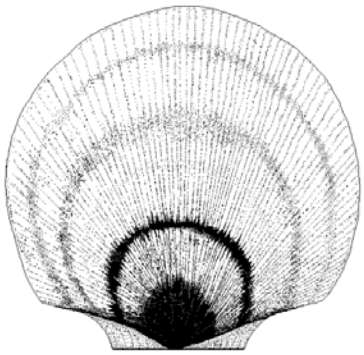
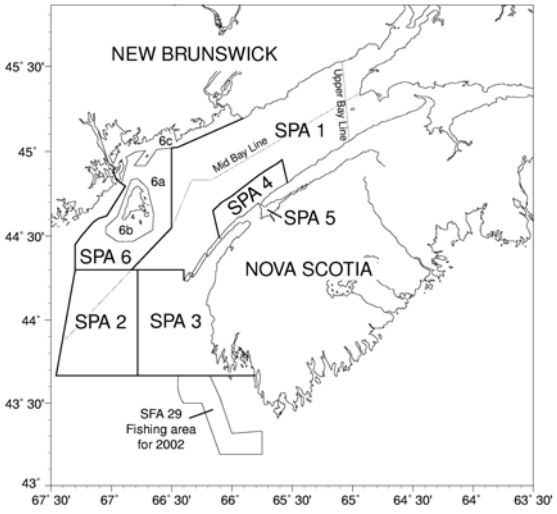


Scallop Production Areas (SPAs) in the Bay of Fundy



Refer to full detail map on page 25 for place names.

Background

The sea scallop Placopecten magellanicus occurs only in the northwest Atlantic Ocean from Virginia north to Labrador. Within this area, scallops are concentrated in persistent, geographically discrete aggregates or "beds", many of which support valuable commercial fisheries. The larger beds are found offshore and in the Bay of Fundy. Scallops in different beds, and in different areas of large beds, show different growth rates and meat yields.

Unlike many commercial scallop species, the sea scallop has separate sexes. Male scallops develop a white gonad in the summer months, while female gonads are bright red. Eggs and sperm are released into the water and fertilization takes place in the sea. Spawning begins in late August to early September, and the larvae drift in the water for almost a month before settling to the bottom in October.

The Bay of Fundy area is fished by the Full Bay and the Mid-Bay licensed fleets. Full Bay vessels are 45' to 65' and Mid-Bay vessels are generally between 30' to 45'. Full Bay licensed vessels are permitted to fish all the Bay of Fundy. The Mid-Bay license holders have access to the New Brunswick side and portions of the Nova Scotia side of the Bay of Fundy to the Mid-bay line and a portion of SPA 2. There are also 16 Upper Bay Licences restricted to the upper reaches of the bay. The fishery has been managed using limited entry, gear size limits, seasonal closures, minimum shell height, meat count and individual meat weight restrictions. The gear width limit is 5.5 m with ring size of not less than 82 mm inside diameter. Quotas were introduced in 1997. Total allowable catches (TACs) are set and landings are reported in terms of meat weights (adductor muscles).

Summary

All SPAs

- Objectives and associated reference points are beginning to be developed for these fisheries. Discussions between the fishing industry and DFO to develop reference points for the scallop fisheries in the Bay of Fundy need to be continued.
- In order to maximize yield-per-recruit, the impact of fishing practices on the mortality of recruits and pre-recruit scallops needs to be investigated.
- Implement research and monitoring to establish the relationship between scallop biomass and future recruitment success.
- Implement research and monitoring to determine the conditions leading to episodic die-offs.

SPA 1

- Preliminary landings for the 2002 fishing seasons were 931 t against a TAC of 800 t.
- Catch rates for all three fleets have increased since 1997, and are at their highest levels.
- The large 1998 year-class has recruited to the 8-16 mile Digby area, and a smaller pulse has recruited along the Mid and Upper Bay boundary.
- The biomass dynamic model and risk analysis indicates that 1200 t could be

removed by the fishery from the 8–16 mile Digby Area in 2002/2003.
- In the rest of SPA 1 the population has not increased to the same extent as in the 8-16 mile Digby Area, however, with the recruitment on the Upper Bay line a modest increase from the 2002 TAC can be supported for the Mid and Upper Bay areas of SPA 1.

SPA 3
- Preliminary landings in 2001/2002 were 31 t against a TAC of 200 t because the Full Bay fleet had redirected their effort to other areas
- Commercial catch rates averaged 35.5 kg/h in 2002, compared to 15.4 kg/h in 2001.
- The 2002 Research Vessel (RV) survey indicated an increase in the biomass of commercial-size scallops from 2001, although estimates from this survey are highly variable.
- The 1999 year-class is below average in biomass and any increases in biomass for commercial size scallops in 2003 are expected to be mainly due to growth.
- Increases in biomass due to growth may be minimal if natural mortality remains as high as observed in 2002.

SPA 4
- Preliminary landings in 2001/2002 were 598 t against a TAC of 650 t.
- Average meat weights in the catch decreased from 14.6 g in October 2001 to 9.5 g at the beginning of May 2002 as the 1998 year-class recruited to the fishery.
- Slower growth in 2002 than in 2001 and a later spawning season resulted in meat weights being lower than expected for the start of the 2002/2003 season but the meats averaged 12.6 g by December 2002.
- Commercial catch rates averaged 64.7 kg/h in 2001/2002 compared to 16.2 kg/h in 2000/2001.
- RV survey estimates of numbers of commercial size scallops in 2002 increased over 2001 estimates to become the second highest estimates in the series.
- The 1999 year-class that will recruit in 2002/2003 is above average in abundance but approximately 1/10th the size of the 1998 year-class.
- Concerns about large increases in natural mortality as occurred in 1989/1990, are continuing to be addressed by a joint monitoring program conducted with industry. To date the mortality rate continues to be low.
- The biomass dynamic model and risk analysis indicates that 1200 t could be removed in 2002/2003.

SPA 5
- Preliminary landings in 2001/2002 were 2.3 t against a TAC of 10 t. This decline was due to effort being directed to SPA 4 in the winter months.
- Average commercial catch rate in 2002 was 44.1 kg/h compared to 12.1 kg/h in 2001.
- RV survey estimates indicate that the stock is healthy with two strong year-classes expected to recruit in 2003 and 2004.
- Continuation of the 10 t TAC for 2002/2003 is advisable.

SPA 6
- Preliminary landings to Dec 2002 were 128 t against a TAC of 195 t.
- Catch rates for the Full Bay fleet decreased from 18.6 to 16.4 kg/h from 2001 to 2002, but are still above the 10 year average.
- Catch rates for the Mid Bay fleet decreased from 11.9 to 9.7 kg/h from 2001 to 2002, but are still above the 10 year average.
- The 2002 RV survey showed little sign of recruitment.
- The high incidence of clappers seen in the Duck Island Sound area in the 2000 and 2001 surveys were not observed in 2002.
- Catch rates are expected to continue to decline for the next few years.

SFA 29
- For the second year, a fishery was conducted in the western portion of Scallop Fishing Area 29. In 2002, the TAC was shared between the Full Bay Fleet and a limited number of inshore east of Baccaro licences.
- A total of 713 t (528 t Full Bay; 185 t east of Baccaro) was landed against a TAC of 800 t.
- Commercial catch rates averaged 68.15 kg/h for Full Bay fleet and 39.74 kg/h for east of Baccaro fleet over the whole area.
- Average meat weights were above 19.7 g in the more heavily fished areas.
- Based on a joint industry/DFO post-season survey, a reduction in TAC was recommended for areas A and C in 2003. The TAC for 2003 for Area B can remain at the 2002 level of 200 t.

- Area D should remain closed for 2003.
- Bycatch of lobster in this area in 2002 was low but it was not clear what impacts the scallop fishery may have had on the lobster population.

SPA 1 – Inner/Upper Bay of Fundy

The Fishery

Landings in SPA 1 reached a peak in 1989, with the large recruitment pulse seen throughout the Bay, and by 1997 had declined to their lowest levels since 1980. Landings have increased since 1997 and there is a large year-class (1998) recruited to the fishery in the Digby area.

The Mid-Bay vessels were not required to keep logbooks until 1996, so their earlier catches cannot be broken down by fishing area. Landings by Statistical District for Districts 24, 40, 43, 44, 48 and 79, (coast of Bay of Fundy from Saint John, N.B. to Morden, Nova Scotia) were used to estimate Mid-Bay landings from Area 1 prior to 1997.

Landings (meats, t)

Full Bay

Year	Avg. 94-98	1999	2000	2001	2001/ 02[2]	2002/ 03[2]
TAC (t)	240[1]	240	240	240	700	1200
Landings	218	274	315	279	745[3]	1[3]

[1] TACs have only been in effect since 1997, so average TAC is for 1997-98 instead of five years.
[2] To January 9, 2002. Starting October 1, 2001, the Full Bay Fleet fishing season changed from a calendar year to Oct. 1 to Sept. 30.
[3] Preliminary landings.

Mid and Upper Bay

Year	Avg. 94-98	1999	2000	2001	2002
TAC (t)	60[1]	50	80	80	100
Landings	45	70	88	102	186[2]

[1] TACs have only been in effect since 1997, so average TAC is for 1997-98 instead of five years.
[2] Preliminary landings.

The 2001/2002 quota for Full Bay licence holders was 700 t, mostly in the 8–16 mile Digby Area, more than double that of previous years. The Mid and Upper Bay fishers had a quota of 100 t in 2002, an increase of 20 t from last year.

The 2002 **landings** are more than double 2001 levels, and more than triple that seen in 1997, which was the lowest point in the 1980–2002 period. The 2002 landings to September 30 were 745 t for the Full Bay licence holders, 105 t for the Mid Bay and 81 t for the Upper Bay fishers. The Mid and Upper Bay fleets split their quota into two seasons, Jan 8 to April 30, and August 5 to September 30. When the 100 t TAC was reached before September 30 it was decided to let them keep fishing as the fishery was concentrating on an area not covered in the research vessel surveys. Delayed reporting by Mid and Upper Bay fleets resulted in a larger quota overrun than anticipated.

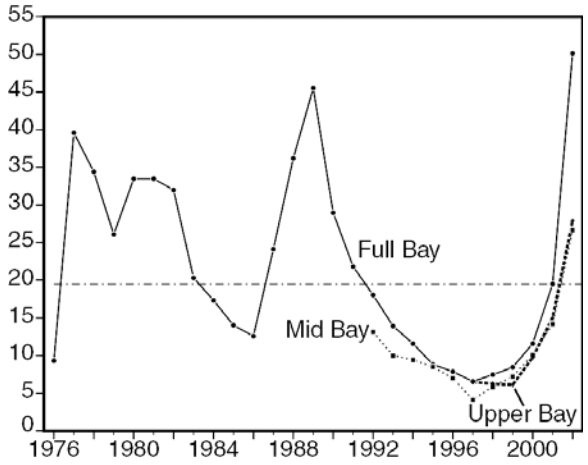
The Full Bay fleet changed their quota year in 2001, and it now runs from October 1 to September 30. The Mid and Upper Bay fleets remain on a calendar year.

Resource Status

Catch per unit effort (CPUE) for the Full Bay fleet declined from the highs of the late 1980's to a low in 1996-1997. It has improved since then, and with the large 1998 year-class recruiting to the Digby area it is now at the highest level seen in the 1976–2002 series. The CPUE can only be calculated for the period since 1992 for the Mid fleet, and since 1997 for the Upper Bay fleet. The increase has not been as dramatic for

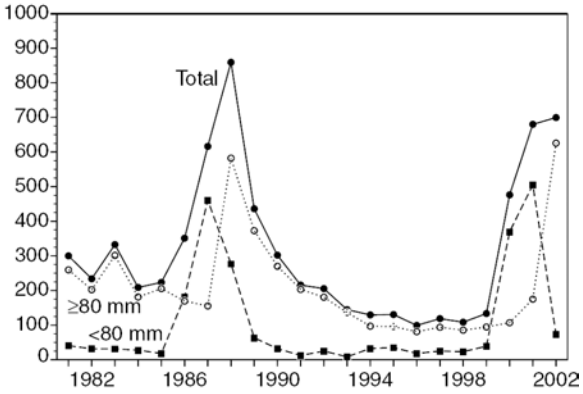
these fleets, but they are at the highest levels in their shorter time series.

Catch Per Unit Effort (kg/h)



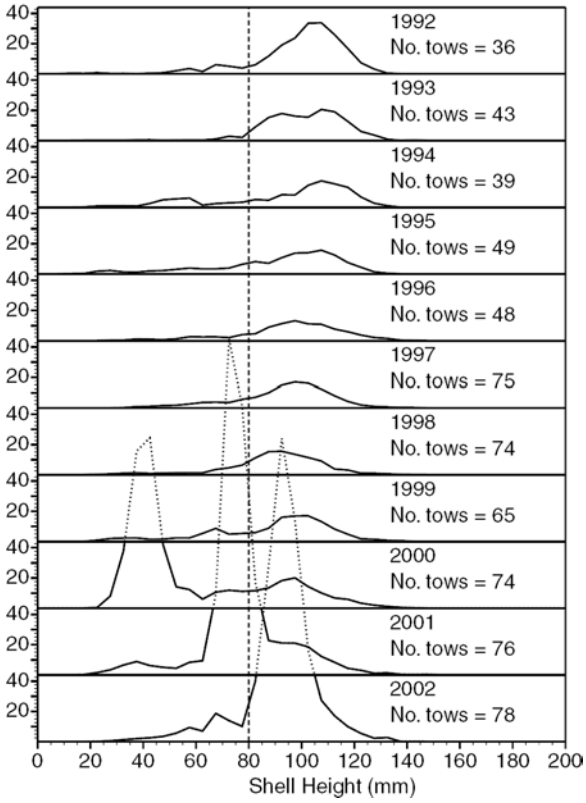
Research vessel (RV) surveys have been conducted annually since 1978 in the 8–16 mile Digby Area off Nova Scotia from Centerville to Hampton. The mean number per standard tow in this area showed a decline in commercial size from the peak in 1988 to a low in 1996. It has climbed the last three years due to the large 1998 year-class recruiting to grounds overlapping SPA 1 and SPA 4.

Survey Indices, 8–16 Mile Digby Area, (Mean No./Std Tow)



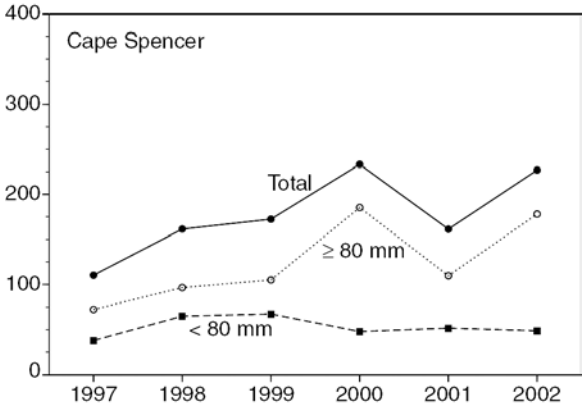
The size frequency distribution from the surveys shows the strong 1998 year-class in the last three surveys as the scallops increased in size. They are now fully recruited to the fishery and should be able to support higher levels of catch for the next few years. Recruitment in 2002 is near levels observed before the peak.

Survey Indicies, 8–16 Mile Digby Area (Mean No./Std. Tow)



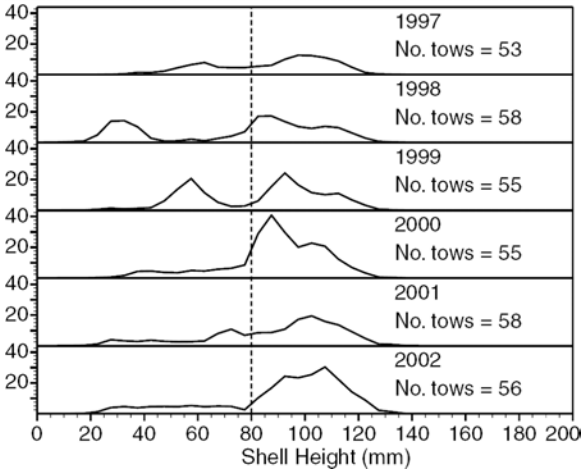
Since 1997, the survey numbers for commercial size scallops in the Cape Spencer area have gradually increased as moderate year-classes entered the fishery. Recruitment in this area has remained relatively constant over the last five years, with no sign of the exceptional year-class observed in the 8–16 mile Digby Area.

Survey Indices, Cape Spencer (Mean No./Std. Tow)



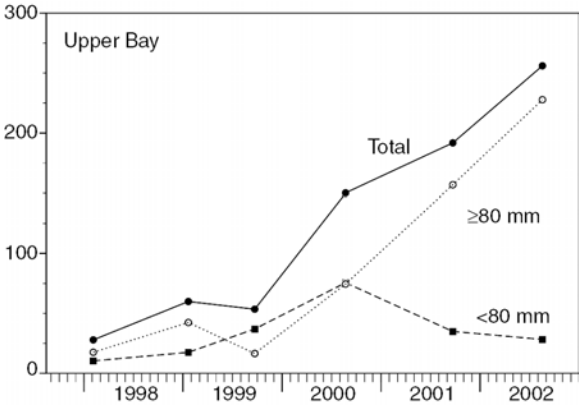
The survey shell height frequencies show the moderate year-class that recruited to the fishery in 2000. Recruitment and growth have kept up with removals from the stock, and even allowed for a gradual increase of the population of commercial size scallops.

Survey Indices, Cape Spencer (Mean No./Std. Tow)



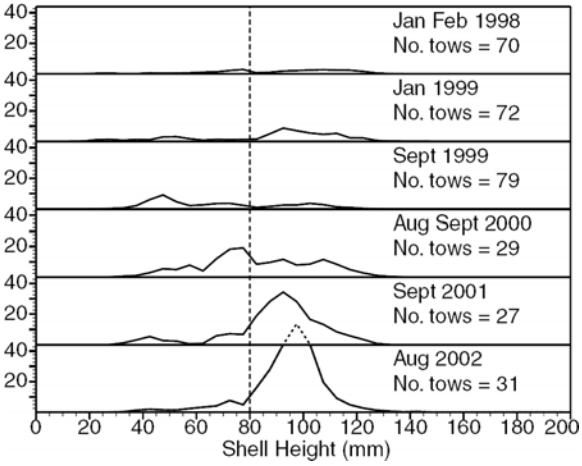
The survey numbers in the Upper Bay area have increased greatly in the last three surveys and are at the highest levels in this short time series.

Survey Indices, Upper Bay (Mean No./Std. Tow)



The 2002 survey shell height frequencies show an abundance of fully recruited scallops in the Upper Bay area.

Survey Indices, Upper Bay (Mean No./Std. Tow)

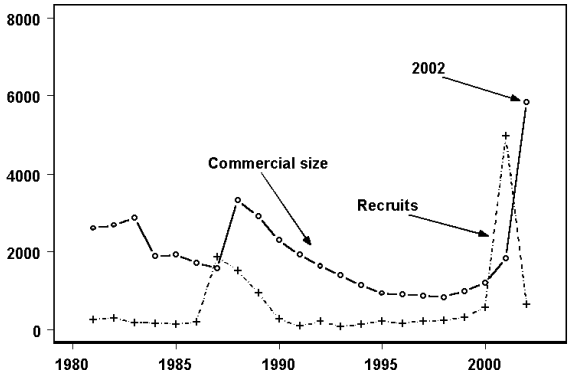


During this year's survey, additional stations were carried out in an area that had attracted recent fishing effort, but was not part of the areas usually surveyed. This area, along the Upper Bay line has an abundance of fully recruited scallops, similar to the Upper Bay survey area.

The biomass dynamic model was used again this year to model the population in the 8–16 mile Digby Area. In 2002, the population biomass of commercial size scallops was the highest in the

series, while the biomass of the recruiting 1999 year-class is 13% of the record sized 1998 year-class.

Population Biomass (meats, t)



Outlook

A provisional reference level biomass (B_c) was established for the 8–16 mile Digby Area portion of SPA 1, corresponding to the biomass of a population being fished at $F_{0.1}$ with the average recruitment biomass in this area excluding peak years. Historically, catches have been at their lowest when the population biomass was less than this level. It is recommended that measures be taken to keep the population biomass above B_c.

A range of catches for 2002/2003 and 2003/2004 were evaluated by calculating the probability that the resultant biomass in each year would drop below B_c based on the population model. These probabilities (see below) were presented at the September 2002 Full Bay fleet Inshore Scallop Advisory Committee meeting.

Decision Table for Evaluating Future Catches

Catch in 2002/2003		$P(B<B_c)$, Catch in 2003/2004			
Meats (t)	$P(B<B_c)$	800	1000	1200	1400
800	0.02	0.08	0.10	0.13	0.15
1000	0.02	0.09	0.11	0.14	0.17
1200	0.03	0.12	0.14	0.16	0.20
1400	0.04	0.13	0.15	0.17	0.20
1600	0.06	0.14	0.17	0.20	0.22
1800	0.08	0.16	0.19	0.23	0.25

The industry members at the meeting decided that a probability of approximately 0.15 was an acceptable level of risk for dropping below the reference biomass level. With this reference, a TAC of 1200 t for 2002/2003 was chosen as a level that was acceptable, and would likely lead to similar catch levels in 2003/2004 for this portion of SPA 1.

The large year-class in the 8–16 mile Digby Area is capable of supporting the fishery at the current TAC level (1200 t in 2002/2003). The monitoring program for signs of increased mortality currently conducted in SPA 4 should be expanded into this area.

In the rest of SPA 1 the population has not increased to the same extent as in the 8–16 mile Digby Area, however, with the recruitment on the Upper Bay line a modest increase from the 2002 TAC can be supported for the Mid and Upper Bay areas of SPA 1.

Management Considerations

The large 1998 year-class has recruited to the fishery but is only available to the Full Bay fleet. This has necessitated a split in the TAC. Sharing formulas between the fleets for the TAC in the remaining part of SPA 1 will have to be agreed upon.

Objectives and associated reference points are being developed through discussions between DFO and industry. Acceptance of a reference level biomass as a management strategy implies a positive relationship between that reference level and future recruitment success. Such a relationship has not yet been satisfactorily established. Industry considers that such a strategy can increase the risk of episodic die-offs, especially at high scallop densities. Implementing research and monitoring aimed at establishing the relationship between scallop biomass and recruitment both within current SPA's and within the Bay of Fundy meta-population as a whole is essential. In addition research and monitoring focussed on determining the conditions resulting in episodic die-offs is warranted.

In order to maximise yield-per-recruit, the impact of fishing practices on the mortality of recruits and pre-recruit scallops needs to be investigated.

SPA 3 – Brier Island, Lurcher Shoal and St. Mary's Bay

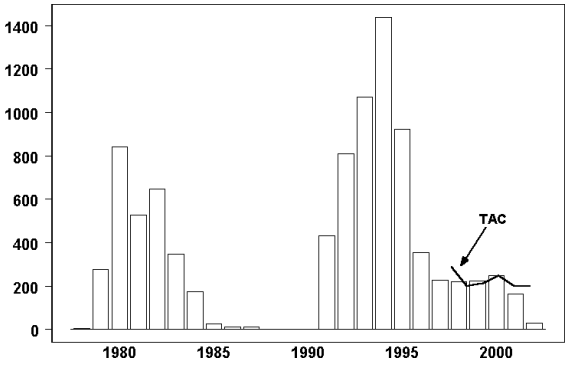
The Fishery

There are three main beds in this area, those around Lurcher Shoal, those below Brier Island, and in St. Mary's Bay, although scallops can be found throughout most of the area. St. Mary's Bay (formerly SPA 7) was combined with SPA 3 in 1999 for management purposes with a single TAC. The lobster fishery influences the scallop-fishing season throughout this area.

In the 1950's and 1960's, this area was heavily exploited but subsequently, fishing was minimal until 1980, when both the inshore and offshore fleets fished the area until 1986. In 1986, an agreement was reached between the two fleet sectors to establish separate inshore and offshore grounds, north and south of latitude 43˚40'N, respectively. This agreement excluded the offshore fleet sector from the area now defined as SPA 3.

Landings in SPA 3 increased each year from 1991 to 1994 to a high of 1439 t. Landings declined from 1995 until 1998. However, there is uncertainty about the landings from 1991 to 1996, due to misreporting.

Landings (meats, t)



Since 1999, the landings for SPA 3 and 7 are combined. There were serious doubts raised about whether all of the landings reported in 1999 for SPA 3 came from this area. There does not appear to be any reason to suspect that landings reported to SPA 3 in subsequent years were from other areas.

Landings (meats, t)

Year	Avg. 1994-98	1999	2000	2001	2002
TAC 3+7	244[1]	200+15	200+50	200	
Total 3+7	632	222[2]	244[3]	163	31*

[1] TACs have only been in effect since 1997, so average TAC is for 1997-98 instead of five years.
[2] Includes 5.8 t from 15 t re-opening in Sept./Oct. 1999.
[3] Includes 18.9 t from 50 t re-opening in Oct./Nov. 2000.
* Preliminary.

Landings in 2002 were 31 t against a quota of 200 t because the Full Bay fleet had redirected their effort to other areas.

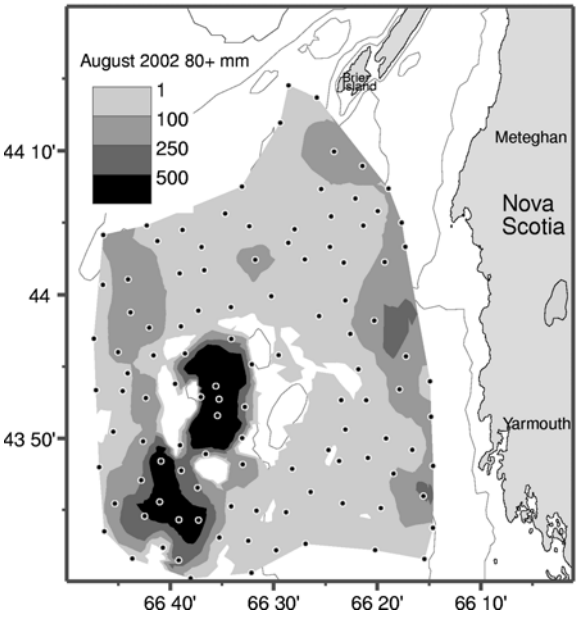
Resource Status

Commercial catch per unit effort (CPUE) averaged 35 kg/h in 2002, compared to 15 kg/h in 2001.

Annual **research vessel (RV) surveys** have been conducted in August since 1991. Due to coverage and design, only the results from the 1995 to 2002 surveys are comparable. Surveys of St. Mary's Bay have been conducted from 1999 to 2001 inclusive. No survey was conducted for St. Mary's Bay in 2002 due to limited ship time.

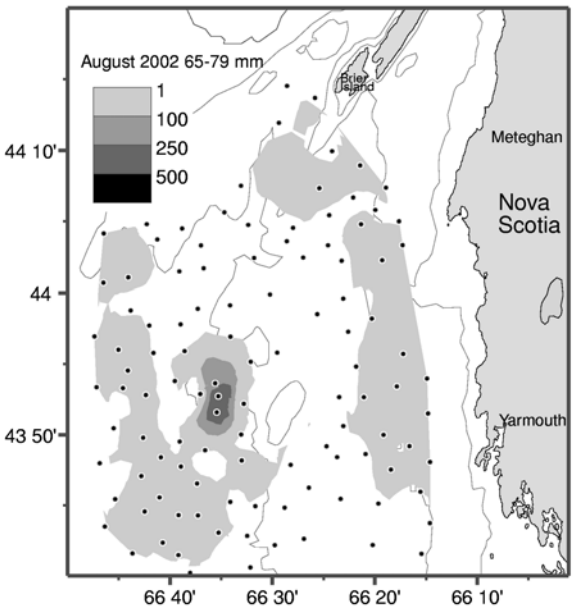
The highest densities of **commercial-size** scallops (shell height ≥80 mm) continue to be in the southwest area of Lurcher Shoal. The scallops in this area usually have smaller meat weight-at-shell height than those caught elsewhere in SPA 3.

Survey Mean No./Tow (Commercial Size: Shell Height ≥80 mm)



The distribution of **recruits** (shell height 65–79 mm) was patchy with one main area of concentration in the Lurcher Shoal area.

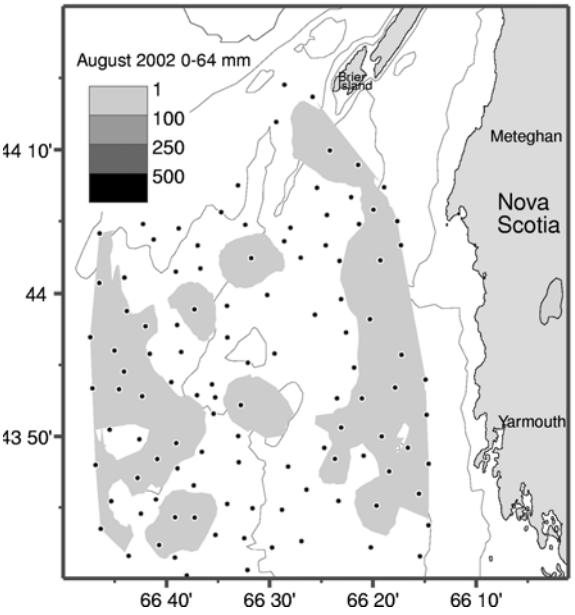
Survey Mean No./Tow (Recruits: Shell Height 65 to 79 mm)



Pre-recruits (shell height <65 mm) occurred in relatively low densities. Estimates of year-class strength from this size range (approximately 2 year-

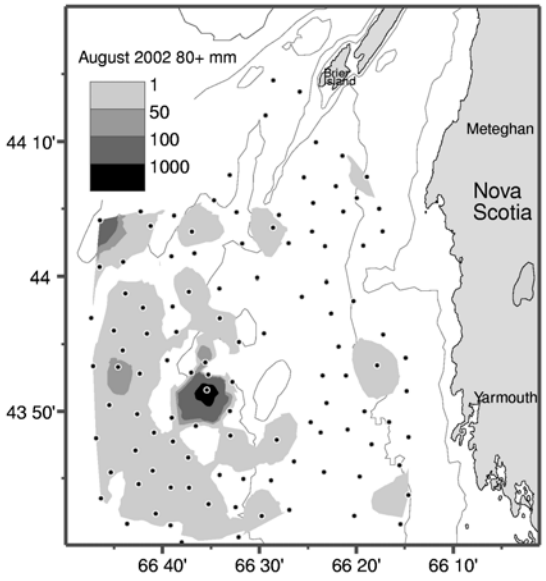
olds) are not very reliable indicators of year-class strength.

Survey Mean No./Tow (Pre-recruits: Shell Height <65 mm)



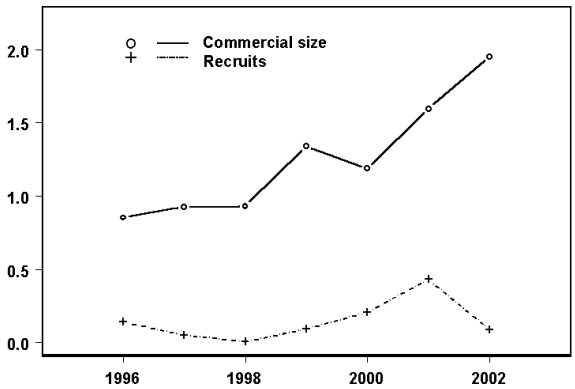
One large tow of clappers was made in the Lurcher Shoal area coincident with the area where large numbers of live scallops were also caught. Nearby catches contained fewer clappers, although the densities of live scallop in these catches were high. The clapper index in 2002 excluding the large tow was still higher than observed for recent years.

Survey Mean No./Tow of Clappers (Commercial Size: Shell Height ≥80 mm)



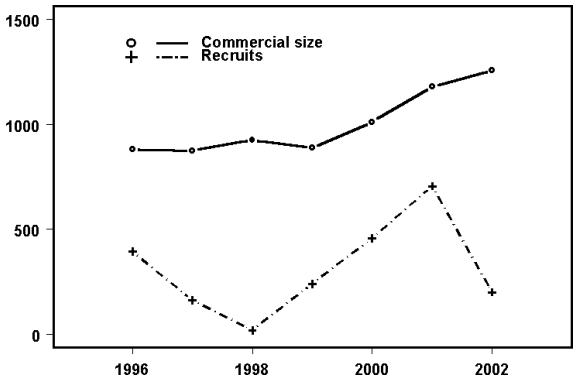
Mean weight per tow from the **RV survey** indicated a continued increase from 2001 for commercial size scallops. This increase was due to the recruitment of the 1998 year-class. The 1999 year-class was less abundant than average. Any increases in commercial size index in 2003 will be mainly due to growth. However, if natural mortality in 2003 stays as high as estimated from clappers in the survey in 2002, this increase due to growth may be minimal or less than losses due to natural mortality.

Survey Biomass Index (kg/tow)



A population model similar to that used for the 8–16 mile Digby Area of SPA 1 and SPA 4 was used to analyze survey biomass and commercial catch data from SPA 3. Natural mortality was modelled using the time series of clappers in the surveys. The model was applied to data from 1996 to 2002, a period during which, with the exception of 1999, catch data was considered reliable. The model was fit to the data assuming that the 1999 catch could either be as much as reported or was half as much as reported. In addition, natural mortality was estimated with and without the large catch of clappers from the 2002 survey. The model with 1999 catch divided by two and excluding the large catch of clappers fit the data the best.

Population Biomass (meats, t)



Outlook

There are no reference points for this fishery. Potential catch levels for 2003 were evaluated with respect to the probability that population biomass in 2003 would exceed that estimated for 2002. Over all of the different catch and mortality scenarios considered for the population model, even no catch in 2003 resulted in at best a 50/50 chance of a population decline.

Decision Table for Evaluating Future Catches

Catch in 2003	Mortality in 2002/2003	P(B(2003)≥ B(2002)	P(B(2003)≥ 0.8×B(2002)
0	0.18	0.50	0.62
	0.35	0.44	0.55
50	0.18	0.49	0.60
	0.35	0.42	0.53
100	0.18	0.47	0.58
	0.35	0.40	0.51
150	0.18	0.46	0.56
	0.35	0.38	0.49
200	0.18	0.43	0.54
	0.35	0.36	0.48

Probabilities of the population biomass in 2003 being more than 80% the biomass for 2002 were also calculated. These indicated that only for catches of 150 t or less would the probabilities be greater than 50%. Given the data available, the predictive ability of this model is limited.

Management Considerations

Objectives and associated reference points are being developed through discussions between DFO and industry. Acceptance of a reference level biomass as a management strategy implies a positive relationship between that reference level and future recruitment success. Such a relationship has not yet been satisfactorily established. Industry considers that such a strategy can increase the risk of episodic die-offs, especially at high scallop densities. Implementing research and monitoring aimed at establishing the relationship between scallop biomass and recruitment both within current SPA's and within the Bay of Fundy meta-population as a whole is essential. In addition, research and monitoring focussed on determining the conditions resulting in episodic die-offs is warranted.

In order to maximise yield-per-recruit, the impact of fishing practices on the

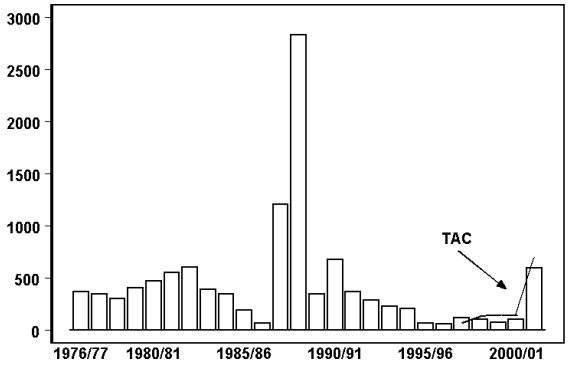
mortality of recruits and pre-recruit scallops needs to be investigated.

SPA 4 – Digby

The Fishery

Landing data in what is now SPA 4 are available from 1976 to 2002. The fishing season in SPA 4 had been restricted to the fall only since it was established in 1997, until the 2001/2002 season. The season now extends from 1 October to 30 April. In 2002, the season was temporarily extended to the first week of May. Prior to 1997, the former Inside Zone (within 6 miles), which represents 75 percent of the present area of SPA 4, was fished from October to the end of April.

Landings (meats, t)



Landings steadily declined from 1991 to 1995 as the remnants of large year-classes (1984, 1985) were fished down. Portions of what is now SPA 4 were closed in 1995 and 1996. A total of 598 t was landed against a TAC of 650 t in 2001/2002. Reasons for the total TAC not being caught include unallocated quota due to ongoing negotiations with First Nations.

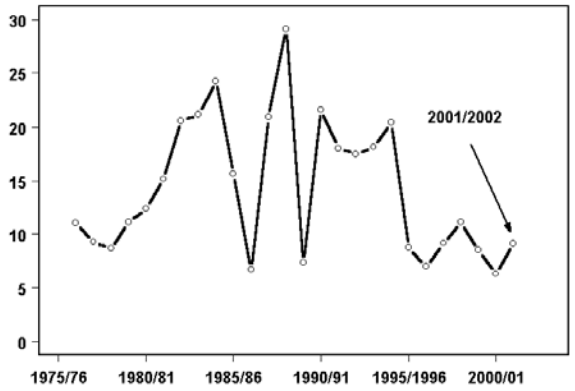
Landings (meats, t)

Season	Avg. 1994–98	1999	2000-2001	2001-2002	2002-2003
TAC	110[1]	120	110	650	1200
Total	112	77	102	598[2]	527*

[1] TACs have only been in effect since 1997, so average TAC is for 1997-98 instead of five years.
[2] Preliminary landings.
* preliminary as of 9 January, 2003.

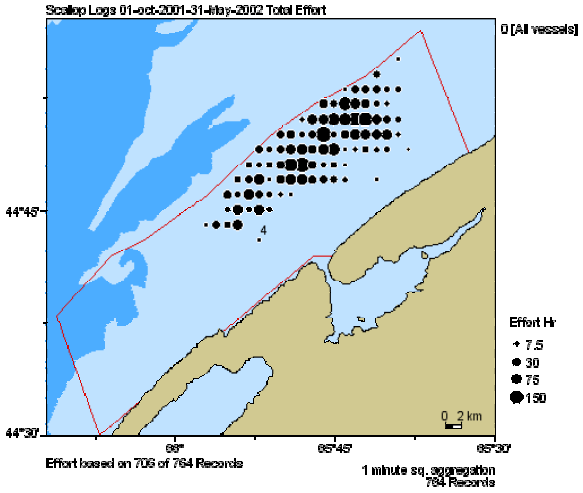
Total **effort** (hours) was low in 1995 and 1996, due to the closures in the Inside Zone, but effort in SPA 4 increased thereafter until 1999. In 2000/01, effort was at its lowest level in 26 years.

Effort ('000 h)



Fishing was restricted to Digby Gut up the Bay to Parkers Cove prior to 30 October 2001 to protect the abundant 1998 year-class. However, fishing continued to be concentrated in this area even after the whole area was opened up.

Effort (hours) in 2001/2002

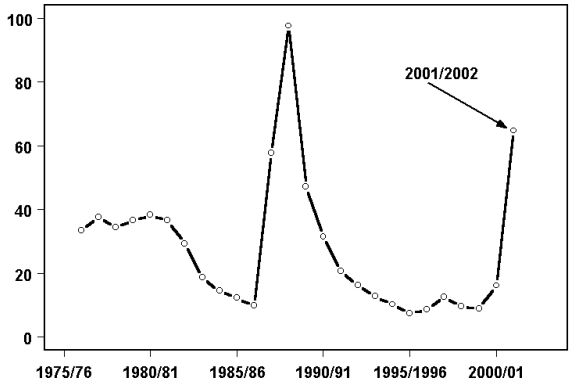


Average meat weights in the catch decreased from 14.6 g in October 2001 to 9.5 g at the beginning of May as the 1998 year-class recruited to the fishery. The average percentage of meats from port samples weighing less than 8 g increased from 1% to 34% over this time period. Slower growth in 2002 and a later spawning season resulted in meat weights being lower than expected for the start of the 2002/2003 season but the meats averaged 12.6 g by December 2002.

Resource Status

The average **commercial catch rate** increased in the 2001/2002 season (64.7 kg/h) over the 2000/2001 season (16.2 kg/h).

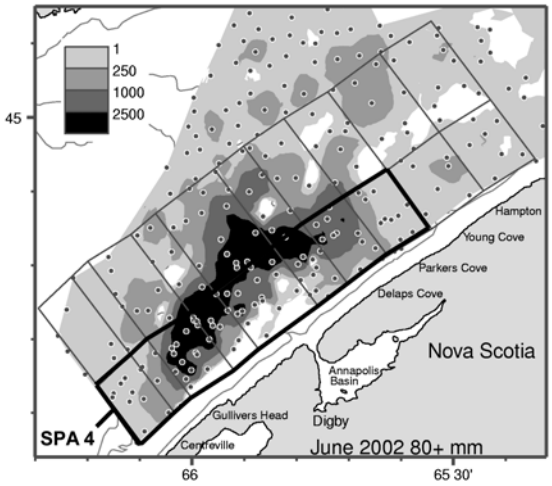
Catch Rate (kg/h)



Research vessel (RV) surveys, using a consistent stratified random design, have been conducted since 1991. Prior to 1991, surveys had been stratified according to the spatial pattern of the current year's commercial catch rate.

In 2002, densities of commercial size scallops (shell heights ≥80 mm) in the survey increased as the 1998 year-class recruited to the fishery. Densities are highest in the Gulliver's Head to Delaps Cove area and extend into SPA 1.

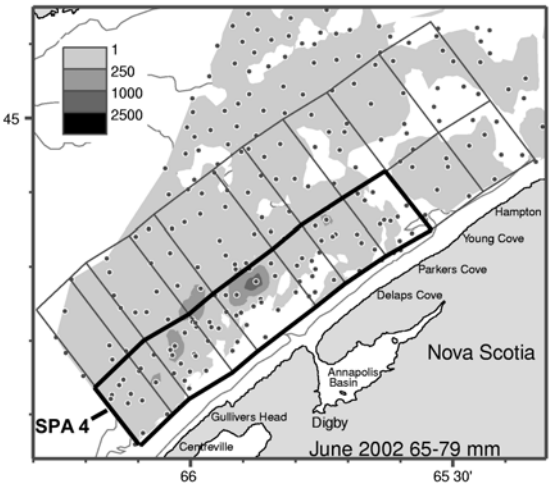
Mean Number per Tow (Commercial Size: Shell Height ≥80mm)



In the 2002 survey, scallops expected to recruit (shell heights 65 to 79 mm) in the 2002/2003 season occurred in most places in low to moderate densities.

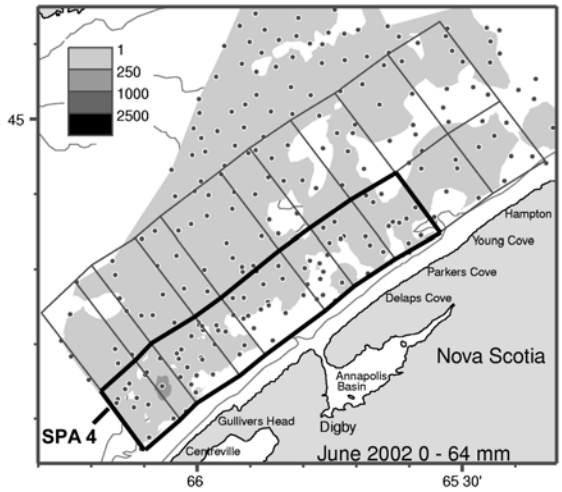
Small areas of high density occurred in Gulliver's Head and Digby Gut.

Mean Number per Tow (Recruits: Shell Height 65 to 79mm)



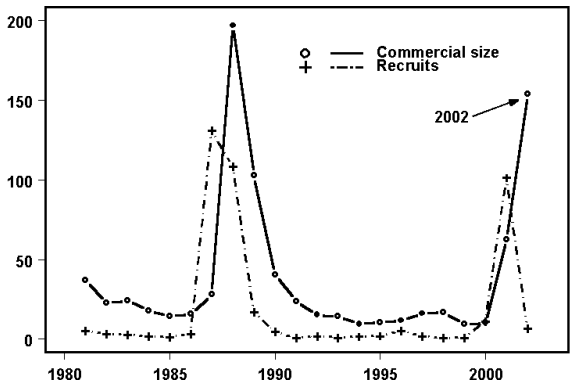
Densities of pre-recruits (shell height < 65 mm, expected to recruit in 2004/2005) were found in low concentrations throughout the area. Survey estimates of this size class are qualitative at best because of catchability problems. Scallops in this size range are probably two-year olds.

Mean Number per Tow (Pre-recruits: Shell Height <65mm)



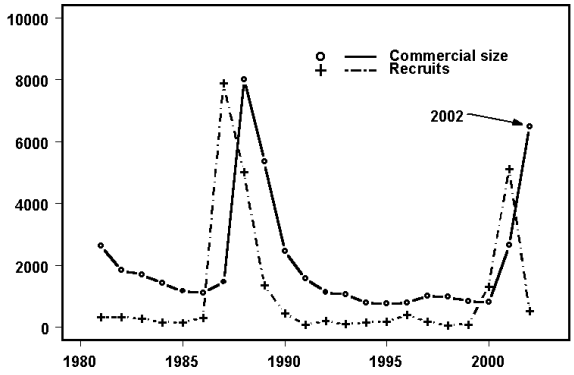
RV survey estimates of numbers of commercial size scallops in 2002 increased over 2001 to become the second highest estimates in the series. This increase is mainly due to the very large 1998 year-class first detected as 2 year olds in the 2000 survey. The 1999 year-class that will recruit in 2002/2003 is above average in abundance but is 1/10th the numbers of the 1998 year-class.

Survey Population Numbers (millions)



The population model developed in last year's assessment was used to analyze the survey and commercial catch data and estimate natural mortality and population biomass. This model estimates that the commercial size biomass in 2002 was the second largest in the 22-year time series.

Population Biomass (meats, t)



This population has seen catastrophic natural mortality in the past but current estimates of mortality remain low.

Sources of Uncertainty

Joint industry/DFO monitoring of clapper trends on a bimonthly basis was initiated in the fall of 2000 and no signs of increasing natural mortality have been detected. However, the underlying reasons for mortality events are unknown. Projections of biomass to the 2002/2003 and 2003/2004 season were made assuming that natural mortality in these two years will be equal to that estimated for 2001/2002.

In 2001, scallops of all sizes exhibited higher than expected growth rates, resulting in the projected biomass for 2002 being underestimated. However, this growth rate declined over all size classes in 2002. At this time it is not possible to predict growth rates into the next year and hence, projections of biomass over the next two years have to assume constant average growth.

Outlook

A provisional reference level biomass (B_c) was established for this SPA corresponding to the biomass of a population being fished at $F_{0.1}$ with the average recruitment biomass in SPA 4, excluding peak years. Historically, catches have been at their lowest when the population biomass was less than this level. It is recommended that measures be taken to keep the population biomass above B_c.

A range of catches for 2002/2003 and 2003/2004 were evaluated by calculating the probability that the resultant biomass in each year would drop below B_c based on the population model. These probabilities (see below) were presented at the September 2002 Full Bay fleet Inshore Scallop Advisory Committee meeting.

Decision Table for Evaluating Future Catches

Catch in 2002/2003		$P(B<B_c)$ Catch in 2003/2004			
Meats (t)	$P(B<B_c)$	800	1000	1200	1400
800	0.02	0.10	0.12	0.13	0.15
1000	0.02	0.11	0.12	0.14	0.16
1200	0.03	0.12	0.14	0.16	0.18
1400	0.04	0.12	0.15	0.16	0.18
1600	0.04	0.14	0.16	0.19	0.21
1800	0.07	0.16	0.18	0.21	0.23

The industry members at the meeting decided that a probability of approximately 0.15 was an acceptable level of risk for dropping below the critical biomass level. With this threshold, a TAC of 1200 t for 2002/2003 was chosen as a level that was acceptable, and would likely lead to similar catch levels in 2003/2004 for SPA 4.

Management Considerations

Objectives and associated reference points are being developed through discussions between DFO and industry. Acceptance of a reference level biomass as a management strategy implies a positive relationship between that reference level and future recruitment success. Such a relationship has not yet been satisfactorily established. Industry considers that such a strategy can increase the risk of episodic die-offs, especially at high scallop densities. Implementing research and monitoring aimed at establishing the relationship between scallop biomass and recruitment both within current SPA's and within the Bay of Fundy meta-population as a whole is essential. In addition research and monitoring focussed on determining the conditions resulting in episodic die-offs is warranted.

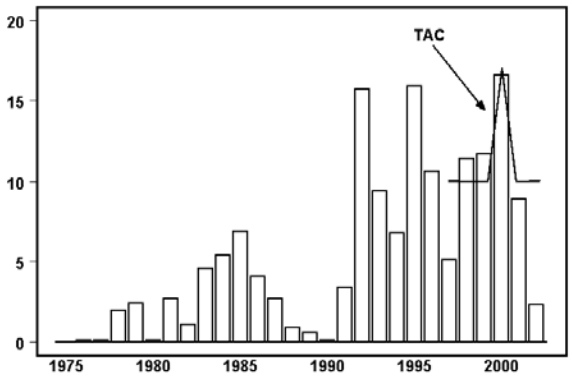
In order to maximise yield-per-recruit, the impact of fishing practices on the mortality of recruits and pre-recruit scallops needs to be investigated.

SPA 5 – Annapolis Basin

The Fishery

This is a small fishery limited to a short period in the winter. In recent years, landings have varied between 2 and 17 t.

Landings (meats, t)



Landings dropped in 2002 to 2.3 t mainly due to increased effort directed to SPA 4 in the winter.

Landings (meats, t)

Season	Avg. 1994–98	1999	2000	2001	2002
TAC	10[1]	10	17	10	10
Total	10	11.7	16.6	8.9	2.3[2]

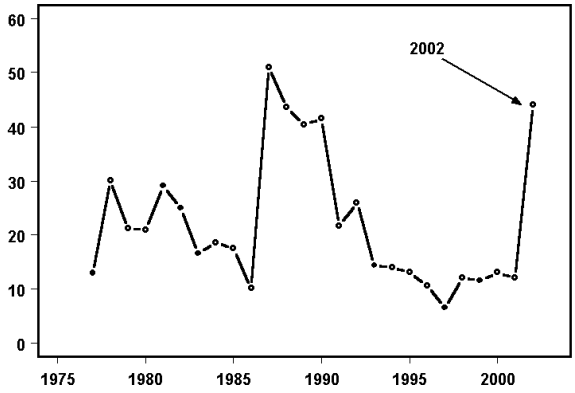
[1] TACs have only been in effect since 1997, so average TAC is for 1997-98 instead of five years.
[2] Preliminary landings.

Only one meat weight sample was collected due to the small amount of landings. Meat weights averaged 21.9 g in that sample.

Resource Status

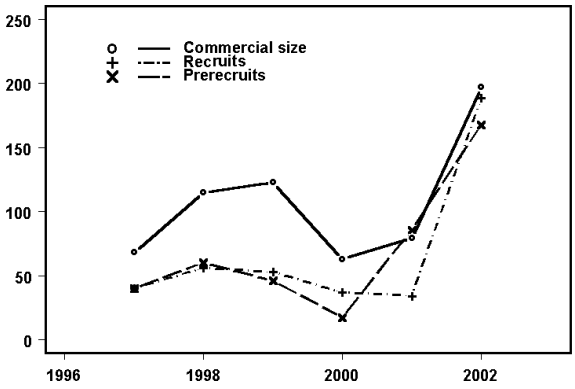
Average **catch rate** in 2002 (44.1 kg/h) was more than four times that observed in 2001 (12.1 kg/h).

Catch Rate (kg/h)



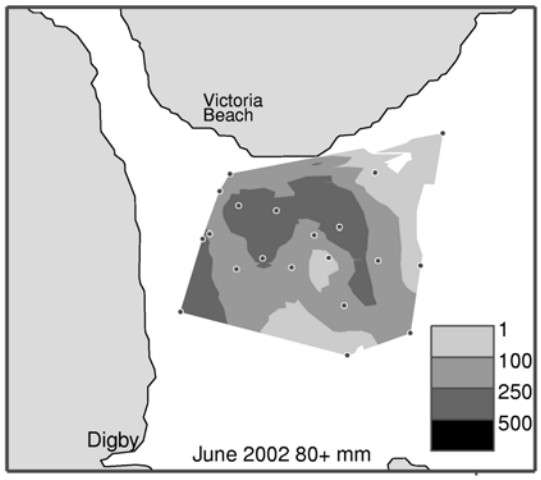
Research vessel surveys have been conducted on a regular basis in Annapolis Basin since 1997. The mean numbers per tow for all size ranges were at their highest level in the 2002 survey.

Survey Mean No./Tow



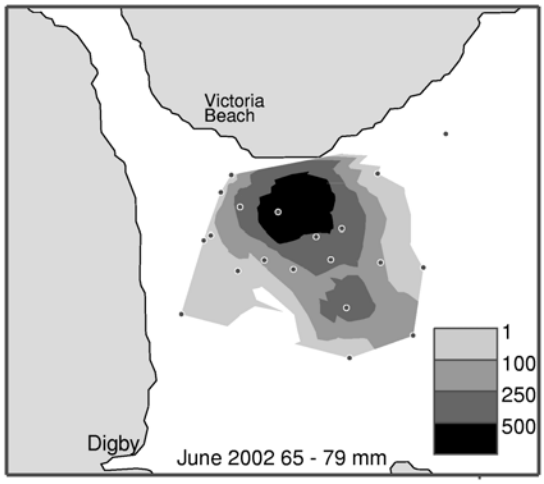
The highest densities of commercial size scallops are in the area just off of Victoria Beach.

Mean Number per Tow (Commercial Size: Shell Height ≥80 mm)



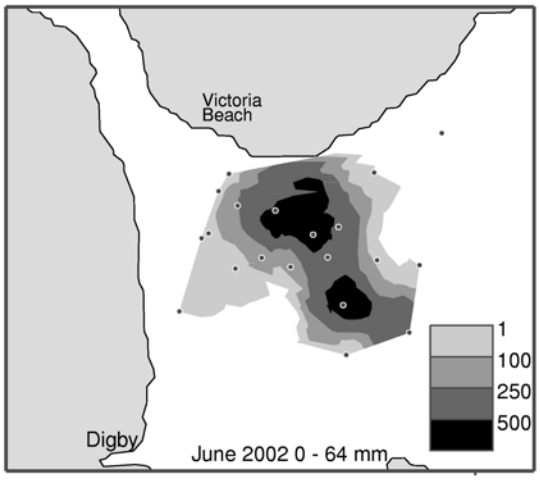
The highest densities of recruits (shell height 65 to 79 mm, probably 1999 year-class) are in the same areas as the commercial size scallops.

Mean Number per Tow (Recruits: Shell Height 65 to 79 mm)



The higher densities of prerecruits (shell height <65mm, probably 2001 year-class) were also found in areas with high densities of commercial size scallops and recruits.

Mean Number per Tow (Pre-recruits: Shell Height <65mm)



Outlook

Currently no population model has been developed for this SPA. Based upon the survey estimates and commercial catch rate the stock is healthy with two strong year-classes recruiting in 2003 and 2004.

Management Considerations

The recruiting year-classes are located in the same places as the commercial size scallops and loss in potential yield could result if these recruits are fished hard. Continuation of the 10 t TAC for 2002/2003 would be advisable. Both the 1999 and 2000 year-classes should be greater than 80 mm shell height by 2004 and the TAC could be increased appropriately at that time.

Objectives and associated reference points are being developed through discussions between DFO and industry. Acceptance of a reference level biomass as a management strategy implies a positive relationship between that reference level and future recruitment success. Such a relationship

has not yet been satisfactorily established. Industry considers that such a strategy can increase the risk of episodic die-offs, especially at high scallop densities. Implementing research and monitoring aimed at establishing the relationship between scallop biomass and recruitment both within current SPA's and within the Bay of Fundy meta-population as a whole is essential. In addition research and monitoring focussed on determining the conditions resulting in episodic die-offs is warranted.

In order to maximise yield-per-recruit, the impact of fishing practices on the mortality of recruits and pre-recruit scallops needs to be investigated.

SPA 6 – Grand Manan and Southwest New Brunswick

The Fishery

The areas around Grand Manan and off southwest New Brunswick are designated SPA 6. This area is further divided into the Grand Manan Island inside zone (SPA 6B), the New Brunswick inside zone including the Wolves (SPA 6C), and the outside zone (SPA 6A).

The TAC for SPA 6 is divided into a winter fishery in the inside zones, SPA 6B+6C, and a summer fishery in SPA 6A. Landings from the individual subareas are available for 1997 to 2002 only.

Landings (meats, t)[1]

Year	Avg 1997-98	1999	2000	2001	2002
TAC	150	160	140	155	195
Landings	153	150	142	161	128[2]

[1] Landings not available by SPA prior to 1997.
[2] Preliminary landings.

Following consultation with industry, the area known as the Duck Island Sound Box was closed to protect the large numbers of juvenile scallops found during the 1999 survey. This closure came into effect the second week of the 2000 fishing season. In 2001 and 2002 it was open for fishing one day per week.

The 2001/2002 SPA 6 quota for the Full Bay fleet was 50 t. Full Bay landings by subarea for 2001/2002 were 2.3 t, 0.7 t and 5.0 t for SPA 6 A, B and C, respectively.

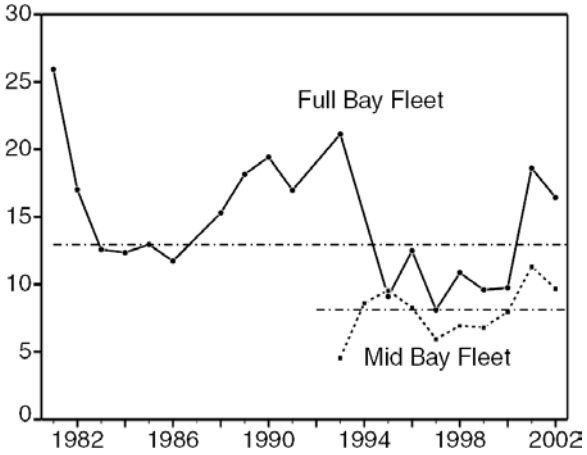
The final quota in 2002 for the Mid Bay fleet was 145 t. This was split 105 t for the inside winter fisheries in 6B and 6C, and 40 for the summer fishery in 6A. Mid Bay landings for 2002 by subarea were 15.9 t, 39.0 t and 59.9 t for SPA 6A, B and C respectively. There have been problems due to late submissions of monitoring documents.

The meat weight sampling program provided information on the sizes of scallop meats less than 11 g in the catch. Port samples in 2002 indicated that the fishery had less reliance on these small scallops than it has in the past.

Resource Status

Commercial catch rates for both fleets decreased from 2001 levels, although the Full Bay feet CPUE remains above the 1981–2002 median level. The Mid Bay fleet's CPUE for 2002 is the second highest level in the limited time series, but is down from last year.

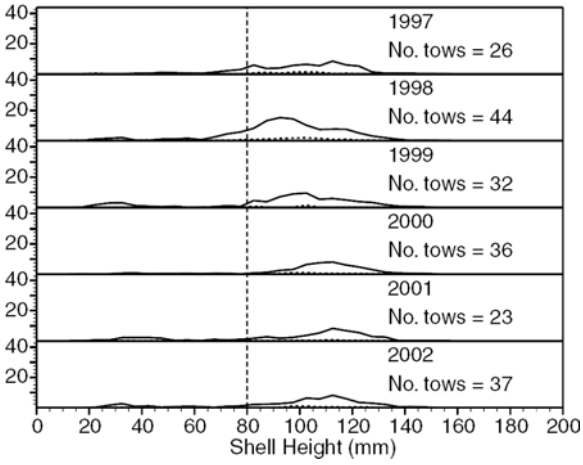
Catch Per Unit Effort (kg/h)



Research vessel (RV) surveys were conducted annually from 1979 to 1991. A new survey series with a different design was initiated in 1996. From 1996 to 1999 SPA 6C was not covered by the survey.

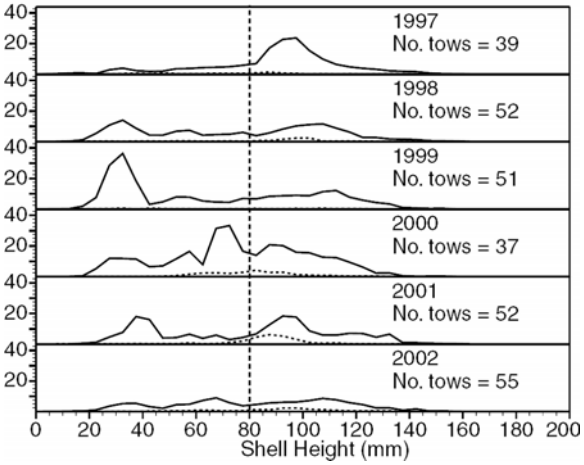
In SPA 6A there has been little sign of recruitment for the last five years and the scallops in the population are growing larger and their numbers are being fished down. Without stronger recruitment in this area catch rates can be expected to decline.

SPA 6A Survey Mean Numbers per Std. Tow



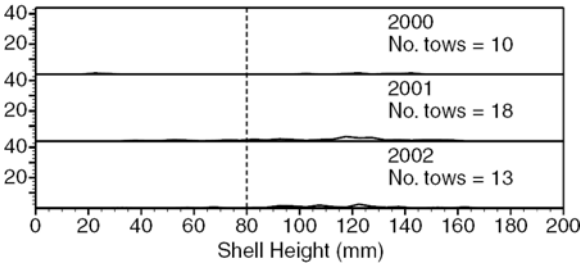
SPA 6B had a strong recruitment pulse enter the fishery in 2001, mainly in the Duck Island Sound area. To protect this recruitment Duck Island Sound was closed in 2000, had a short one-day a week fishery in 2001 and was open for one day a week in 2002. A great cause of concern has been the increase in clappers (dead paired shells) in the area in the 2000 and 2001 surveys. (horizontal dashed line in figure below). In the 2002 survey there were few clappers observed. The year-class observed at 40 mm shell height in the 2001 survey does not appear to be as strong at 70 mm in the 2002 survey.

SPA 6B Survey Mean Numbers per Std. Tow



SPA 6C has only been covered by the recent survey series in the last three years. This area contains low numbers of larger scallops, but the fishery has been able to locate patches of scallops. In 2002, a majority of the landings came from Mace's Bay. Much of the bottom in this area is mud and fishers use a lighter gear than in most fishing areas. The survey gear may not be fishing efficiently on the mud in this area.

SPA 6C Survey Mean Numbers per Std. Tow



Outlook

The stock indicators show little signs of good recruitment and fully recruited scallops that are being fished down. Catch rates will probably decline again this year.

Management Considerations

Without signs of exceptional recruitment for the next few years the catch rates are expected to decline, tending towards the 10 year average for the area. The TAC should not be increased.

Measures should be taken to ensure that monitoring documents are submitted in a timely manner.

Mid Bay Fishers in this area are interested in investigating alternate objective based management systems.

Concerns have been raised, particularly in regards to Duck Island Sound, about the impact of salmon aquaculture and other human activities on commercial scallop grounds.

SFA 29 – Southwest Nova Scotia

The Fishery

Scallop Fishing Area (SFA) 29 encompasses a very large inshore area inside the 12-mile territorial sea, from the south of Yarmouth (latitude 43˚40'N) to Cape North in Cape Breton. SFA 29 inshore scallop licenses were historically restricted to east of Baccaro (East of longitude 65˚30'W). This report refers to only that portion of SFA 29 west of longitude 65˚30'W continuing north to SPA 3 at latitude 43˚40'N.

A limited fishery by the Full Bay fleet was granted from 1996–98. Prior to 1986, this fleet had fished in this area without restrictions. Access was again granted to this fleet in 2001 with a full at sea monitoring program, and with a condition of a post-season industry-funded survey. Scallop fishers had consulted with lobster fishers in the area to deal with potential conflicts. Lobster by-catch was minimal in 2001 despite high scallop catch rates.

In 2002, the Minister approved access to this area by the Full Bay fleet and inshore east of Baccaro licence holders who are authorized to fish in SFA 29. A joint project agreement was signed with the fishing fleets, Natural Resources Canada and Department of Fisheries and Oceans provided funds to conduct multi-beam acoustic mapping of the seafloor and other scientific work. A map showing bottom features in area C was prepared from this work in time for the fishery and distributed to the fishermen.

A TAC of 800 t was subdivided by area between the two fleet sectors for 2002.

Landings (meats, t)

		Full Bay		East of Baccaro	
Year	Area	TAC	Landings	TAC	Landings
2001	Total	400	400		
2002	29A	75	1	25	4
	29B	150	193	50	75
	29C	375	334	125	106
	Total	600	528[1]	200	185[1]

[1] Preliminary landings.

The 2002 fishery opened for the Full Bay July 3 and the East of Baccaro fleet July 18 and was scheduled to close Aug 31, 2002. Management extended the season to Sept 6, as the TAC had not been caught. The fishery removed a total of 713 t with the majority (62%) of the catch coming from area C. Reasons

for the total Full Bay fleet TAC not being caught include unallocated quota due to ongoing negotiations with First Nations.

The largest average meat weights were obtained in area C with the average ranging from 20 g to 23.8 g. The smallest average meat weights came from area A, ranging from 15.5 g to 16.3 g.

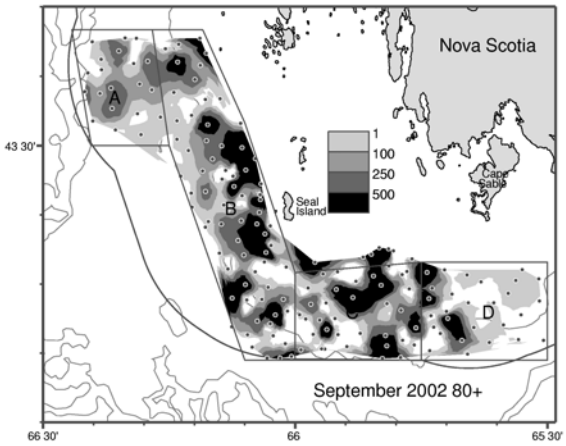
Resource Status

Average catch rates for the Full Bay Fleet were 68.15 kg/h over the whole area in 2002 compared to 109.60 kg/h in 2001. The highest catch rates in 2002 by area were in C at 78.95 kg/h. The average catch rate for the east of Baccaro Fleet was 39.74 kg/h over the whole area with highest rates observed in area B at 50.47 kg/h.

A post-season joint industry/ departmental survey was conducted in September 2002. While, the 2001 survey had covered a larger area, the 2002 survey was restricted to areas A to D. The 2002 survey also included extra tows to supplement the information collected in June by the Atlantic Geoscience Centre and Canadian Hydrographic Service during their multibeam mapping of the bottom in the area.

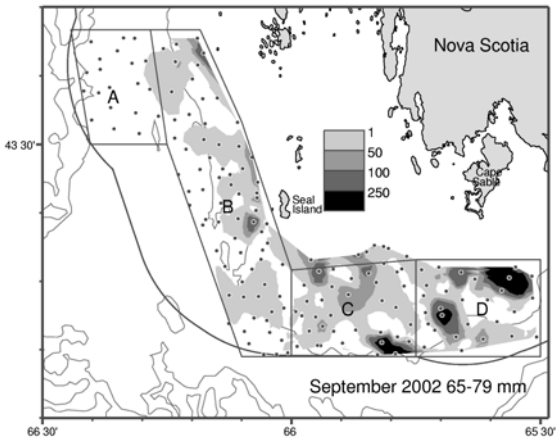
Large concentrations of commercial size scallops (shell height > 80 mm) were found throughout the areas B, C and D, with larger concentrations generally on the nearshore edge of the survey area.

Mean Number per Tow (Commercial Size: Shell Height >80mm)



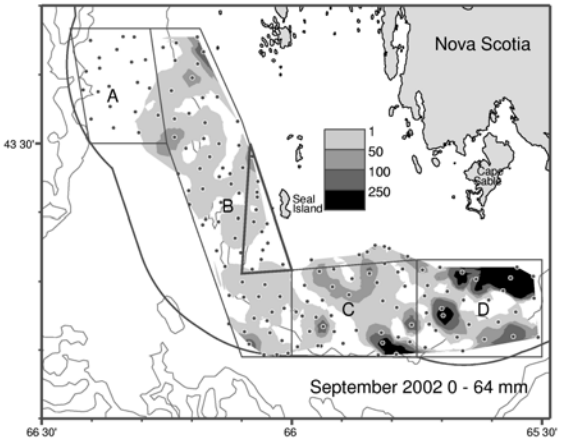
Recruits (shell height 65–79 mm) were mainly concentrated in the southern portion of area C and in area D.

Mean Number per Tow (Recruits: Shell Height 65-79mm)



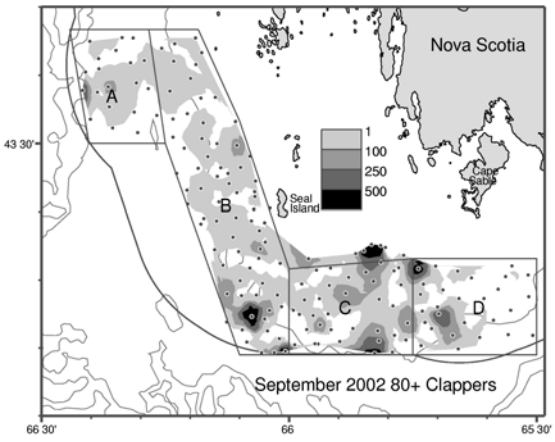
The distribution of pre-recruits (shell height < 65 mm, expected to recruit to fishery in two years) overlapped that of the recruits but the highest densities were in the eastern area of C and in area D.

Mean Number per Tow (Pre-recruits: Shell Height <65mm)



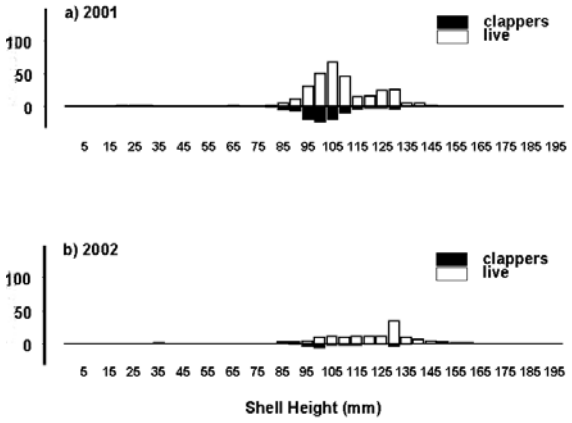
Some fishermen reported concentrations of clappers in the first weeks of the fishery. The mean number of clappers per tow in the 2002 survey had increased over that observed in 2001 for areas B (2 times), C (2.3 times) and D (9.6 times). Most of this increase occurred for commercial size scallops and the distribution of the clappers was quite patchy.

Mean Number Clappers per Tow (Commercial Size: Shell Height >80mm)



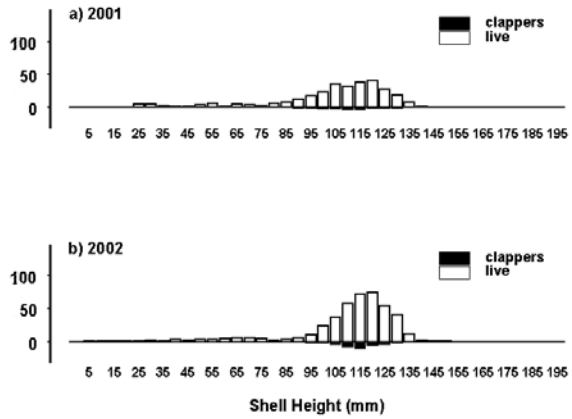
The shell height frequencies for area A in 2002 show a decline in commercial size scallops over 2001, even though only 5 t of catch came from this area.

Shell Height Frequency from Survey (SFA 29A)



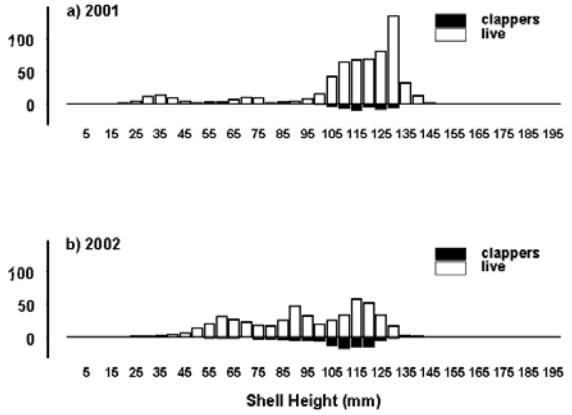
Commercial size scallops increased in area 29 B in 2002 over 2001.

Shell Height Frequency from Survey (SFA 29B)



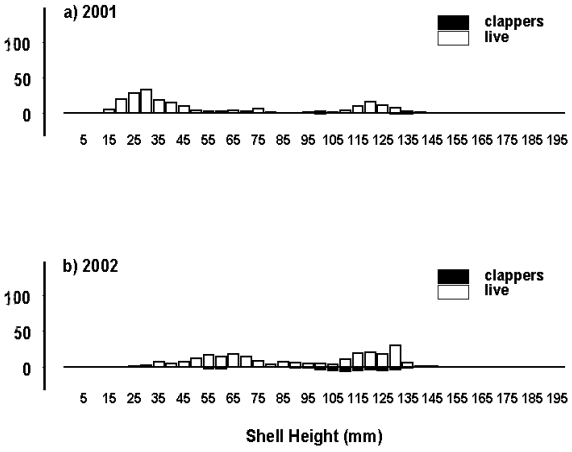
Close to 62% of the total catch came from area C and the shell height frequencies show the cropping down of the commercial size scallops in 2002 relative to 2001.

Shell Height Frequency from Survey (SFA 29C)



No fishery was allowed in area D. The progression of the year-class with shell heights of 20 to 45 mm observed in 2001 can be seen in 2002. The number per tow for commercial size scallops in 2002 was double that observed in 2001.

Shell Height Frequency from Survey (SFA 29D)



Sources of Uncertainty

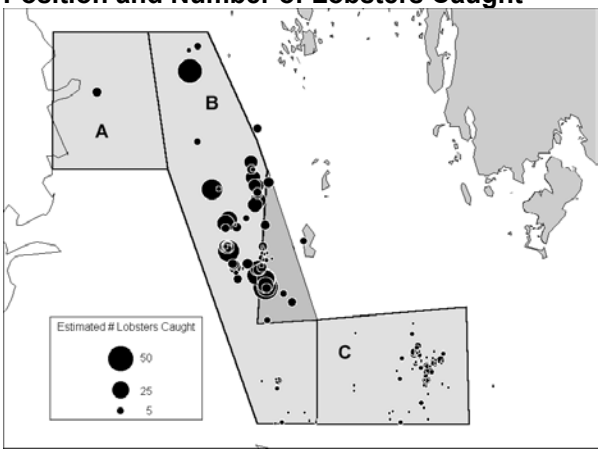
There are only two years of extensive surveys of areas A to D in SFA 29. These surveys were conducted with a commercial vessel using commercial gear. A comparative fishing experiment between the DFO survey vessel and this same commercial vessel conducted in SPA 4, indicated differences between the two vessels and gears. It is unlikely that catchability or fishing efficiency estimates obtained for the departmental vessel after many years' experience will be applicable to the commercial vessel. Therefore, a longer time series will be required before trends can be interpreted from this survey.

There is little knowledge of the recruitment or mortality dynamics in this area.

Lobster Bycatch

Observer coverage was required for both fleets to monitor lobster bycatch. Lobsters were observed in all areas but the highest catch rates were in area B. A section of area B was closed during the season due to the high bycatch reported in the area. The number of lobsters caught in the 2002 scallop fishery in areas B and C was estimated to be 7037 with 65% being less than minimum legal size. This compares with the estimated 3,075,395 lobsters removed by the commercial lobster fishery in areas B and C during the 2000/2001 season in the same area.

Position and Number of Lobsters Caught



Regulations required that all lobsters caught were returned to the water but it is not known at this time how many were damaged when returned.

Outlook

With only two years of surveys it is difficult to recommend precise catch levels for the 2003 fishery. The impact of the 2002 fishery was evaluated by statistically testing for differences between mean number and meat weight per tow for the surveys in 2001 and 2002. These tests indicated that recruitment by numbers probably compensated for the removal of scallops in each of the areas fished. In the case of area B, recruitment in numbers more than compensated for the fishery.

These tests indicated that there was a significant decline in biomass in area C. A total catch of 440 t resulted in a 58% decrease in the mean weight per tow in area C. The tests did not indicate that significant declines of biomass had occurred in areas A, B and D.

Taking into account the uncertainty in the survey estimates, the TAC for area C should be reduced in 2003, while area B could remain at the 2002 level. A catch of 5 t in area A was compensated by recruitment and growth. However, considering the evidence in the 2002 survey of cropping down of the commercial size scallops, this area may not be amenable to being fished at level higher than 5 t.

Area D should remain closed for 2003. A fishery for the area in 2004 could be considered after the analysis of data from the 2003 survey.

Management Considerations

Bycatch of lobster in this area was low but it was not clear what impacts the scallop fishery may have on the lobster population. The impacts of the scallop fishery on juvenile lobsters and on lobster habitat were not evaluated. During the molting period lobsters are less mobile, more prone to injury and involved in mating. Efforts should be taken to avoid those areas and times when lobsters are in high concentrations or are soft-shelled. The closure of a portion of area B in 2002 due to high lobster catches was an example of the types of measures that could be taken.

Mandatory observer coverage of lobster bycatch with more detail on the condition of lobsters caught, and an industry post-season survey should be continued in 2003.

For more Information

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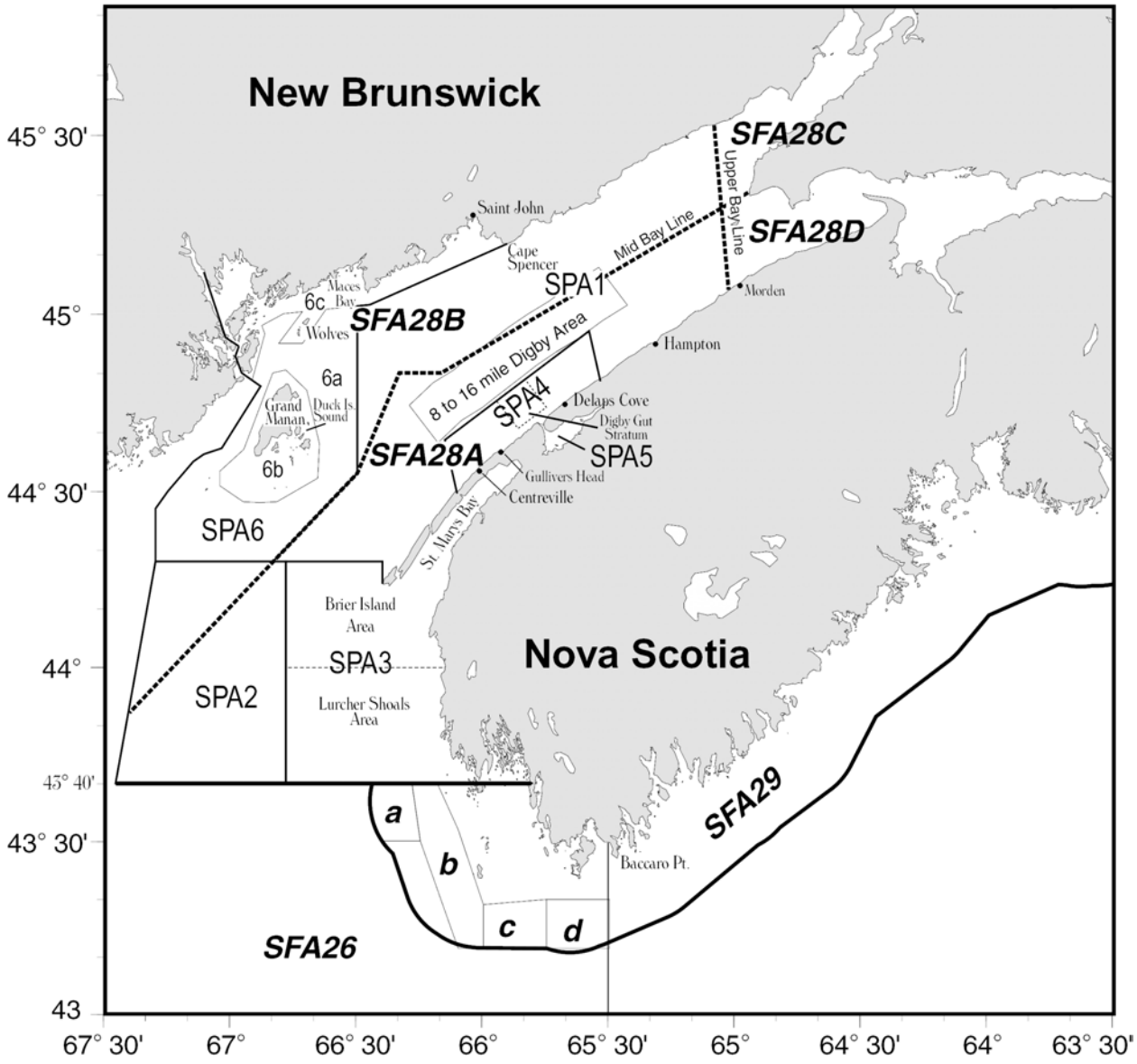

Locations and Place Names used in this Stock Status Report