

Sea Scallop Resources off the Northeastern U.S. Coast, 1975

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INTRODUCTION

The sea scallop, *Placopecten magellanicus* (Gmelin), is one of the commercial mollusks off the Atlantic coast of the United States and Canada. It is harvested over its entire range, which extends from the Gulf of St. Lawrence (Posgay, 1957) to south-southeast of Cape Hatteras, N.C. (Porter, 1974). Historically, the largest harvests by U.S. fishermen have been from Georges Bank with smaller harvests from the Gulf of Maine, Cape Cod Bay, and the Middle Atlantic Shelf, but since 1975, more than 60 percent of the total U.S. scallop harvest has been from the latter area. Canadian fishermen harvest sea scallops from Georges Bank northward to the Gulf of St. Lawrence. In 1976, 8,712 metric tons of sea scallop meats were landed by U.S. fishermen (ICNAF, 1977), a quantity more than three times larger than that landed in any year between 1969 and 1974 (Fig. 1); the Canadian landings were a record high.

The Woods Hole Laboratory of the Northeast Fisheries Center has studied sea scallop stocks on Georges Bank regularly since the late 1950's. Popula-

tion distribution, length and age composition, and growth rates have been monitored. The St. Andrews Biological Station, New Brunswick, Canada, has also surveyed sea scallops on Georges Bank (Caddy, 1975; pers. commun.). An early survey of sea scallops on the Middle Atlantic Shelf was made by the U.S. fisheries schooner *Grampus* in 1913 (Anonymous, 1914); a later one by the RV *Delaware* in 1960 (Merrill, 1962).

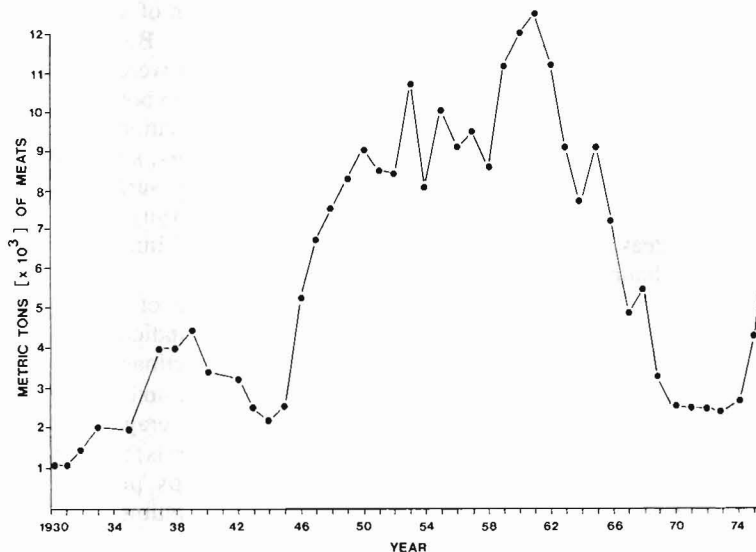
The objectives of the 1975 surveys were to make observations on the distribution and abundance, spawning season, and length frequency of sea

scallops on Georges Bank and the Middle Atlantic Shelf.

MATERIALS AND METHODS

Two sea scallop surveys on the RV *Albatross IV* extended from Georges Bank southward to Cape Hatteras in 1975. A standard 10-foot (3.05-m) sea scallop dredge with a bag of 2-inch (5.08-cm) rings was used. Tows were of 15-minute duration at 6.3 km/hour (3.5 knots). Scallop numbers, condition of the gonads, and shell lengths were recorded. Gonadal condition was determined using criteria established by Posgay and Norman (1958). Gonads

Figure 1.—Historical landings of sea scallops by U.S. fishermen. Sources: Lyles (1969); Fishery Statistics of the United States (1968-73); Fisheries of the United States (1974-75); ICNAF (1977).



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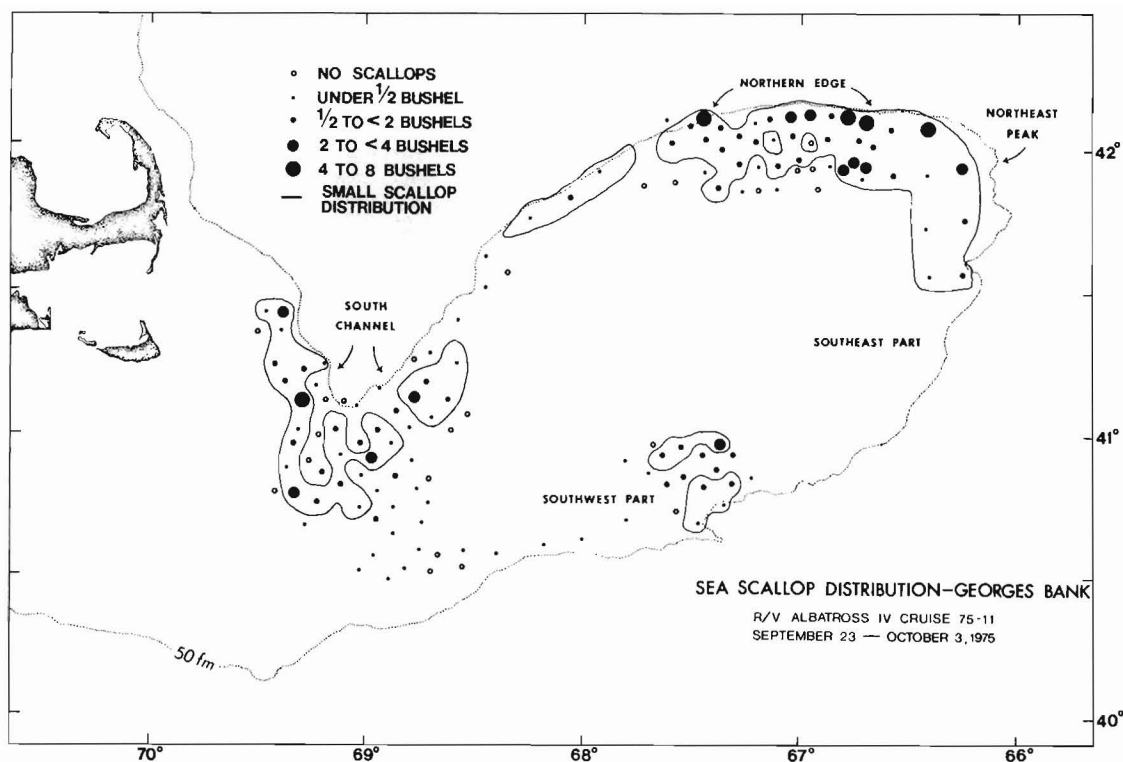


Figure 2.—Station pattern and sea scallop distribution and abundance (bushels per 15-minute tow) on selected areas of Georges Bank, 23 September to 3 October 1975. Solid lines indicate probable limits of distribution of small scallops, mostly the 1972 year class.

were divided into those spawned and not spawned. Between 42 and 130 males and 51 to 116 females were examined at five stations over the surveyed area. The depths of the stations were near the mean depth for scallops on Georges Bank and the Middle Atlantic Shelf. Temperature data were collected from bathythermographic casts.

A total of 144 stations, mostly spaced about 8 km apart, was sampled on Georges Bank between 23 September and 3 October 1975. Station depths ranged from 22 to 183 m. Stations were in three sections of known scallop abundance: 1) Northern Edge and Northeast Peak, 2) Southwest Part, and 3) South Channel. A survey of the southeast part of Georges Bank was planned, but hurricane threats limited sampling operations.

A total of 99 stations was sampled on the Middle Atlantic Shelf between 7 and 16 August 1975. Station depths ranged from 26 to 148 m. Stations were spaced along and among eight transects that were nearly perpendicular to shore and equidistant from each other be-

tween eastern Long Island, N.Y., and Cape Hatteras, N.C.

RESULTS

Georges Bank

Distribution and Abundance

The distribution of sea scallops surveyed on Georges Bank is shown in Figure 2. Scallops were taken at 118 of the 144 stations, on bottoms consisting of various combinations of sand, gravel, rocks, boulders, and shells of dead mollusks—mostly surf clam, *Spisula solidissima* (Dillwyn); ocean quahog, *Artica islandica* (Linné); and sea scallop.

The abundance of sea scallops on Georges Bank is indicated in Figure 2. The largest collections were made on the Northern Edge and Northeast Peak, where stations averaged 1.2 bushels (range, 0-7.5 bushels) (1 bushel = 35.2 liters) of scallops per tow. In the Southwest Part, stations averaged 0.75 bushels (range, 0-2.0 bushels) of scallops per tow. In the South Channel,

stations averaged 0.4 bushels (range 0-4.0 bushels) of scallops per tow.

Solid lines encircling areas of distribution of small scallops, most of which belonged to the 1972 year class, are also shown on Figure 2. Small scallops were taken at about two-thirds of stations on the Northern Edge, at all the Northeast Peak stations, and at about one-third of stations in the Southwest Part and the South Channel.

Scallops were collected at depths that ranged from 37 to 100 m (two scallops were caught at 183 m); mean depth for scallops was about 68 m:

Depth range (m)	Scallops (percent)
37-50	13
50-75	54
76-100	33

Spawning Season

The gonadal condition of the scallops indicated that spawning was in progress in late September and early October. The percentages of scallops that had

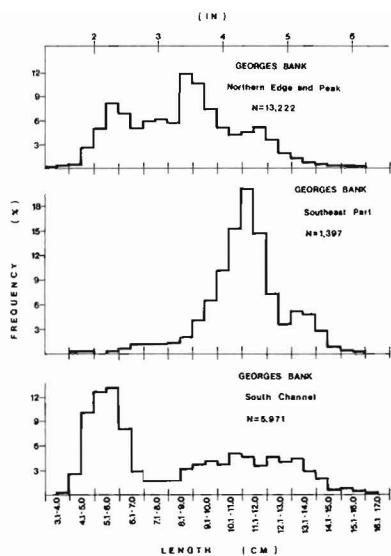


Figure 3.—Length-frequency histograms of sea scallops from three sections of Georges Bank. Number of scallops measured is indicated.

spawned and the bottom temperatures by section were:

Section	Percent spawned		Depth (m)	Bottom temperature (°C)
	Males	Females		
Northern edge	60.2	36.6	68	11.2
Southwest part	2.8	10.4	68	10.0
South channel	50.0	41.2	60	9.0

Collectively, the samples contained 216 males and 219 females, a 1:1 sex ratio.

Length Frequency

Figure 3 shows the length-frequency histograms of sea scallops within the three sampled sections of Georges Bank. A significant number of scallops ranged between 3.0 and 7.0 cm long; most represented the 1972 year class. Within the surveyed sections, the approximate percentages of scallops between 3.0 and 7.0 cm were: Northern Edge and Northeast Peak, 28 percent; Southwest Part, 2 percent; and South Channel, 50 percent.

Middle Atlantic Shelf

Distribution and Abundance

The distribution of sea scallops surveyed on the Middle Atlantic Shelf is shown in Figure 4. Scallops were taken at 57 of the 99 stations, on bottoms

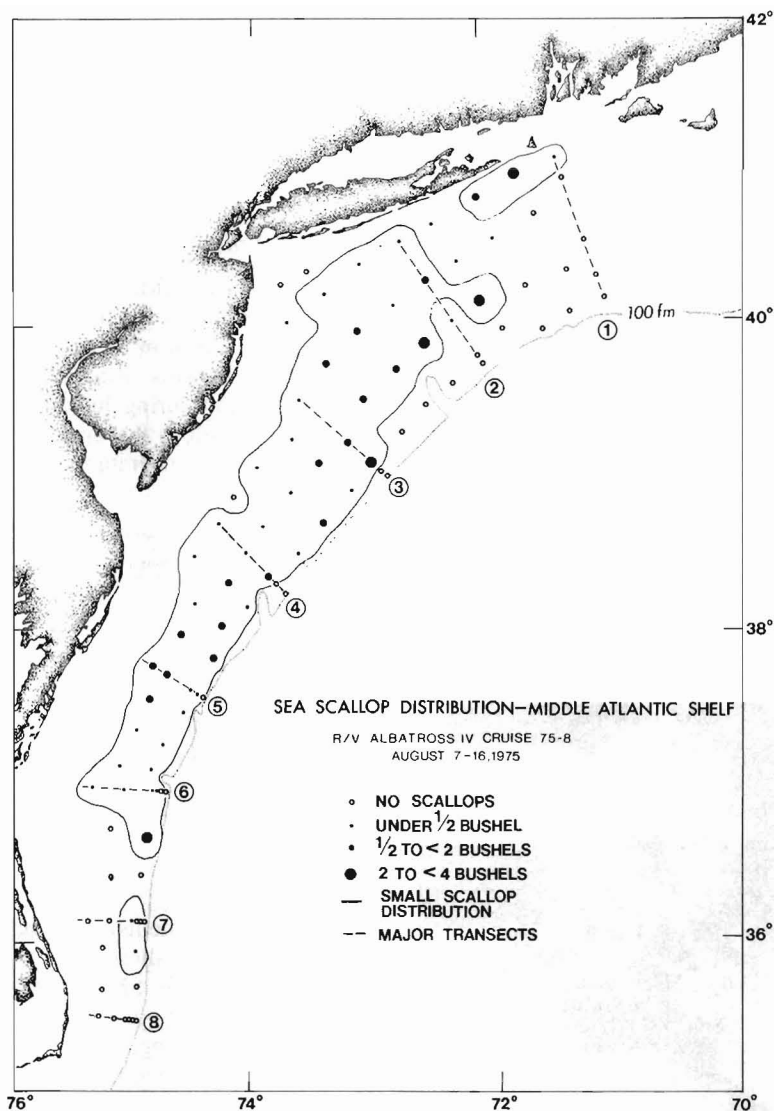


Figure 4.—Station pattern and sea scallop distribution and abundance (bushels per 15-minute tow) on the Middle Atlantic Shelf, 7-16 August 1975. Solid lines indicate probable limits of distribution of small scallops, mostly the 1972 year class.

consisting of sand and sand-gravel. Scallops were distributed closer to shore at the northern end than at the southern end of the shelf. The southernmost collection of scallops was taken off Oregon Inlet, N.C. (lat. 35°53'N, long. 74°55'W).

The abundance of sea scallops on the Middle Atlantic Shelf is indicated in Figure 4. The largest collections were made south of Long Island and east of New Jersey where six stations had between 1.0 and 2.0 bushels of scallops per tow. The largest collection, 2.5 bushels, consisted mostly of individu-

als ranging from 3.0 to 8.0 centimeters long, and was offshore of the Virginia-North Carolina border.

Small scallops that belonged mostly to the 1972 year class were taken at half the stations; their distribution is shown by solid lines in Figure 4. Small scallops were distributed over nearly the full width of the sampling area from mid-Long Island to the mouth of Chesapeake Bay. In addition, they were also found in two other discrete areas; one off the southeastern tip of Long Island and another off Albemarle Sound, N.C.

Scallops were collected at depths that

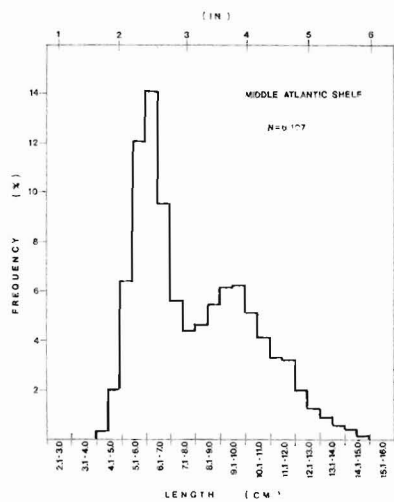


Figure 5.—Length-frequency histogram of sea scallops from the Middle Atlantic Shelf. Number of scallops measured is indicated.

Sorting the catch.



ranged from 31 to 80 m (one scallop was collected at 110 m), mean depth for scallops was about 55 m:

Depth range (m)	Scallops (percent)
31-50	24.8
51-75	75.0
76-80	0.2

Spawning Season

The gonadal condition of the scallops indicated spawning during mid-August. Judging from the condition of some flaccid gonads, it appeared that spawning began during July. The percentages of scallops that had spawned and the bottom temperatures were:

Section	Percent spawned		Depth (m)	Bottom temperature (°C)
	Males	Females		
Off southeastern Long Island	60.3	54.3	64	6.5
Off Chincoteague Bay	67.5	74.5	37	11.0

Collectively, the samples contained 236 males and 163 females, a 1.4 to 1 sex ratio.

Length Frequency

Figure 5 shows the length-frequency histogram of sea scallops from the entire Middle Atlantic Shelf. About 50 percent of the scallops were between 3.0 and 7.0 cm long, and most represented the 1972 year class.

DISCUSSION

Distribution and Abundance

Sea scallops were collected on the traditional commercial fishing grounds on Georges Bank and the Middle Atlantic Shelf. Scallops were found in commercial quantities nearly 85 km farther south (lat. 35°33'N, long. 74°55'W) than previously by Merrill (1962) on the Middle Atlantic Shelf.

Mean depth for scallops on Georges Bank, about 68 m, was 13 m deeper than that on the Middle Atlantic Shelf, about 55 m.

The extensive distribution of the 1972 year class of scallops is likely to disperse the commercial fishing effort over the Bank and the Shelf. The scar-

city of older year classes may lead to the 1972 year class being overfished.

Spawning Season

The time of sea scallop spawning has been infrequently documented. Previous records include: Georges Bank, September (Posgay and Norman, 1958); Cape Cod Bay, September and October (Posgay, 1950); New Hampshire, September (Culliney, 1974); Maine, August (Drew, 1906); and Bay of Fundy, August and September (Stevenson, 1936; Dickie¹). No records exist for scallop spawning on the Middle Atlantic Shelf. The current observations revealed that scallops were spawning off Virginia and Long Island during August, and on Georges Bank during late September and early October. Spawning had not progressed as far on the Bank then as it had on the Shelf during August. Probably, scallops begin spawning on the Middle Atlantic Shelf during July, and a progression of spawning ensues northeastward onto Georges Bank as the season advances.

Length Frequency and Recent Landings

There was excellent recruitment to the sea scallop population on Georges Bank and the Middle Atlantic Shelf, primarily due to the exceptionally abundant 1972 year class. The scallops became large enough for harvest in 1975, 1976, and 1977 and have led to significant increases in landings during those years. United States sea scallop landings doubled from 4,422 metric tons (meats) in 1975 to 8,712 metric tons in 1976 (Fig. 1). Similarly, Canadian landings from the Georges Bank fishery increased from 7,387 to 8,564 metric tons between 1975 and 1976 (ICNAF, 1977); the 1976 scallop harvest was the highest in the history of the Canadian fishery. Total scallop landings (United States and Canada) in 1976 from Georges Bank and the Middle Atlantic Shelf were 18,371 metric

¹Dickie, L. M. 1953. Fluctuations in abundance of the giant scallop, *Placopecten magellanicus* (Gmelin), in the Digby area of the Bay of Fundy. Unpubl. rep. Fish. Res. Board Can. Manusc. Rep., Biol. Ser., No. 526.

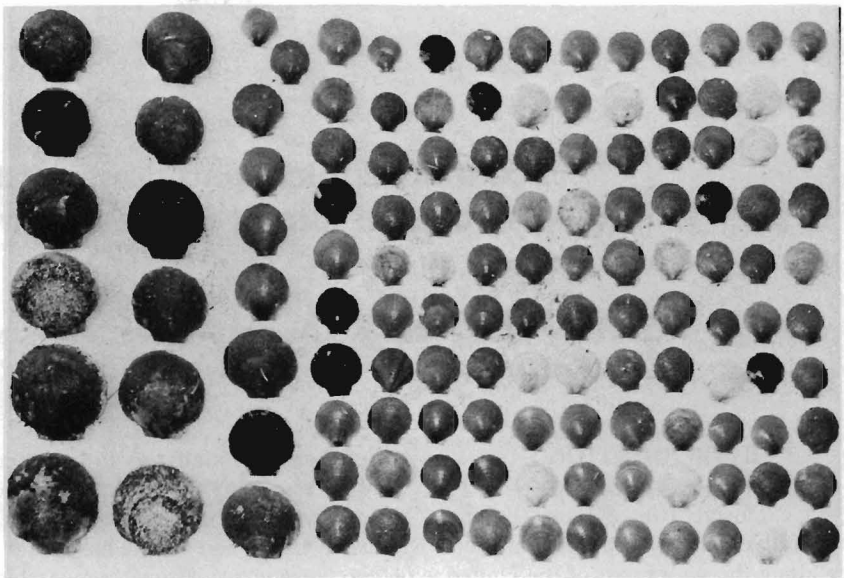
tons, a 56 percent increase over the total 1975 catch of 11,809 metric tons (ICNAF, 1977). Preliminary analysis of U.S. scallop landings during the first several months of 1977 suggests that the total U.S. landings for the year may be substantially greater than those of 1976.

CONCLUSIONS

Commercial scallop length frequency data (both United States and Canada) indicate that the present scallop fisheries are dependent mostly on the 1972 year class. The high abundance exhibited by the 1972 year class does not, in itself, insure that the scallop stock will not be overfished. Indeed, it is possible that growth overfishing (the removal of scallops before they have attained their maximum growth potential, i.e., yield per recruit) may have already transpired. From the little knowledge available of stock-recruitment relationships for sea scallop populations and given the characteristic irregularity of recruitment, it appears desirable to estimate the size of an adult spawning stock that is large enough for providing adequate recruitment in the future and then regulate for preserving it, in order that a viable fishery will be maintained. Management alternatives to reach this objective are currently being considered by the newly established Regional Fishery Management Councils.

ACKNOWLEDGMENT

We wish to thank J. Arthur Posgay for reviewing the manuscript.



The entire catch at a sampling station on the Middle Atlantic Shelf. 1972 recruits are on the left, older scallops on the right.

LITERATURE CITED

- Anonymous. 1914. Opportunity for a new sea scallop fishery off the Middle Atlantic coast. U.S. Bur. Fish. Econ. Circ. 7, 5 p.
- Caddy, J. F. 1975. Spatial model for an exploited shellfish population, and its application to the Georges Bank scallop fishery. J. Fish. Res. Board Can. 32:1305-1328.
- Culliney, J. L. 1974. Larval development of the giant scallop *Placopecten magellanicus* (Gmelin). Biol. Bull. (Woods Hole) 147:321-332.
- Drew, G. A. 1906. The habits, anatomy and embryology of the giant scallop (*Pecten tenuicostatus* Mighels). Univ. Maine Stud., No. 6, p. 3-71.
- ICNAF. 1977. Provisional nominal catches in the Northeast Atlantic. 1976. Int. Comm. North Atl. Fish. Summary Document 77/VI/29 (revised 16 June 1977), 52 p.
- Lyles, C. H. 1969. Historical catch statistics (shellfish). U.S. Fish Wildl. Serv., Curr. Fish. Stat. 5007, 116 p.
- Merrill, A. S. 1962. Abundance and distribution of sea scallops off the Middle Atlantic coast. Proc. Natl. Shellfish Assoc. 51:74-80.
- Porter, H. J. 1974. The North Carolina marine and estuarine mollusca - an atlas of occurrence. Univ. North Carolina, Inst. Mar. Sci., Morehead City, N.C., 351 p.
- Posgay, J. A. 1950. Investigations of the sea scallop, *Pecten grandis*. Third report on investigations of methods of improving the shellfish resources of Massachusetts. Commonw. Mass., Dep. Conserv., Div. Mar. Fish., 1950:24-30.
- _____. 1957. The range of sea scallops. Nautilus 71(2):55-57.
- _____, and K. D. Norman. 1958. An observation on the spawning of the sea scallop, *Placopecten magellanicus* (Gmelin), on Georges Bank. Limnol. Oceanogr. 3(4):478.
- Stevenson, J. A. 1936. The Canadian scallop; its fishery, life-history, and some environmental relationships. M.A. Thesis, Univ. Western Ontario, London, Ont.

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