Results from the 2008 Maine Sea Scallop Survey

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Executive Summary

The 2008 Maine scallop survey was carried out in November (prior to the December 1 opening of the fishery) in survey strata 2-7 (W. Quoddy Head to Matinicus Is.). These strata were last surveyed in 2006 (Kelly 2007). There were 183 tows completed in ’08. Most of the tow locations were randomly selected within the known scallop grounds of each stratum. The survey indicated that overall scallop abundance either declined slightly or remained unchanged at a low level of abundance for all areas except Zone 6 (E. Penobscot Bay and W. Blue Hill Bay). A slight increase was observed in the latter area. Presence of seed scallops (< 2½ in. shell height) was noted at six (6) locations.

Introduction

The sea scallop (*Placopecten magellanicus*) fishery in the Gulf of Maine occurs primarily in state waters. Scallops have been harvested along the Maine coast since the late 1800's (Wallace 1997; Schick and Feindel 2005). The fishery has been characterized by wide fluctuations in abundance with fishing pressure increasing rapidly in times when scallops were more plentiful (Walton 1980; Alden and Perkins 2001; Schick and Feindel 2005). The primary gear type is the dredge (638 scallop dragger licenses issued by Maine DMR in 2008), although Maine also permits commercial and non-commercial harvest of scallops by diving.

Maine scallop landings are currently low. In some years however the landed value of scallops in Maine has been second only to lobster. The 2008 landings (preliminary data) were reported to be only 137 thsd. meat lbs. (Fig. 1).

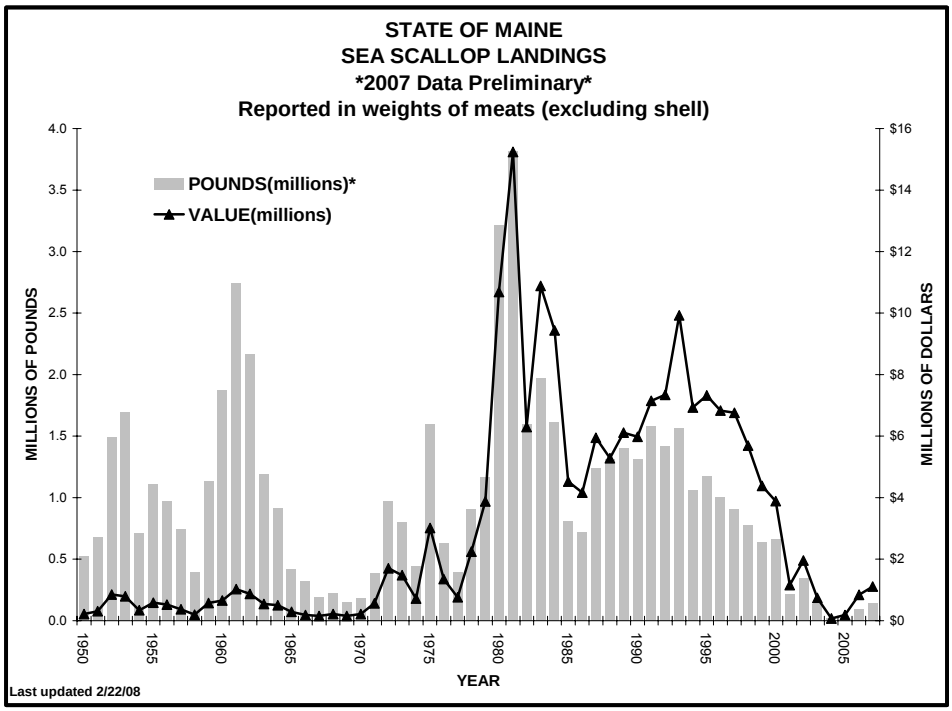


Figure 1. Maine scallop landings 1950-2007 (source: Maine Department of Marine Resources (DMR)).

An annual dredge-based fishery-independent survey by DMR of the scallop resource within Maine state waters has been conducted since 2002 (with the exception of 2004). The survey provides information on geographic distribution, relative abundance, population size structure, meat yield and occurrence of seed and sublegal scallops.

For the first two years (2002, 2003) the entire coast was surveyed. Subsequent to this one of three (1. New Hampshire border to western Penobscot Bay, 2. eastern Penobscot Bay to Quoddy Head, 3. Cobscook Bay) major sections of the coast has been surveyed each year on a rotating basis. The following is a chronology of survey coverage by year:

Year	Area surveyed
2002	Coastwide, including Cobscook Bay
2003	Coastwide, including Cobscook Bay
2004	no survey
2005	New Hampshire border to western Penobscot Bay
2006	eastern Penobscot Bay to St. Croix River, including Cobscook Bay (*higher intensity survey than '02 and '03*)
2007	Cobscook Bay
2008	Quoddy Head to Matinicus Is.

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. It is necessary to monitor changes in abundance and stock size from year to year to evaluate effects of the fishery, document recruitment events and determine what is available for harvest. The survey provides information needed to evaluate potential management strategies such as rotational closures, harvest limits and area closures to protect spawning and enhance recruitment.

The 2008 survey took place in survey strata 2-7 (Quoddy Head west to Matinicus Is.). These strata were last surveyed in '06 when scallop abundance was found to be generally low and to have decreased since the previous survey ('03; Kelly 2007).

Methods

Vessels and timing

The survey was conducted aboard two commercial scallop vessels each equipped with a standardized survey drag. Vessels were selected for the survey by a Request for Proposals (RFP) process in '06. Two vessels were used in order to broaden industry participation, to take advantage of local knowledge and to maximize survey efficiency (the survey was conducted over a broad geographic area with increased sampling intensity and within a fairly narrow time frame). Vessels were the 45 ft. *F/V Foxy Lady II* from Stonington and the 42 ft. *F/V Alyson J 4* from Cutler.

The ‘08 survey was carried out over 14 survey days during Nov. 4-24. The survey was done during this time to help minimize conflict with lobster traps and to complete the survey prior to the opening of commercial scallop season on December 1.

Gear

The survey dredge is a 7 ft. wide New Bedford-style chain sweep with 2½ in. rings in the ring bag to retain smaller scallops (Fig. 2)**.** Drag specifications were determined in consultation with several Maine scallop industry members in ’02 prior to the inaugural survey. The dredge is unlined and has rock chains. The twine top is 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, heavy enough to sample deeper waters and of a size that can be transported by a large pickup truck (Schick and Feindel 2005).

Figure 2. View of survey drag showing position of rock chains.

Survey design

A subset of the coastal zones (or “strata”) defined for the 2002-03 surveys were used in 2008 (Fig. 3). Strata 2-7 were surveyed in 2008.

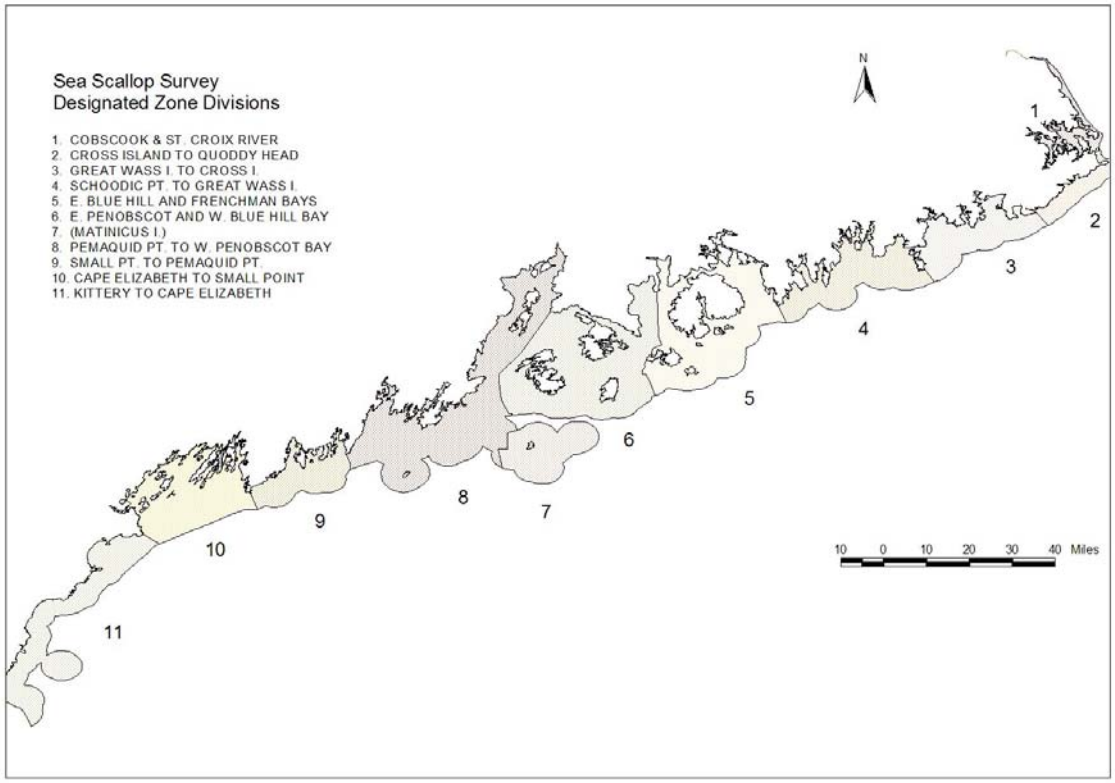


Figure 3. Survey strata - Maine DMR scallop survey.

Strata were sized to provide a manageable balance between area and sampling intensity. Scallop areas within the strata were mapped based on fisher information, prior survey data, surficial sediment maps (http://megisims.state.me.us/metadata/surf.htm) and coastal wildlife inventory maps (http://megisims.state.me.us/metadata/shell.htm) (Schick and Feindel 2005).

Within each stratum, survey stations within scallop areas were selected randomly using a 500 m grid (stratified random design). The number of stations assigned within each region was roughly proportional to the size of the strata. There were also a number of fixed stations located in some of the more historically important scallop areas such as Gouldsboro Bay and Libby Islands.

Sampling procedure

Stations to be sampled were plotted using Capn Voyager™ navigational software. A Garmin™ Map 76 GPS unit with Garmin™ GA 29 GPS antenna interfaced with a laptop computer displaying station location 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.

Tow times were 2.5-5 minutes depending on bottom conditions and presence of lobster traps. Stations were sampled by a straight line tow. Boat speed averaged 3.5-4 knots.

A ruggedized handheld computer with an RS232 serial port input for digital calipers was used to facilitate rapid entry of 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 sampling protocol was employed for each tow:

1.) Station information (location, time, depth) was entered from the wheelhouse.

2.) Bottom type was recorded as combinations of mud, sand, rock, and gravel based on sounder information 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 (*Cucumaria frondosa*) and ocean quahogs (*Arctica islandica*) were culled from the drag contents for subsequent measurement. Catches of the latter species were quantified because of their importance in other drag fisheries. While the survey gear is not suitable for formally sampling ocean quahogs their presence in the catch does suggest the existence of a bed below the sediment.

5.) Bycatch was enumerated using a 0-5 qualitative abundance scale corresponding to “absent”, “present”, “rare”, “common”, “abundant”, and “very abundant”.

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

7.) The shell height (SH; distance from the umbo to the outer edge, perpendicular to the hinge line) of individual scallops was measured. All scallops from catches of 100 animals or less were measured for SH. If >100 scallops were present at least 100 were measured. Where n > 1,000 a subsample of 10% was measured.

8.) On selected tows (normally every third or fourth tow) a subsample of 24 scallops, chosen to represent the catch of scallops ≥ 3½ in. shell height, were measured (shell length, width and height) and shucked for meat weight determination. Meats were placed in a compartmentalized box in the order that the animals were measured and later individually weighed on shore (using an Ohaus Navigator™ balance interfaced with the ruggedized handheld computer) and matched to the corresponding shell measurements.

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 – <101.6 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 183 total tows between Quoddy Head and Matinicus Is. There were 1,763 scallops measured for shell height and 465 scallops were

measured and sampled for meat weight determination. Fifty-three tows caught no scallops and the largest number of scallops in a single tow was 380 in Southeast Harbor near Deer Isle.

Zone 2 (Cross Is. to Quoddy Head)

Seventeen stations were sampled in this zone in '08 (Fig. 4). These were repeat (fixed) tows from the '06 exploratory survey of this stratum.

Mean total scallop abundance declined from 0.040 per m^2 in '06 to 0.020 per m^2 in '08 (Fig. 4). However, this difference was not significant due to relatively high variability in the '06 data. Seed density was extremely low (0.0002 per m^2) and seed were, in fact only observed on one tow. Sublegals declined from 0.023 per m^2 to 0.009 per m^2 and harvestables decreased from 0.014 to 0.011 per m^2. Again, these results were not statistically significant due to the '06 variability.

The highest overall catch rate was in Moose Cove and the highest catch rate of harvestables was between Moose Cove and Bog Brook.

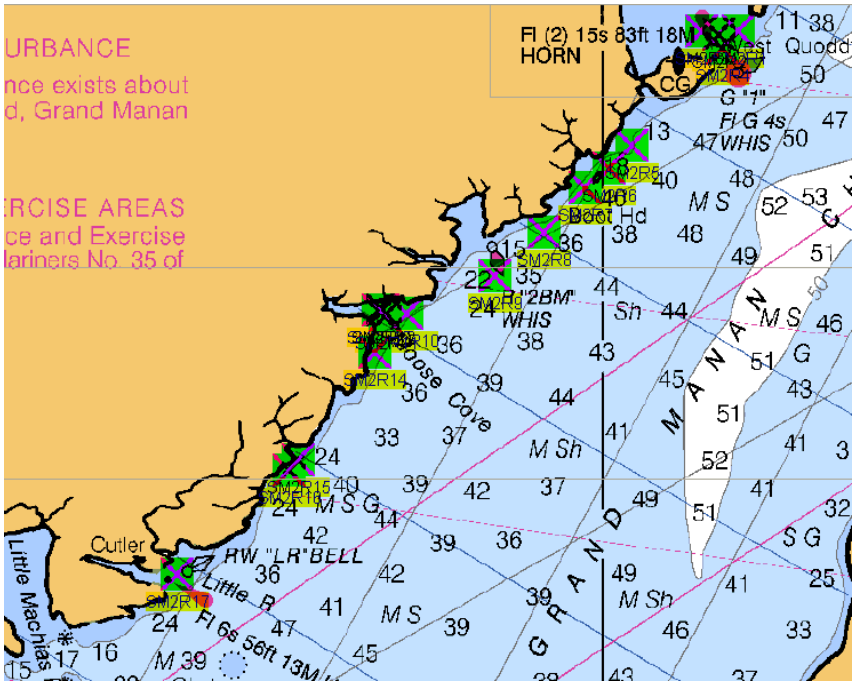
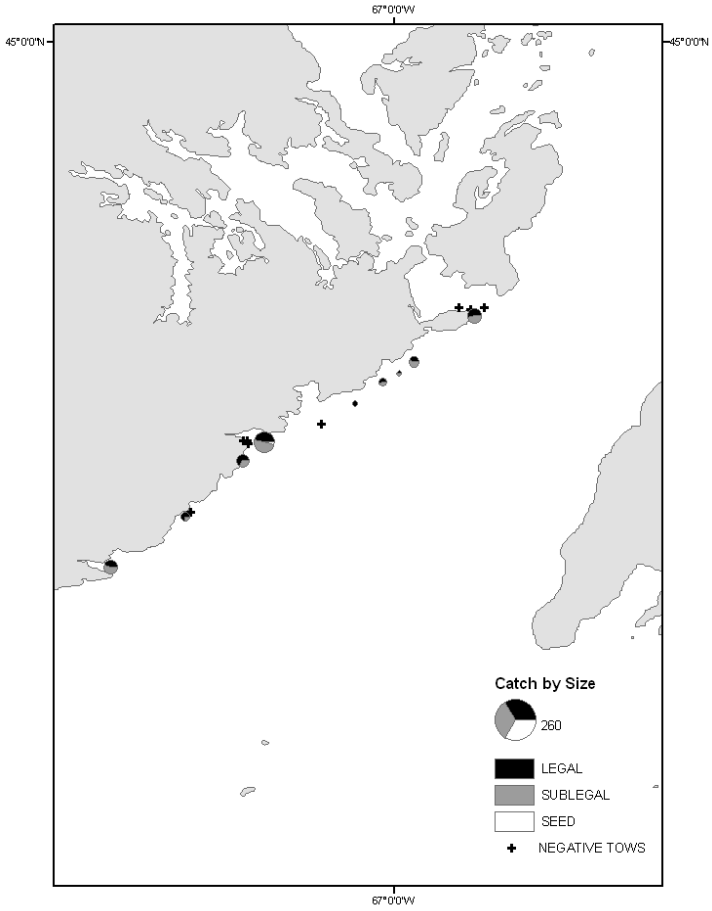
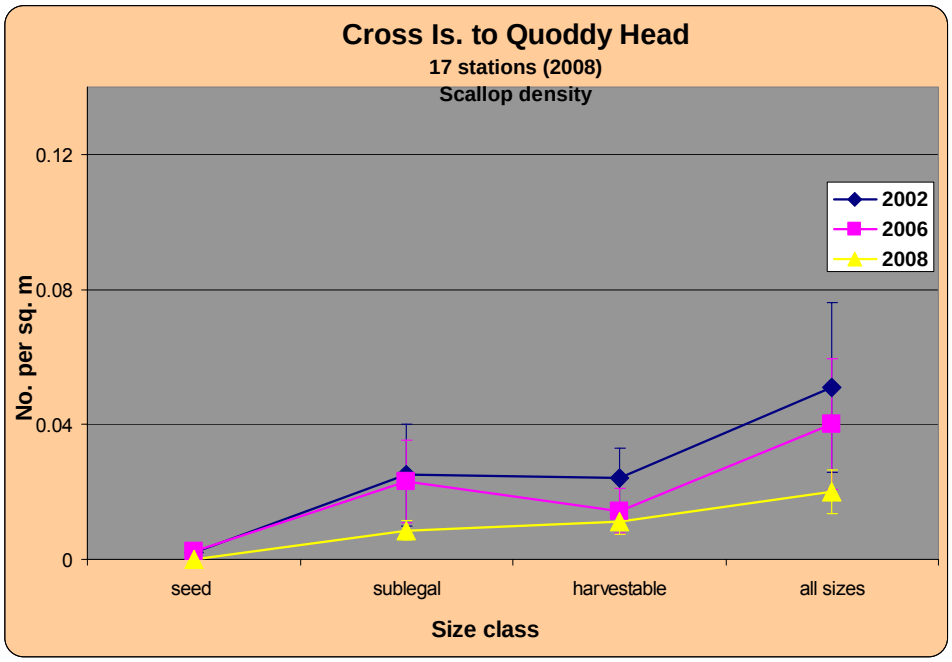


Figure 4. Location of 2008 survey stations (*above*) and scallop size class composition and abundance (*below*) (Cross Is. to Quoddy Head).


67°0'0"W
45°0'0"N
45°0'0"N
Catch by Size
260
LEGAL
SUBLEGAL
SEED
NEGATIVE TOWS
67°0'0"W


Cross Is. to Quoddy Head
17 stations (2008)
Scallop density
0.12
0.08
0.04
0
No. per sq. m
2002
2006
2008
seed
sublegal
harvestable
all sizes
Size class

Zone 3 (Great Wass Is. to Little River)

There were 42 stations sampled compared to 44 in ’06 (Fig. 5). Two (2) stations could not be surveyed due to untowable bottom or the presence of lobster traps and alternate tows were used at two other stations due to the presence of fixed gear. There were 38 random and four (4) fixed stations surveyed.

Mean total scallop abundance decreased (not statistically significant) from 0.031 per m^2 in ’06 to 0.021 per m^2 in ’08 and was 80.8% less than the previous high of ’03 (0.111 per m^2; Fig. 5). Harvestable abundance was 0.014 per m^2 in ’08 compared to 0.012 per m^2 in ’06. Seed density was 0.0015 per m^2 in ’08 compared to 0.0007 per m^2 in ’06. Sublegals declined from 0.015 per m^2 in ’06 to 0.008 per m^2 in ’08.

Highest catch rate of both overall and harvestables was at Black Ledges outside of Little Machias Bay.

Libby Islands

This historically important scallop area within Zone 3 was sampled with two (2) fixed and two (2) random tows in the ’08 survey. Overall abundance was lower in ’08 (0.013 per m^2) than in ’06 (0.017 per m^2). There was a notable decline in harvestables (2006: 0.013 per m^2 to 2008: 0.004 per m^2), while sublegals increased very slightly from 0.004 per m^2 (’06) to 0.006 per m^2 (’08). Seed were not observed at all in ’06 but there were some present in ’08 (0.003 per m^2) and all were in a single tow.

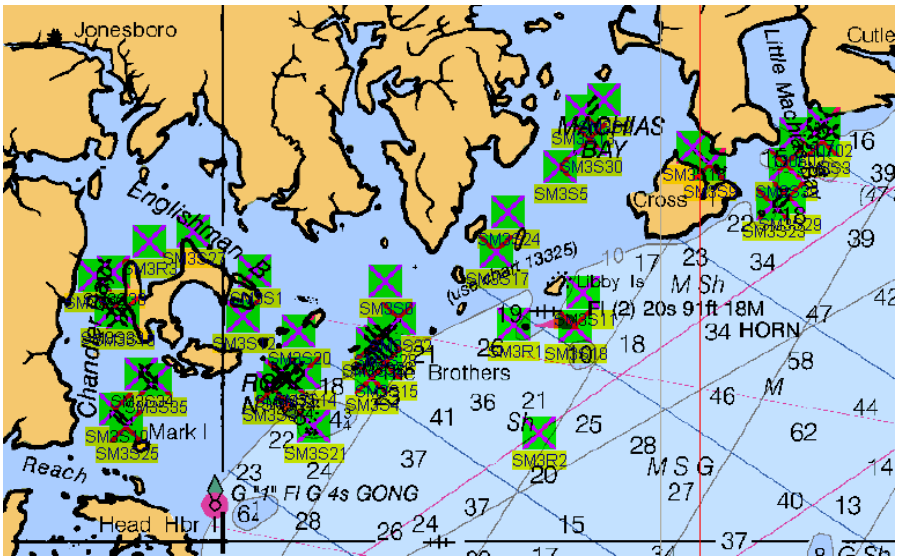
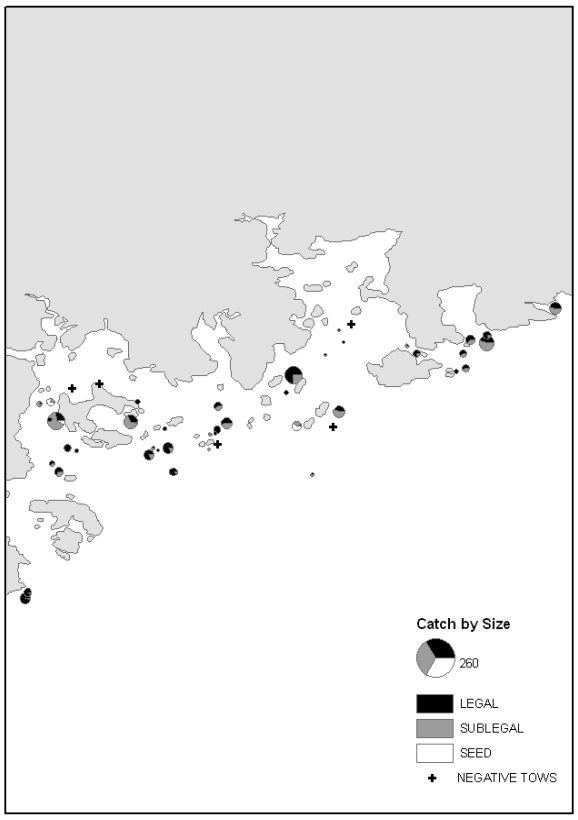
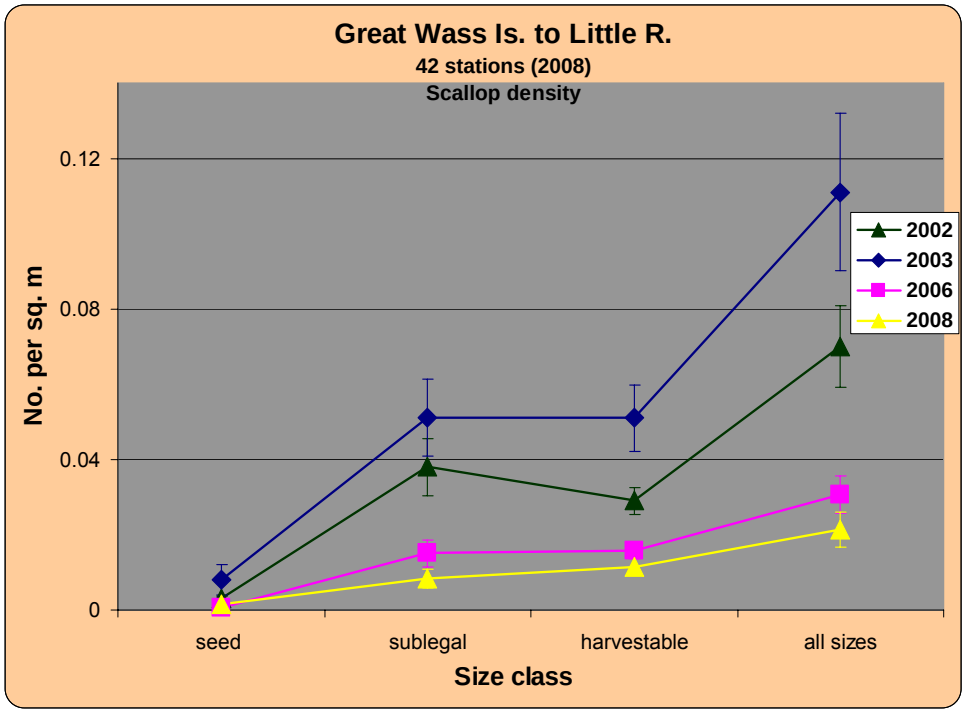


Figure 5. Location of 2008 survey stations (*above*) and scallop size class composition and abundance (*below*) (Great Wass Is. to Little River).


Catch by Size
260
LEGAL
SUBLEGAL
SEED
NEGATIVE TOWS


Great Wass Is. to Little R.
42 stations (2008)
Scallop density
No. per sq. m
0.12
0.08
0.04
0
seed
sublegal
harvestable
all sizes
Size class
2002
2003
2006
2008

Zone 4 (Schoodic Pt. to Great Wass Is.)

The ’08 survey of this stratum consisted of 44 stations (compared to 38 in ’06; Fig. 6). There were 34 random, eight (8) fixed and two (2) exploratory tows made.

Overall abundance was slightly lower (not statistically significant) than the previous survey (2006: 0.017 per m^2 to 2008: 0.012 per m^2; Fig. 6). Harvestable density declined from 0.008 per m^2 to 0.005 per m^2 during this period. Sublegals declined very slightly from 0.008 per m^2 (’06) to 0.006 per m^2 (’08). Seed density was 0.0010 per m^2 in ’06 and 0.0008 per m^2 in ’08.

The highest overall catch rate was in Gouldsboro Bay and the highest catch rate of harvestables was off Red Head (Great Wass Is.).

Gouldsboro Bay

This historically productive area within Zone 4 contains six (6) fixed stations. Overall density decreased between ’06 (0.044 per m^2) and ’08 (0.032 per m^2). The density of sublegals (0.020 per m^2) was unchanged between the two surveys. More seed were observed in ’08 (0.0038 per m^2) than ’06 (0.0013 per m^2) and most of the seed were present in one tow.

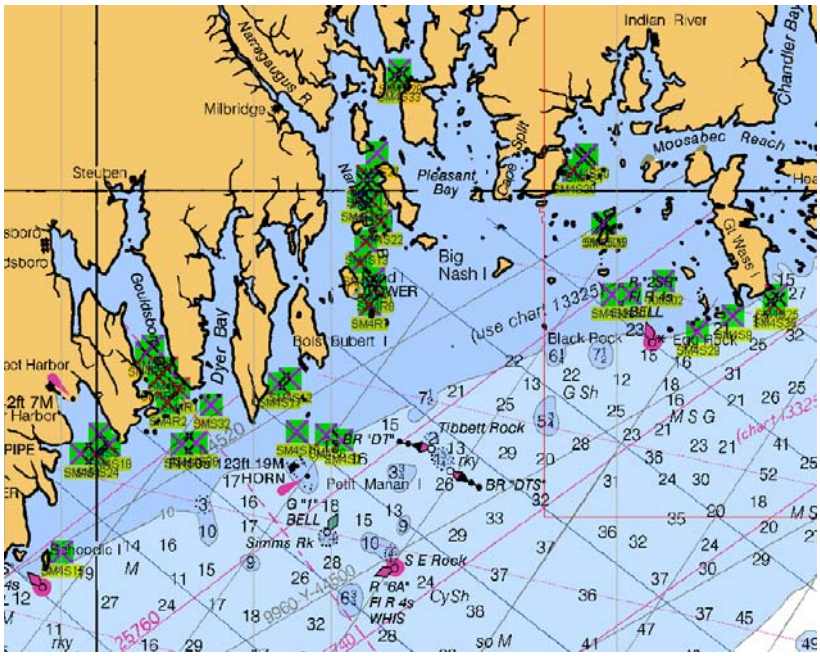
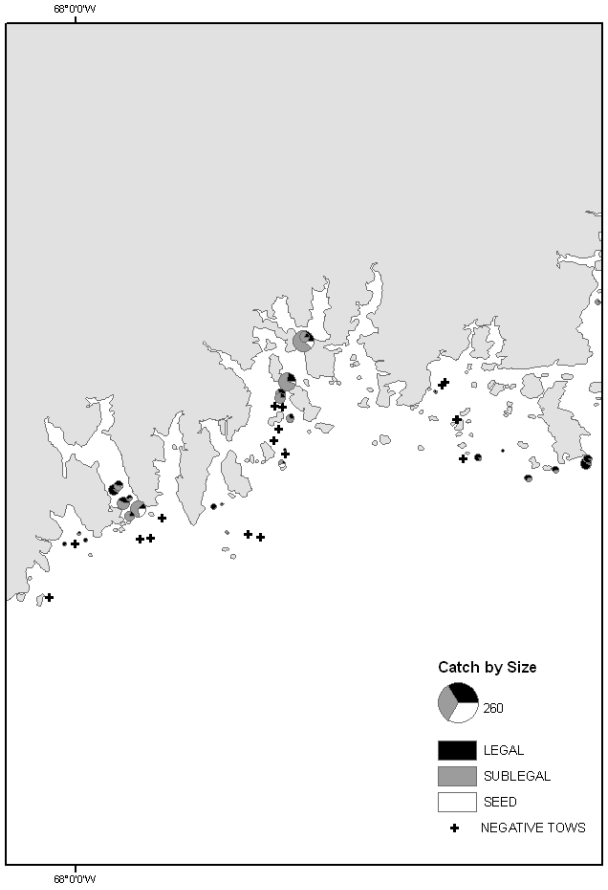
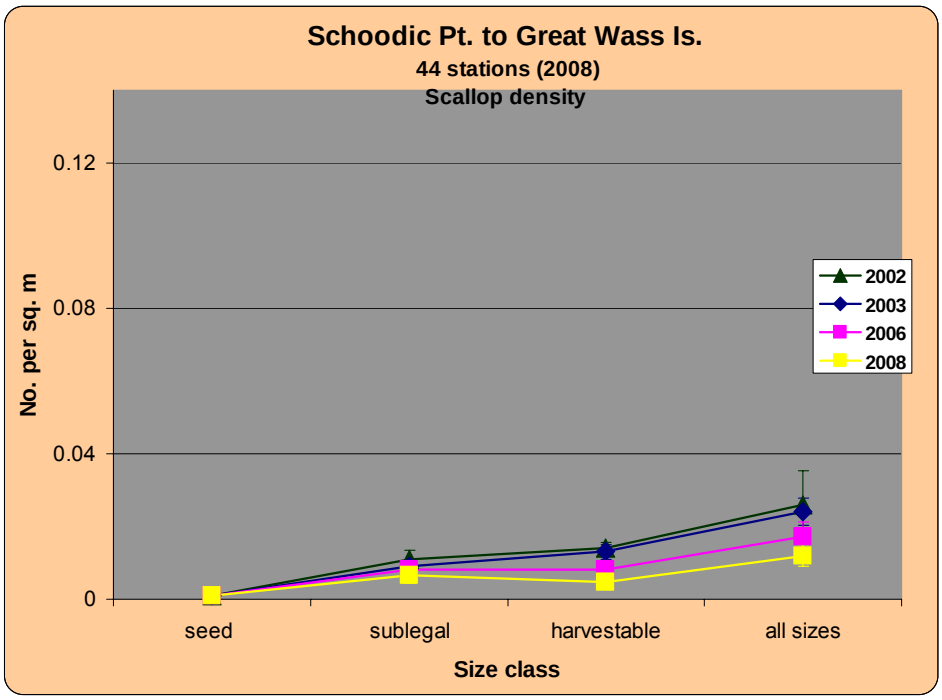


Figure 6. Location of 2008 survey stations (*above*) and scallop size class composition and abundance (*below*) (Schoodic Pt. to Great Wass Is.).


68°0'0"W
Catch by Size
260
LEGAL
SUBLEGAL
SEED
NEGATIVE TOWS
68°0'0"W


Schoodic Pt. to Great Wass Is.
44 stations (2008)
Scallop density
No. per sq. m
0.12
0.08
0.04
0
seed
sublegal
harvestable
all sizes
Size class
2002
2003
2006
2008

Zone 5 (Eastern Blue Hill Bay and Frenchman Bay)

The ’08 survey of this stratum consisted of 39 tows (compared to 41 in ’06; Fig. 7). Six (6) stations could not be surveyed in ’08 due to presence of fixed gear. Alternate tows were selected at four (4) other sites due to presence of lobster traps, divers or submerged power/phone cables.

There were 28 random and 11 fixed stations sampled.

Mean total scallop abundance was low (0.012 per m^2) and decreased slightly from ’06 (0.017 per m^2; Fig. 7). Harvestable density was very low (0.005 per m^2) and declined slightly from ’06 (0.008 per m^2). Occurrence of seed was extremely low (0.0008 per m^2). Seed were however noted on tows in Union River Bay and off South Hancock. Sublegal density was low (0.005 per m^2) but slightly higher than ’06 (0.002 per m^2).

The highest catch rate of scallops both overall and harvestable was off South Hancock.

Duck Islands

Sampling in this historically important area was hampered by the presence of lobster gear on the ’08 survey. One (1) fixed station was surveyed and no scallops were caught. Overall abundance was also very poor (0.003 per m^2) around the Duck Islands in ’06.

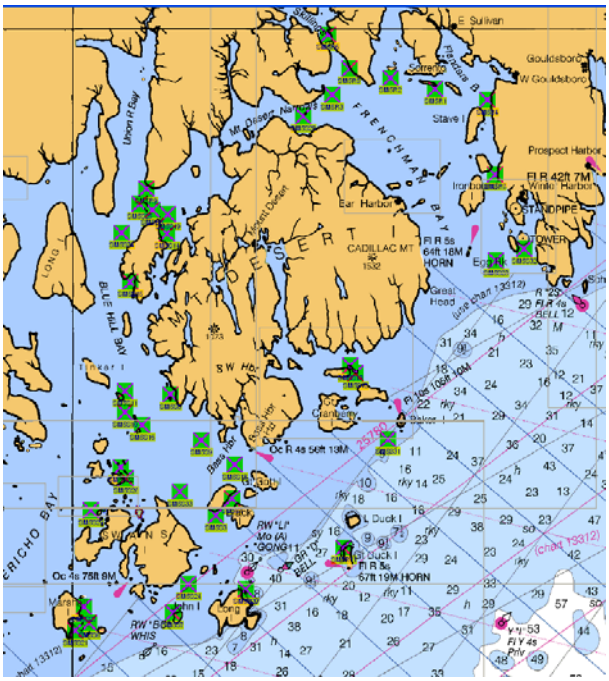
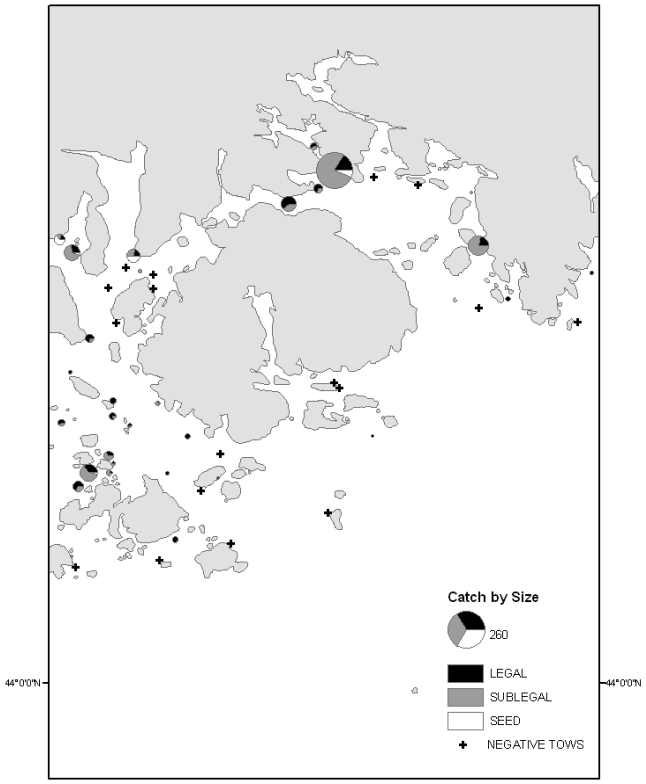
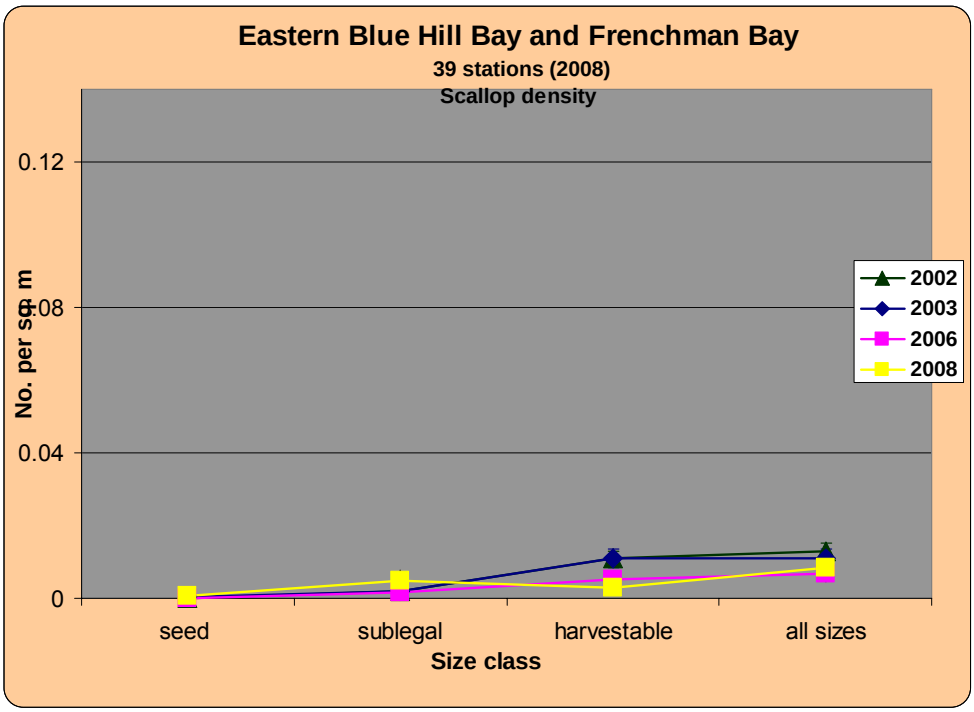


Figure 7. Location of 2008 survey stations (*above*) and scallop size class composition and abundance (*below*) *(*Eastern Blue Hill Bay and Frenchman Bay*).*





Zone 6 (Eastern Penobscot Bay and Western Blue Hill Bay)

The '08 survey consisted of 32 tows (27 in '06; Fig. 8). These were all fixed stations. One station was not surveyed due to lobster gear and for another an alternate tow was selected.

A very slight increase in overall scallop abundance was observed (2006: 0.027 per m^2 to 2008: 0.029 per m^2; Fig. 8). Overall abundance was actually 126.0% higher than '03. Harvestable density (0.010 per m^2) was essentially unchanged from '06. Sublegals (0.018 per m^2) slightly increased and seed (0.0014 per m^2) very slightly decreased. Seed scallops were noted in Southeast Harbor and Blue Hill Harbor.

The highest catch rate both overall and of harvestable scallops was in Southeast Harbor.

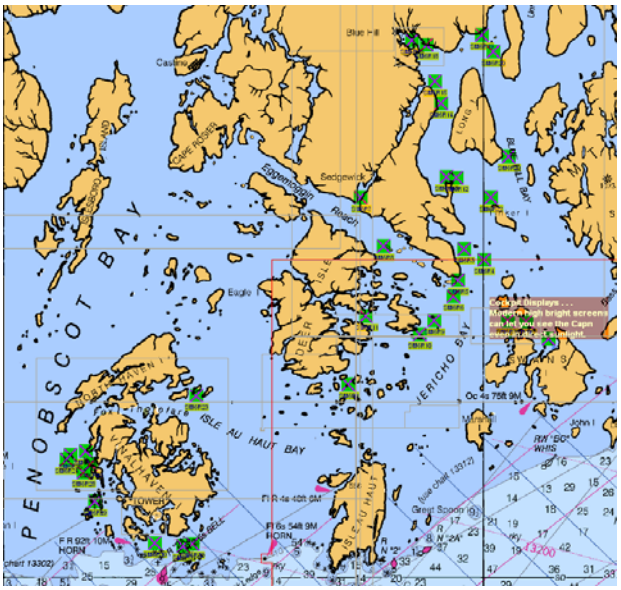
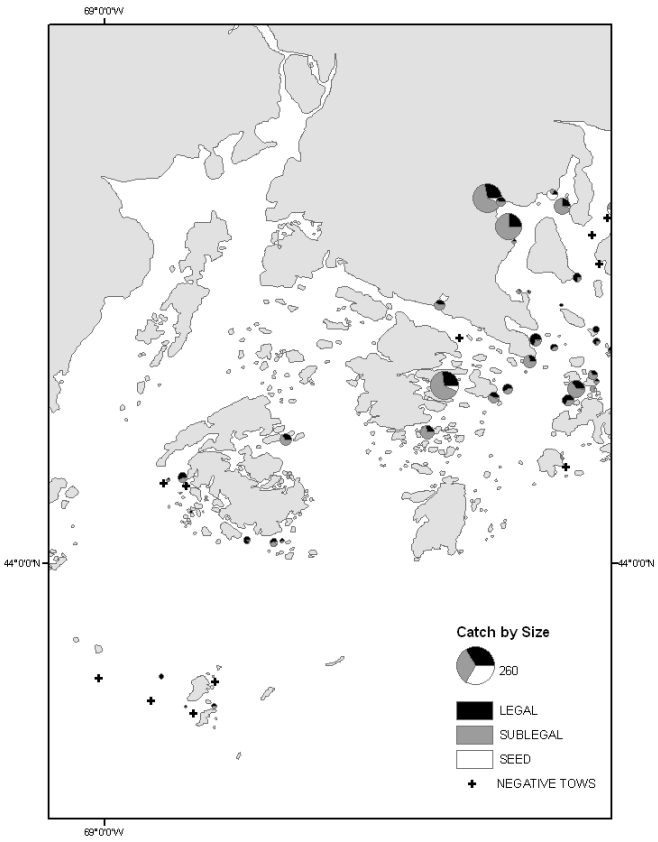
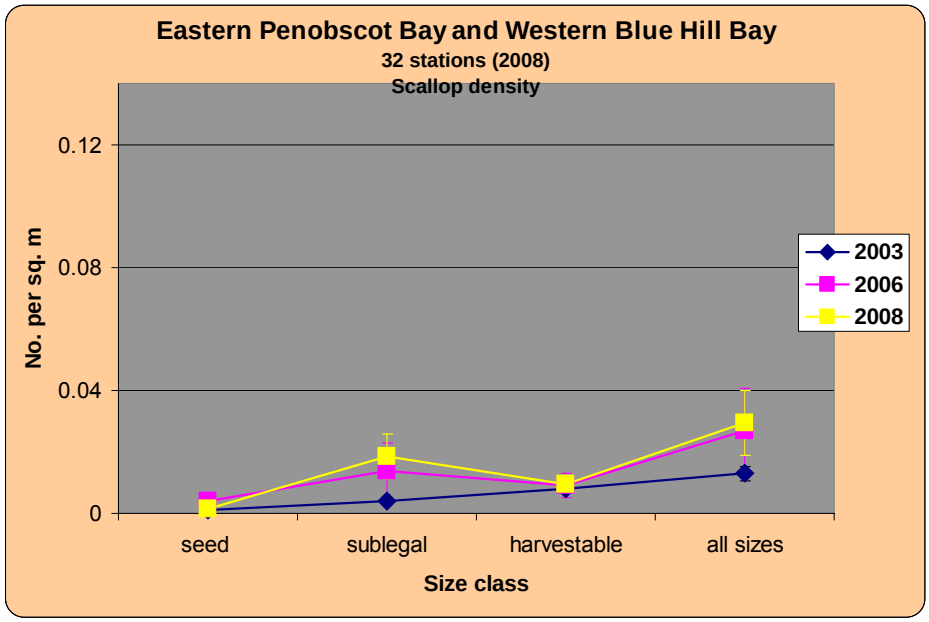


Figure 8. Location of 2008 survey stations (*above*) and scallop size class composition and abundance (*below*) (Eastern Penobscot Bay to Western Blue Hill Bay incl. Matinicus Is.).





Zone 7 (Matinicus Is.)

Matinicus Island was last surveyed in ’05 (11 stations). In ’08 there were eight (8) tows completed (three (3) tows could not be done due to lobster gear: Fig. 9).

Total scallop abundance was extremely low (0.0012 per m^2) and essentially unchanged since ’05 (Figs. 8-9). Harvestable density was 0.0009 per m^2 and sublegal density was 0.0003 per m^2. No seed were observed.

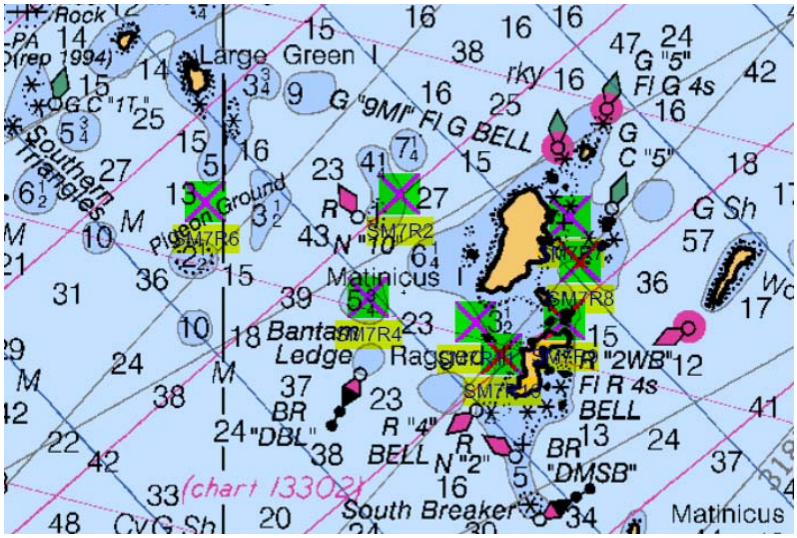
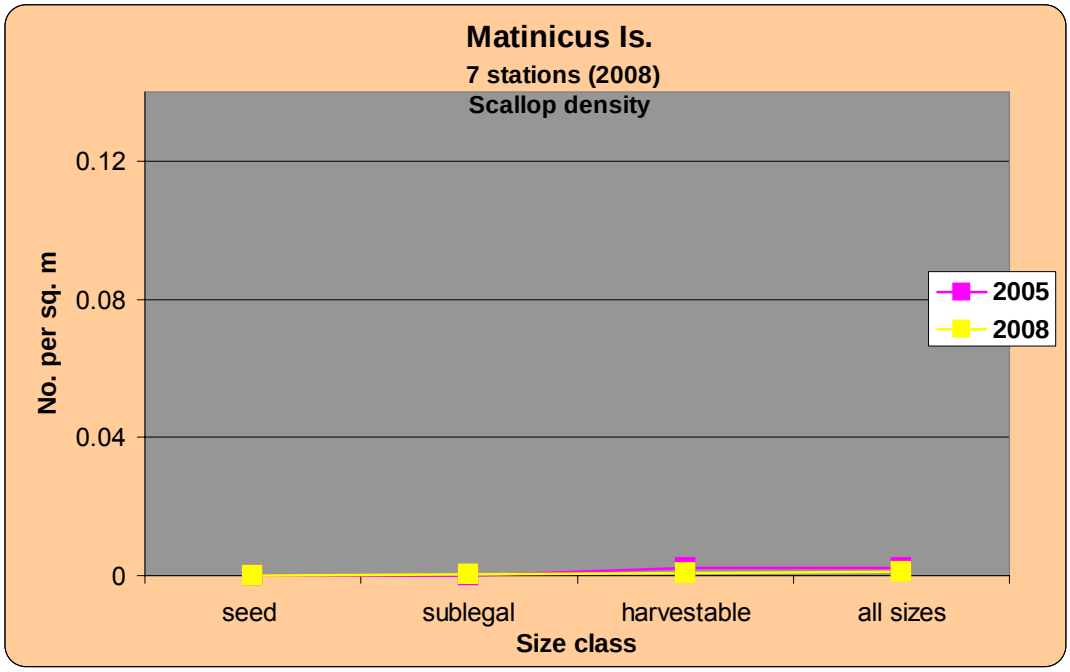


Figure 9. Location of 2008 survey stations (*above*) and scallop abundance (*below*) (Matinicus Is.).



Conclusions

Results from the survey indicate that scallop abundance has remained low and in some areas has slightly declined along the eastern Maine coast. These results are similar to those being reported for contiguous areas of the Canadian coast where landings and survey indices have either declined or remained unchanged since '06 (Smith et al. 2008). The only region which showed slight improvement was between eastern Penobscot Bay and western Blue Hill Bay.

Some small recruitment signals were observed however with the presence of seed in Zone 3 (Libby Is.), Zone 4 (Gouldsboro Bay), Zone 5 (Union River Bay and South Hancock) and Zone 6 (Blue Hill Harbor and Southeast Harbor). There is currently a proposal by DMR to close several portions of the coast to scallop fishing for three years for rebuilding of the resource and possible enhancement. Three of the locations (Gouldsboro Bay, Blue Hill Harbor and Southeast Harbor) where seed were observed on the survey would be afforded protection under the area closure proposal. It is hoped the area closures could be particularly beneficial in areas such as these where some resource is present that could be allowed to grow to an optimal size for harvest.

Acknowledgements

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Thanks to the DMR Scallop Advisory Council for their input and advice.

Kohl Kanwit (DMR) provided additional figures as well as a helpful review of this report.

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