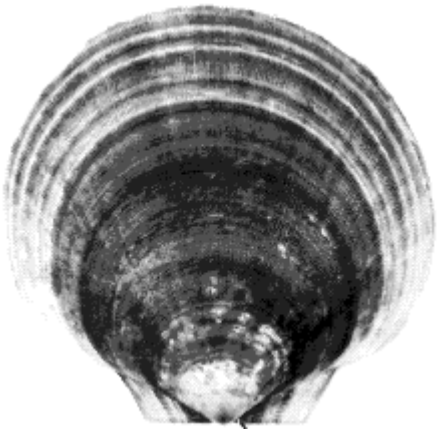

Results from the 2005 Maine Sea Scallop Survey

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September 14, 2009

Executive Summary

The Maine sea scallop survey was carried out between November 2005 and April 2006 in Zones 7-11 (Matinicus Is. to Kittery). The survey last took place in this portion of the coast in 2003. A total of 109 tows were made with two commercial vessels each using a standardized survey drag. Results indicate scallop abundance declined across all size categories and throughout all western coastal Maine strata since the last survey. Overall densities were 49-59% less than in 2002-03, with the Casco Bay region having the largest decrease.

Introduction

An annual dredge-based fishery-independent survey of the sea scallop (*Placopecten magellanicus*) resource within state waters has been conducted by Maine DMR since 2002 (with the exception of 2004). This survey has provided information on size distribution, the shell height-meat weight relationship, abundance, stock size and spatial distribution of scallops from nearshore waters. In the first two years (2002, 2003), the entire coast was surveyed. Subsequent to this, one of three major sections of the coast (New Hampshire border to western Penobscot Bay, eastern Penobscot Bay to Quoddy Head, Cobscook Bay) is surveyed each year on a rotating basis.

Purpose and extent of survey

The purpose of the survey is to characterize and monitor the sea scallop resource within Maine's coastal waters, and to compare results to previous years' surveys in light of regulatory and environmental changes. The survey provides information on geographic distribution, relative abundance, population size structure, meat yield and occurrence of seed and sublegal scallops.

During November 2005-April 2006, survey strata 7-11 (Kittery to Matinicus Is., Fig. 1) were surveyed. These strata were last surveyed in 2003. *(Note: Although a portion of the survey took place during calendar year 2006, this survey will be referred to as the "2005 survey" which avoids confusion with the "2006 survey" that took place in the fall of 2006; Kelly 2007)*.

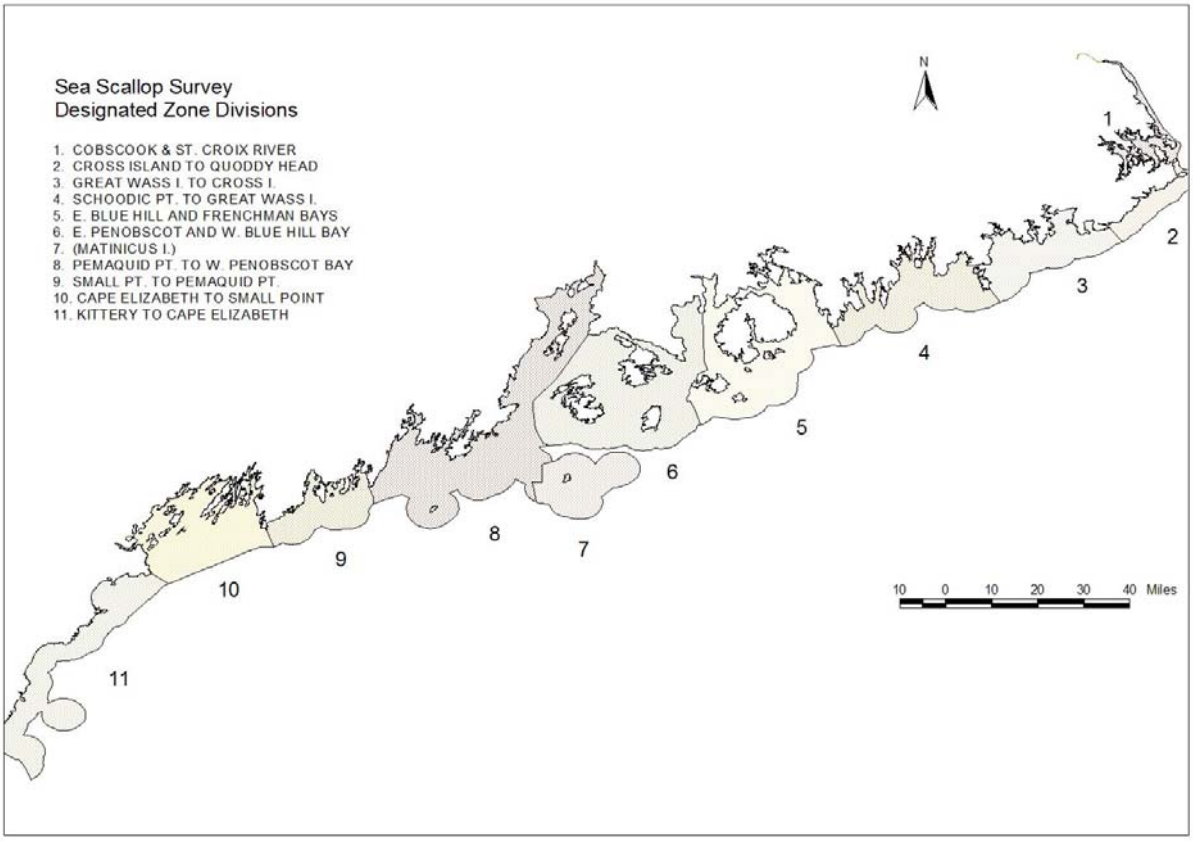


Figure 1. Survey strata - Maine DMR scallop survey.

Methods

Vessels and timing

The ’05 survey was carried out over 19 vessel days between Nov. 17, 2005 and April 25, 2006. The two contracted vessels were the *F/V North Star* from Portland and the *F/V Sea Ryder* from Spruce Head. The Portland vessel covered strata 10-11 during Nov.-Dec. ’05 and the Spruce Head vessel covered the remaining strata during Feb.-Apr. ’06.

The survey was intended to be performed during late fall, prior to the Dec. 1 opening of the scallop season and after most lobster traps had been removed from the water. For strata 10-11 however, vessel availability and an extended presence of lobster gear in the area precluded completion of the survey before Dec. 1, 2005. In strata 7-9, the survey vessel was not available until January and sampling personnel were not available until February.

Gear

The survey dredge was a 7 ft. wide chain sweep**.** Drag specifications had been determined prior to construction of the gear for the inaugural DMR scallop survey (’02) in consultation with several Maine scallop industry members. There were 2½ in. rings in the ring bag to retain small scallops. The dredge was unlined and had rock chains. The twine top was double hung with 3½ in. mesh. The drag size and weight represented a compromise between being wide enough to cover a significant area per tow and heavy enough to sample deeper waters yet small enough to be transported by a large pickup truck (Schick and Feindel 2005).

Survey design

Within each stratum, a series of fixed stations were selected that were sampled in the ’02 and/or ’03 surveys. The number of stations assigned within each stratum was roughly proportional to the size of the area although fewer stations were assigned in areas considered to be only of minor importance. Over most of western Maine, the scallop resource is generally less consistent and more sporadically productive than in eastern areas (Schick and Feindel 2005) and spatial distribution of scallops is not as well understood.

It was determined for the ’05 survey that a combination of fixed and exploratory tows would best accommodate the need to evaluate resource abundance while also providing more information for mapping scallop distribution in these zones. Exploratory tows were conducted in areas that had either not been surveyed or only lightly surveyed previously.

Sampling procedure

Stations to be sampled were plotted using Capn Voyager™ navigational software. A Garmin™ Map 76 GPS unit interfaced with a laptop computer with the navigational program was used to position the vessel on station. Location and time were recorded at three points (dredge in, tow start and haulback) for each tow. A Juniper Allegro™ ruggedized handheld computer was also interfaced with a GPS unit to record time/date/location information. Each tow was approximately 3-5 minutes at a vessel speed of 3½ knots in a straight line.

A ruggedized handheld computer with an RS232 serial port input for digital calipers was used to facilitate rapid entry of scallop shell measurements and other information while sampling. Data entry screens for the sampling programs and survey were configured using Data Plus Professional™ software, which aided in standardizing data entry, providing error checks and minimizing subsequent data auditing and keying (Schick and Feindel 2005).

The following protocol was employed (based on Schick and Feindel 2005):

1.) Station information was entered from the wheelhouse (tow duration, depth, and bearing).

2.) Bottom type was recorded as combinations of mud, sand, rock, and gravel based on sounder information, charts, and dredge contents. For example “Sg” designated a primarily sand substratum with some gravel (after Kelley et al.1998).

3.) Once the drag was emptied, a digital picture of the haul was taken.

4.) Scallops, sea cucumbers, and ocean quahogs were culled from the pile for subsequent measurement. (Catch of the later species was quantified because of their importance in other drag fisheries. While the chain sweep is not a suitable sampling device for ocean quahogs, their presence in the catch suggests the existence of a bed below the sediment.)

5.) A representative sample of bycatch was set aside and enumerated using a 0-5 qualitative abundance scale (corresponding to “absent”, “present”, “rare”, “common”, “abundant”, and “very abundant”).

6.) The total weight and volume of the scallop, sea cucumber, and ocean quahog catch was recorded.

7.) The shell height (distance from the umbo to the outer edge, perpendicular to the hinge line) of all scallops was measured.

8.) On selected tows, a subsample of 24 scallops, chosen to represent a wide size range of the catch, were measured (shell length, width, and height), shucked, and the meats placed in a compartmentalized box, in the order that the animals were measured so that weights could be matched to the corresponding shell measurements when weighed on shore.

The following table summarizes data collected for each tow:

Data items collected – ME DMR Sea Scallop survey

COLLECTED DATA - FIELD SUMMARY

TRIP	**STATION INFORMATION** IDENTIFIERS	TOW LOCATION	TOW INFO	ENVIRON. DATA
Trip identifier	Tow identifier	Dredge in (Lat, Lo, Time stamp)	Tow time elapsed	Bottom type
Trip date	Zone	Tow start (Lat, Lo, Time stamp)	Depth	Bottom temperature
Port sailed from	Strata	Haulback (Lat, Lo, Time stamp)	Bearing	
Weather	Location (description)	Drag off-bottom (Lat, Lo, Time stamp)	Wire out	
Precipitation	Tow number	Distance towed	Tow speed	
Wind/ sea stata	Sample type			
Return time	(random, exploratory, "fixed", other)			
Comments				

SCALLOP DATA CATCH	SIZE STRUCTURE	BIOMETRICS	BYCATCH
Number scallops caught	Shell height	Shell height	Tow photo ID
Volume of catch (shellstock)		Shell length	Species
Weight of catch (shellstock)		Shell depth	Abundance (1-5 scale)
Proportion of tow sampled (100, 50, 25%)		Meat weight	Trash type
Number of clappers			Trash amount (1-5 scale)
Coments			Comments

AUXILLARY DATA QUAHOG CATCH	SEA CUCUMBER CATCH	CTD DATA
Number of quahogs	Number of cucumbers	Location (lat/ long)
Shell height	Catch weight	File identifier
Shell length	Catch volume	
Shell depth	Coments	
Shell (dead) abundance (1-5 scale)	Size index (SL x diam 1 x diam 2)	

from Schick and Feindel (2005)

Data analysis

Area swept per tow was determined from tow distance (tow start to haulback) and drag width (7 ft., or 2.1 m). Tow distance was determined using Capn Voyager™ software. The scallop catch for each tow was standardized to density (number of scallops per square meter). Total scallop catch was divided into the following size categories:

- "seed": < 2½ in. (< 63.5 mm) SH
- "sublegal": 2½ in. to < 4 in. (63.5 – <101.5 mm) SH
- "harvestable": ≥ 4 in. (≥101.6 mm) SH

Estimates of total abundance for each of the three size classes were calculated using the classic Cochran (1977) approach. For each of the six survey substrata identified above, the overall average abundance by area swept was estimated as:

$$\bar{X} = \sum_{h=1}^{H} W_h \bar{X}_h$$

where $\bar{X}_h$ is the average abundance of swept area for substratum h, H is the total number of substrata, and W_h is proportion of the area of substratum h with respect to the survey area. The associated standard error can be calculated as

$$\textbf{std error}(\bar{X}) = \sqrt{\sum_{h=1}^{H} W_h^2 \frac{1 - f_h}{n_h} S_h^2}$$

where S_h^2 is the variance estimated for substratum h, $f_h = \frac{n_h}{N_h}$ is the finite population correction for substratum h, and n_h and N are the number of stations sampled and the total number of stations available for sampling, respectively, in substratum h. The finite population correction factor was ignored since the proportion of area sampled was small compared to the total area of each substratum.

Results

The survey comprised 109 total tows between Saco Bay and Matinicus Is. There were 1,094 scallops measured for shell height, of which 829 were also measured and sampled for meat weight determination. The smallest individual sampled was 50.0 mm (1.97 in.) SH and the largest was 167.9 mm (6.61 in.) SH. Thirty tows caught no scallops and the largest number of scallops in a single tow was 68 in the Damariscotta River.

Zone 7 (Matinicus Is.)

This stratum was not covered in previous surveys but 11 exploratory tows were done in February-March 2006 (Fig. 2). Abundance was extremely low with no seed or sublegals occurring in any tows (Figs. 2-3). The density of harvestable scallops (0.002 per m²) was very low. Only 15 harvestable scallops were recorded and these were all older, larger (125-168 mm) animals.

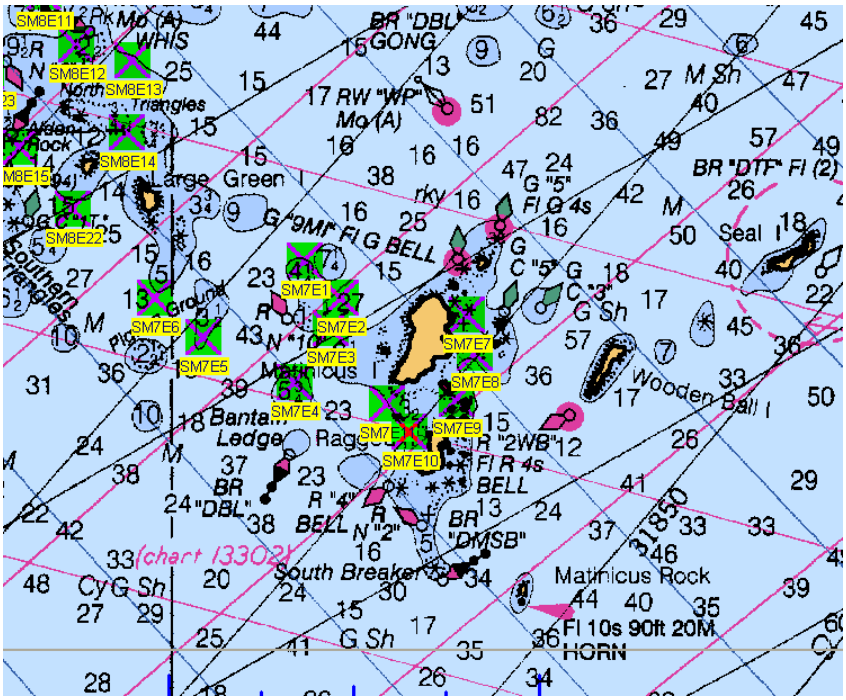
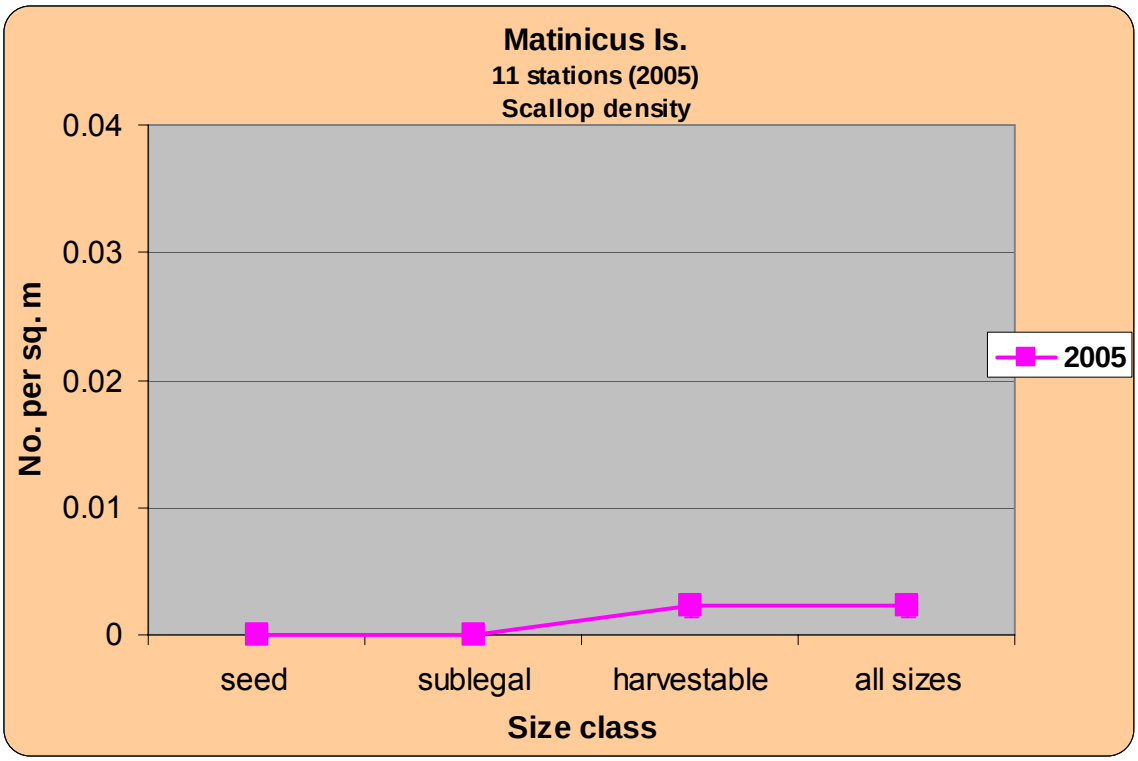


Figure 2. Location of 2005 survey stations (*above*) and scallop abundance (*below*) (Matinicus Is.).



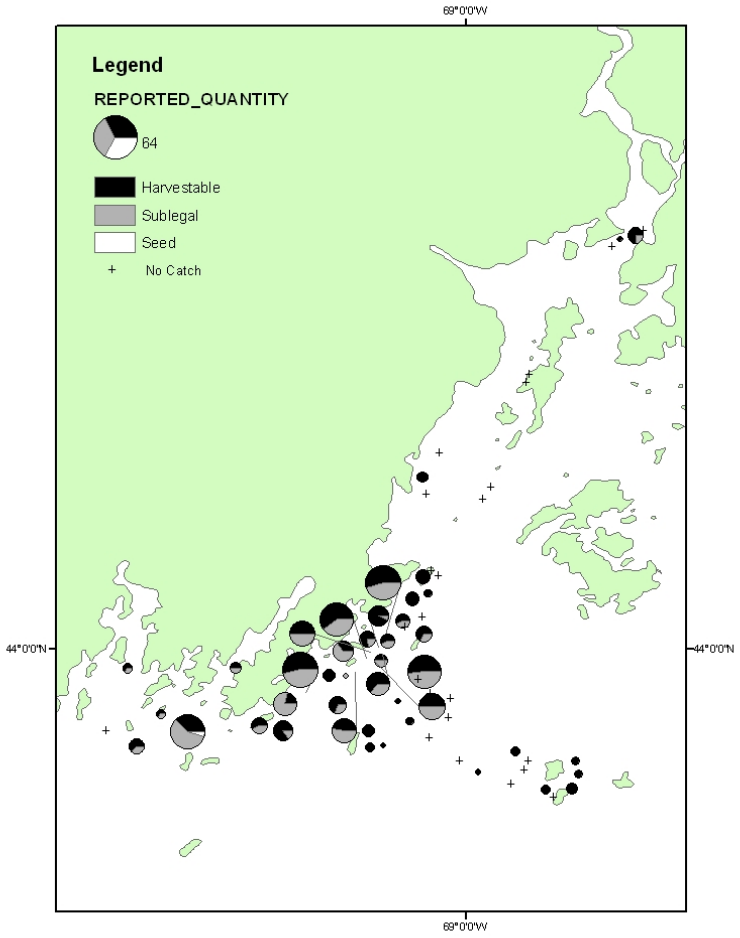


Figure 3. Number of scallops and size class composition by tow, Zones 7-8.

Zone 8 (Pemaquid Pt. to W. Penobscot Bay)

Sampling intensity was greater in the ’05 survey (55 stations; Fig. 4) than in 2002 (41 stations) or 2003 (10 stations). There were 21 fixed and 34 exploratory stations done in February-April 2006. Distribution of sampling locations varied somewhat between the ’02 and ’05 surveys. In both years there was fairly intense sampling of the Muscle Ridge Channel area off of Spruce Head. In ’02 however more sampling took place in the Medomak River and Muscongus Bay areas. The ’05 survey directed more effort in the offshore Alden Rock-Green Is.-Metinic Is. areas where the survey vessel captain indicated there was some historical abundance.

Overall scallop density was 48.7% less between ’02 (0.018 per m²) and ’05 (0.009 per m²; Figs. 3-4). Harvestable density dropped 51.7% from 0.011 scallops per m² in ’02 to 0.005 per m² in ’05. Sublegal abundance also decreased and very little seed was observed in any survey year. There was less variability in scallop catch rate between tows in ’05 perhaps due to increased sampling.

The highest density of both harvestable and overall scallops was in Muscle Ridge Channel.

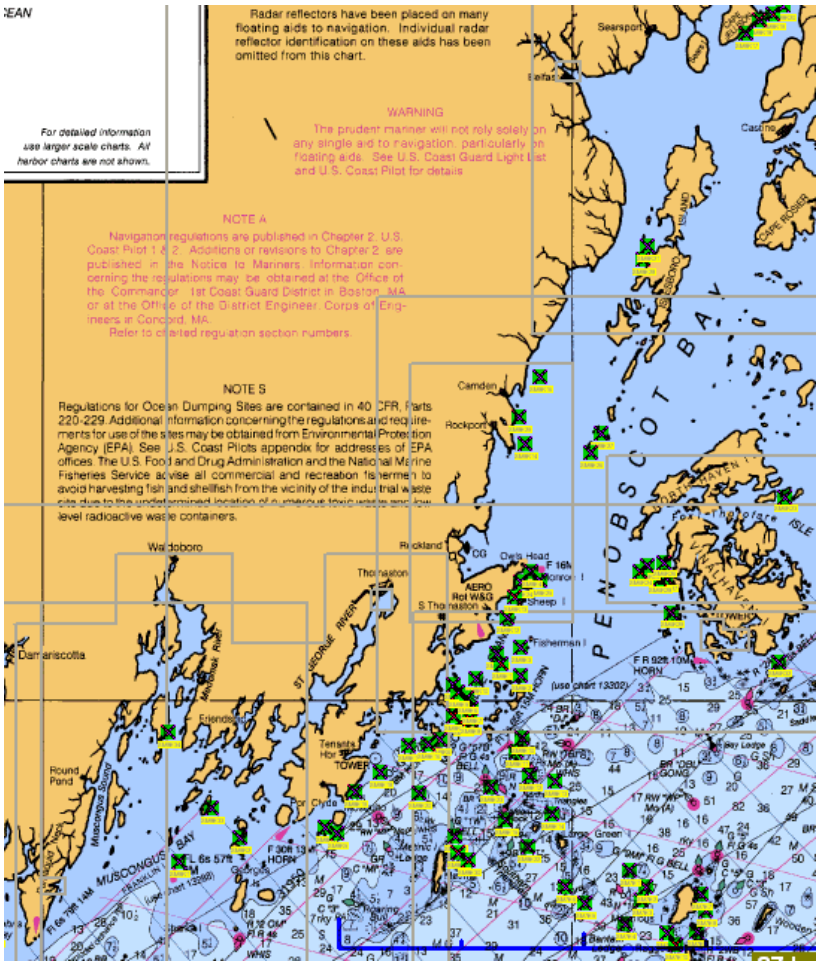
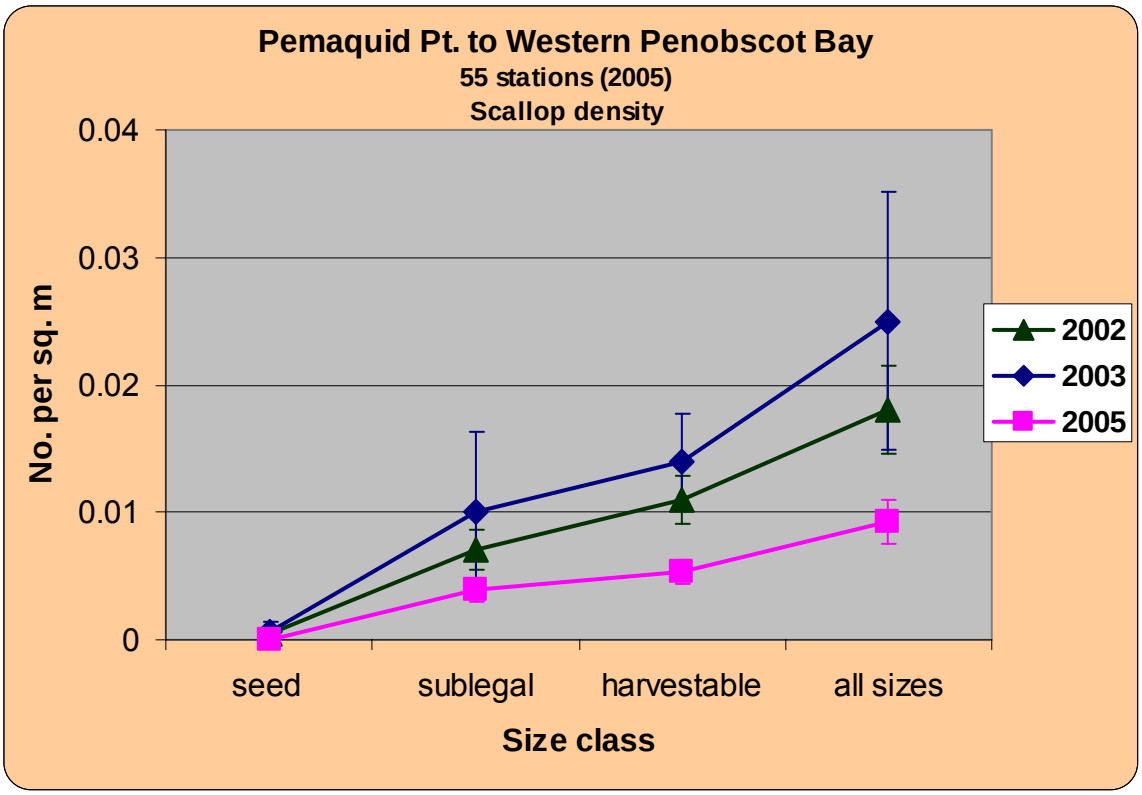


Figure 4. Location of 2005 survey stations (*above*) and scallop abundance (*below*) (Pemaquid Pt. to Western Penobscot Bay).



Zone 9 (Small Pt. to Pemaquid Pt.)

There were 14 stations sampled in the ’05 survey (Fig. 5), compared to 41 in 2003. In the ’05 survey there were seven fixed and seven exploratory stations. Though there were significantly less overall tows done in this zone in ’05 than in ’03, the most productive portions (Damariscotta R., Sheepscot R., Seguin Is.) were all sampled with nearly the same effort.

Overall abundance decreased 56.6% between ’03 (0.031 per m²) and ’05 (0.013 per m²; Fig. 5). Sublegal density did not change appreciably but an 82.0% decrease in harvestable density was noted (0.019 per m² in ’03 and 0.003 per m² in ‘05).

Highest overall density of scallops was observed in the Damariscotta R. and the highest harvestable density was in Sheepscot Bay.

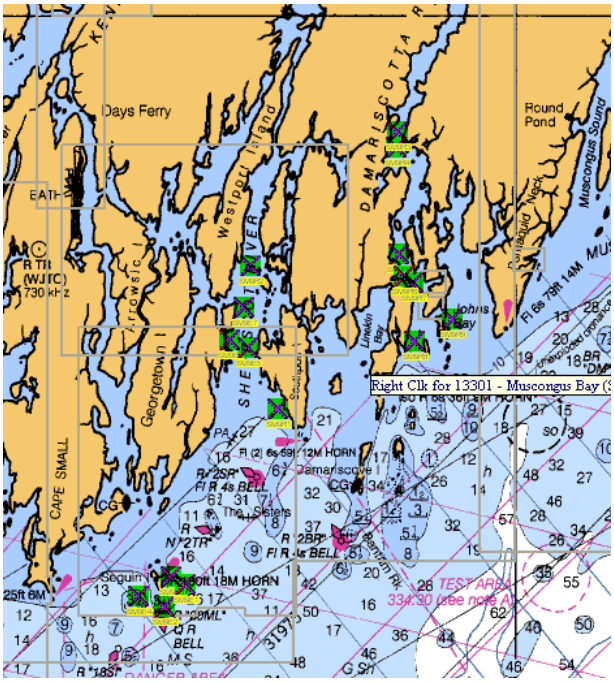
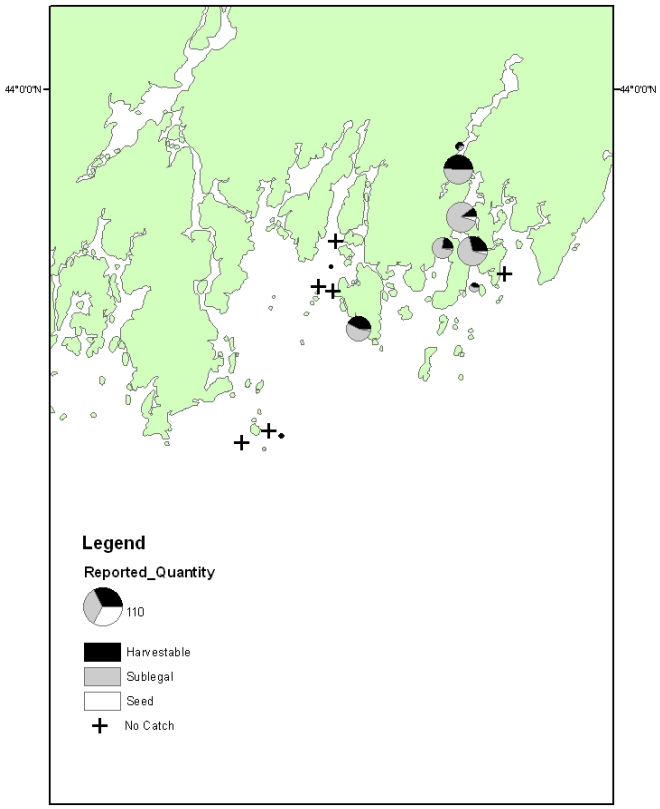
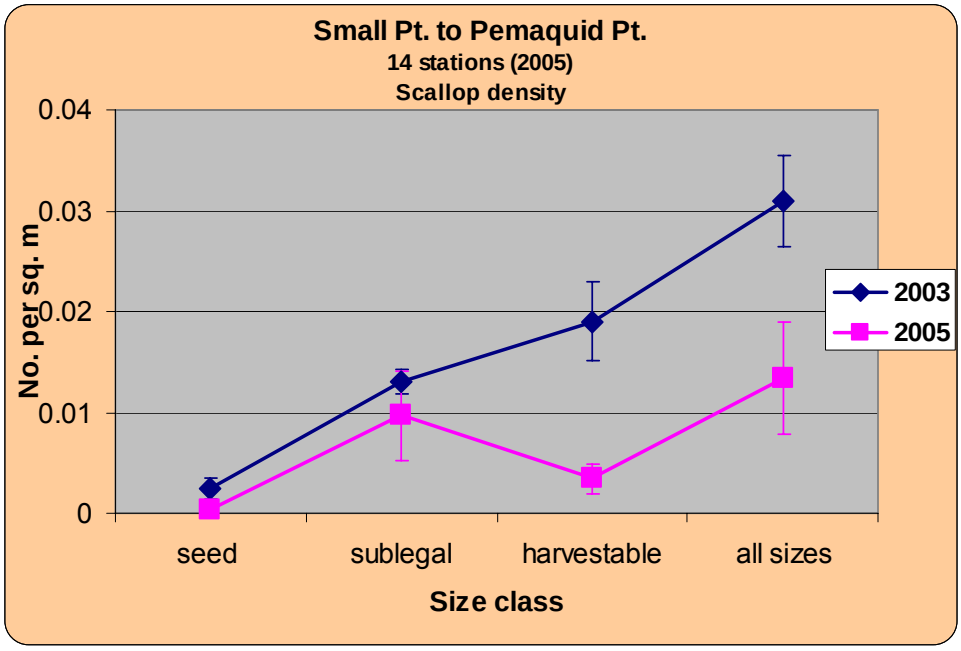


Figure 5. Location of 2005 survey stations (*above*) and scallop size composition and abundance (*below*) (Small Pt. to Pemaquid Pt.).





Zone 10 (Cape Elizabeth to Small Pt.)

The 2005 survey took place in November-December and covered 21 stations (nine fixed and 12 exploratory; Fig. 6). The '02 survey encompassed 15 stations and 25 stations were covered in '03.

Casco Bay was sampled at approximately the same level in '05 as '03. Harpswell Sound however could not be surveyed in '05 due to the presence of lobster gear.

Overall scallop abundance in '05 (0.013 per m²) was 44.5% less than in '02 (0.023 per m²) and 58.8% less than '03 (0.031 per m²; Figs. 6-7). Catch rates were less variable in '05 than in '02 and '03. Abundance of seed was very low (0.0002 per m²) and sublegal density (0.006 per m²) was similar to '02 but less than '03 (0.013 per m²). Harvestable density (0.006 per m²) was 54.6% less than '02 (0.014 per m²) and 57.6% less than '03 (0.015 per m²).

Highest harvestable and overall scallop density was observed around House Is.

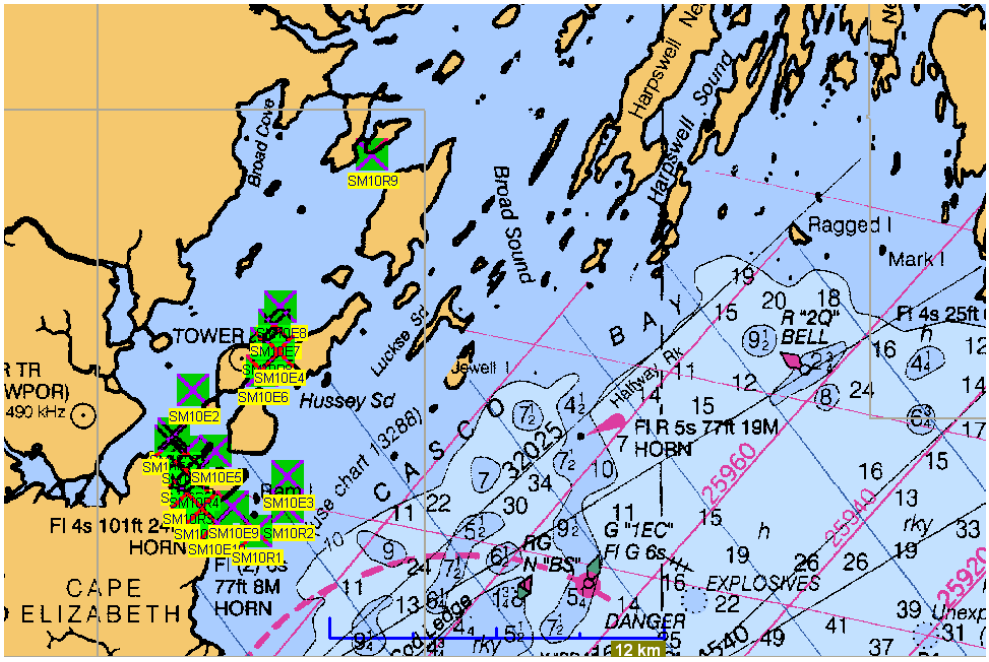
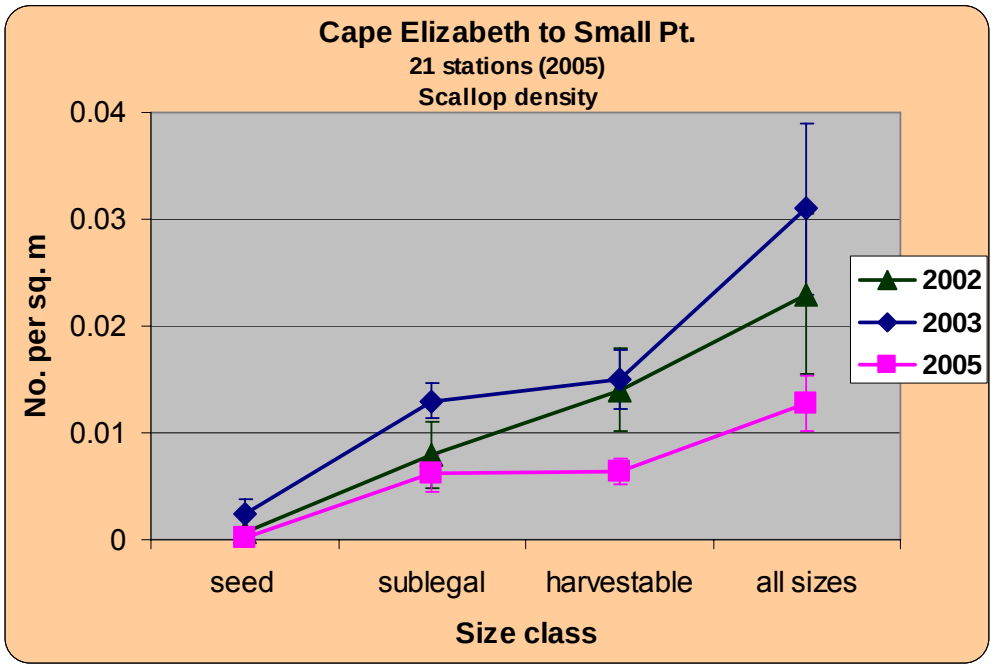


Figure 6. Location of 2005 survey stations (*above*) and scallop abundance (*below*) (Cape Elizabeth to Small Pt.).



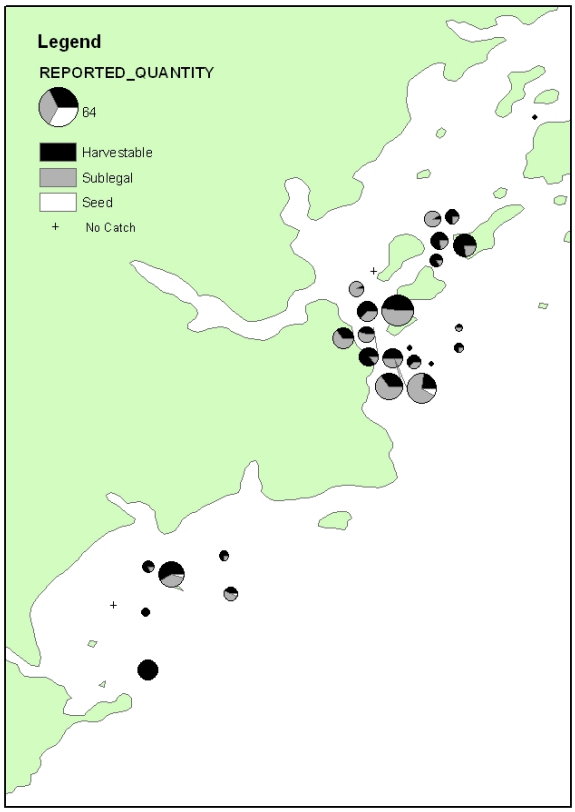


Figure 7. Number of scallops and size class composition by tow, Zones 10-11.

Zone 11 (Kittery to Cape Elizabeth)

This zone had not been covered by previous surveys. In December 2005 seven exploratory tows were performed in and around Saco Bay (Fig. 8). Overall scallop density (0.008 per m²) was low (Figs. 7-8). Virtually no seed scallops were seen and sublegal density was only 0.002 scallops per m². Some harvestables (0.005 per m²) were observed and these were mostly older, larger scallops.

The most productive tow was located between Prouts Neck and Bluff Is. and was composed fairly evenly of both sublegal and harvestable scallops. Highest density of harvestable scallops (0.014 per m²) was seen around Wood Is.

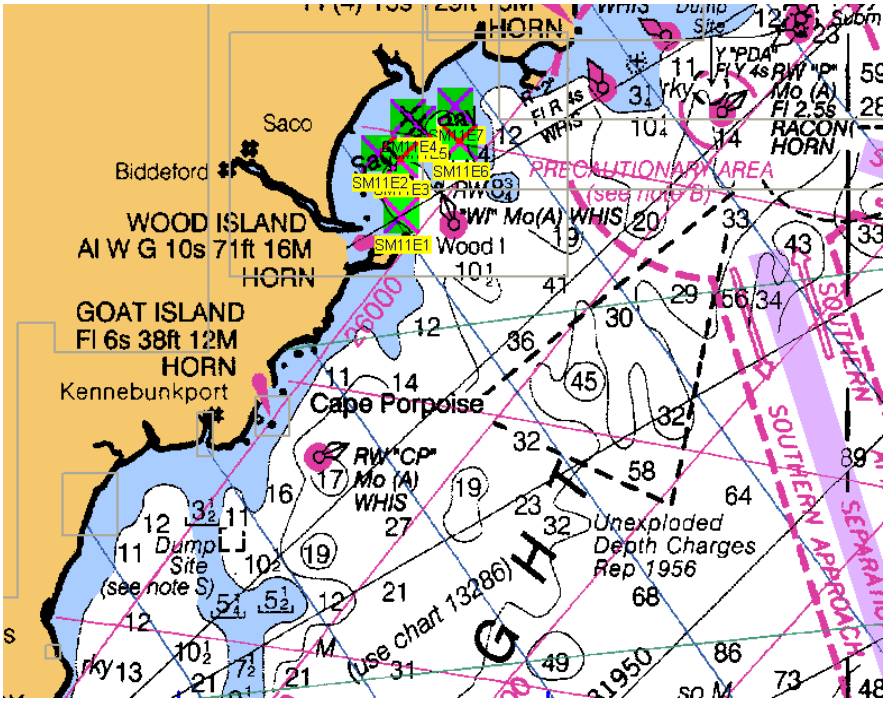
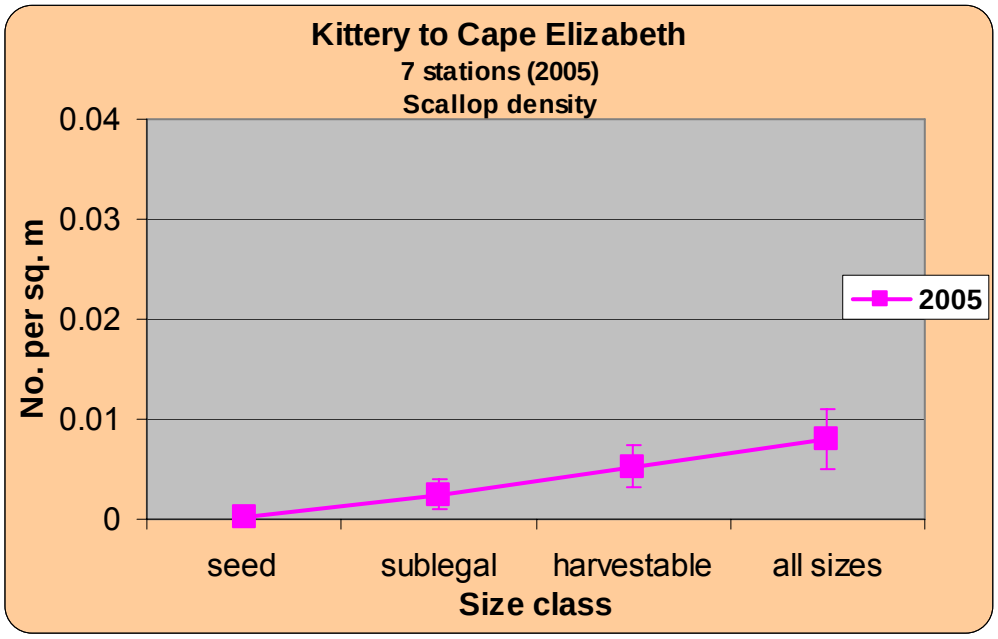


Figure 8. Location of 2005 survey stations (*above*) and scallop density by size (*below*) (Kittery to Cape Elizabeth).



Conclusions

Results from the survey indicate that scallop abundance has declined across all size categories and throughout all western coastal Maine strata. Overall scallop densities were 49-59% lower than in previous surveys done in 2002 and 2003. The survey zone which comprises Casco Bay had the largest decline.

Casco Bay had the highest density of harvestable scallops (0.006 per m²) observed in the ’05 survey. By comparison the density of harvestables in South Bay (part of Cobscook Bay, the most productive scalloping area in Maine waters) was 0.070 per m² when surveyed in 2006 (Kelly 2007). Highest harvestable density observed in the survey in western Maine was 0.019 per m² in the Small Pt. to Pemaquid Pt. stratum in ’03. This survey zone declined to 0.003 per m² in the ’05 survey.

Interpretation of the results should be tempered by the fact that the ’05 survey was carried out between Small Pt. and Matinicus Is. well after the commercial scallop season had begun. Although scallop fishing pressure is considered low throughout western Maine (perhaps the Damariscotta River being an exception) it is possible that ‘05/’06 season fishing activity could have had an impact on the survey observations. This may account particularly for the size structure of scallops sampled in the Small Pt. to Pemaquid Pt. stratum in the ’05 survey. Although sublegal density was similar between ’03 and ’05, harvestable density was much lower in ’05. Fishing removals during ‘05/’06 may account for some of the lower density of harvestable scallops observed in the Sheepscot and Damariscotta Rivers.

It will be important to continue to monitoring western coastal Maine for signs of incoming scallop recruitment by surveying on a regular basis (every 3-4 years).

Acknowledgements

Appreciation is extended to Erik Waterman (*F/V Sea Ryder*) and Vincent Balzano (*F/V North Star*) for their efforts on the survey.

Glenn Nutting (DMR) led the survey in the field.

David Libby and Kohl Kanwit (DMR) provided additional figures and Kohl Kanwit provided a helpful review of this report.

References

Cochran, W.G. 1977. Sampling techniques, 3rd ed. John Wiley & Sons, New York. 428 p.

Kelley, J.T., W.A. Barnhardt, D.F. Belknap, S.M. Dickson and A.R. Kelley. 1998. The seafloor revealed: the geology of the northwestern Gulf of Maine inner continental shelf. Open-File 96-6 Maine Geological Survey Natural Resources Information and Mapping Center.

Kelly, K.H. 2007. Results from the 2006 Maine sea scallop survey. Maine Department of Marine Resources, Research Reference Document, 34 p.

Schick, D.F. and S.C. Feindel. 2005. Maine scallop fishery: monitoring and enhancement. *Final Report to the Northeast Consortium (Sept. 1, 2005)*, 72 p.