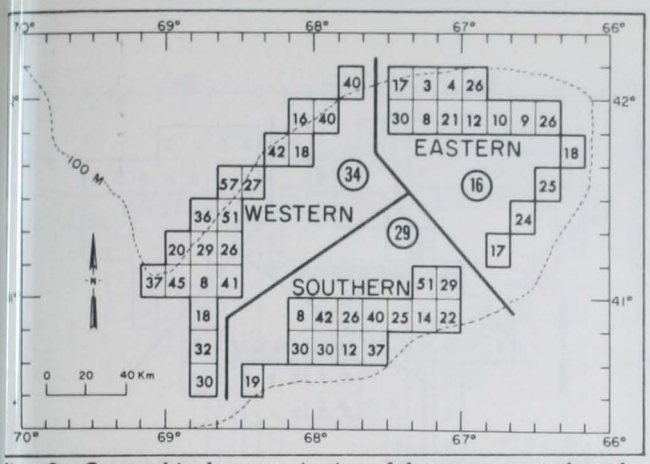

Fig. 3 - Geographical summarization of the average number of fish caught per dredge haul, all species combined. Values in the circles are sector averages; values in the rectangles are unit-area averages.

ranged from 1 to 30); the most abundant kinds were skate, yellowtail flounder, and sculpin.

Although the abundance of certain species of fish may vary from season to season, or year to year, the average catch of all species combined can be expected to remain about the same, seasonally, and from one year to the next. For example, the fish catch in scallop dredges in September 1965, by the "Albatross IV," was very similar in species composition and quantity to those described here for May 1961.

GEOGRAPHIC DISTRIBUTION

Catch records from this series of samples provide a general indication of the geographic distribution of some of the larger, slow-moving, groundfish found in the Georges Bank region. Several kinds of fish represented in the dredge samples are widely distributed over the bank. These wide-ranging fish were frequently the more abundant kinds, such as goosefish, yellowtail flounder, skate, and sculpin (fig. 4). They were common in all 3 sectors. The windowpane was considerably less numerous but also occurred over a large portion of the bank. These fish habitually lie on the sea bottom or partially buried in the bottom sediments. So they are more likely to be caught in the scallop dredge than pelagic species or the more active demersal species.

Twenty percent of the species exhibited a restricted geographic distribution, or a markedly higher density in specific parts of the Georges Bank. Squirrel hake were especially common in the Southern Sector (fig. 5); they were rare or absent in other sectors. Witch flounder, also, were most plentiful in the Southern Sector (fig. 5). Their occurrence there (in May) is in marked contrast to their fall (September-November) distribution, which is limited to deepwater regions north of Georges Bank (Fritz, 1965). Winter flounder were most abundant in the northeastern part of Georges Bank. Haddock were common in the northeast part of the bank and in the Western Sector; they appeared in only a few collections in the Southern Sector. Silver hake were in highest density along the northwestern periphery of Georges Bank. The only other collections of this species were a few in the Southern Sector.

RELATION OF FISH CATCH TO TOWING SPEED

Speeds at which the dredge was towed were calculated by dividing the distance traveled (odometer measurements) by towing time (10 minutes for each haul). Towing speeds ranged from 1.4 to 4.6 knots; the majority were 3.0 to 3.8 knots.

Towing speeds were determined to learn whether or not speed significantly influenced the catch of fish. The numbers of fish caught at various speeds indicate a pronounced increase in catch with increased towing speed (table 2--see note on page 63, fig. 6). At 1.4 knots, the average catch was about 8 fish per haul; the catch increased to over 42 fish per haul at 4.6 knots. This increase in catch with increase in speed is regular, except for deviations at the very slow and very fast speeds. These deviations are not due to sampling in unusually deep or shallow waters, or the result of fishing on a particular type of bottom. The best explanation is the inadequate number of dredge hauls at the slower and faster speeds. Also, the relatively small number of flatfish, gadoids, and goosefish taken at towing speeds over 4 knots (see fig. 7), and differences in density of fish among the 3 sectors of the bank, contribute to the variations in catch rate.

Catch rate of the different kinds of fish varied considerably with dredge towing speed. The rate of capture of skate, most commonly caught, more than doubled when towing speed was increased from 2 to 3 knots (table 3--see note on page 63, fig. 7). At faster speeds their number continued to increase, leveling off at 16 to 17 per haul at speeds of $3\frac{1}{2}$ to $4\frac{1}{2}$ knots. Time of day had no significant influence on the catch of skate--it was nearly the same at all hours of day and night. Gadoids

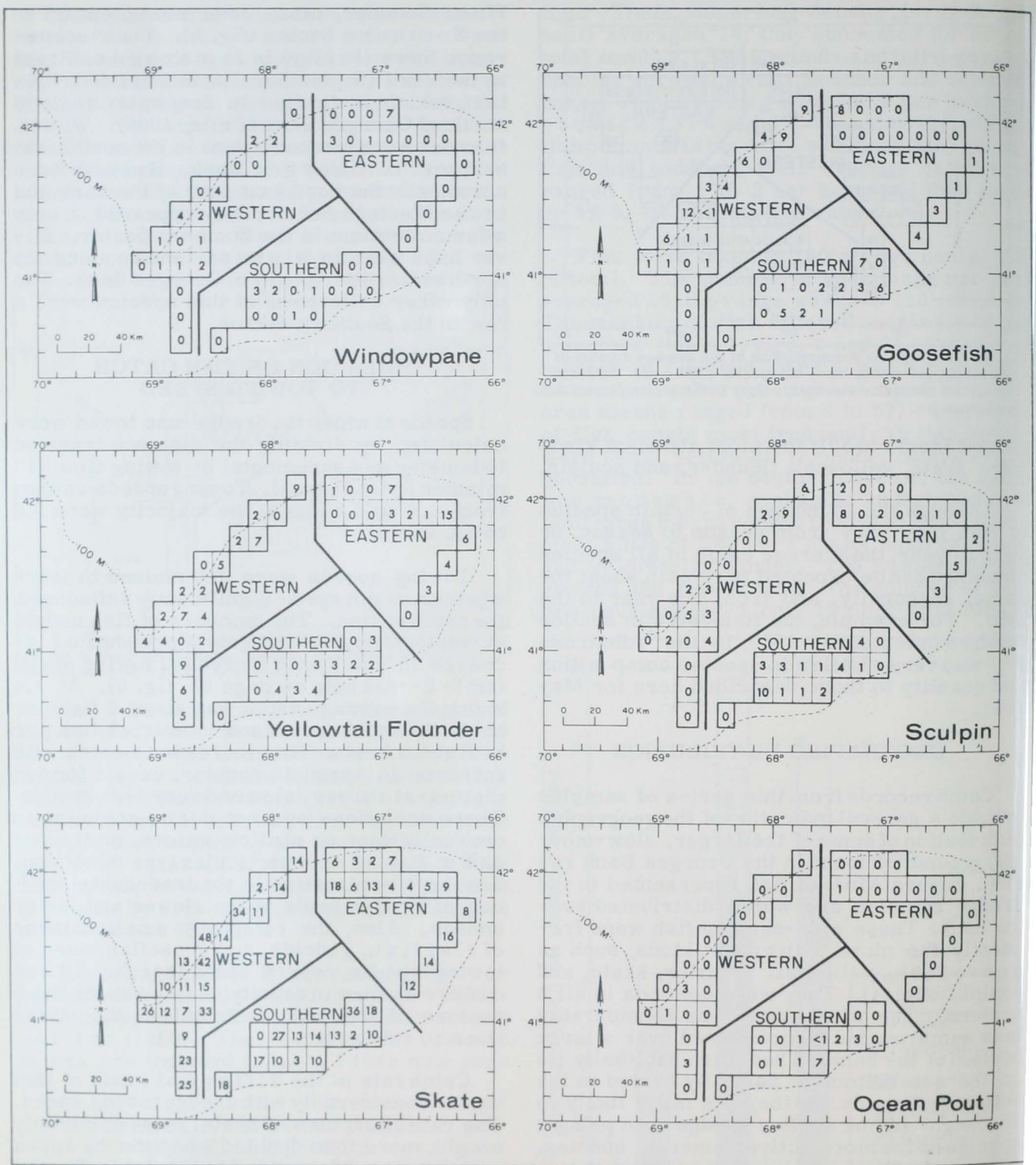

Fig. 4 - Geographic distribution and relative density of the more common finfish caught by scallop dredges on Georges Bank. The value given for each unit area is the average number of specimens per dredge haul.

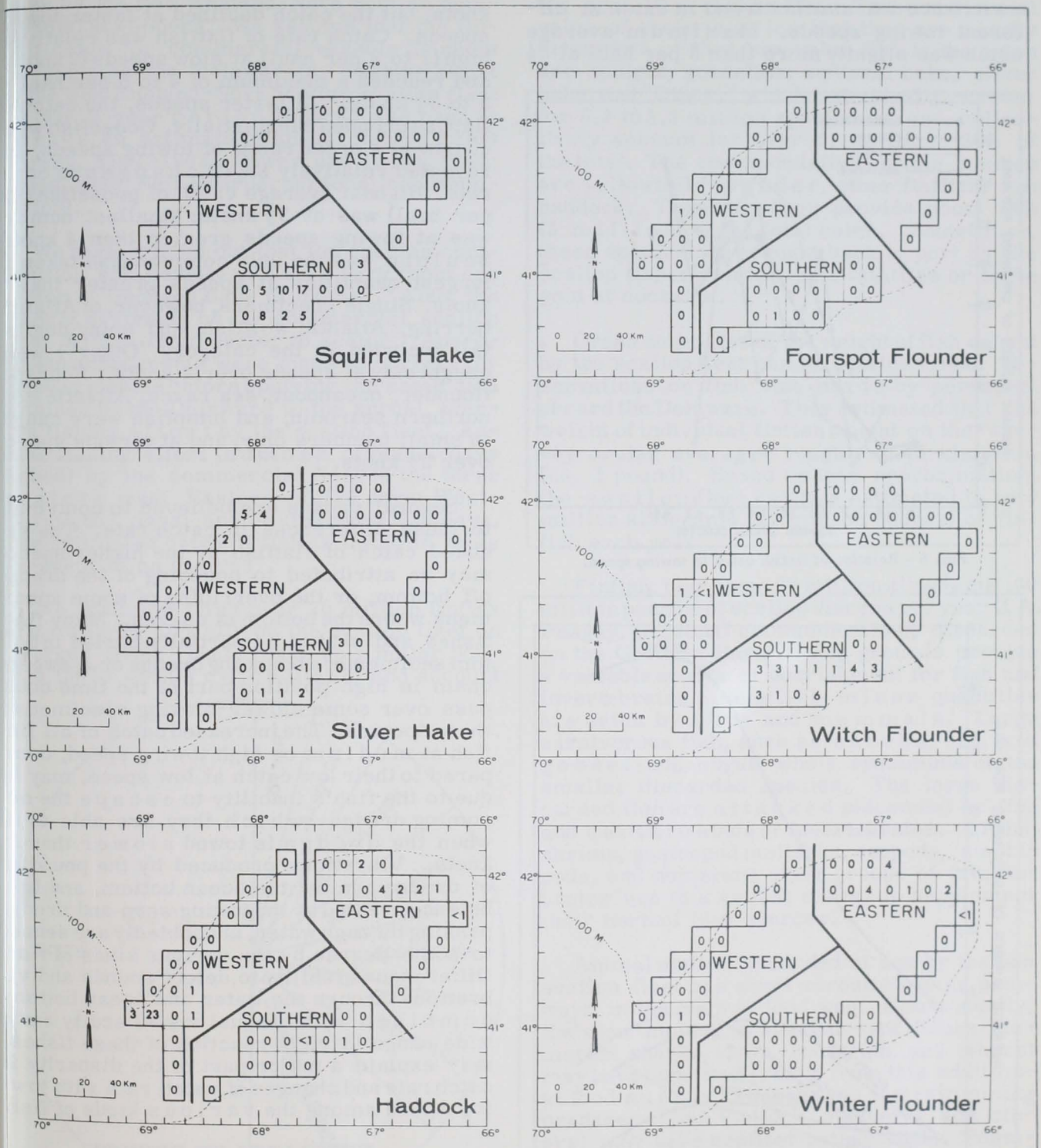

Fig. 5 - Geographic distribution and relative density of the less common finfish caught by scallop dredges on Georges Bank. The value for each unit area is the average number of specimens per dredge haul.

exhibited a similar trend in catch at different towing speeds. Maximum average catch was slightly more than 5 per haul at $3\frac{1}{2}$ knots, but the catch declined at faster towing speeds. Catch rate of flatfish was relatively high (1 to 2 per haul) at slow speeds (2 knots), and reached a maximum of 4 to 5 per haul at 3 to $3\frac{1}{2}$ knots. At faster speeds, the catch of flatfish dropped substantially. Goosefish were caught at a broad range of towing speeds, and revealed relatively small changes in catch rate. Highest average catch of goosefish (2.3 per haul) was at $3\frac{1}{2}$ knots; smallest number was at towing speeds greater than 4 knots. Sculpin was the only common fish taken in largest quantities at speeds greater than 4 knots. Single specimens, however, of Atlantic herring, Atlantic wolffish, and spiny dogfish (all included in the category "Other") were caught only at speeds over 4 knots. Fourspot flounder, oceanpout, sea raven, Atlantic cod, northern searobin, and lumpfish were caught in small numbers only, and at various speeds over $2\frac{1}{2}$ knots.

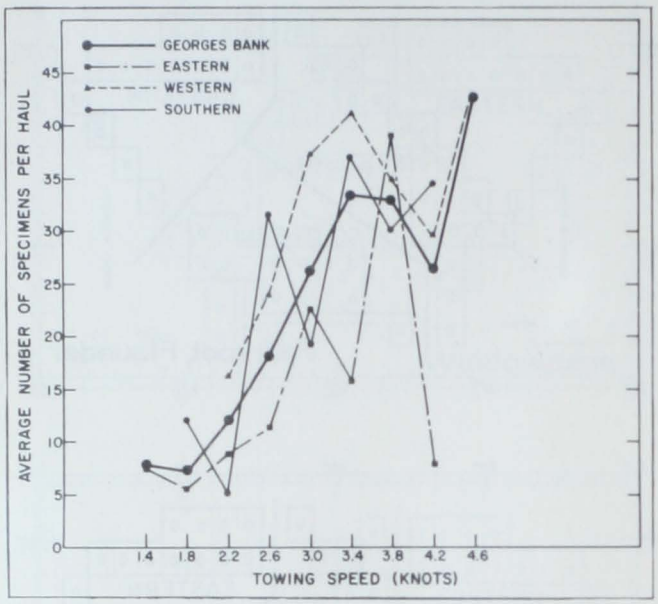

Fig. 6 - Relation of finfish catch to towing speed.

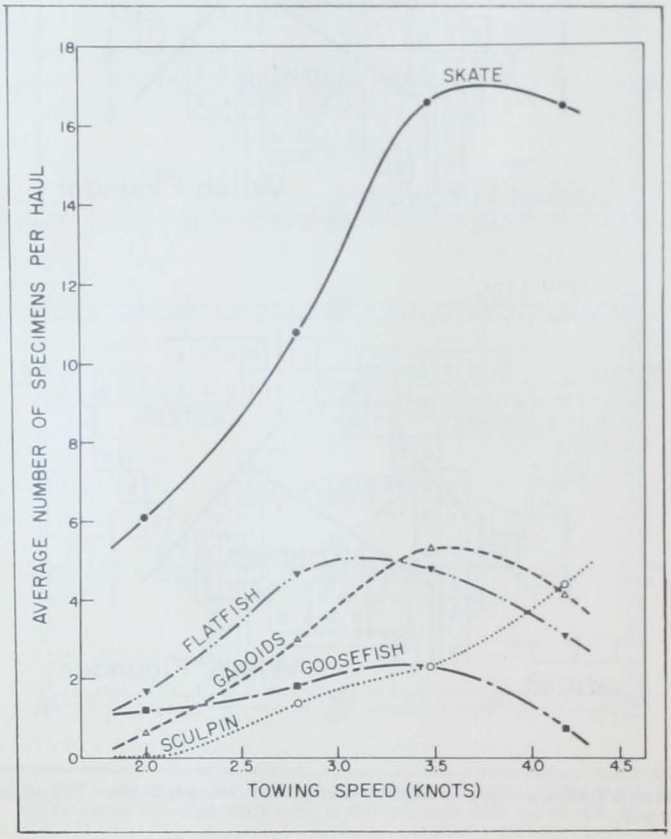

Fig. 7 - Catch-rate of representative species and species groups in relation to towing speed.

Several causes are believed to contribute to these differences in catch rate. The reduced catch of flatfish at the higher speeds may be attributed to bouncing of the dredge off bottom, or the overriding of some specimens where the bottom is uneven. Many flatfishes and skates lie partially buried in bottom sediments; a bouncing dredge or a sweep-chain in high position part of the time could pass over some slower-moving specimens of these species. The increased catch of all finfish at medium or high towing speed, compared to their low catch at low speed, may be due to the fish's inability to escape the oncoming dredge--which they are able to do when the dredge is towed slower than 2 knots. Vibrations produced by the pounding of dredge against the ocean bottom, and turbulence created by the towing warp and dredge passing through water, undoubtedly are sensed to some degree by the various kinds of fish. Differences in ability to detect sounds and vibrations through the water and ocean bottom, combined with unequal visual acuity and a wide range in fright reaction of these fishes, may explain a major part of the disparity in catch rate and changes of catch rate with towing speed among the various kinds of fish.

ESTIMATES OF FINFISH CAUGHT BY COMMERCIAL SCALLOP FLEET

In this section, we present preliminary estimates of the finfish caught on Georges

Bank by the New England-Nova Scotian commercial scallopers. We assume that the finfish catch for commercial vessels is about the same as the Delaware's. Fishing effort by the New England-Nova Scotian scallop fleet for the 5-year period 1959-63 was used to derive an estimate of annual fishing effort (Power, 1961-1963; Power and Lyles, 1964; Lyles, 1965; Neil Bourne, personal communication).

We have pointed out that the species composition and density of fishes vary from one sector of Georges Bank to another. Also, the amount of fishing by the commercial scallop fleet differs from sector to sector. Appropriate adjustments were made to correct for these variables before applying the catch data obtained by the Delaware to the annual average fishing effort by the scallop fleet. Annual fishing effort (number of vessel-days fished) by the commercial fleet in the three sectors was: Eastern--7,796 days; Western--1,821 days; and Southern--2,436 days. The estimated catch of fish is listed in table 4--see note on page 63.

We estimate that over 20 million finfish are caught annually by the scallop fleet on Georges Bank. Skate make up a major portion (50%) of this catch (fig. 8) and account for over 10 million fish. The commercial value of skate is so low that they are usually discarded. Other low-value fish in the catch are sculpin, goosefish, squirrel hake, silver hake, and "Other," which individually account for 0.3 to 1.8 million specimens, and collectively account for over 5.4 million--26% of the total. The commercially valuable species are yellowtail flounder, other flatfish, and haddock. Together, they provide about 24% (5 million) of the total catch. Sometimes, these species are brought back to port by the scallop fishermen for their families or to be sold at dockside.

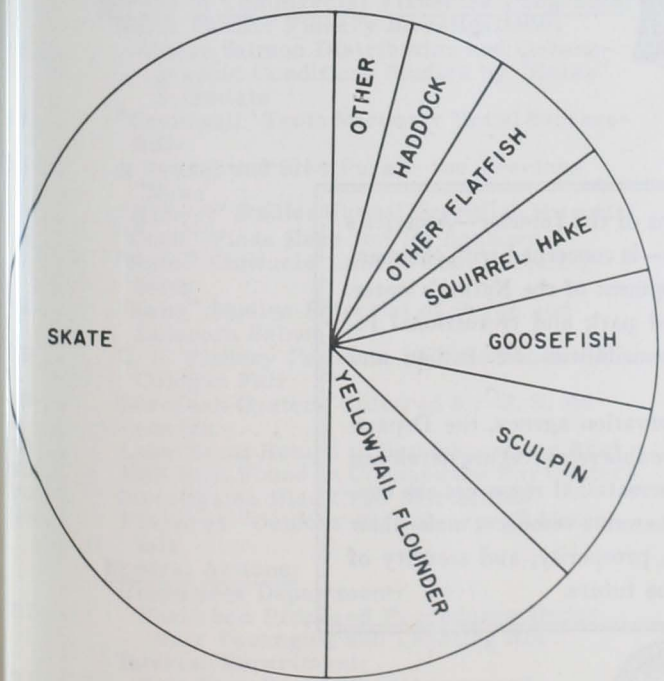

Fig. 8 - Composition of finfish catch (in terms of numbers) made by the commercial scallop fleet on Georges Bank. "Other" includes ocean pout and silver hake; "other flatfish" includes: fourspot flounder, witch flounder, winter flounder, and windowpane.

Gross estimates of the weight of fish caught by the scallop fleet can be obtained from observations on fish size made by personnel aboard the Delaware. They estimated that the weight of individual finfish caught on the survey cruise averaged roughly 0.45 kilogram (ca. 1 pound). Based on this approximation, the scallop fleet catch is estimated to be 9 million kilograms (20 million pounds) of finfish each year.

Finfish, plus about 27 million kilograms (60 million pounds) of scallop viscera per year (J. A. Posgay, personal communication), discarded on the Georges Bank fishing grounds provide a valuable source of nourishment for fish and invertebrates. Relatively minor quantities are eaten by birds and mammals. Large carnivorous fish, such as sharks, cod, and goosefish, engulf whole specimens of the smaller discarded species. The large discarded fish are attacked piecemeal by fish and certain kinds of invertebrates. Crabs, shrimp, gastropod mollusks, isopods, amphipods, and numerous other groups of invertebrates use this animal matter to supplement their normal food sources.

Animal matter discarded at sea by the sea scallop fleet has short-circuited some pathways in the normal food web. Consequently, the slow-moving, scavenger-type fishes (demersal sharks, skate, goosefish, and others) may have benefited greatly from this additional food supply, whereas the fast-swimming predaceous fish (pollock, mackerel, and others) may have profited rather little. Possibly, the large quantities of food material dumped on the fishing grounds over many decades has contributed to changing the species composition of the animal populations in the heavily fished areas of Georges Bank.

ACKNOWLEDGMENTS

Information for this study was collected from aboard the BCF research vessel Delaware. Arthur S. Merrill was Chief Scientist, assisted by John R. Donovan, Henry W. Jensen, Samuel R. Nickerson, and Llewellyn R. Porter, Jr. J. Arthur Posgay read the original manuscript and offered suggestions for its improvement.

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