ASSESSMENT OF NORTHERN SHRIMP ON THE EASTERN SCOTIAN SHELF (SFAs 13-15)

(J. Domm 2006)

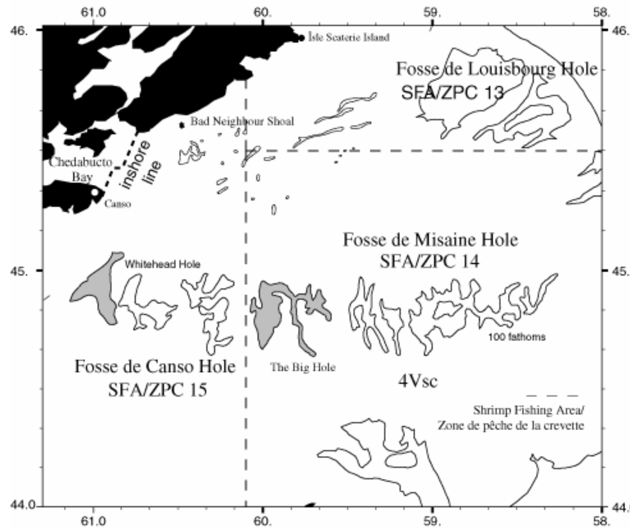

Figure 1. Shrimp fishing areas (SFAs) on the Eastern Scotian Shelf.

Context:

Advice on the status of the Eastern Scotian Shelf shrimp stock is requested by DFO Fisheries and Aquaculture Management Branch and industry to help determine a Total Allowable Catch (TAC) that is consistent with the management plan. Annual assessments are required because of rapid changes in abundance, variable recruitment to the population and fishery, and changes in the size of shrimp available for harvest. The resource is near the southern limit of the species' distribution where it is thought to be more vulnerable to significant and rapid declines, as has been observed in the adjacent Gulf of Maine stock. The current report provides information and advice for management of the 2011 fishery.

The trawl fishery on the Scotian Shelf occurs primarily during late spring and early summer with some fishing during fall, in the deep offshore shrimp "holes", and on an inshore area near the Bad Neighbour Shoal. The main management tools are limits on the number of licenses and size of vessels used, minimum codend mesh size (40mm), use of a Nordmøre separator grate, and a TAC. This fleet (about 20 active trawlers) is divided into two sectors, a midshore sector consisting of vessels 65-100' Length Over All (LOA) based in New Brunswick in the Gulf Region, and an inshore sector consisting of vessels mainly <65' LOA based in the Maritimes Region. A trap fishery, currently consisting of 7 active vessels is restricted to Chedabucto Bay. All licenses except traps operate under Individual Transferable Quotas (ITQs). Stock assessments are conducted annually based on indicators from commercial, scientific survey, and environmental monitoring data.

This Science Advisory Report is from the Fisheries and Oceans Canada, Maritimes Region Science Advisory Meeting of 5 December 2011 to assess the status of Northern Shrimp on the Eastern Scotian Shelf (SFAs 13-14). Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

SUMMARY

- The point estimate of the 2011 spawning stock biomass (16,823 mt) decreased for the second consecutive year from the near-record high 2009 estimate, but remains above the upper limit reference point of 14,558 mt (i.e., in the Healthy Zone).
- Because the relative decrease in the point estimate of spawning stock biomass exceeded the Total Allowable Catch (TAC) reduction from 2010 to 2011, female exploitation rose to 20.3%, which is slightly above the removal reference point of 20%.
- The abundance of Age 2 shrimp decreased in 2011, which is consistent with the low belly-bag index in 2010.
- The abundant 2007 year class increased the index of abundance of Age 4 male shrimp in 2011, which is expected to provide good recruitment to the spawning stock biomass in 2012.
- For the past two years, a large proportion of the TAC (32-41%, assuming the TAC is caught in 2011) has been taken during the egg-bearing period, which risks a loss of reproductive potential by removing egg-bearing females before spawning.
- Ecosystem indicators (high temperatures and reductions in the abundance of sympatric species) suggest that conditions are currently unfavourable for shrimp.
- Despite generally favourable indicators of abundance, the continuation of the biomass downturn in 2011, coupled with decreases in shrimp size, poor recruitment, a temporal shift in fishing effort, and unfavourable ecosystem indicators, suggest that a TAC reduction would be prudent for 2012 to minimize the likelihood of bringing the stock below the upper limit reference point or of further exceeding the removal reference point.

BACKGROUND

Species Biology

The Northern or Pink Shrimp, *Pandalus borealis*, is the only shrimp species of commercial importance in the Maritimes Region. Shrimp are crustaceans that have a hard outer shell, which they must periodically shed (molt) in order to grow. Females generally produce eggs once a year (not more) in the late summer-fall and carry them, attached to their abdomen until the spring, when they hatch. Consequently, shrimp bear eggs, (i.e., are "ovigerous") for about 8 months of the year. Newly hatched shrimp spend 3 to 4 months as pelagic larvae, feeding near the surface. At the end of this period they move to the bottom and take up the life style of the adults. On the Scotian Shelf, the Northern Shrimp first matures as a male at 2 years of age, and at Age 4 it changes sex, to spend another 1 to 2 years as a female. They generally live up to 8 years, depending on current environmental conditions and population dynamics. Shrimp concentrate in deep "holes" (>100 fathoms) on the Eastern Scotian Shelf (Figure 1), but nearshore concentrations along the coastline were discovered in 1995 by the DFO-Industry survey. In general, Northern Shrimp prefer temperatures of 2-6ºC, and a soft, muddy bottom with a high organic content.

The Fishery

The fishery currently consists of 28 inshore licenses (16 active vessels), mostly <65’ length overall (LOA), and 14 midshore licenses (5 active vessels) 65-100’ LOA. All mobile licenses have been under Individual Transferable Quotas (ITQs) since 1998. A competitive trap fishery with 14 licenses (7 currently active) is restricted to Chedabucto Bay. The fishery operates under an “evergreen” management plan, which documents sharing agreements between fleet sectors. The management plan was most recently updated in September, 2011.

Catches have been close to the Total Allowable Catch (TAC) since individual Shrimp Fishing Areas (SFAs) quotas were combined into a single TAC in 1994, with minor shortfalls associated with re-allocations of uncaught trap quotas to the mobile fleet late in the season (Table 1; Figure 2). More substantial shortfalls occurred in 2005-2008 unrelated to resource availability. The gap between TAC and catch has narrowed steadily since 2005 as problems associated with market conditions and quota reallocations have been resolved. Although trap fishing effort and catches had decreased to negligible amounts (1 mt in 2010) since 2005 due to low prices, this has not been the case in 2011. A new buyer/processor is marketing the trap shrimp as a high-end product exported to Japan. The 2011 southern Chedebucto Bay trap fishery began in early September with one vessel fishing approximately 35 traps. By mid-November, 6 vessels had begun actively fishing their full complement of 100 traps with an average catch per trap haul (CPTH) of approximately 7 lbs. Hail-in estimates during two weeks in November totaled 22 mt of shrimp landed after 7300 trap hauls. There have been considerably higher landings in 2011 (due to new market) than in the past several years, and landings continued to accumulate at the time of this report. The mobile fleet continues to prefer open access to all areas (i.e., no individual SFA quotas) because of the flexibility this offers in obtaining favourable combinations of good catch rates and counts (shrimp sizes).

Table 1. Recent shrimp TACs and landings (‘000’s mt).

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TAC	5.5	5.0	3.0	3.0	3.5	5.0	5.0	5.0	5.0	3.5	5.0	4.6
Landings	5.4	4.8	2.9	2.8	3.3	3.6	4.0	4.6	4.3	3.5	4.6	4.6[1]

[1]Landings projected to December 31, 2011.

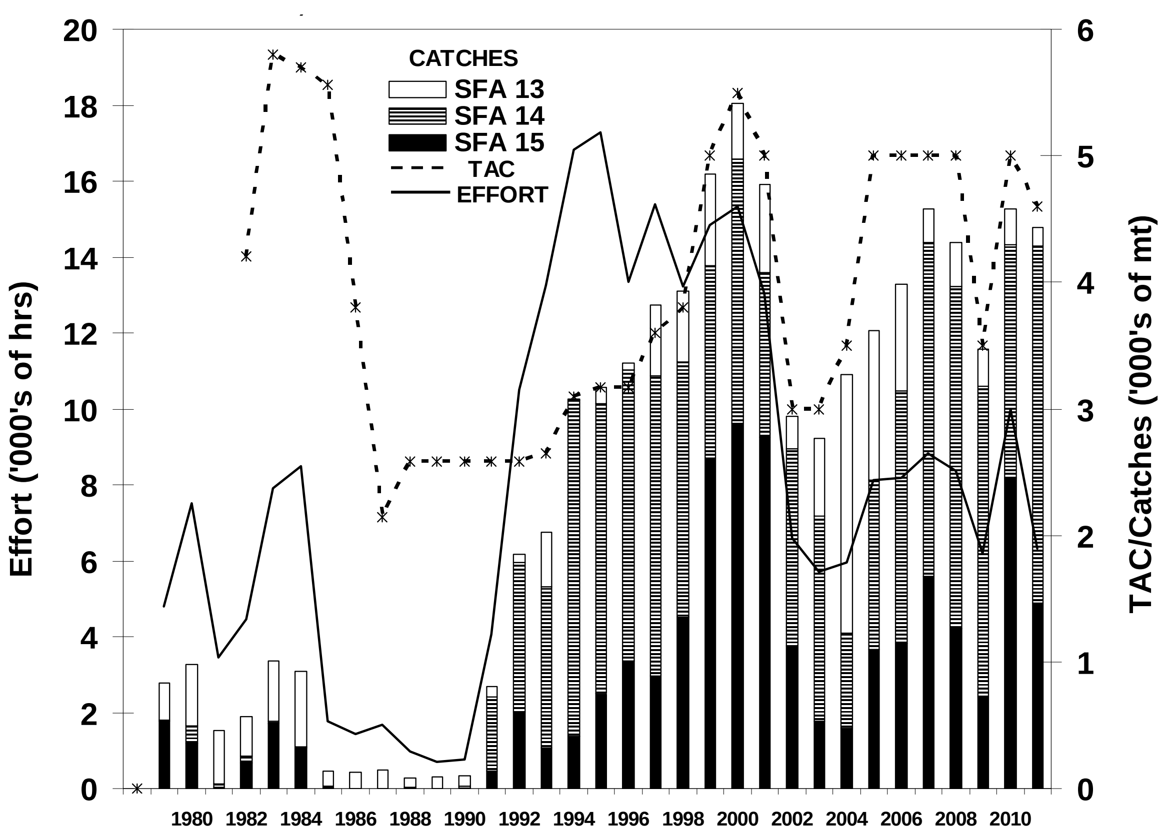

Figure 2. Landings, TACs, and Effort.

Relative to previous years, but similar to 2010, a greater percentage of the catch was taken in March-April and November-December (projected) in 2011 (Figure 3, left). Although most shrimp are caught during April-June, less of the catch was taken during this period in 2010-2011 than in recent years. If the remainder of the TAC is caught this fall (likely), the amount of **fishing during the ovigerous period** (August-April) will be the highest on record. Fishing during the ovigerous period can contribute to reduced egg production. Other factors that could decrease egg production include decreasing size at sex change, female sizes, and spawning stock biomass.

The **spatial pattern** of the fishery has changed significantly over the years (Figure 2), reflecting changing distributions of biomass and size frequencies. In 2004, a large part of the TAC (57%) was taken in SFA 13, but this has declined since 2007 as effort shifted back to SFA 14 to take advantage of the large accumulated biomass there. Although a larger proportion of the catch was taken in SFA 15 in 2010, this returned to a lower level in 2011.

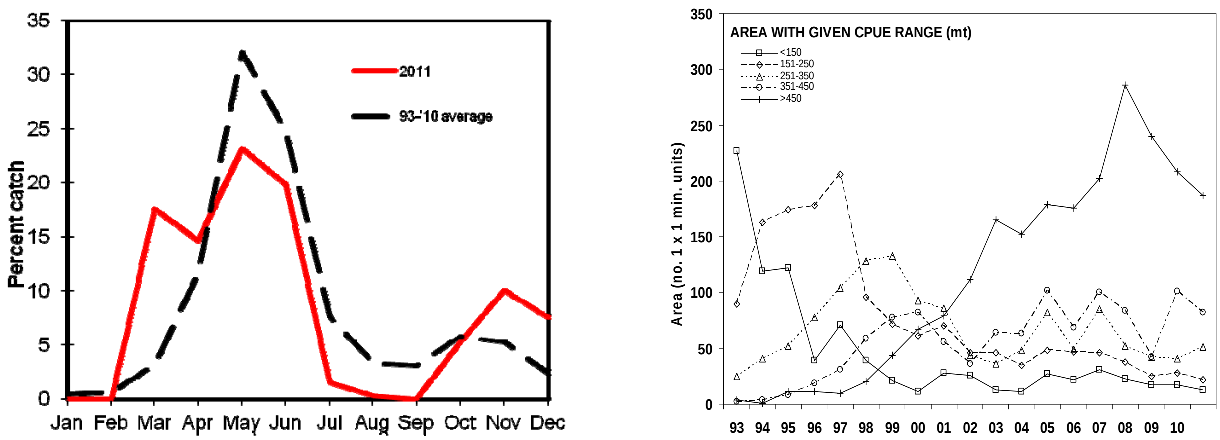

Figure 3. Temporal (left) and spatial (right) patterns in the Scotian Shelf shrimp fishery.

ASSESSMENT

Stock Trends and Current Status

After a sustained long-term increase, commercial Catch Per Unit Effort (CPUE**)** indices (Figure 4) leveled off and have been fluctuating at a high level since 2002. The DFO-Industry trawl survey has shown two divergences from CPUE trends (Figure 5). The first, between 2000-2003, was attributed to changing spatial distribution patterns of the relatively large 1994-1995 year classes as these moved through the population and died off. However, the second divergence (2005-2008) was not consistent with a shrinking, more concentrated resource since the area of highest catch rates (>450 kg/hr; Figure 3, right) had continued to increase, while the areas of lower catch rates have remained relatively small. The DFO-Industry survey index (Figure 4) increased significantly in all areas in 2009, with an overall increase of nearly 50% from the previous year. Some of this increase can be attributed to growth and increased availability to the survey trawl of the 2001 year class. A concurrent increase in the standardized CPUE index is also likely due to this; however, the CPUE increase was only 10% above the previous year, the difference presumably being due to survey-related factors. It is probable that a decrease in the attack angle of the Nordmøre grate in the survey trawl, discovered and repaired prior to the 2009 survey, was at least partly responsible for this second divergence. Moreover, since the survey index experienced its largest one-year increase in 2004, when the survey trawl was new, the possibility that the first divergence just prior to this was also at least partly due to decreased trawl efficiency cannot be ruled out. In 2011, the three CPUE-based indicators provided somewhat equivocal results. The survey CPUE decreased by about 18%, while the standardized CPUE remained stable and the Gulf vessel CPUE increased (Figures 4 and 5). A decreasing trend in the areas of highest catch-rates, while areas of low-moderate catch rates remain relatively stable or increase slightly (Figure 3, right), coupled with the decrease in the point estimates of total and spawning stock biomass, provide evidence of a continuation of the population downturn that began in 2010. This is consistent with the prediction that a lag between the end of the abundant 2001 year class and the recruitment of the next abundant year classes (2007-2008) to the adult population would take place (Figure 8).

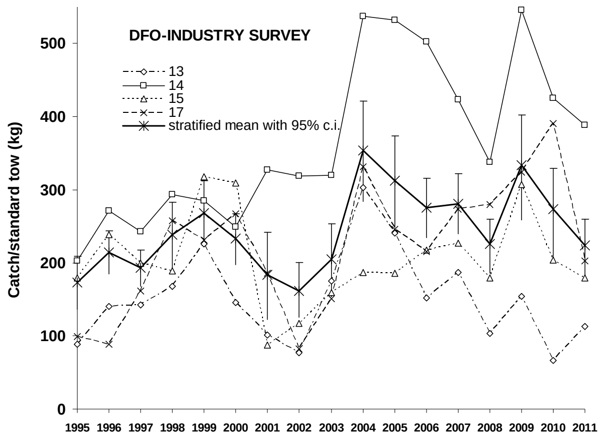

Figure 4. DFO-Industry survey abundance indices by area.

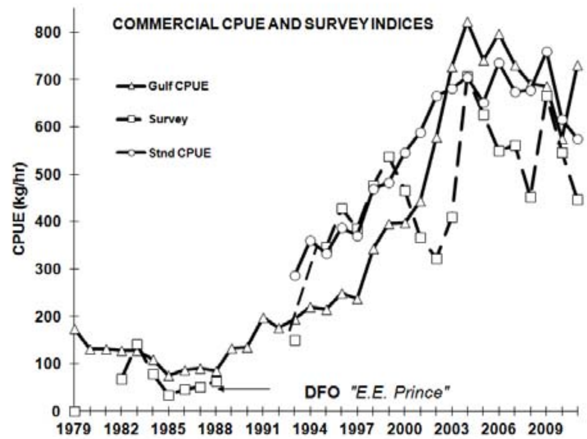

Figure 5. Commercial CPUE and survey abundance indices.

Based on the survey indices, the **total biomass** point estimate decreased to 30,510 mt in 2011. Although **spawning stock biomass** (SSB, females) decreased to 16,823 mt this year (Figure 6), it remains above the upper stock reference point of 14,558 mt (Healthy Zone).

Because the decreases in point estimates of total and female biomass exceeded the relative decrease to the TAC in 2011, **total exploitation** increased to 14.8% and **female exploitation** increased to 20.3%, slightly above the 20% removal reference (Figure 7).

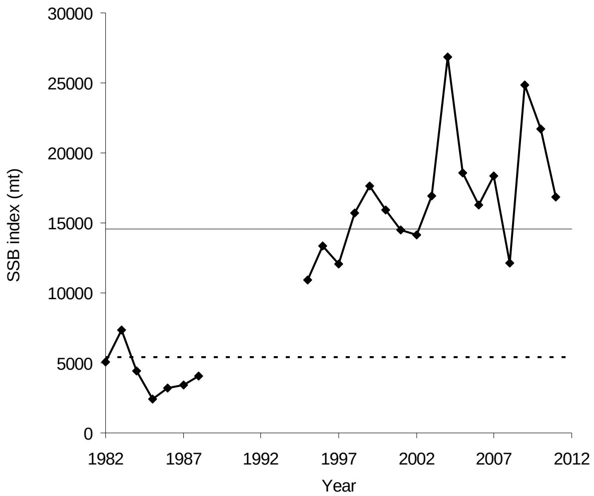

Figure 6. Changes in the spawning stock biomass index for the Eastern Scotian Shelf shrimp population. The dashed lines show the upper and lower limit reference points.

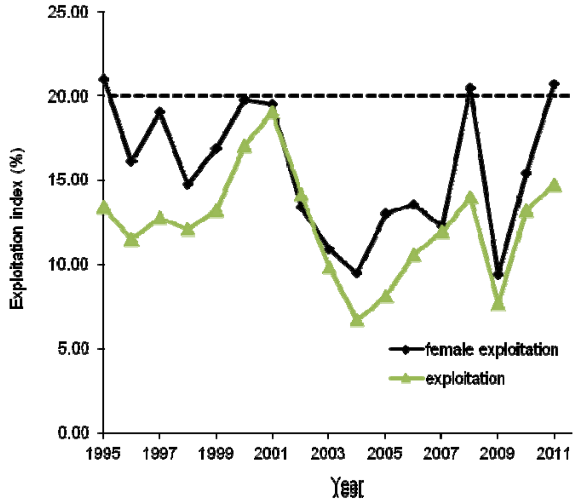

Figure 7. Changes in the exploitation index for the Eastern Scotian Shelf shrimp fishery. The dashed line shows the limit reference point of 20% for the exploitation index.

The interpretation of year class strength and longevity is complicated by a number of factors including: the low catchability of shrimp younger than Age 4; the strong influence of growth rate on the catchability of Age 4 shrimp; difficulty in distinguishing and assessing year classes after Age 3; and changing longevities and natural mortalities associated with environmental or density dependant influences. Furthermore, the tendency of a single year class, especially large ones such as 2001, to change sex over a number of years, makes it difficult to distinguish them from adjacent year classes. Nonetheless, the recruitment pulses of 2001 and 2007-2008 coincide with the maturation of strong year classes, i.e. 1993-1995 and 2001, respectively. This is evidence that strong year classes have produced large spawning stock biomasses.

The abundance of **Age 2 shrimp** increased to above average in 2009, apparently confirming the strength of the 2007 year class determined as 1 year old shrimp from belly-bag results in 2008. The strength of the 2008 year class as **Age 1 shrimp** in belly-bag results were also above average. Belly-bag catches are not affected by changes to the Nordmøre grate and appear to corroborate the recruitment pulses shown in the main survey trawl results. The abundant 2007-2008 year classes continue to provide a detectable signal in the trawl survey (Figure 8) as they begin recruitment to the fishery, which is expected to continue with the recruitment of Age 5 female shrimp from the 2008 year class in 2012-2013. The declines in the abundances of Age 1 and Age 2 shrimp in 2011 are consistent with elevated sea surface temperature and the low belly-bag index in 2010, respectively.

The abundance of **Age 4 male shrimp** increased again in 2011 as the abundant 2007 age class began to enter the fishery. These are expected to contribute to relatively strong spawning stock biomass as they transition to females in 2012. Abundant Age 4+ males observed in 2009 provided females to the spawning population in 2010 and 2011, which accounts for the relatively good recruitment to the spawning stock biomass in 2011 despite an overall population downturn.

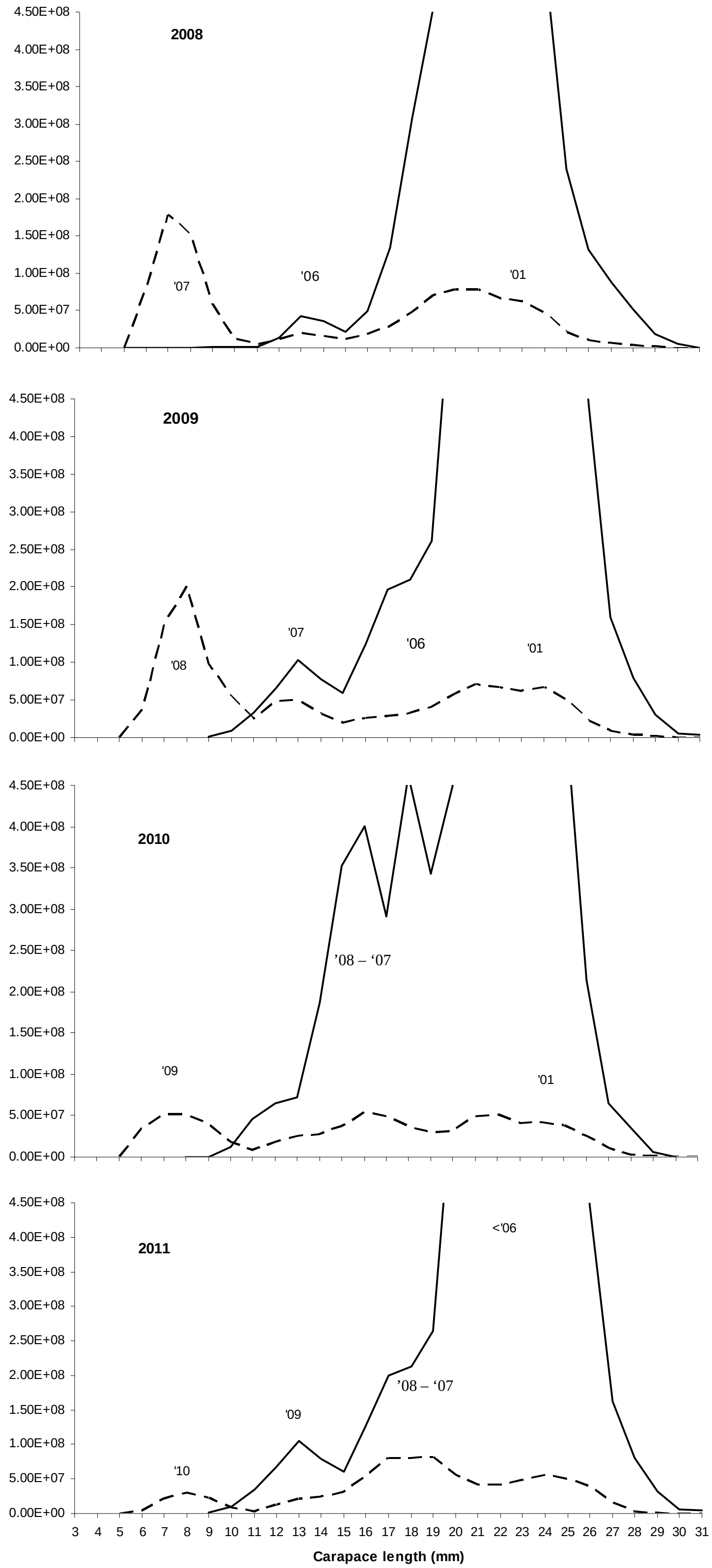

Figure 8. Population estimates from belly-bag (dashed line) and main (solid line) trawl catches for the 2007-2011 survey.

Decreases in average **length at sex change** (L_t) in shrimp stocks can contribute to population downturns due to decreased female fecundity (smaller shrimp produce fewer eggs). On the Scotian Shelf, length at sex change has shown a decreasing trend since the mid 1990s, when monitoring began (Figure 9), and approached the small sizes associated with the low population levels of the 1980s. Length at sex change increased from 2006-2010, probably due to late sex change of 2001 year class males, some of which had an additional year(s) to grow. **Maximum size** (L_{max}) has shown a similar decreasing trend, and then increased in 2009-2010, likely for the same reasons (Figure 9). The possibility that the observed long-term decreasing trend in both indicators is a cumulative fishing effect that may be having a negative impact on the population's reproductive capacity bears consideration. Both indicators decreased in 2011, probably because females currently recruiting to the population derive from less abundant cohorts than the late-maturing cohorts that followed the 2001 year class.

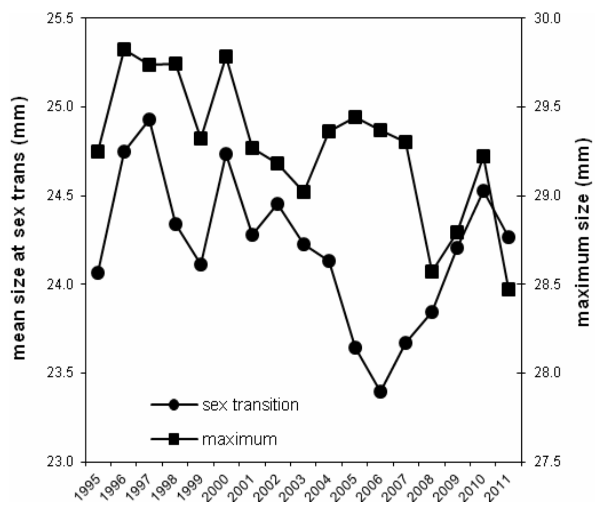

Figure 9. Changes in mean carapace size at sex transition and maximum carapace size.

Indicators of shrimp size began to decline in 2011. The **average sizes of females** in the catch decreased from 1997-2001 compared to the larger sizes of the early to mid 1990s (Figure 10, left). This trend reversed after 2001, as the survivors of these year classes continued to grow and the weaker succeeding year classes achieved larger sizes. Female size decreased greatly in 2007-2008 as the slow growing 2001 year class changed sex, but increased in 2009 as these females died off and were replaced by late-maturing males that had additional years to grow before sex transition. In 2011, new recruits to the female component of the population currently derive from smaller males that are transitioning after Age 4, as is characteristic of less abundant cohorts.

The **proportion of females** (Figure 10, left) caught increased from 2000-2004. This trend reversed in 2005-2008 as the 1993-1995 year classes died off and males from the strong 2001 year class recruited to the fishery. This began to reverse in 2009, much as in the previous cycle, and continued to increase in 2010 as late-maturing males recruit to the female component of the stock. The small increase in the proportion (by weight) of females in the 2011 catch reflects the relatively high spawning stock biomass relative to less abundant following year classes. Commercial **count** estimates (numbers of shrimp per pound) mirror these changes, increasing significantly in 2005-2007 as males from the 2001 year class recruited to the fishing gear (Figure 10, right). They have decreased since 2007 as these shrimp changed sex and continued to grow as females, and as the abundant Age 4+ males recorded in 2009 are recruiting to the female portion of the population. Counts increased slightly in 2011 due to the recruitment of the

2007 cohort to the fishery as smaller Age 4 males, while spawning stock biomass (large shrimp) decreased.

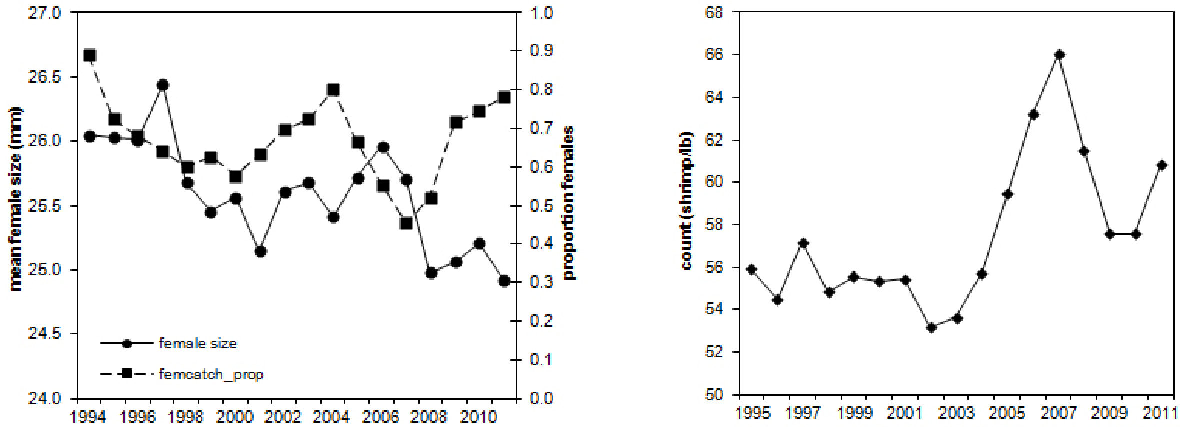

Figure 10. Mean female carapace length, proportion of females (left) and the count per pound (right) in the commercial shrimp trawl fishery.

Predator feeding studies have shown that shrimp are important prey for many finfish species, and significant negative correlations between shrimp and finfish abundance have been demonstrated from the Gulf of Maine to Greenland. Although many groundfish stocks remain at low levels on the Eastern Scotian Shelf, the index of predation increased sharply in 2011 (Figure 11). If this trend continues, the possibility that **natural mortality due to predation** will increase bears consideration.

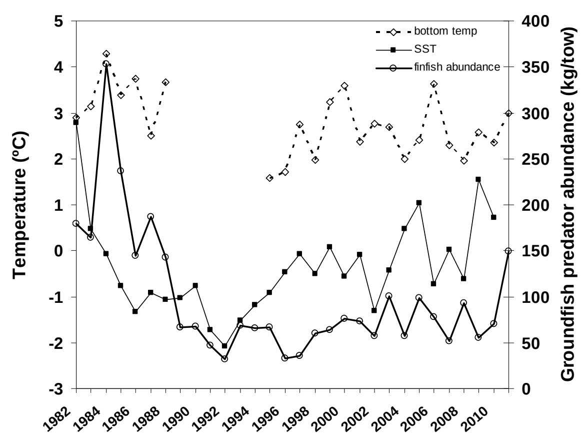

Figure 11. Bottom temperatures and predator abundance on the Eastern Scotian Shelf shrimp grounds.

For some Northern Shrimp stocks near the southern limits of the species' range, abundance is negatively correlated with water temperatures. On the Eastern Scotian Shelf, the large population increase that occurred from the mid 1980s to the mid 1990s is associated with colder surface and bottom **water temperatures**. This is at least partly because colder temperatures increase the length of the egg incubation period, resulting in later egg hatchings that are closer to the spring phytoplankton bloom and warming of the surface layers where larvae feed and grow. Large fluctuations in bottom water temperatures (Figure 10) may also be associated with the cyclical recruitment pattern experienced since the early 1990s (i.e., 1993-1995, 2001 and 2007-2008 year classes). **Spring surface temperatures** remained high in 2011, while shrimp **survey bottom temperatures** also increased, which could have a negative effect on recruitment in 2012, and would be a concern for the shrimp stock if the trend continues. The abundance of cold water indicator species (**capelin** and **Greenland Halibut**) both decreased, suggesting that current environmental conditions are not optimal for coldwater species such as shrimp.

The introduction of the Nordmøre grate in 1991 reduced **bycatch** and allowed the fishery to expand to its present size. Bycatch information from Observer coverage of 121 commercial sets from 2010 (4 trips from Gulf-based vessels; 3 trips from Nova Scotia vessels) and 2011 (2 trips from Nova Scotia vessels) suggests that Gulf and Nova Scotia fleet trawl configurations including the use of the Nordmøre grate continue to ensure low total bycatch (2.71%) by weight. It is noteworthy that this value is very likely over-estimated due to the minimum 1 kg weight recorded by the observers (e.g. a single sand lance would be recorded as 1 kg despite weighing only a few grams). However, total bycatch by weight from observed trips in 2010-2011 is approximately 50% higher than was summarized from observed trips in 2008-2010 (Hardie et al. 2011), which appears to be due to the addition of Observer coverage in SFA 13, where high bycatch of herring (1.97%) and capelin (3.45%) contributed to a total bycatch by weight of 7.3%, much higher than in the other areas. Striped Wolffish were caught in one observed commercial set (8 juveniles weighing less than 2 kg in total). Nonetheless, the Eastern Scotian Shelf mobile shrimp fishery currently poses little risk in terms of bycatch amount or species-composition.

Figure 12 provides a summary of 25 indicators related to the health of the Eastern Scotian Shelf shrimp stock. Each indicator was assigned a color for every year there is data according to its percentile value in the series (i.e., >0.66 percentile = green or healthy, 0.66-0.33 percentile = yellow or cautious, and <0.33 percentile = red or critical). Indicators have been grouped into stock characteristics of abundance, production, fishing effects and ecosystem. Note that indicators are not weighted in terms of their importance, and the summary given at the top of the figure was determined as a simple average of individual indicators.

The summary indicator for 2010 decreased from green to yellow after the complete 2010 data were updated from all sources. In 2011, based on complete survey data and partial commercial data, the summary indicator declined further from yellow to red. In general, the Abundance characteristics remained quite favourable, while the Production (green to yellow), Fishing Effects (red to lower red) and Ecosystem (green to red) characteristics became much less favourable.

The Abundance characteristic has remained favourable (green) for the last eight years due to the influence of the commercial CPUE indices which remained strong throughout the downturn in the survey index from 2005-2008. In 2011, the downturn in the survey CPUE index was offset by a stable or increasing commercial CPUEs and improvements in the coefficient of variation of survey catches and improvements in the area of moderate commercial catch rates.

There were sharp declines in the abundance of Age 1 (belly-bag) and Age 2 shrimp, as well as decreases in indices of shrimp size and an increase in predator abundance. However, spawning stock biomass remains at a healthy level and the abundant Age 4 shrimp are expected to recruit to the female portion of the population in 2012. The index of female exploitation for 2011 reached (and slightly exceeded) the precautionary approach removal reference, and the expected proportion of the TAC taken during the ovigerous period is the highest on record. Changes in most other indicators are minor, and mostly reflect high natural mortality of the late-maturing age classes that followed the 2001 year class. Ecosystem indicators were unfavourable for 2011, due to high water temperature and low sympatric species (cod, Greenland Halibut, capelin) abundances.

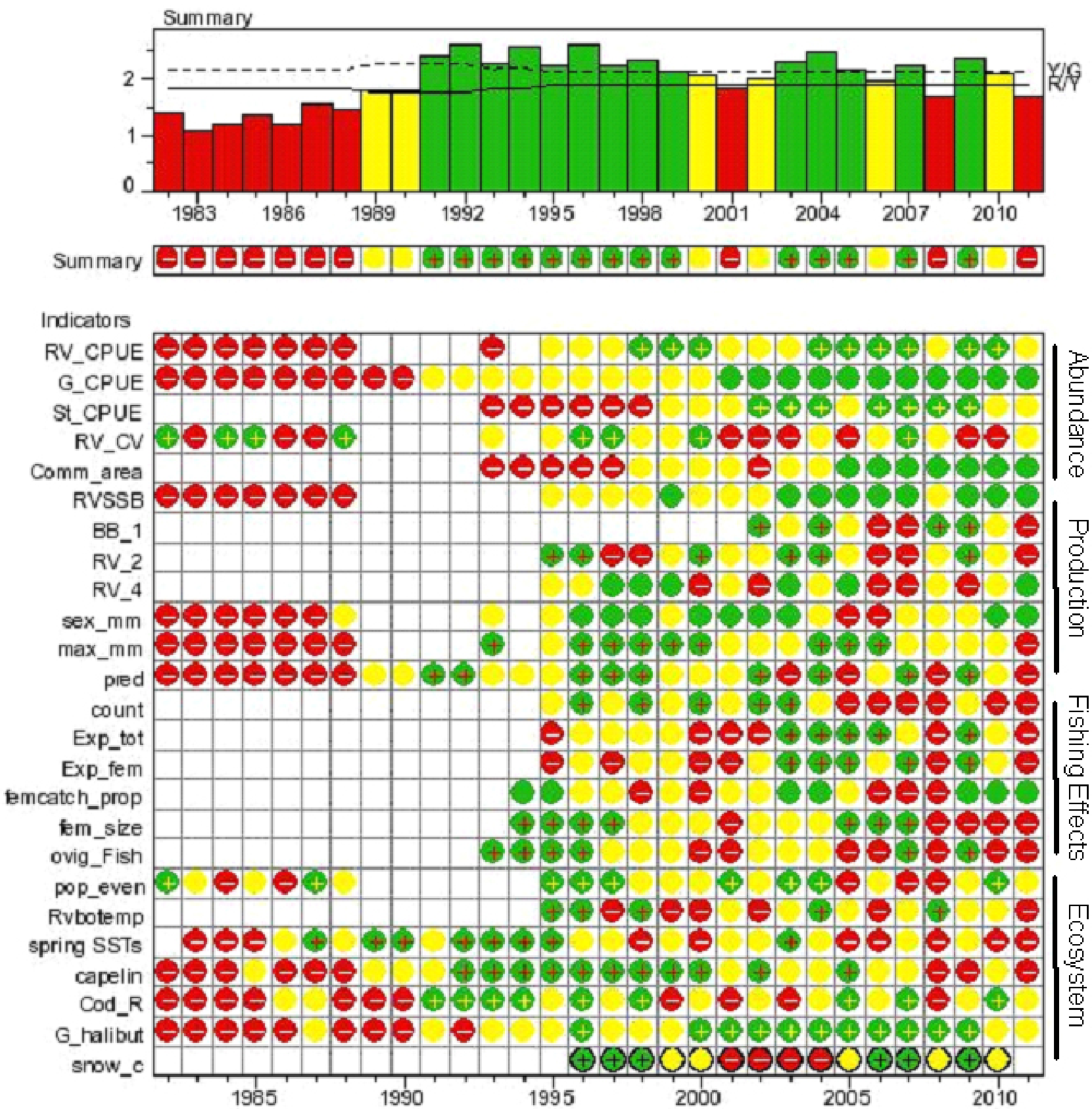

Figure 12. Traffic Light Analysis. Not all indicators in the Traffic Light table are discussed in the text. Please consult the current CSAS Research Document for a detailed description.

Sources of Uncertainty

DFO-Industry shrimp survey results are associated with high variances and biases associated with survey gear changes. Spatial and temporal variability in the distribution of shrimp is a source of uncertainty with regard to the accuracy of survey estimates; the survey is conducted consistently during the first 10 days of June to try to mitigate this effect. In 2007-2008 problems with NETMIND distance sensors and data logging required use of historical average instead of actual wing spread data to calculate swept areas and abundance. Given the inability to accurately age shrimp, modal groups are assigned to age classes, a process that is somewhat subjective, particularly for larger individuals. Growth rates can change dramatically due to density dependence, as happened with the strong 2001 year class. Consequently, recruitment to the fishery will be delayed and spread over a longer time period.

CONCLUSIONS AND ADVICE

The DFO-Industry survey stratified mean decreased by 18% for the second year in a row. The biomass estimate fell from 37,510 to 30,510 mt. This is consistent with the prediction of a lag between the complete mortality of the long-lived 2001 year class in 2010 and the recruitment of the next moderately abundant 2007-2008 year classes to the fishery in 2012-2013.

Although commercial CPUEs were stable (standardized) or increasing (Gulf-based vessels) the distribution of catch rates are consistent with a declining resource, where areas of very high catch rates continue to decline while areas of low-moderate catch rates are stable or increasing. For the past two years, a large proportion of the TAC (32-41%, assuming the TAC is caught in 2011) has been taken during the egg-bearing period, which risks a loss of reproductive potential by removing egg-bearing females before spawning.

The point estimate of the 2011 spawning stock biomass (16,823 mt) decreased (by about 22%) for the second consecutive year from the near-record high 2009 estimate, but remains above the upper limit reference point of 14,558 mt (i.e., it is in the Healthy Zone).

Because the relative decrease in the point estimate of spawning stock biomass exceeded the TAC reduction from 2010 to 2011 (i.e., TAC was reduced to 4600 mt in 2011), female exploitation rose to 20.3%, which is slightly above the removal reference point of 20%. This is based on the assumption that the TAC will be caught.

Indices of production suggest very poor recruitment from the 2010 year class, which is consistent with high spring sea surface temperatures that year. The abundance of Age 2 shrimp also decreased in 2011, which is consistent with the low belly-bag index in 2010. The abundant 2007 year-class increased the index of abundance of Age 4 male shrimp by 50% in 2010, which is expected to provide good recruitment to the spawning stock biomass. This is consistent with the increase in Age 3 shrimp from length-frequency analysis in 2010. The 2007 year class is expected to fully enter the fishery in 2012.

Size-based indicators (size at sex-transition, average maximum size, female size, count) show that the size of shrimp in the population is decreasing. This is consistent with the end of the influence of the late-maturing year classes that followed the 2001 year class and matured as larger than average females, and their replacement by smaller shrimp that are not delaying maturity, as is characteristic of less abundance year classes.

Ecosystem indicators (high temperatures and reductions in the abundance of sympatric species) suggest that conditions are currently unfavourable for shrimp. Temperatures and the abundance of predators known to have a negative influence on juvenile shrimp recruitment increased in 2011, and the abundance of sympatric species decreased.

The overall “traffic light”, summarizing 25 stock health indicators, reverted from green to yellow when the 2010 data were finalized, and further reduced to red for 2011, largely due to negative values of production and ecosystem characteristics and the ongoing downturn of abundance resulting in exploitation increases. Although the index of stock abundance remains in the Healthy Zone, the removal reference was exceeded (assuming the TAC is caught), albeit barely, in 2011.

A TAC reduction is recommended for 2012. Despite generally favourable indicators of abundance, the continuation of the biomass downturn in 2011, coupled with the decreases in shrimp size, poor recruitment, a temporal shift in fishing effort (i.e., a large proportion of the catch taken during the ovigerous period in recent years), and unfavourable ecosystem indicators, suggest that a TAC reduction would be prudent for 2012 to minimize the likelihood of bringing the stock below the upper limit reference point or of further exceeding the removal reference point. Although the stock is currently within the Healthy Zone, and the 2007-2008 year classes are likely to help sustain this situation over the next two years, several other lines of evidence point to a biomass downturn in the following years as a series of poor age-classes will follow. Moreover, decreasing indicators of shrimp size will further limit recruitment (because fecundity is directly related to size). A TAC reduction is recommended to maintain precautionary (higher) spawning stock and total population biomass to encourage escapement of a larger proportion of females to increase the likelihood of strong recruitment if conditions are suitable.

SOURCES OF INFORMATION

This Science Advisory Report has resulted from a Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Maritimes Regional Advisory Meeting of December 5, 2011 on the Assessment of Eastern Scotian Shelf Shrimp; Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

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