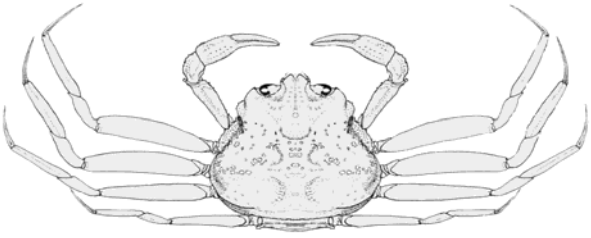
Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Newfoundland and Labrador Region

Canadian Science Advisory Secretariat
Science Advisory Report 2009/045

ASSESSMENT OF NEWFOUNDLAND AND LABRADOR SNOW CRAB



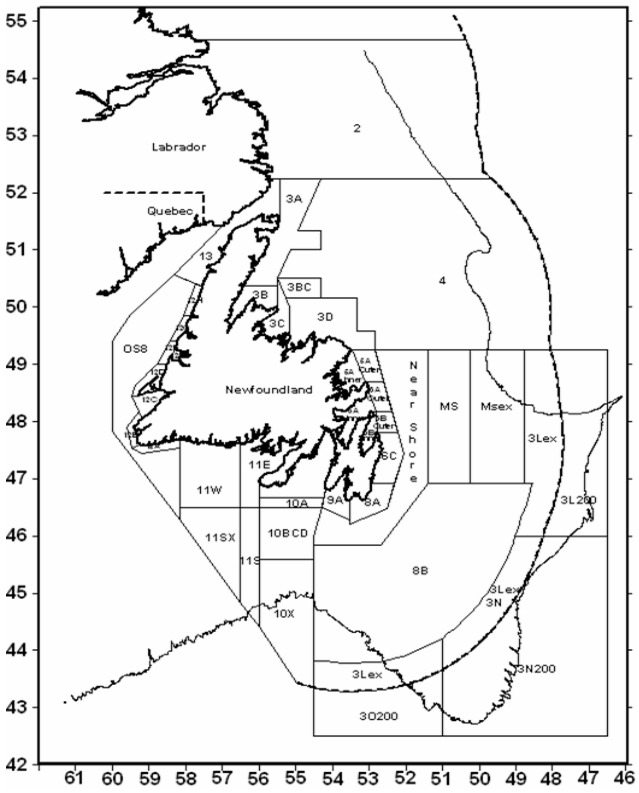


Figure 1: Newfoundland and Labrador Snow Crab Management Areas.

Context

Snow crab (Chionoecetes opilio) occur over a broad depth range in the Northwest Atlantic from Greenland to the Gulf of Maine. Distribution in waters off Newfoundland and southern Labrador is widespread and continuous.

Crab harvesters use fleets of conical baited traps. The minimum legal size is 95 mm carapace width (CW). This regulation excludes females from the fishery while ensuring that a portion of the adult males in the population remains available for reproduction.

Total Allowable Catch (TAC) management was initiated in the late 1980's. This led to the development of multiple TAC-controlled management areas (Fig. 1) with over 3300 licence holders across several vessel fleets under enterprise allocation in 2008. All fleets have designated trap limits, quotas, trip limits, fishing areas within divisions, and differing seasons.

Stock status is assessed annually for inshore and offshore areas (where applicable) within each NAFO Division. A vessel monitoring system (VMS) was fully implemented in the offshore fleets in 2004.

Resource status is evaluated based on trends in fishery catch per unit of effort (CPUE), exploitable biomass indices, recruitment prospects, and mortality indices. Data are derived from multi-species bottom trawl surveys in Div. 2HJ3KLNOP, DFO inshore trap surveys in Div. 3KL, fishery data from logbooks, observer catch-effort data, industry-DFO collaborative trap survey data, as well as biological sampling data from multiple sources.

A meeting of the Regional Advisory Process (RAP) was held Feb. 17-21 and Feb. 23-27, 2009 in St. John's, NL to assess the status of the snow crab resource. Participants included DFO scientists, fisheries managers, and representatives from industry, the provincial government and Memorial University.

SUMMARY

- Total landings increased by 20% since 2005 to 52,800 t in 2008.
- The multi-species trawl surveys indicate that the exploitable biomass declined from the late 1990's to 2003, but has since increased.
- Recruitment has increased overall since 2005.
- Longer-term recruitment prospects are uncertain.

Division 2H

- A commercial TAC was first established in 2008, at 100 t, and landings totaled 140 t.
- The exploitable biomass has decreased in recent years. The post-season trawl survey exploitable biomass index doubled between 2004 and 2006, but has since decreased by 66%.
- Recruitment has decreased since 2004 and is expected to be low over the next several years.
- Maintaining the current level of fishery removals would likely result in an increase in the exploitation rate in 2009.

Division 2J

- Landings increased by 60% from 1500 t in 2005 to 2400 t in 2008, following a decline since 2002, while effort declined by 18%.
- CPUE has increased steadily since 2004 to the long-term average.
- The exploitable biomass decreased in 2008. The post-season trawl survey exploitable biomass index increased from 2002-07, remaining below levels observed prior to 2002. This index and the post-season trap survey index both decreased in 2008.
- Post-season trawl and trap surveys indicate that recruitment will decrease in 2009 and remain relatively low in the short term.
- The exploitation rate index and the pre-recruit fishing mortality index both declined sharply from 2003-05 and have since changed little.
- Maintaining the current level of fishery removals would likely result in an increase in the exploitation rate in 2009.

Division 3K Offshore

- Landings almost doubled from 5970 t in 2005 to 11,600 t in 2008 after decreasing sharply in 2005. Effort declined by 50% from 2005-07 and increased by 12% in 2008.
- CPUE increased sharply from 2005 to a record high level in 2008.
- The exploitable biomass increased substantially in recent years and remains relatively high, as indicated by both post-season surveys.
- Recruitment remains promising for the next several years.
- The trawl survey exploitation rate index has declined slightly over the past 3 years. The pre-recruit fishing mortality index decreased sharply in 2006 and has since changed little.
- Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

Division 3K Inshore

- Landings increased by 28% from 2700 t in 2005 to 3460 t in 2008, after decreasing by 21% from 2004-05, while effort declined by 48%.
- CPUE increased sharply from 2005 to a record high level in 2008.
- The exploitable biomass increased substantially to 2006 and remains relatively high. The fall trap survey exploitable biomass index increased from 2004-06 and since changed little.
- Recruitment prospects are uncertain.
- The trap survey-based exploitation rate index changed little since 2005. Data are insufficient to estimate pre-recruit mortality rates.
- Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

Division 3L Offshore

- Landings have averaged about 20,000 t since 2000, while effort has increased steadily to its highest level in 2008.
- CPUE has declined steadily from 2000-08, to the lowest level since 1991.
- Trends in the exploitable biomass are uncertain but levels remain low. The exploitable biomass index declined sharply in both post-season surveys in 2006. It has since remained low in the trap survey but has increased in the trawl survey over the past two years.
- Both post-season surveys indicate that recruitment has been increasing and is expected to increase further over the next two to three years.
- The exploitation rate index remained at a high level in 2008 while the pre-recruit fishing mortality rate index decreased to about the long-term average.
- The ratio of pre-recruits to exploitable crab is expected to increase to a high level due to the low biomass and increasing recruitment. This could pose a risk of high fishery-induced mortality to soft-shelled immediate pre-recruits in 2009.

Division 3L Inshore

- Landings increased by 12% from 6100 t in 2005 to 6825 t in 2008, while effort decreased by 23%.
- CPUE increased by 53% from 2004 to 2008.
- The post-season trap survey exploitable biomass index indicates the exploitable biomass increased from 2004-06 and changed little since.
- Recruitment prospects are uncertain.
- The trap survey-based exploitation rate index changed little since 2005. Data are insufficient to estimate pre-recruit mortality rates.
- Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

Division 3NO

- The fishery has been primarily concentrated along the shelf edge. Landings increased by 22% from 3600 t in 2005 to 4400 t in 2008 while effort increased by 57%, to an all-time high in 2008.
- CPUE has declined since 2002, to its lowest level in 2008.
- Trends in the exploitable biomass are uncertain as survey indices are unreliable.

- Recruitment has been increasing and is expected to increase further over the next two to three years.
- The abundance of pre-recruits is expected to increase in 2009. This could pose a risk of high fishery-induced mortality to soft-shelled immediate pre-recruits in 2009.

Subdivision 3Ps Offshore

- Landings increased by 35% from 2340 t in 2006 to 3180 t in 2008, following a 46% decline from 2002-06. Effort increased by 19% in 2007 and decreased by 25% in 2008 to its lowest level since 2001.
- CPUE increased by 48% in 2008 but remains below the long-term average.
- Trends in the exploitable biomass are uncertain but the level remains low. The post season trap survey exploitable biomass index increased slightly since 2004. Meanwhile the pre-season trawl survey exploitable biomass index has shown no trend and remains well below pre-2001 levels.
- The pre-season trawl survey indicates that recruitment has been increasing and is expected to increase further over the next two to three years.
- Exploitation rate indices based on trap and trawl surveys have shown no consistent trend over the past 4 years. The trawl survey pre-recruit fishing mortality index has declined sharply since 2003 to a very low level.
- Maintaining the current level of fishery removals would not likely result in a substantial change in fishery-induced mortality.

Subdivision 3Ps Inshore

- Landings doubled from 660 t in 2005 to 1350 t in 2008, following an 80% decline since 2002. Meanwhile, effort changed little since 2005 until it decreased by 22% in 2008.
- CPUE more than doubled since 2005 to the long-term average.
- The exploitable biomass has recently increased. The post-season trap survey exploitable biomass index increased substantially from 2006-08.
- The post-season trap survey indicates that recruitment prospects remain promising in the short-term.
- The post-season trap survey-based exploitation rate index fluctuated without trend during 2005-08. Data are insufficient to estimate pre-recruit fishing mortality rates.
- Fishery removals could likely be increased in 2009 without increasing the exploitation rate.

Division 4R Offshore

- Landings and effort peaked in 2002 before steadily declining to historical lows in 2006. Landings and effort have been variable in recent years, but remained at low levels.
- There are insufficient data to assess resource status.

Division 4R Inshore

- Landings declined by 74% from 950 t in 2003 to a record low of 250 t in 2008. Effort decreased sharply in 2005 and changed little since.
- CPUE has steadily declined since 2002 to its lowest level in 2008.

- Post-season trap survey catch rates show that the exploitable biomass declined from 2004–06 and changed little since.
- Recruitment is expected to change little over the next two to three years.
- Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2009.

BACKGROUND

Species Biology

The snow crab life cycle features a planktonic larval period, following spring hatching, involving several stages before settlement. Benthic juveniles of both sexes molt frequently, and at about 40 mm CW (~ 4 years of age) they may become sexually mature.

Crabs grow by molting, in spring. Females cease molting after sexual maturity is achieved at about 40-75 mm CW and so do not contribute to the exploitable biomass. However sexually mature (adolescent) males may continue to molt annually until their terminal molt, when they develop enlarged claws (adults), which enhances their mating ability. Males may molt to adulthood within a size range of about 40-115 mm CW, and so only a portion of any cohort will recruit to the fishery at 95 mm CW (~ 8 years of age).

Adult legal-sized males remain new-shelled with low meat yield throughout the remainder of the year of their terminal molt. They are considered to be pre-recruits until the following year when they begin to contribute to the exploitable biomass as older-shelled adults. Males may live about 5-6 years as adults after the terminal molt.

Large males are most common on mud or mud/sand, while smaller crabs are common on harder substrates. Snow crab diet includes fish, clams, polychaete worms, brittle stars, shrimp, snow crab, and other crustaceans. Predators include various groundfish, other snow crabs, and seals.

The Fishery

The fishery began in Trinity Bay (Management area 6A, Fig. 1) in 1967. Initially, crabs were taken as gillnet by-catch but within several years a directed trap fishery developed in inshore areas along the northeast coast of Div. 3KL. The minimum legal mesh size of traps is 135 mm, to allow small crabs to escape. Under-sized and new-shelled males that are retained in the traps are returned to the sea and an unknown proportion dies.

Until the early 1980's, the fishery was prosecuted by approximately 50 vessels limited to 800 traps each. In 1981 fishing was restricted to the NAFO Division where the licence holder resided. During 1982-87 there were major declines in the resource in traditional areas in Div. 3K and 3L while new fisheries started in Div. 2J, Subdiv. 3Ps and offshore Div. 3K. A snow crab fishery began in Div. 4R in 1993.

Licences supplemental to groundfishing were issued in Div. 3K and Subdiv. 3Ps in 1985, in Div. 3L in 1987, and in Div. 2J in the early 1990's. Since 1989 there has been a further expansion in the offshore. Temporary permits for inshore vessels <35 ft., introduced in 1995, were converted to licences in 2003. There are now several fleet sectors and about 3300 licence holders.

In the late 1980's quota control was initiated in all management areas of each division. All fleets have designated trap limits, quotas, trip limits, fishing areas within divisions, and differing seasons. The fishery has started earlier in recent years and is now prosecuted predominately in spring, resulting in reduced incidence of soft-shelled crabs. A protocol was initiated in 2004 that results in closure of localized areas when the percent soft-shelled crabs within the legal-sized catch exceeds 20%.

Mandatory use of the electronic vessel monitoring system (VMS) was fully implemented in all offshore fleets in 2004, to ensure compliance with regulations regarding area fished.

Landings for Div. 2HJ3KLNOP4R (Fig. 2) increased steadily from 1989 to peak at 69,100 t in 1999, largely due to expansion of the fishery to offshore areas. They decreased by 20% to 55,400 t in 2000 and changed little until they decreased to 44,000 t in 2005, primarily due to a sharp decrease in Div. 3K where the TAC was not taken. Landings increased by 20% since 2005 to 52,800 t in 2008, due primarily to increases in Div. 3K. Historically, most of the landings have been from Div. 3KL. Effort has increased since the 1980's and has been broadly distributed in recent years (Fig. 3).

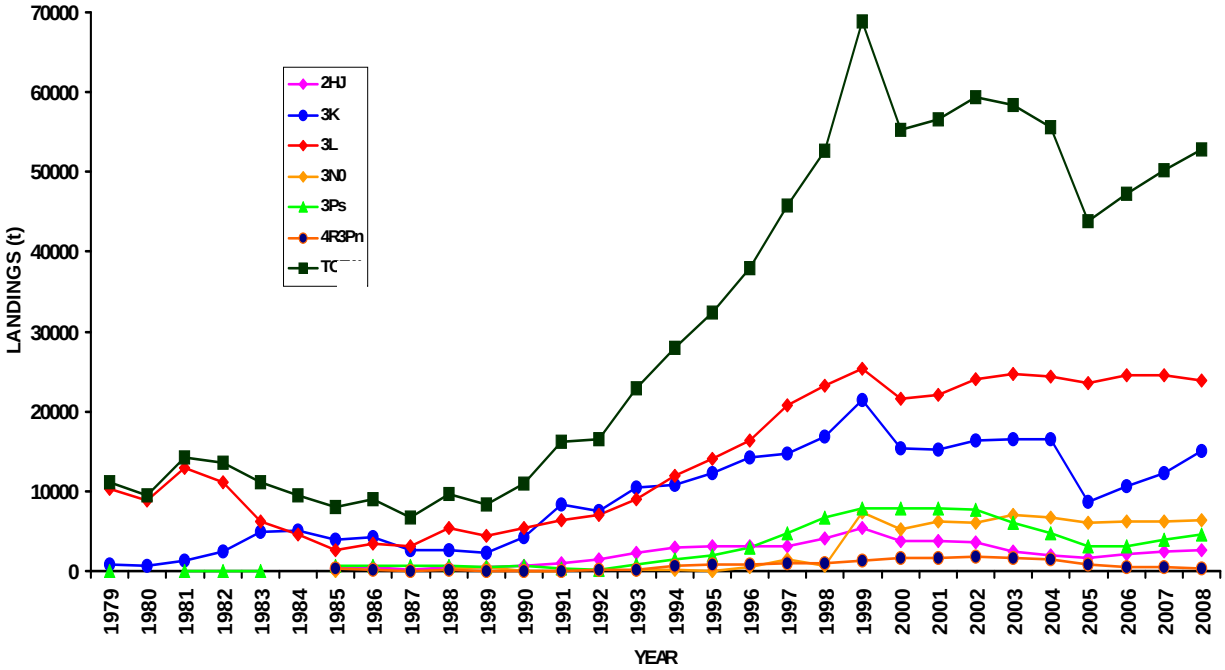


Figure 2: Trends in total landings by NAFO Division.

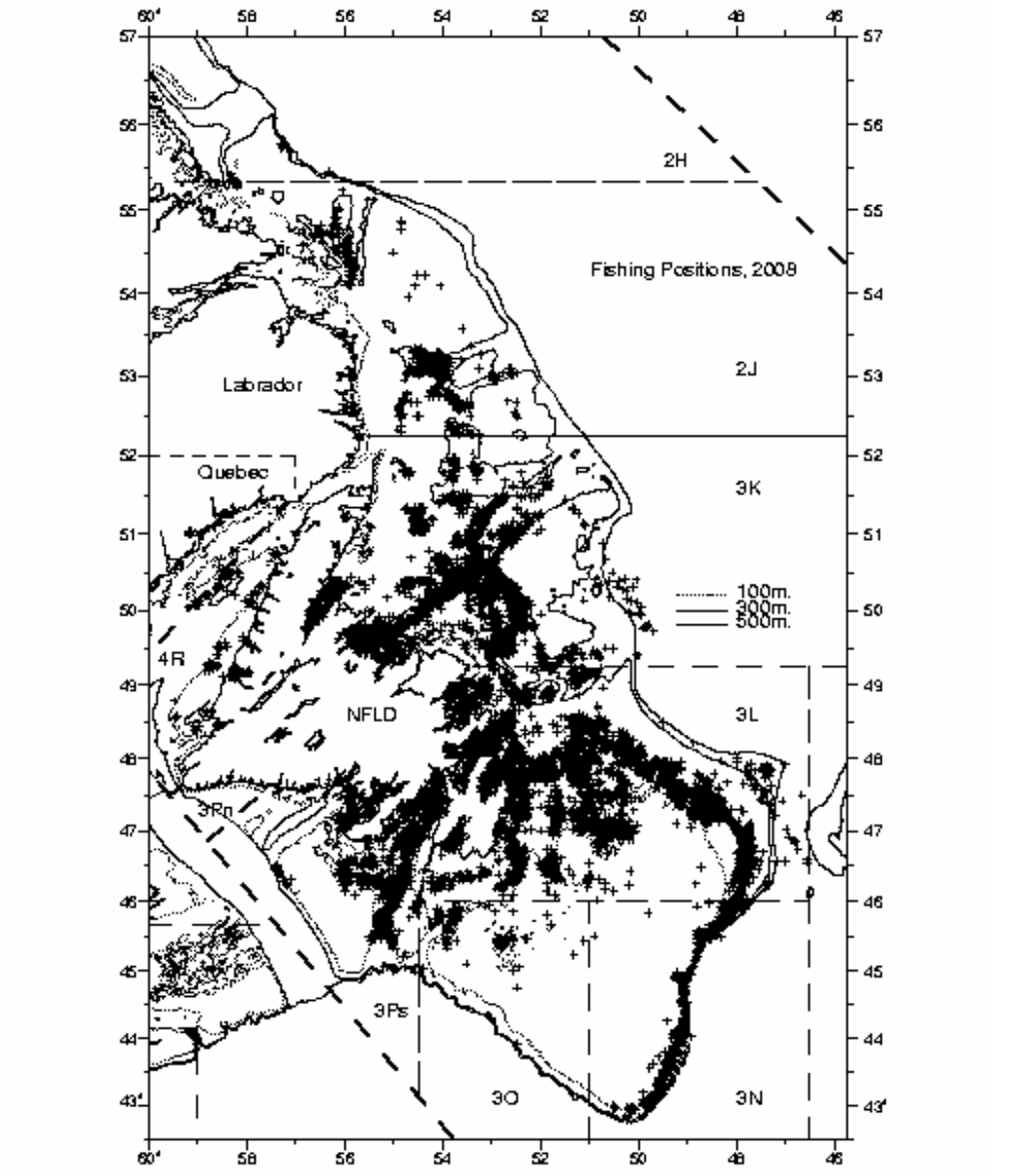


Figure 3: Spatial distribution of commercial fishing effort during 2008.

ASSESSMENT

Resource status was evaluated based on trends in fishery CPUE, exploitable biomass indices, recruitment prospects and mortality indices. Information was derived from multi-species bottom trawl surveys conducted during fall in Div. 2J3KLNO and during spring in Subdiv. 3Ps. The trawl used in these multi-species surveys was changed to a Campelen shrimp trawl in the fall of 1995 and this trawl proved to be more efficient in sampling crabs than the previously used groundfish trawl. Snow crab sampling during spring Subdiv. 3Ps surveys did not begin until 1999. The fall post-season trawl survey was conducted in Div. 2H during 1996-99, 2004, 2006 and 2008. Spring (pre-fishery) trawl surveys are considered to be less reliable than fall (post-fishery) surveys because some population components are relatively poorly sampled during spring when mating

and molting take place. Information was also available from an Industry-DFO fall post-fishery trap survey initiated in 2003. Fall post-season surveys provide the most recent data available for the annual RAP. Information is also utilized from DFO inshore trap and trawl surveys in Div. 3KL, fishery data from logbooks and observer catch-effort data, as well as biological sampling data from multiple sources.

The resource is assessed separately for offshore and inshore areas of each division, where appropriate (Div. 3KLPs4R). Div. 3NO represents a fully offshore area, and there is no distinction between inshore and offshore areas in Div. 2HJ (Figs. 1 and 3). More data are available in most divisions for offshore than for inshore areas. Trawl survey data are used only for offshore areas because these surveys have not consistently extended into inshore areas. Observer coverage and sampling has also been more extensive in offshore than inshore areas. Also, vessel monitoring devices are used only on offshore vessels.

Spring pre-season (Subdiv. 3Ps) and fall post-season (Div. 2HJ3KLNO) bottom trawl surveys provide data that are used to predict changes in biomass and recruitment for the upcoming fishery in the same year (Subdiv. 3Ps) or the following year (Div. 2HJ3KLNO). These surveys provide an index of the exploitable biomass (older-shelled adults of legal size) that is expected to be available for the upcoming fishery. This index, based on offshore survey strata, is used together with an exploitable biomass index (all legal-sized crabs) from the post-season collaborative trap survey in offshore areas to evaluate trends in the exploitable biomass. The inshore post-season collaborative trap survey exploitable biomass index is compared with commercial CPUE and catch rates from inshore DFO trap surveys, where available (Div. 3KL).

Bottom trawl surveys also provide data on adolescents larger than 75 mm CW that are used to calculate an index of pre-recruit males that would begin to recruit to the fishery 2 years later, as older-shelled adults. Recruitment prospects are also inferred from catch rates of sub-legal-sized (‘under-sized’) males from observer at-sea sampling and post-season trap surveys.

There is little evidence of progression of smallest males (<40 mm CW) to larger sizes from spring or fall multi-species survey size frequency data. Therefore, longer-term recruitment prospects are uncertain.

Fishery-induced mortality is a function of the proportion of the exploitable population that is harvested and the proportion of the pre-recruit population that dies as a result of being caught and released. Trends in exploitation rate are inferred from changes in the ratio of landings to the exploitable biomass index from the most recent trap and trawl surveys. Trends in pre-recruit fishing mortality are inferred from changes in the ratio of the estimated total catch of pre-recruits to the trawl survey pre-recruit biomass index from the most recent trawl survey. The total catch of pre-recruits is estimated as the ratio of observed discards to observed landings scaled to total landings. Mortality indices based on post-season trap surveys use biomass indices from the previous year. Those based on trawl surveys use the biomass indices from either the fall post-season survey of the previous year (Div. 2HJ3KLNO) or the spring pre-season survey of the same year (Subdiv. 3Ps).

The pre-recruit fishing mortality index reflects an unknown (but likely high) mortality on released pre-recruits. Pre-recruit mortality is reduced by increasing trap mesh size and soak time, as well as by careful handling and quick release of pre-recruits.
The percentage discarded by weight of the total catch, as estimated from observer data, is interpreted as an index of wastage of pre-recruits. Mortalities on pre-recruits, including wastage,

will impact short-term (about 1-3 years) recruitment. Also, mortality on small (<95 mm CW) males may adversely affect insemination of females, especially when abundance of larger males is low.

Overall Resource Status, Divisions 2HJ3KLNOP4R

The multi-species trawl surveys indicate that the exploitable biomass declined from the late 1990's to 2003-04, but has since increased (Fig. 4). The fall post-season surveys in Div. 2J3KLNO indicate that the exploitable biomass was highest during 1996-98. The more limited time series from spring multi-species surveys in Div. 3LNOPs also indicated a decline in exploitable biomass in the early years of the surveys. The spring and fall surveys both showed decreases in the exploitable biomass indices from 2001 to 2003-04, with little change until the fall index increased in 2007.

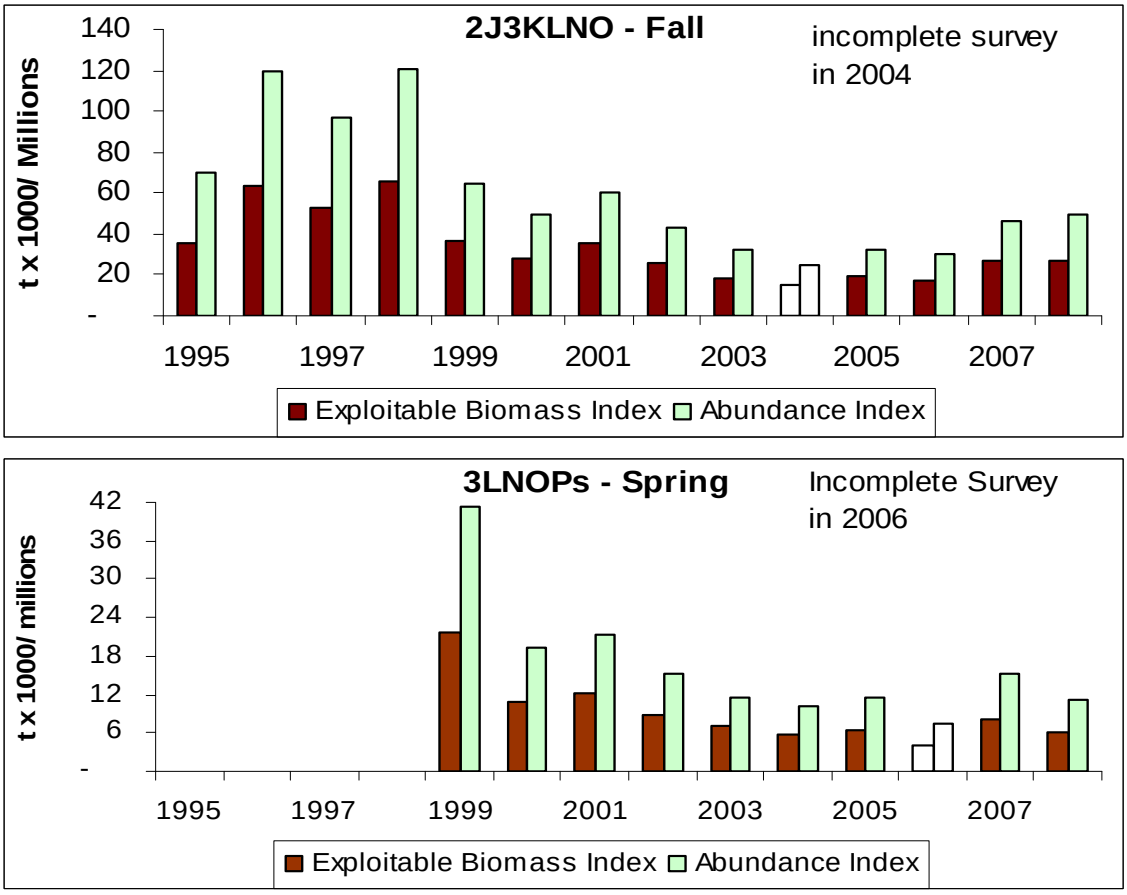


Figure 4: Trends in the multi-species survey exploitable biomass and abundance indices, for Div. 2J3KLNO during fall (above) and for Div. 3LNOPs during spring (below).

Recruitment has recently increased overall and prospects remain promising (Fig. 5). The survey abundance and biomass indices of pre-recruits have been increasing since 2005 due to increases in the south (Div. 3LNOPs).

Longer-term recruitment prospects are uncertain but the spring and fall surveys indicate that there has been a decline in abundance indices of smallest males (<60 mm CW) in recent years that may indicate reduced biomass in the long term.

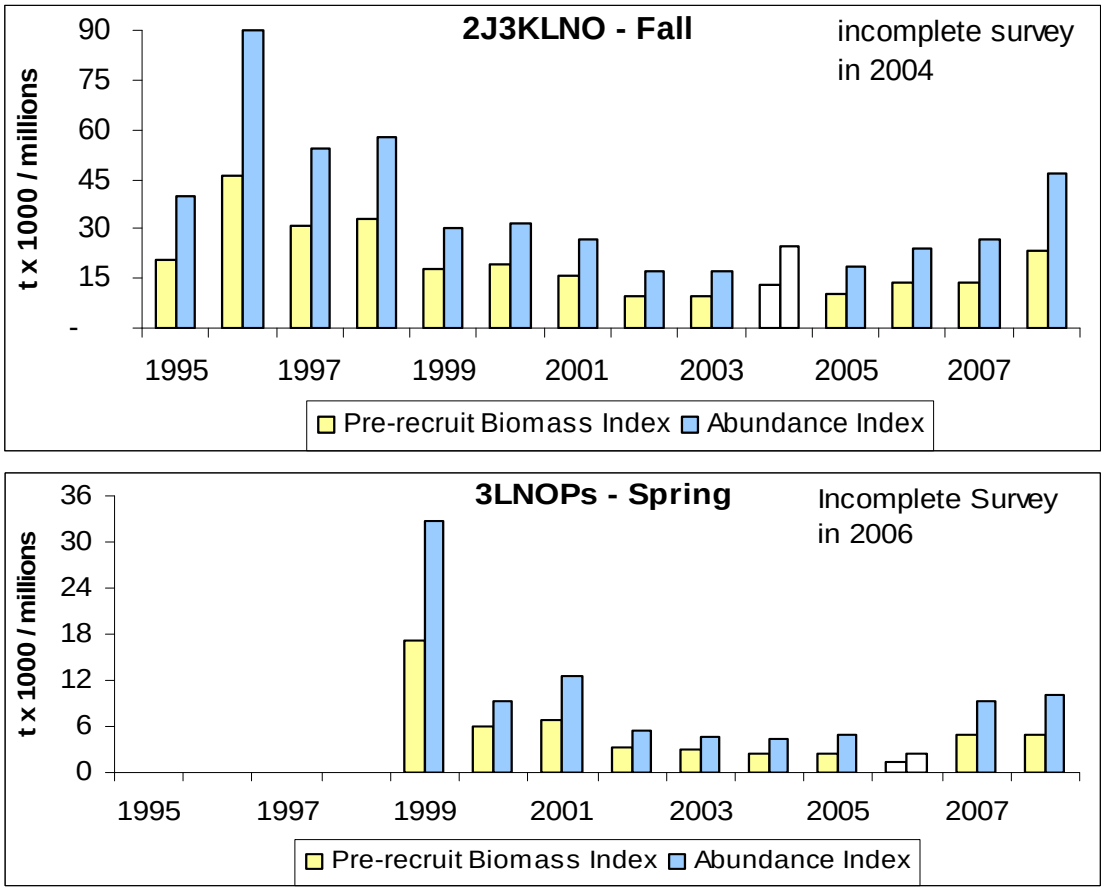


Figure 5: Trends in the multi-species survey pre-recruit biomass and abundance indices for Div. 2J3KLNO during fall (above) and for Div. 3LNOPs during spring (below).

Resource Status, Division 2H

Commercial Fishery

There have been exploratory fisheries since the mid 1990's. A commercial TAC was first established in 2008, at 100 t, and landings totaled 140 t.

Biomass

The exploitable biomass has decreased in recent years. The post-season trawl survey exploitable biomass index doubled between 2004 and 2006, but has since decreased by 66% t (Fig. 6).

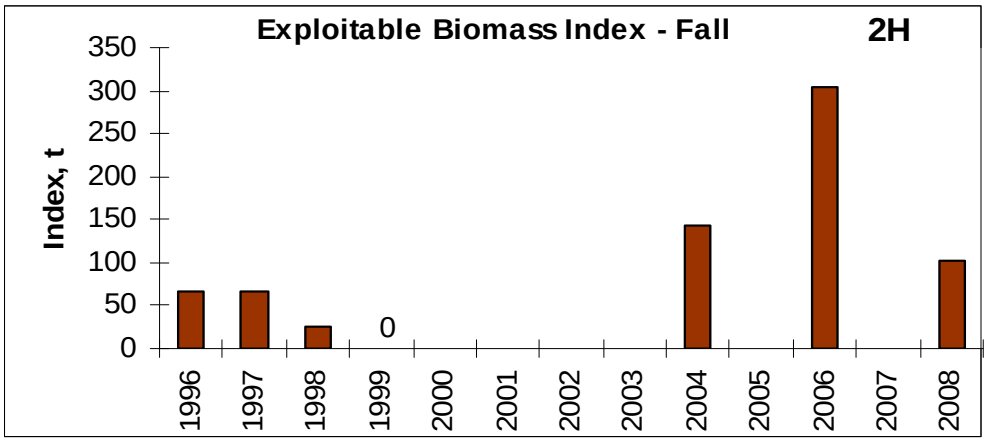


Figure 6: Trends in the Div. 2H exploitable biomass index based on the post-season trawl survey.

Recruitment

Recruitment has decreased since 2004 and is expected to be low over the next several years. The post-season trawl survey pre-recruit index decreased greatly between 2004 and 2008 (Fig. 7).

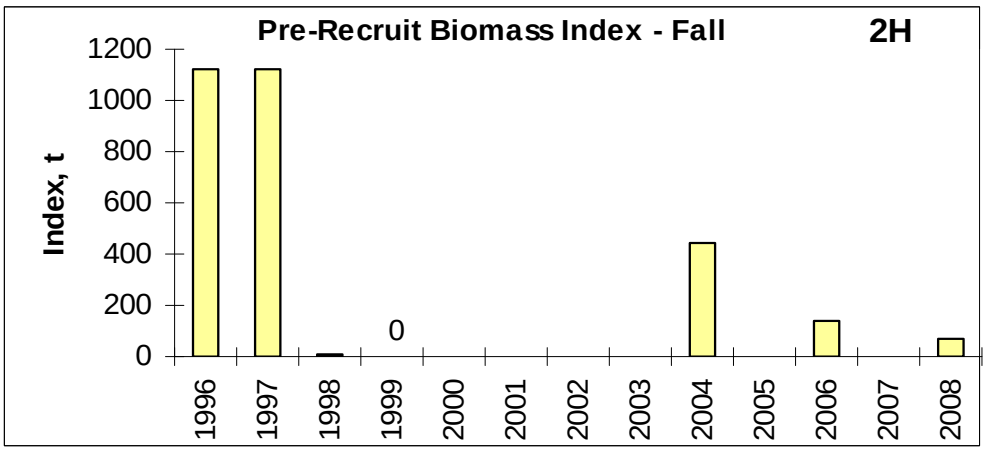


Figure 7: Trends in the Div. 2H pre-recruit biomass index based on the post-season trawl survey.

Mortality

Maintaining the current level of fishery removals would likely result in an increase in the exploitation rate in 2009.

Resource Status, Division 2J

Commercial Fishery

Landings (Fig. 8) peaked in 1999 at 5420 t, decreased sharply to 3680 t in 2000 and changed little to 2002, before declining to 2005. They increased by 60% from 1500 t in 2005 to 2400 t in 2008. Effort increased from 2000 to a record high level in 2002-04. It decreased sharply in 2005 and further declined by 18% to 2008.

The 2008 fishery was concentrated in Hawke and Cartwright channels, as it was in the previous two years. In 2006-2008 there was no fishery on the slope as there was in previous years.

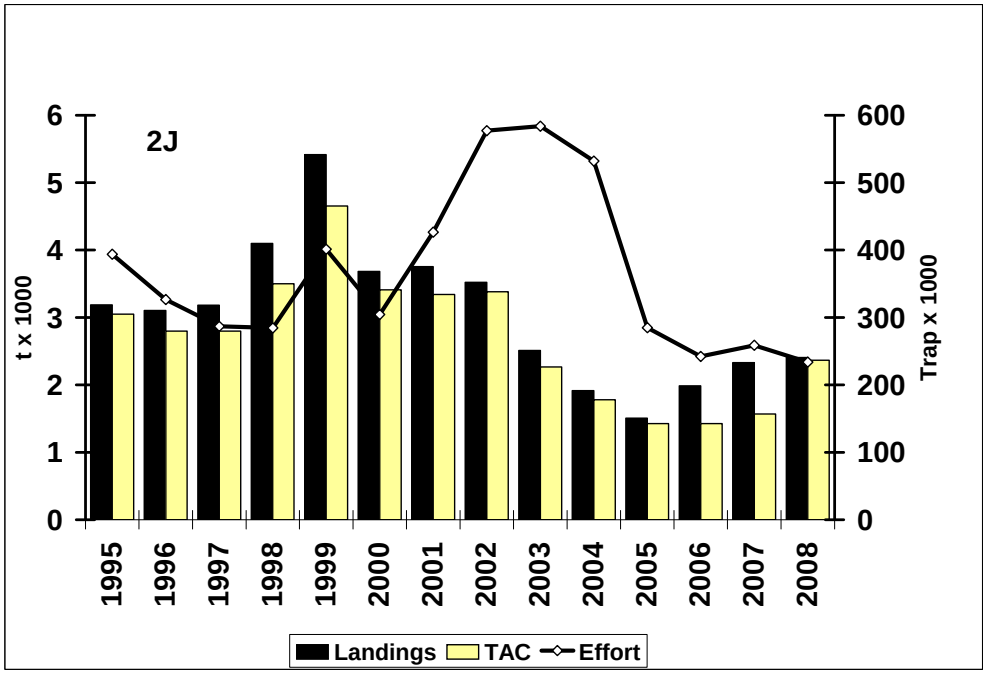


Figure 8: Trends in TAC, landings, and fishing effort in Div. 2J.

Commercial catch rate (CPUE) has oscillated over the time series (Fig. 9), initially decreasing from 1991-95, and increasing to a peak in 1998. It declined steadily by 76% from 1998 to a record low level in 2004. It has increased steadily since 2004 to the long-term average.

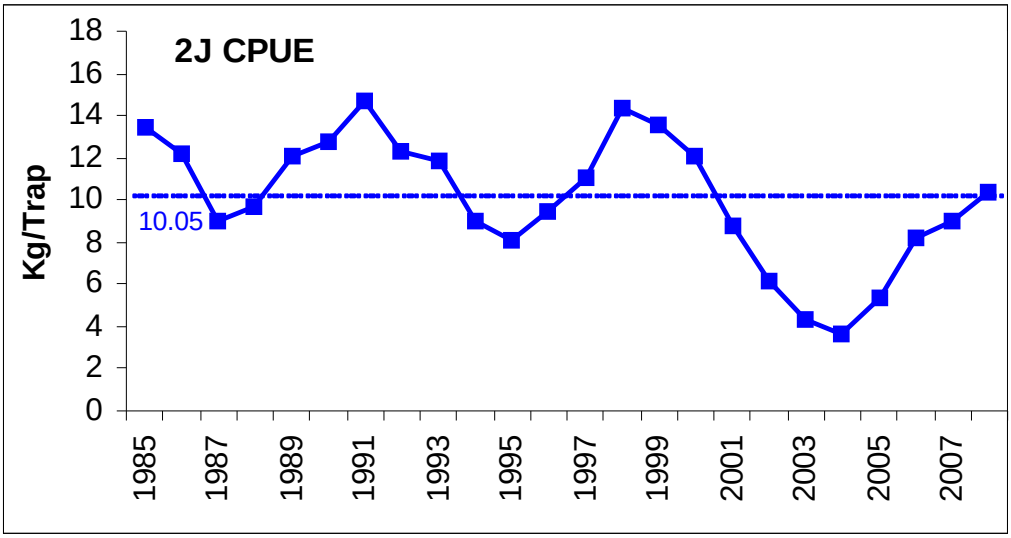


Figure 9: Trends in Div. 2J commercial CPUE in relation to the long-term average (dotted line).

Biomass

The exploitable biomass decreased in 2008. The post-season trawl survey exploitable biomass index decreased steadily, by 94%, from 1998-2002 (Fig. 10). It increased from 2002-07, remaining

below levels observed prior to 2002. This index and the post-season trap survey index both decreased in 2008. However, the post-season trap survey index is limited to only two years and reflects only the Hawke Channel portion of the fishery.

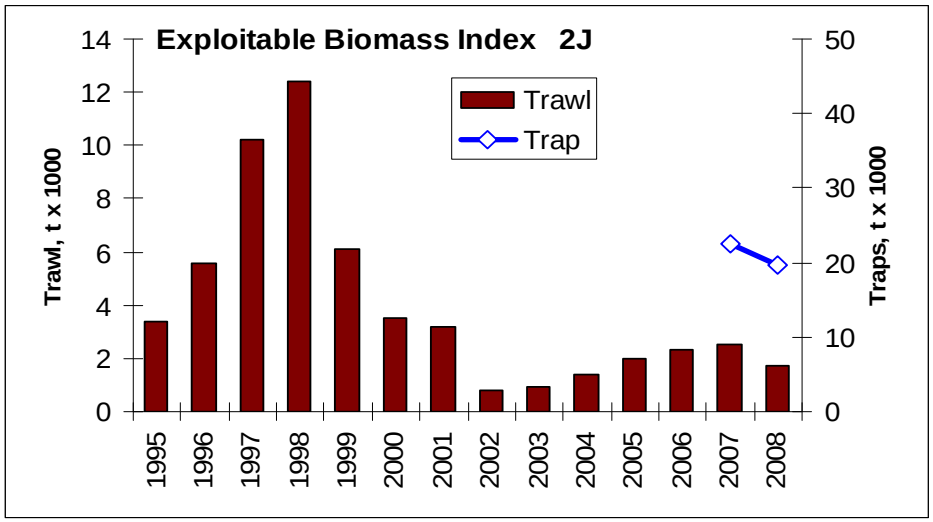


Figure 10: Trends in the Div. 2J exploitable biomass indices based on post season trawl and trap surveys.

Recruitment

The post-season trawl survey indicates that the component of the exploitable biomass that represents immediate recruits (new-shelled legal-sized crab) decreased in 2008, following an increase since 2002. This suggests that recruitment will decrease in 2009.

Recruitment is expected to decrease further in the next several years. The fall survey pre-recruit index decreased from 1998 to a lower level during 1999-2003 (Fig. 11) before increasing sharply to a peak in 2004. It has since decreased to the 1999-2003 level in 2007-08. The catch rate of under-sized crabs in the post-season trap survey decreased from 2007-08 (Fig. 11).

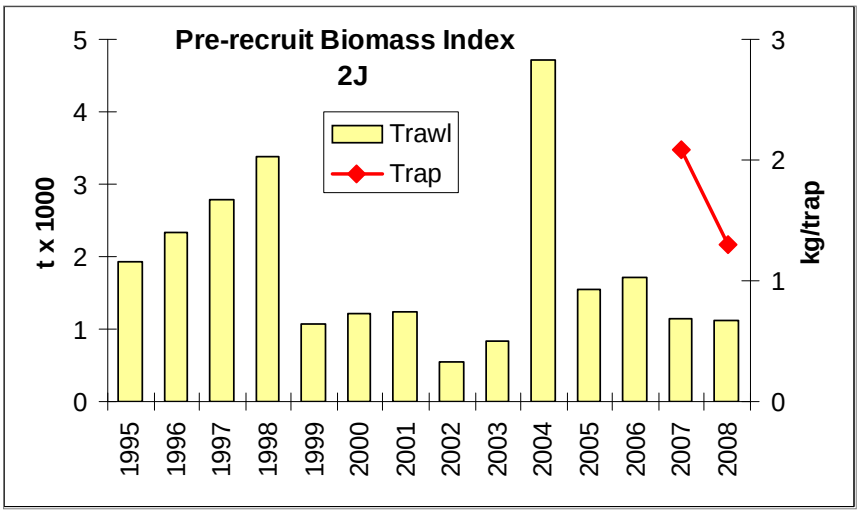


Figure 11: Trends in the Div. 2J post-season trawl survey pre-recruit biomass index and in the catch rate of under-sized crabs from the post-season collaborative trap survey.

Mortality

The percentage of the total catch discarded (Fig. 12) increased sharply in 2002, was unchanged in 2003, and further increased to a record high level in 2004. It has since declined sharply to its lowest level, implying reduced wastage of under-sized and new-shelled pre-recruits in the fishery.

The exploitation rate index increased sharply from 2000 to 2003 whereas the pre-recruit fishing mortality index increased sharply from 2001 to 2003. Both indices declined sharply from 2003-05 and have since changed little (Fig. 12), implying relatively low fishery-induced mortality in 2008.

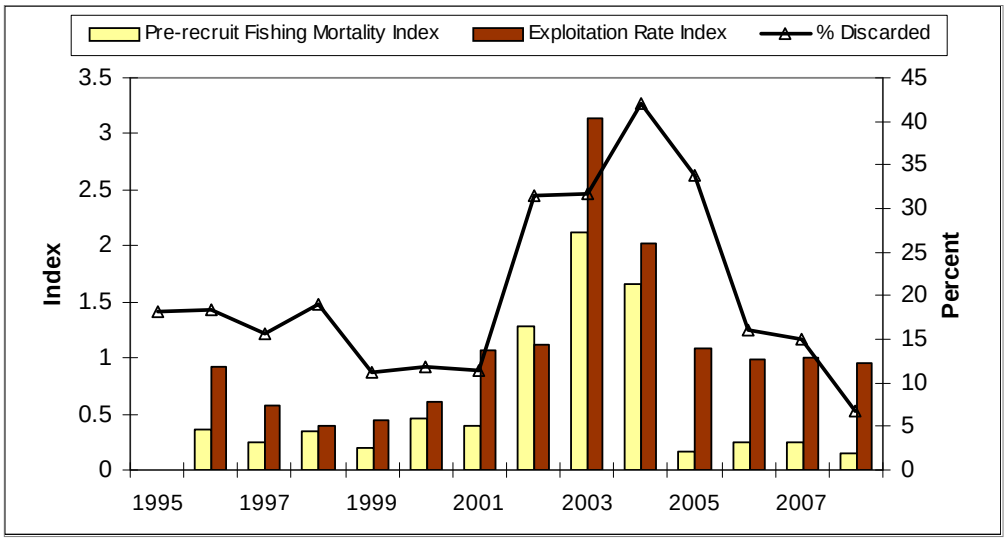


Figure 12: Trends in two Div. 2J mortality indices (the exploitation rate index and the pre-recruit fishing mortality index) and in the percentage of the catch discarded in the fishery.

Maintaining the current level of fishery removals would likely result in an increase in the exploitation rate in 2009.

Resource Status, Division 3K

Commercial Fishery

Offshore landings have generally been higher than inshore landings by a factor of 3-5 (Fig. 13). Offshore landings peaked in 1999 at 17,900 t. They decreased to about 13,000 t in 2000-04, due to a reduction in the TAC. They decreased sharply in 2005 when the TAC was not fully subscribed because the fishery was closed prematurely due to high levels of soft-shelled crabs in the catch. Landings almost doubled from 5970 t in 2005 to 11,600 t in 2008. Effort increased sharply in 2004 and decreased sharply in 2005. It declined by 26% from 2005-07 and increased by 12% in 2008.

Inshore landings (Fig. 13) peaked in 1999 at 3460 t and decreased sharply in 2000 due to a TAC reduction. They increased to 3340 t in 2003, changed little in 2004, and decreased by 21% in 2005. Landings increased by 28% from 2700 t in 2005 to 3460 t in 2008, while effort declined by 48%.

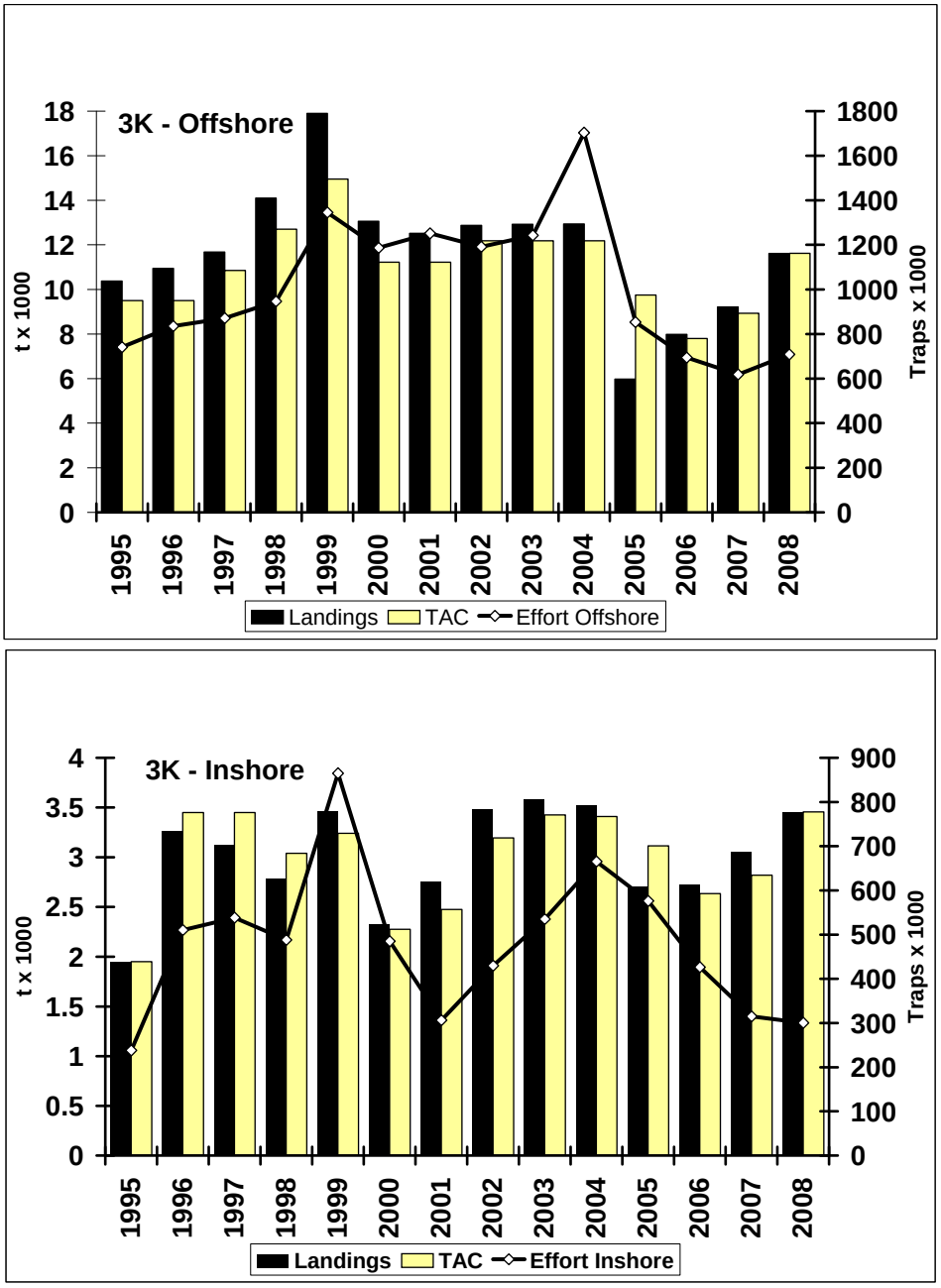


Figure 13: Trends in TAC, landings, and fishing effort in Div. 3K offshore (above) and inshore (below).

Commercial CPUE (Fig. 14) indicates that fishery performance has improved substantially in both inshore and offshore areas since 2004. Inshore CPUE has been consistently lower than offshore CPUE. Both offshore and inshore CPUE have increased sharply from 2005 to record high levels in 2008.

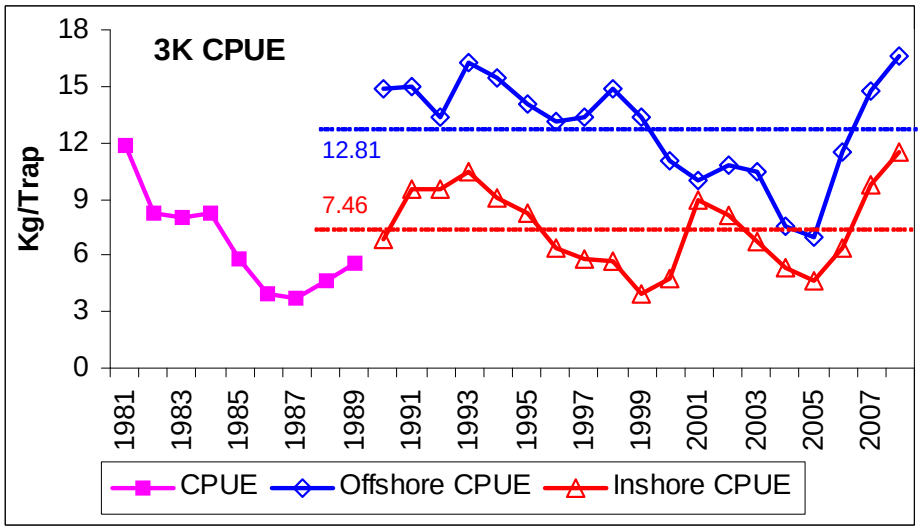


Figure 14: Trends in Div. 3K inshore and offshore commercial CPUE in relation to their long-term averages (dotted lines).

Division 3K Offshore

Biomass

The exploitable biomass increased substantially in recent years and remains relatively high, as indicated by both post-season surveys. The post-season trawl survey exploitable biomass index (Fig. 15) decreased from its highest level by almost half in 1999. It changed little until it decreased again from 2001 to its lowest level in 2003. It increased sharply from 2003-07 to approach the highest level previously observed before decreasing slightly in 2008. The post-season trap survey exploitable biomass index increased sharply in 2006 (Fig. 15) and has since fluctuated while remaining higher than it was during 2004-05.

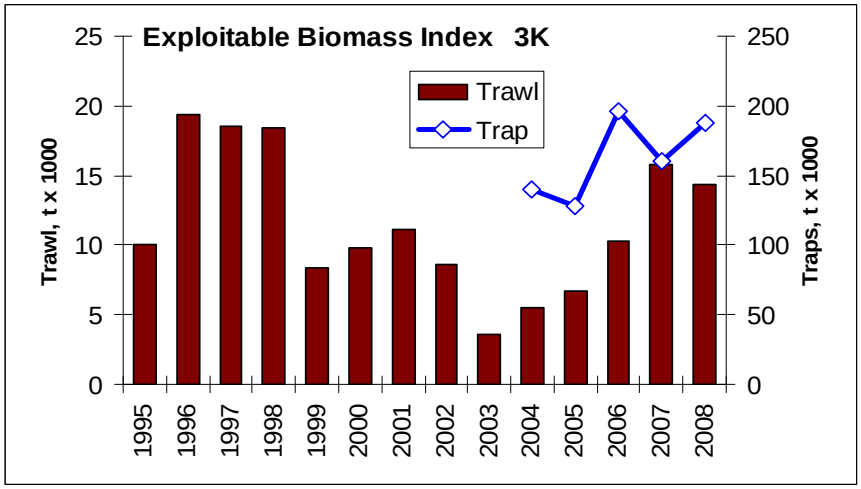


Figure 15: Trends in the Div. 3K offshore exploitable biomass indices based on post-season trawl and trap surveys.

Recruitment

Recruitment has increased in the recent years, as reflected by the increase in exploitable biomass while landings increased**.** Also, the post-season trawl survey indicates that the component of the exploitable biomass that represents immediate recruits (new-shelled legal-sized crab) has increased steadily since 2004. This suggests that recruitment will increase in 2009.

Recruitment remains promising for the next several years. The fall survey pre-recruit index (Fig. 16) declined from 1997 to its lowest level in 2003, and then increased sharply to 2006. It has since fluctuated and remains relatively high in 2008. The post-season trap survey catch rate of undersized crabs has fluctuated throughout its limited time series (Fig. 16).

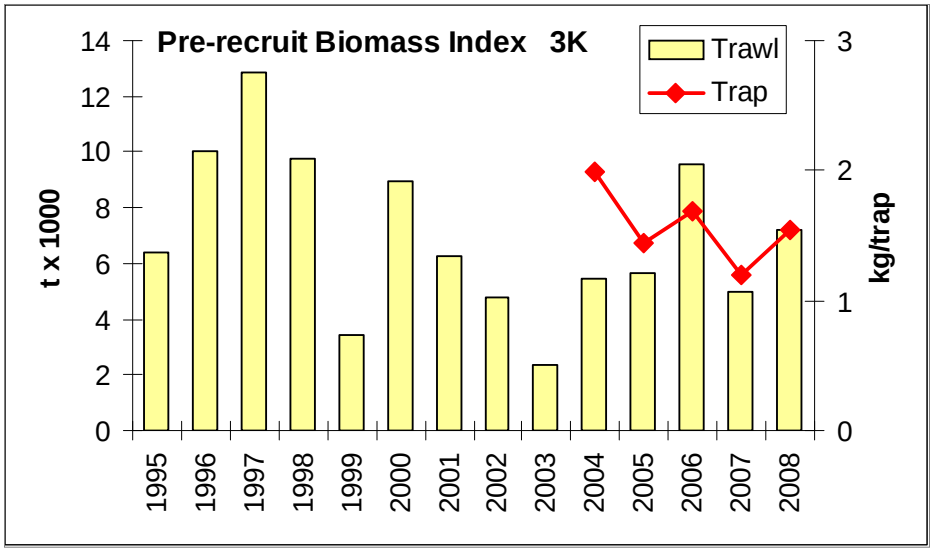


Figure 16: Trends in the Div. 3K offshore post-season trawl survey pre-recruit biomass index and in the catch rate of under-sized crabs from the post-season collaborative trap survey.

A group of small adolescents that has been apparent in the fall multi-species size distributions during the past two years achieved a modal size of about 65 mm CW in 2007. These adolescents would not yet have achieved the minimum legal size, but contributed to the relatively high pre-recruit biomass index in the 2008 post-season survey.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 17) decreased sharply in 2006 and continued to decline to its lowest value in 2008. This implies greatly reduced wastage of under-sized and soft-shelled pre-recruits in the fishery since 2005.

The trawl survey exploitation rate index has declined slightly over the past 3 years. The pre-recruit fishing mortality index decreased sharply in 2006 and has since changed little.

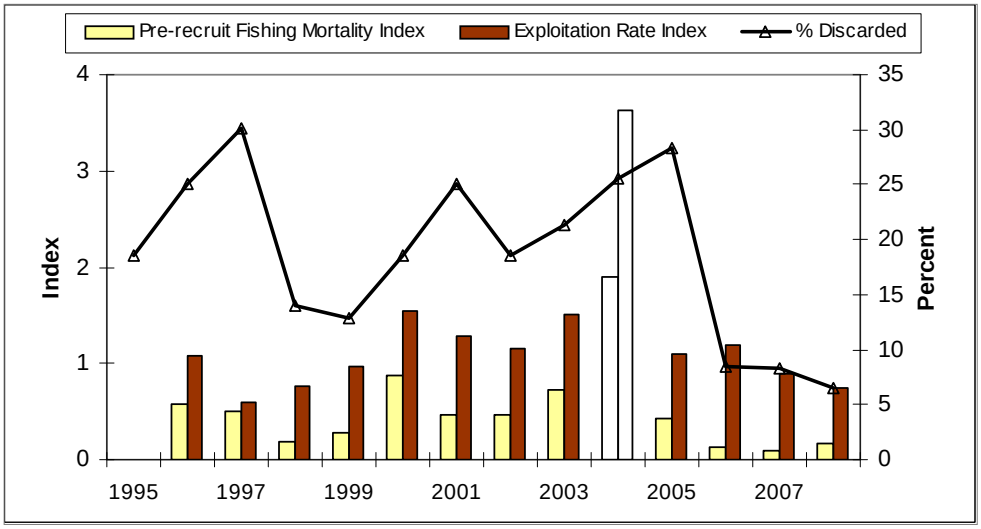


Figure 17: Trends in two Div. 3K offshore mortality indices (the exploitation rate index and the pre-recruit fishing mortality index) and in the percentage of the catch discarded in the fishery. Anomalously high values for 2004 mortality indices are due to very low 2003 biomass indices.

Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

Division 3K Inshore

Biomass

The exploitable biomass increased substantially to 2006 and remains relatively high. The post-season trap survey exploitable biomass index increased from 2004-06 and has since changed little (Fig. 18).

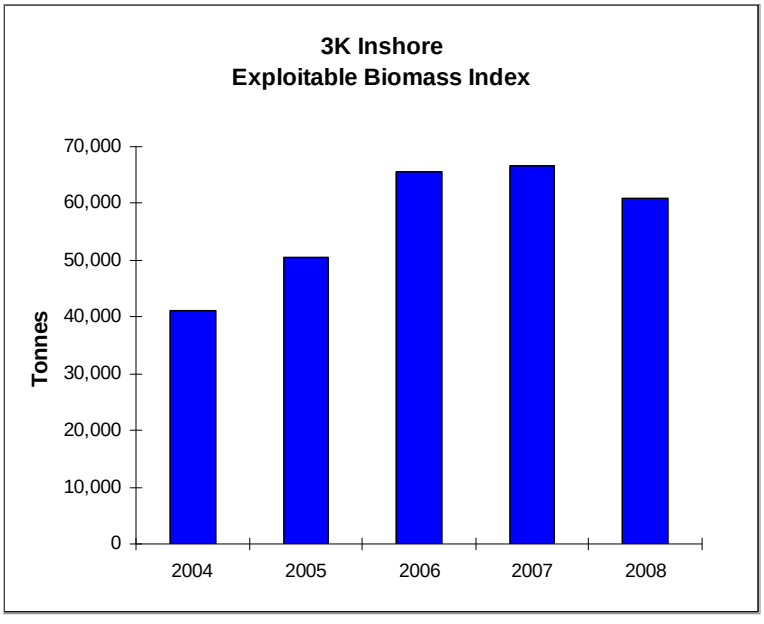


Figure 18: Exploitable biomass index based on the collaborative post-season trap survey in inshore Div. 3K.

Recruitment

Recruitment has increased in the recent years, as reflected by the increase in the post-season trap survey exploitable biomass index while fishery removals increased.

Recruitment prospects are uncertain. Collaborative post-season trap survey catch rates of undersized crabs have changed little since 2004 (Fig. 19). However, this survey as well as the DFO post-season survey indicates different trends between the two bays that comprise the inshore area. Recruitment has recently decreased in Notre Dame Bay, whereas it is expected to increase in White Bay.

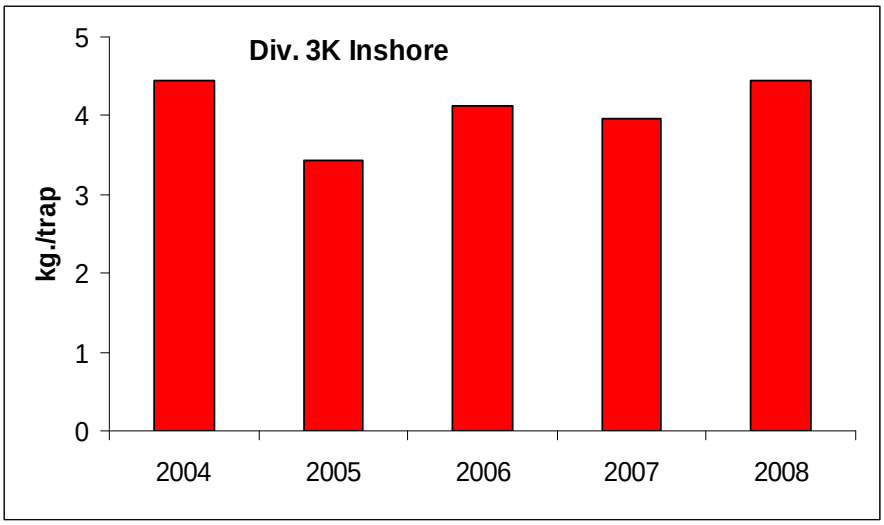


Figure 19: Catch rates of undersized (<95 mm CW) crabs from the post-season trap survey in inshore Div. 3K.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 20) decreased sharply to the lowest level in the time series from 2005-07 and was unchanged in 2008, implying little wastage of under-sized and new-shelled pre-recruits in the 2008 fishery.

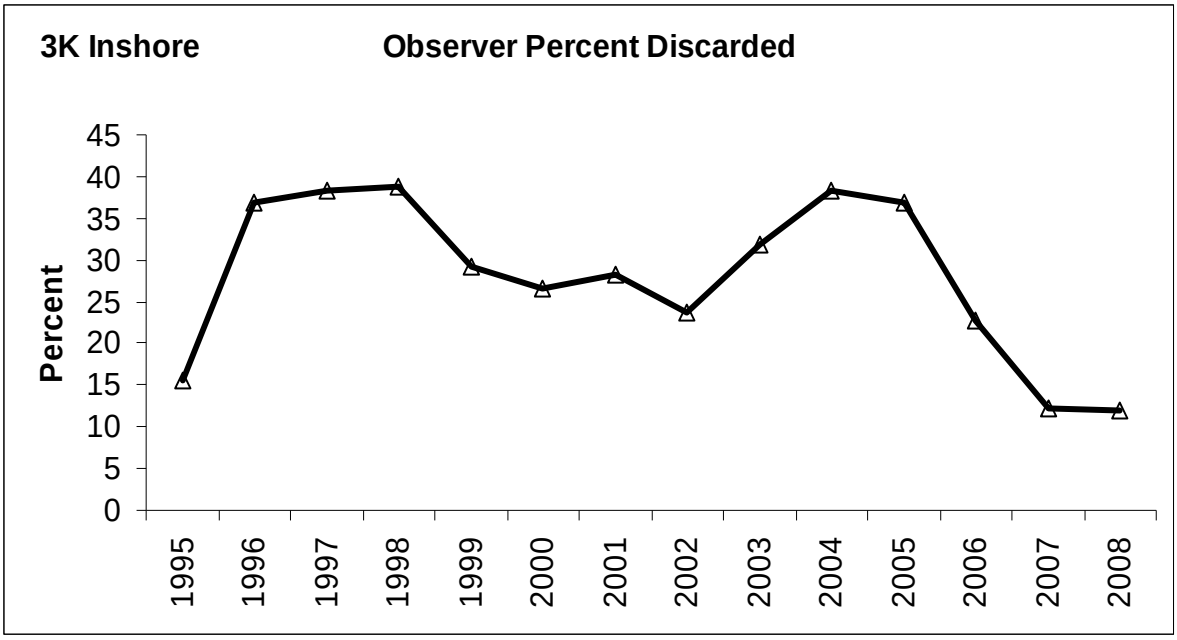


Figure 20: Percentage of the catch discarded in the inshore Div. 3K fishery from observer data.

The trap survey-based exploitation rate index (Fig. 21) changed little since 2005. Data are insufficient to estimate pre-recruit mortality rates.

Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

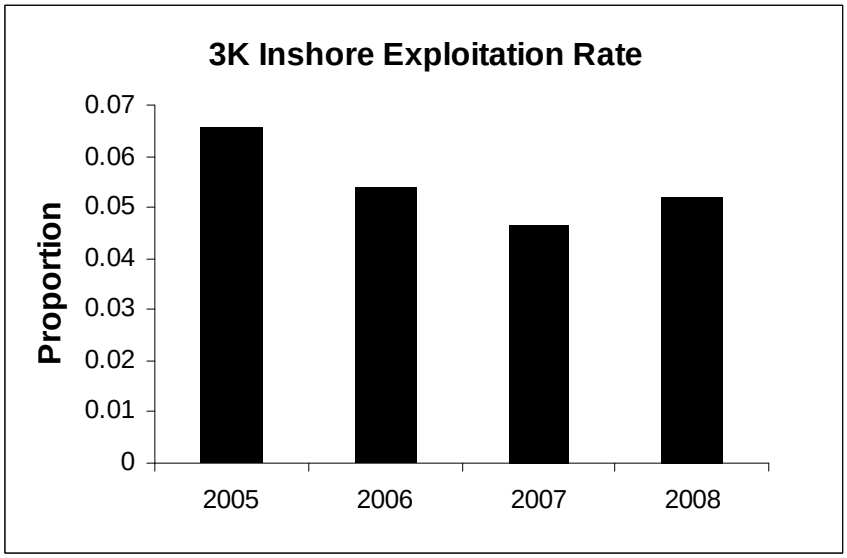


Figure 21: Trends in the exploitation rate index based on the post-season trap survey in Div. 3K.

Resource Status, Division 3L

Commercial Fishery

Offshore landings have generally been higher than inshore landings by about a factor of 3 in recent years (Fig. 22). Offshore landings peaked at 21,700 t in 1999 and decreased to about 18,700 t in 2000 due to a reduction in the TAC. Landings have averaged about 20,000 t since 2000. They decreased by 6% from 20,140 t in 2007 to 18,990 t in 2008. Effort has increased steadily since 2000 to its highest level in 2008.

Inshore landings (Fig. 22) peaked in 1996 at 7920 t. They declined to 4730 t in 2000, increased to 6810 t in 2003, and decreased slightly to 6110 t in 2005 due to changes in the TAC. Landings increased by 12% from 6110 t in 2005 to 6830 t in 2008, while effort decreased by 23%.

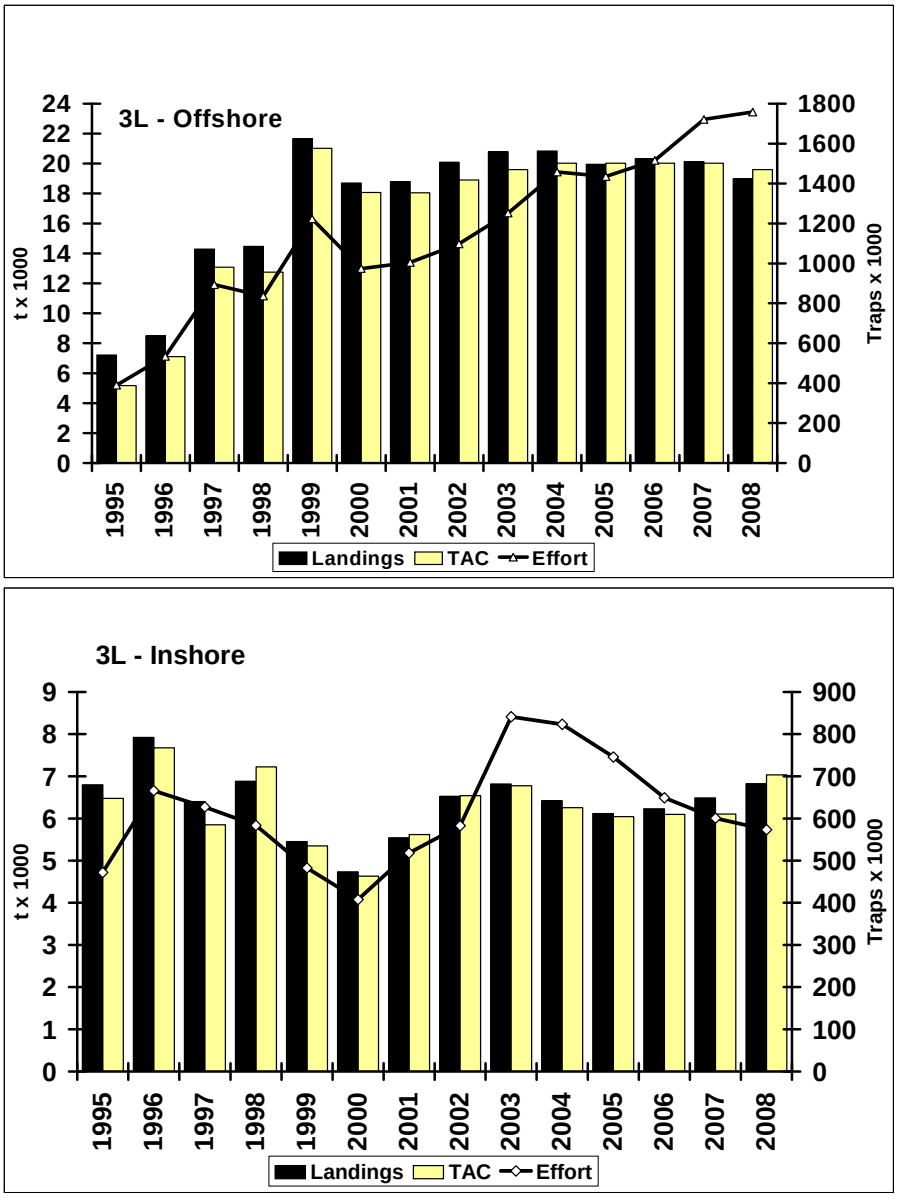


Figure 22: Trends in TAC, landings, and fishing effort in Div. 3L offshore (above) and inshore (below).

Commercial CPUE (Fig. 23) indicates that fishery performance has deteriorated offshore but improved inshore over recent years. Inshore CPUE was higher than offshore CPUE for the first time in 2008. Offshore CPUE has declined steadily from 2000-08, to the lowest level since 1991. Inshore CPUE increased by 53% from 2004 to 2008.

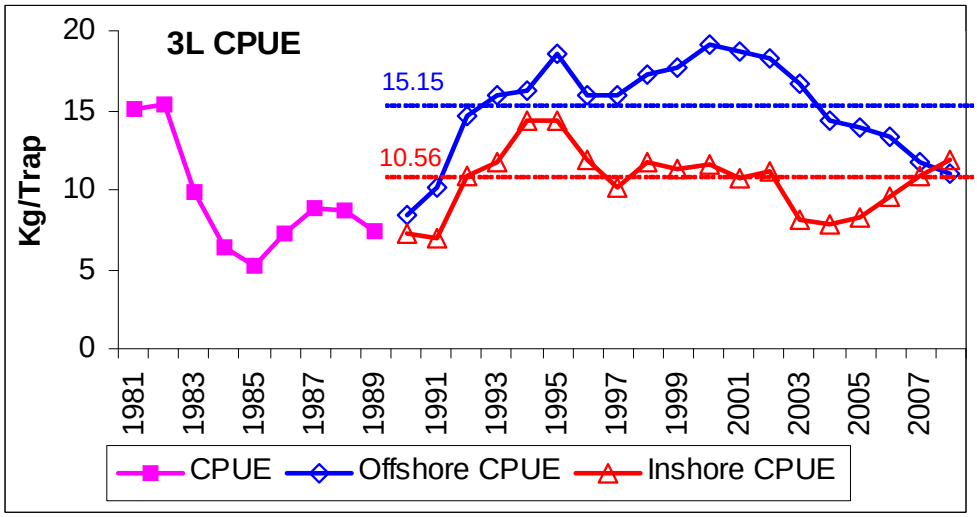


Figure 23: Trends in Div. 3L inshore and offshore commercial CPUE in relation to their long-term averages (dotted lines).

Div. 3L Offshore

Biomass

Trends in the exploitable biomass are uncertain but levels remain low. The trawl survey exploitable biomass index declined sharply from 1996-2000 and changed little to 2005 (Fig. 24). The exploitable biomass index declined sharply in both post-season surveys in 2006. It has since remained low in the trap survey but has increased in the trawl survey over the past two years.

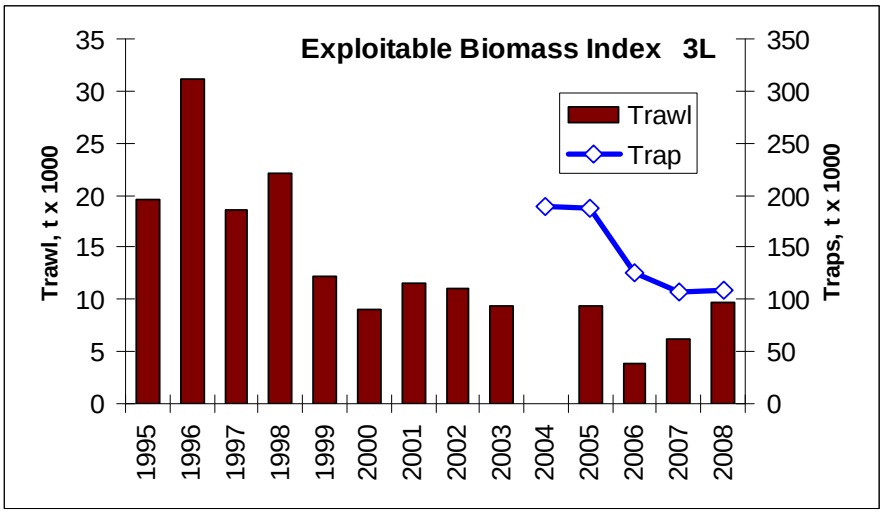


Figure 24: Trends in the offshore Div. 3L exploitable biomass indices based on post-season trawl and trap surveys; the trawl survey was incomplete in 2004.

Recruitment

Recruitment has recently increased. The post-season trap and trawl surveys indicate that the component of the exploitable biomass that represents immediate recruits (new-shelled legal-sized crab) has increased since 2006. This suggests that recruitment will increase in 2009.

Both post-season surveys indicate that recruitment has been increasing and is expected to increase further over the next two to three years. The post-season trawl survey pre-recruit index and the post-season trap survey catch rate of under-sized crabs have both increased sharply since 2006 (Fig. 25). The 2008 trawl survey index was the highest since 1996.

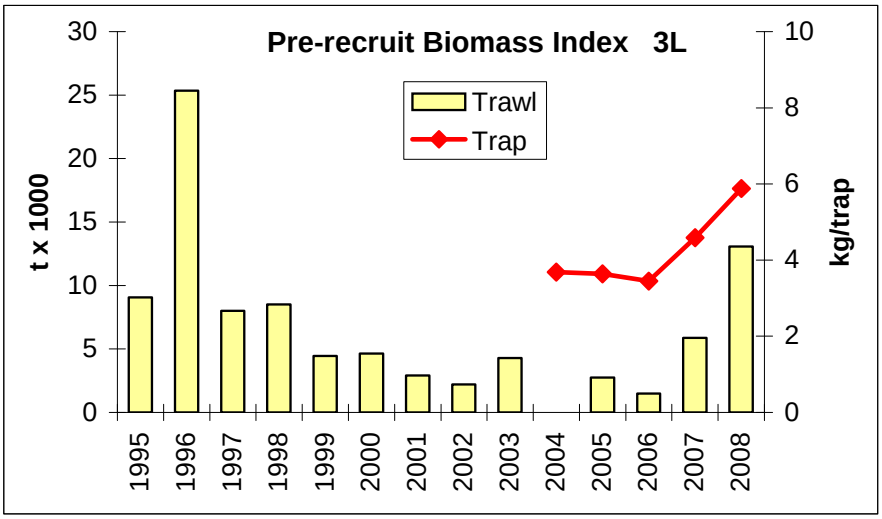


Figure 25: Trends in the offshore Div. 3L post-season trawl survey pre-recruit biomass index and in the catch rate of undersized crabs from the collaborative post-season trap survey.

The recent sharp increase in the post-season trawl survey pre-recruit index reflects a recent increase in the abundance index of a group of adolescents in the trawl survey size distributions, with a modal size of about 77 mm CW in 2008. These adolescents are expected to provide increasing recruitment for the next 2-3 years.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 26) increased sharply in 2008 from a low level during 2004-07. This implies an increase in wastage of under-sized and new-shelled pre-recruits in the fishery in 2008.

The exploitation rate index and pre-recruit fishing mortality index (Fig. 26) both increased to their highest levels in 2007. The exploitation rate index remained at a high level in 2008 while the pre-recruit fishing mortality rate index decreased to about the long-term average.

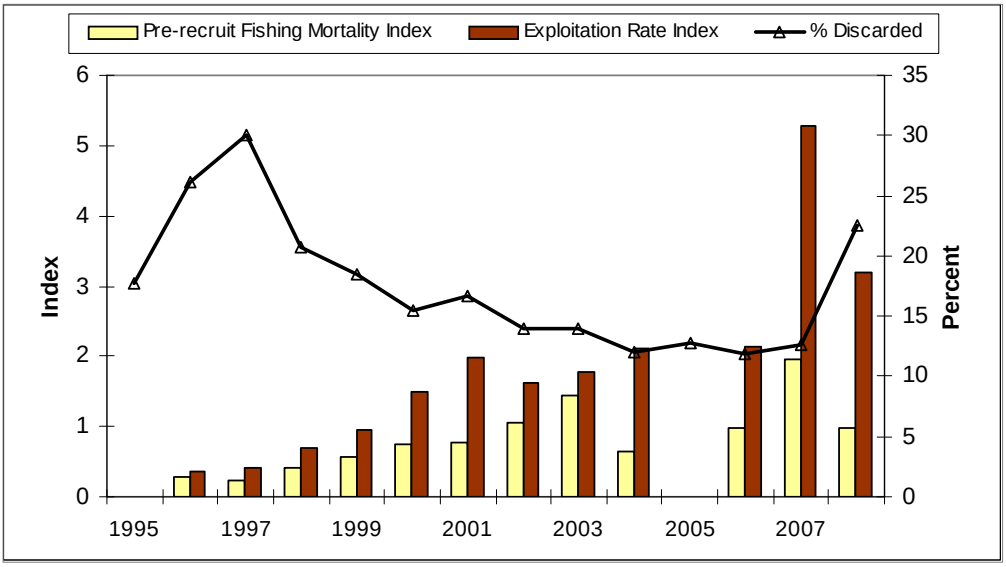


Figure 26: Trends in two offshore Div. 3L mortality indices (the exploitation rate index and the pre-recruit fishing mortality index) and in the percentage of the catch discarded in the fishery. Mortality indices were not calculated for 2005 because the survey was incomplete in 2004.

Although recruitment is increasing, the post-season survey catch rate of old-shelled crabs has declined steadily since 2005 from the trap survey and decreased sharply in 2006 from the trawl survey. This indicates that the fishery has become increasingly dependent upon immediate recruitment.

The ratio of pre-recruits to exploitable crab is expected to increase to a high level due to the low biomass and increasing recruitment. This could pose a risk of high fishery-induced mortality to soft-shelled immediate pre-recruits in 2009.

Div. 3L Inshore

Biomass

The post-season trap survey exploitable biomass index (Fig. 27) indicates that the exploitable biomass increased from 2004-06 and changed little since.

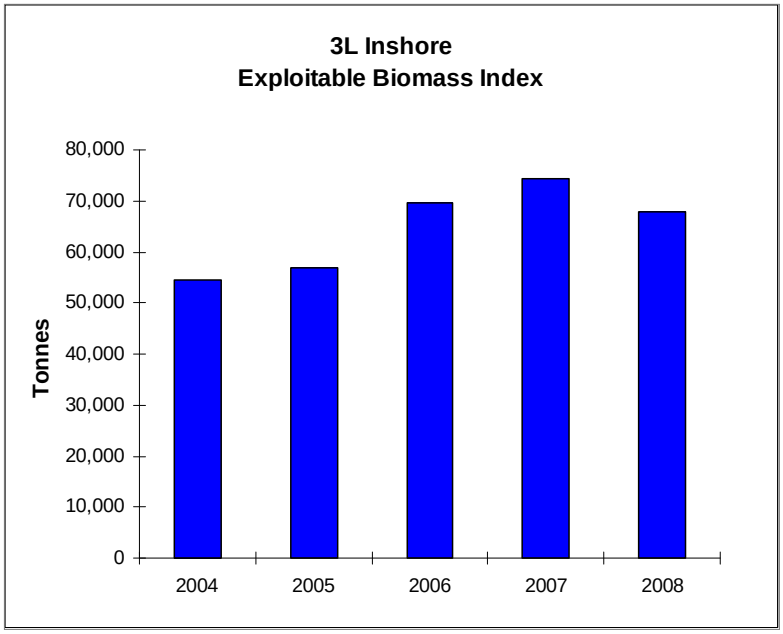


Figure 27: Exploitable biomass index based on the collaborative post-season trap survey in inshore Div. 3L.

Recruitment

Recruitment had increased in recent years, as reflected by the increase in the post-season trap survey exploitable biomass index while fishery removals increased. However, the post-season collaborative trap survey catch rate of legal-sized new-shelled crabs decreased in 2008, suggesting decreased recruitment. This survey and localized DFO trap surveys in two bays indicate that there is considerable spatial variability in recent recruitment.

Recruitment prospects are uncertain. The post-season collaborative trap survey data show no recent change in catch rates of sub-legal sized crabs (Fig 28).

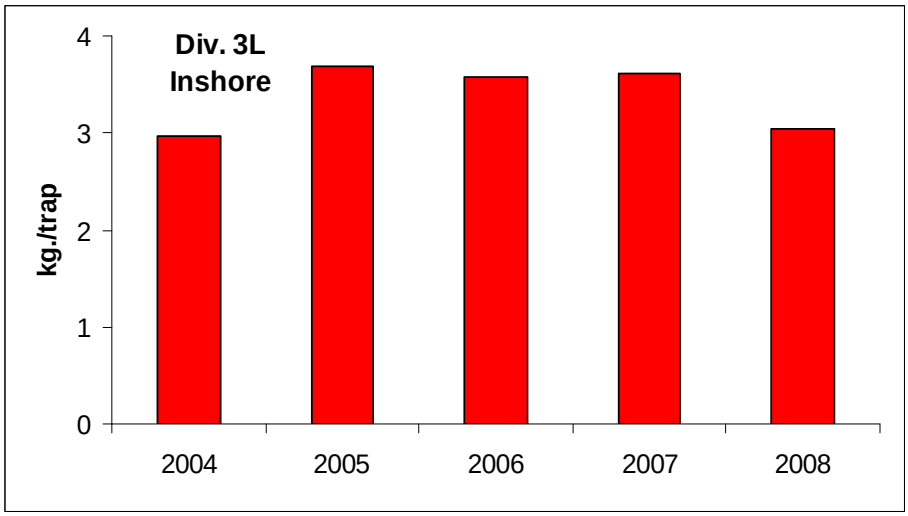


Figure 28: Catch rates of undersized (<95mm CW) crabs from the collaborative post-season trap survey in inshore Div. 3L.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 29) increased in 2008 to about the long-term average, implying increased wastage of under-sized and new-shelled pre-recruits in the 2008 fishery. However, this index is biased by a change in spatial distribution of observer sampling in 2008.

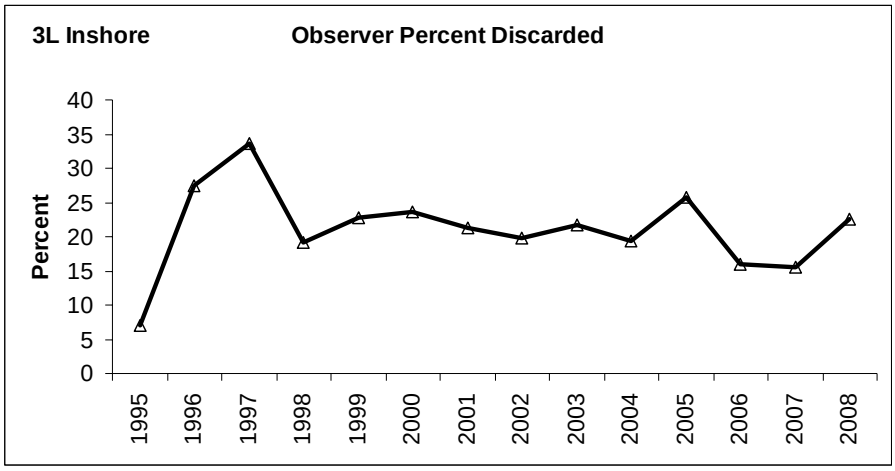


Figure 29: Percentage of the catch discarded in the inshore Div. 3L fishery.

The trap survey-based exploitation rate index changed little since 2005 (Fig. 30). Data are insufficient to estimate pre-recruit mortality rates.

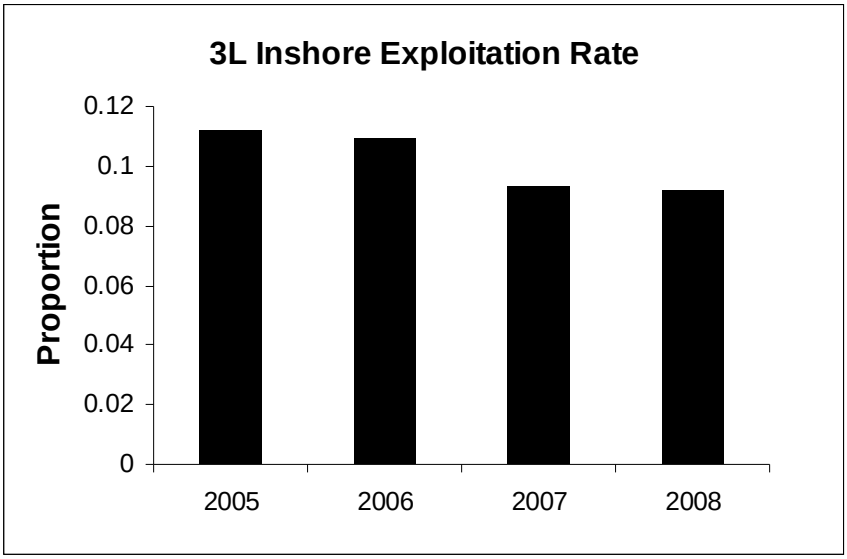


Figure 30: Trends in the exploitation rate index based on the post-season collaborative trap survey in Div. 3L.

Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

Resource Status, Divisions 3NO

Commercial Fishery

The fishery has been primarily concentrated along the shelf edge. Landings increased by 22% from 3600 t in 2005 to 4400 t in 2008 while effort increased by 57%, to an all-time high in 2008 (Fig. 31).

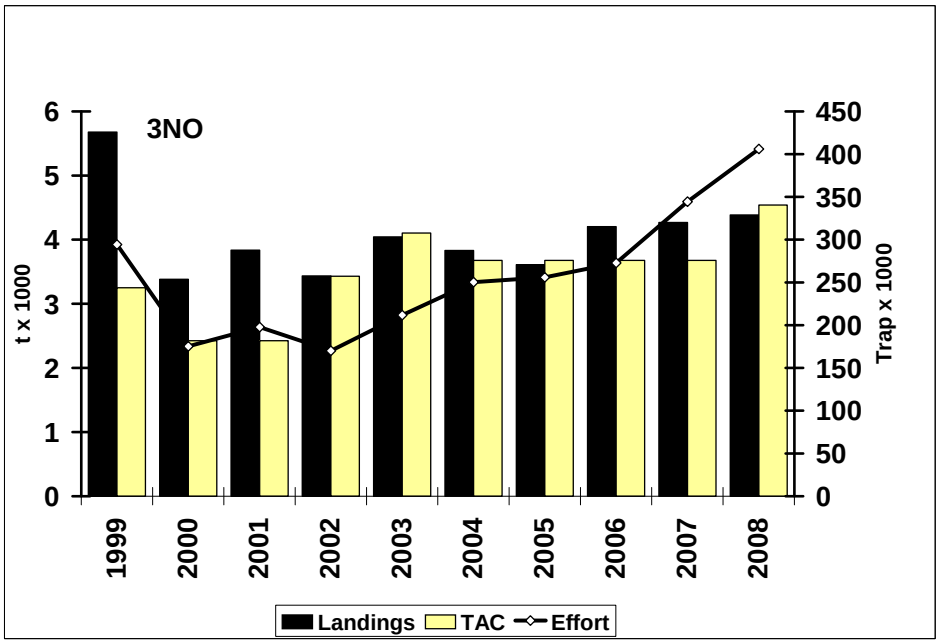


Figure 31: Trends in landings, TAC, and fishing effort in Div. 3NO.

CPUE has declined since 2002, to its lowest level in 2008 (Fig. 32).

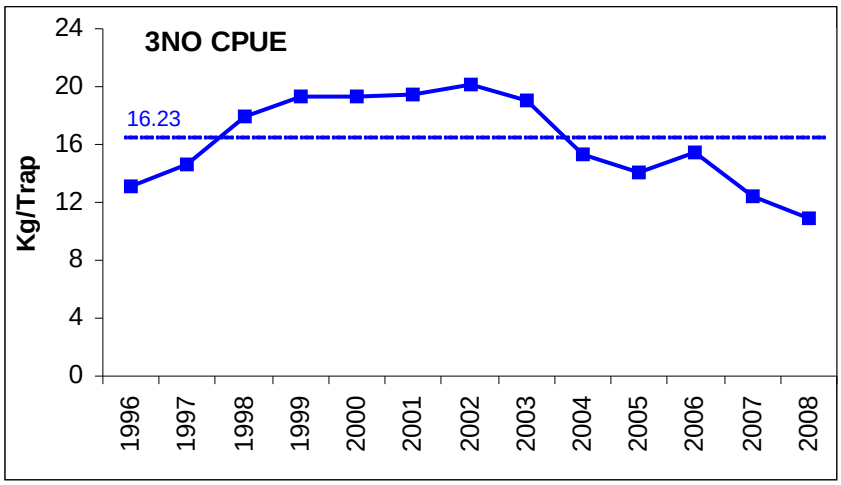


Figure 32: Trends in Div. 3NO commercial CPUE in relation to its long-term average (dotted line).

Biomass

Trends in the exploitable biomass are uncertain as survey indices are unreliable. This is due to limited sampling of the resource which is concentrated in a small proportion of the survey area.

Recruitment

Recruitment has been increasing and is expected to increase further over the next two to three years. A group of adolescents is apparent in the trawl survey, as also seen in Div. 3L, which should result in continued increasing recruitment for the next two to three years. This is consistent with an increase in catch rates of undersized crabs from observer data in 2008.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 33) increased sharply in 2008, implying increased wastage of pre-recruits in the fishery.

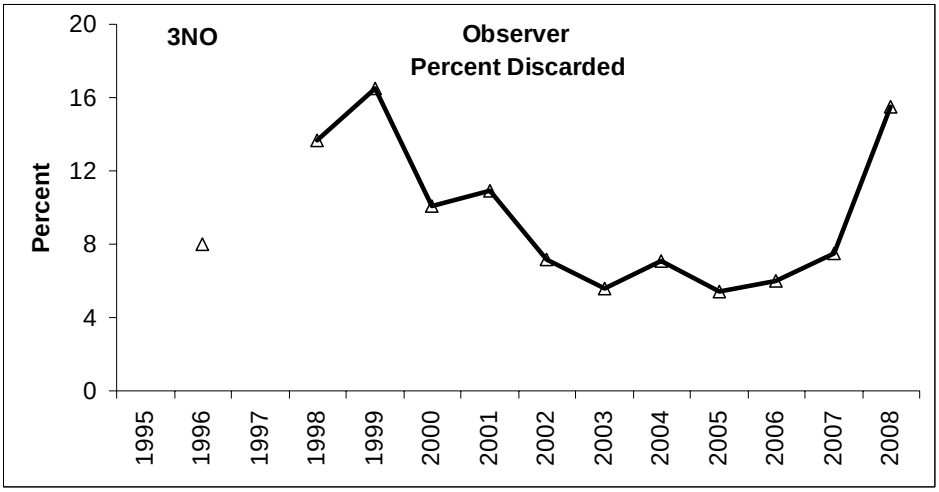


Figure 33: Trends in the percentage of the catch discarded in the Div. 3NO fishery.

Trends in fishery-induced mortality are unknown. The exploitation rate and pre-recruit fishing mortality indices are not informative because of uncertainties associated with the survey biomass indices.

The abundance of pre-recruits is expected to increase in 2009. This could pose a risk of high fishery-induced mortality to soft-shelled immediate pre-recruits in 2009.

Resource Status, Subdivision 3Ps

Commercial Fishery

Landings (Fig. 34) from offshore areas have been about twice as high as those from inshore areas in recent years. Landings from both offshore and inshore areas were at their highest level during 1999-2002.

Offshore landings increased by 35% from 2340 t in 2006 to 3180 t in 2008, following a 46% decline from 2002-06. Offshore effort increased by 19% in 2007 and decreased by 25% in 2008 to its lowest level since 2001.

Inshore landings doubled from 660 t in 2005 to 1350 t in 2008, following an 80% decline since 2002**.** Meanwhile, inshore effort changed little since 2005 until it decreased by 22% in 2008.

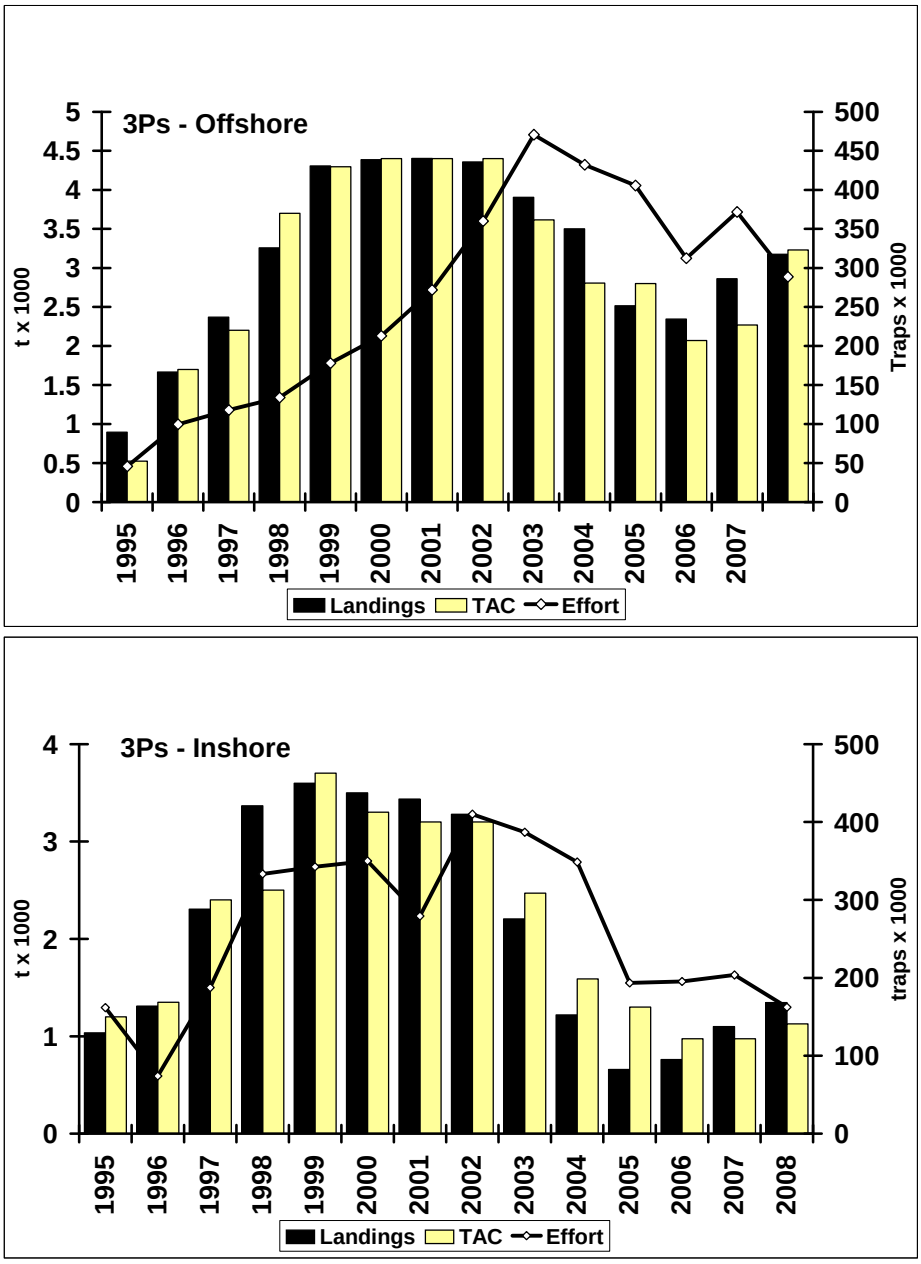


Figure 34: Trends in TAC, landings, and fishing effort in Subdiv. 3Ps offshore (above) and inshore (below).

Commercial CPUE has consistently been higher offshore than inshore (Fig. 35). Offshore CPUE increased by 48% in 2008 but remains below the long-term average. Inshore CPUE more than doubled since 2005 to the long-term average.

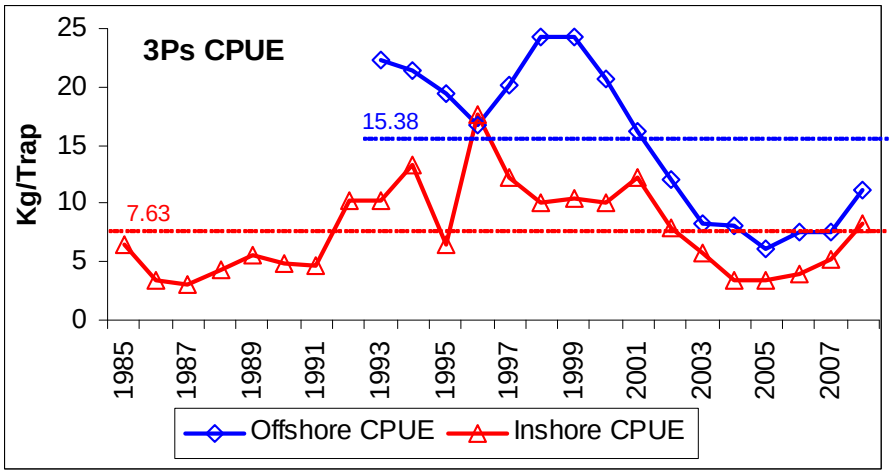


Figure 35: Trends in Subdiv. 3Ps inshore and offshore commercial CPUE in relation to their long-term averages (dotted lines).

Subdiv. 3Ps Offshore

Biomass

Trends in the exploitable biomass are uncertain but the level remains low. The post-season trap survey exploitable biomass index increased slightly since 2004 (Fig. 36). Meanwhile the pre-season trawl survey exploitable biomass index has shown no trend and remains well below pre-2001 levels.

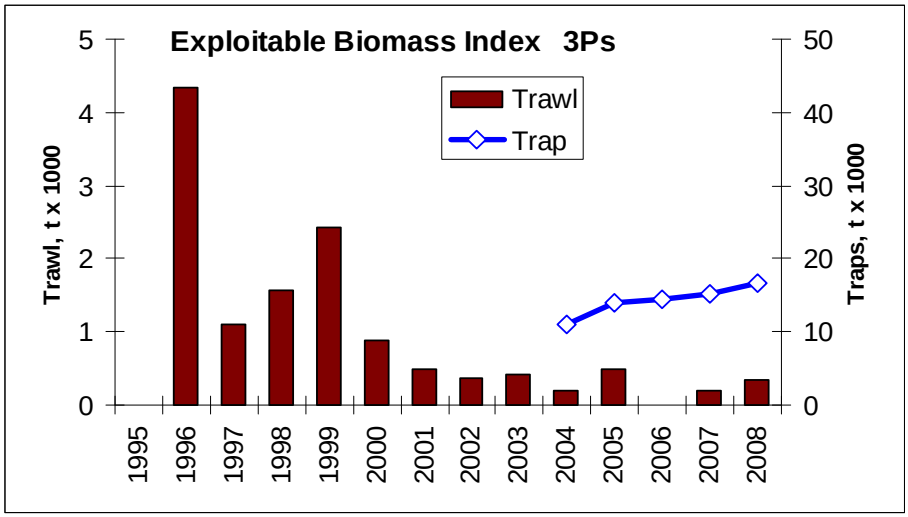


Figure 36: Trends in the offshore Subdiv. 3Ps exploitable biomass indices from the pre-season trawl survey and the post-season collaborative trap survey.

Recruitment

The pre-season trawl survey indicates that recruitment has recently been increasing. This is reflected in the recent steady increase in the post-season trap survey exploitable biomass index

(Fig. 36) while landings increased (Fig. 34). Also, the post-season trap survey index of legal-sized new-shelled crabs increased in 2006 and has since changed little.

Recruitment is expected to increase further over the next two to three years. The pre-season trawl survey pre-recruit index increased steadily from 2003-08 to its highest level since 1996 (Fig. 37). This increase is related to a modal group of adolescents first observed in the spring trawl survey size distributions in 2005, which achieved a modal size of about 86 mm CW in 2008.

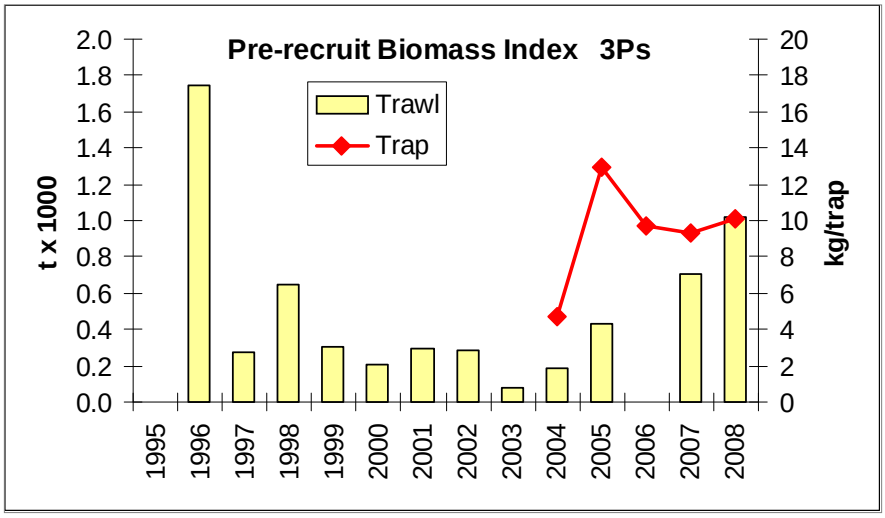


Figure 37: Trends in the offshore Subdiv. 3Ps pre-season trawl survey pre-recruit biomass index and in the post-season trap survey catch rate of under-sized crabs.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 38) almost doubled to about 45% in 2005 and declined to about 22% in 2008, implying a reduction in wastage of pre-recruits in recent years. The percent discarded in Subdiv. 3Ps is generally higher than in other areas as it includes a larger component of under-sized crabs, an unknown portion of which is comprised of small adults that will never recruit to the fishery.

Exploitation rate indices based on trap and trawl surveys have shown no consistent trend over the past 4 years. The trawl survey pre-recruit fishing mortality index has declined sharply since 2003 to a very low level (Fig. 38).

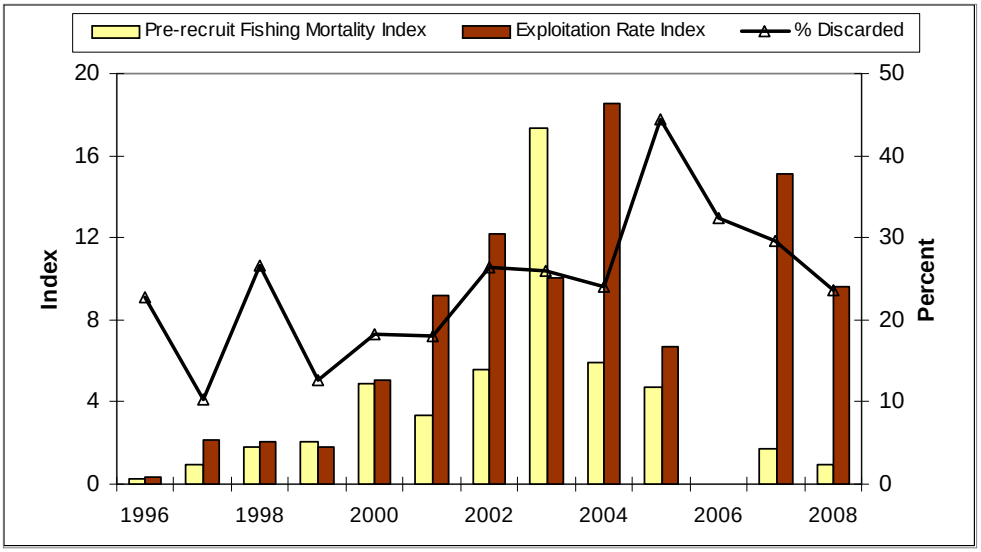


Figure 38: Trends in two offshore Div. 3Ps mortality indices (the exploitation rate index and the pre-recruit fishing mortality index) and in the percentage of the catch discarded in the fishery. Mortality indices were not calculated for 2006 because the 2006 survey was incomplete.

Maintaining the current level of fishery removals would not likely result in a substantial change in fishery-induced mortality.

Subdiv. 3Ps Inshore

Biomass

The exploitable biomass has recently increased. The post-season trap survey exploitable biomass index increased substantially from 2006-08 (Fig. 39).

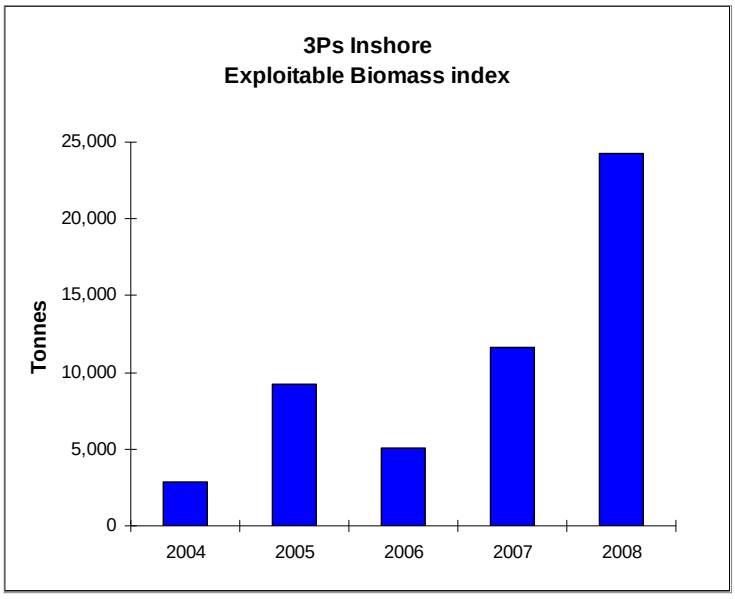


Figure 39: Exploitable biomass index based on the collaborative post-season trap survey in inshore Subdiv. 3Ps.

Recruitment

Recruitment has recently been increasing. This is reflected in the recent steady increase in the post-season trap survey exploitable biomass index (Fig. 39) while landings increased (Fig. 34). Also, the post-season trap survey index of legal-sized new-shelled crabs has increased substantially from 2004-08.

The post-season trap survey indicates that recruitment prospects remain promising in the short-term. The post-season trap survey catch rate of undersized crabs (Fig. 40) increased substantially from 2004-07 and decreased, while remaining relatively high in 2008.

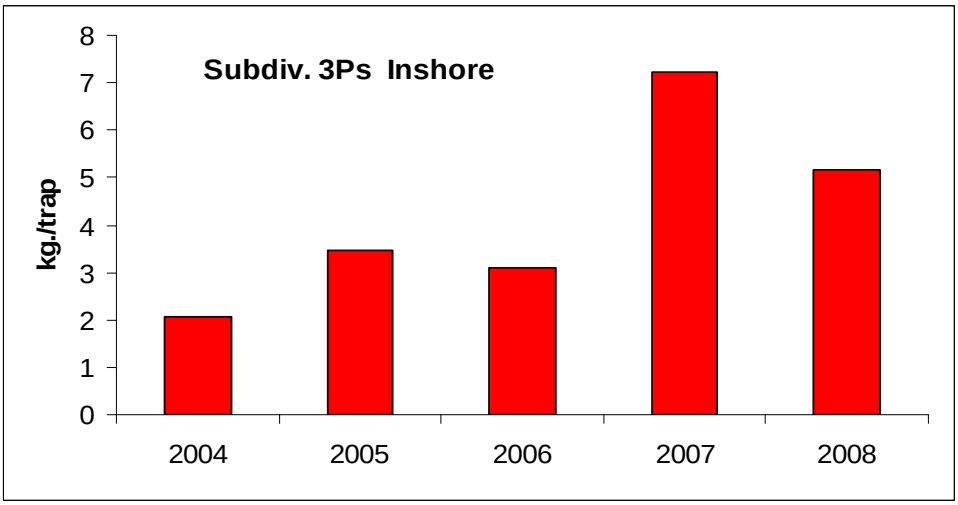


Figure 40: Catch rates of undersized (76-94 mm CW) crabs from the post-season collaborative trap survey in inshore Subdiv. 3Ps.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 41) was at its highest, about 60%, in 2005 and 2006. It has since decreased substantially to about 30% in 2008, implying reduced wastage of pre-recruits in recent years.

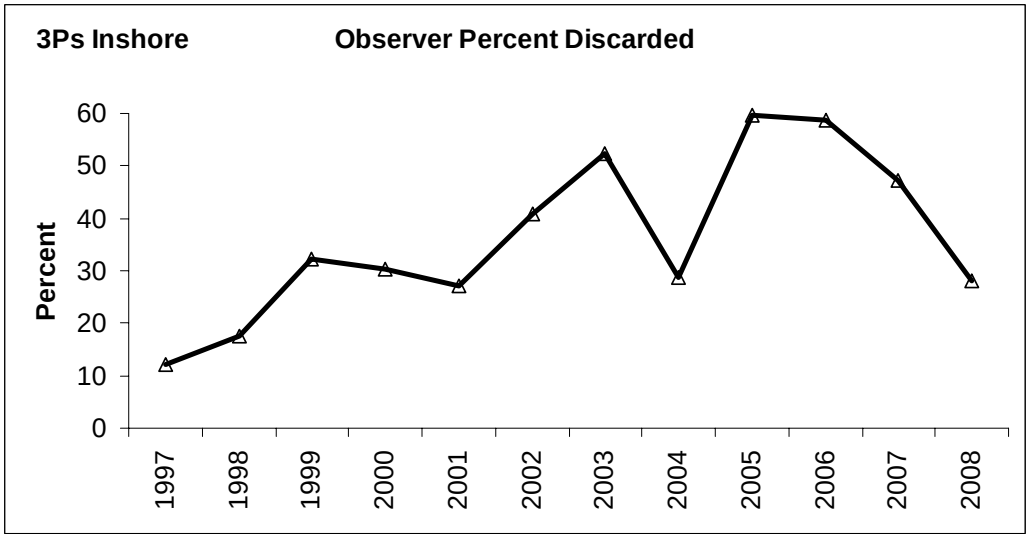


Figure 41: Trends in the percentage of the catch discarded in the inshore Subdiv. 3Ps fishery.

The post-season trap survey-based exploitation rate index fluctuated without trend during 2005-08 (Fig. 42). Data are insufficient to estimate pre-recruit fishing mortality rates.

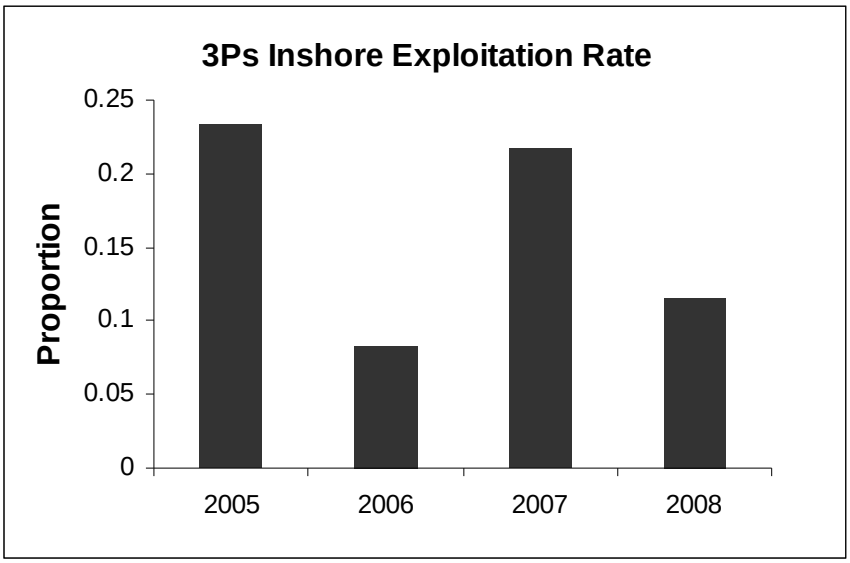


Figure 42: Trends in the exploitation rate index based on the post-season trap survey in inshore Subdiv. 3Ps.

Fishery removals could likely be increased in 2009 without increasing the exploitation rate.

Resource Status, Division 4R

Commercial Fishery

Landings (Fig. 43) have generally been comparable between inshore and offshore areas. TACs have not been taken since 2002. Offshore landings and effort peaked in 2002 before steadily declining to historical lows in 2006. Landings and effort have been variable in recent years, but remained at low levels.

Inshore Landings declined by 74% from 950 t in 2003 to a record low of 250 t in 2008. Inshore effort decreased sharply in 2005 and changed little since.

The spatial distribution of fishing effort has changed substantially since 2002. Effort has become highly aggregated, both offshore and inshore, within a few localized areas.

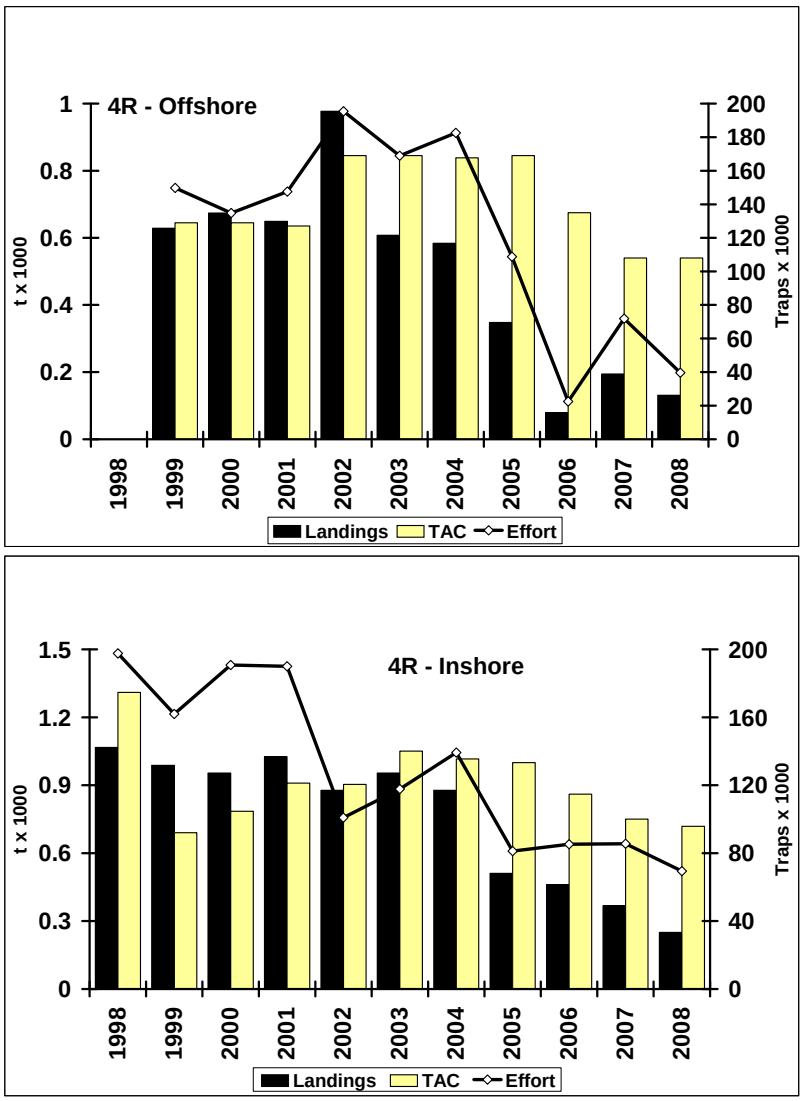


Figure 43: Trends in TAC, landings, and fishing effort in Div. 4R offshore (above) and inshore (below).

Commercial CPUE (Fig. 44) has been higher in inshore than in offshore areas but low relative to other divisions. Offshore CPUE is strongly affected by spatial changes in distribution of fishing effort. Inshore CPUE has steadily declined since 2002 to its lowest level in 2008.

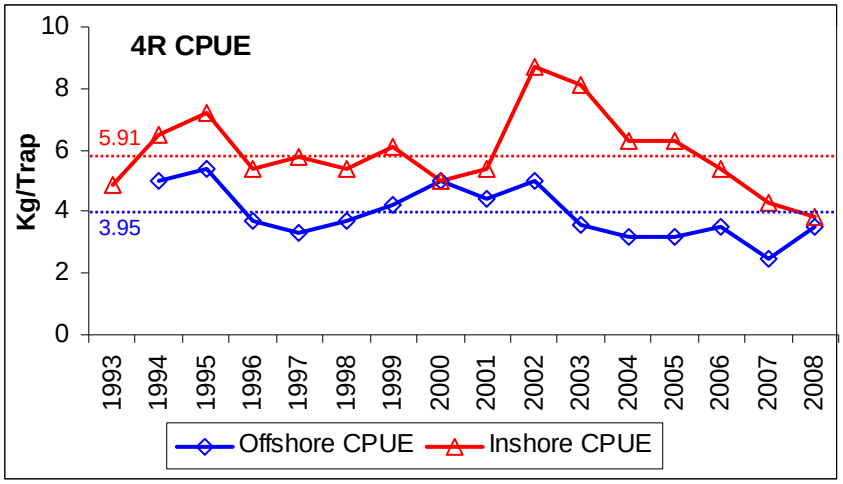


Figure 44: Trends in Div. 4R inshore and offshore commercial CPUE in relation to their long-term averages (dotted lines).

Div. 4R Offshore

Biomass

Trends in exploitable biomass are unknown.

Recruitment

There are no data available that could be used to infer recruitment. Therefore, short-term recruitment prospects are unknown.

Mortality

The observer data are insufficient to estimate the percentage of the catch discarded in the fishery or to infer wastage of pre-recruits. Trends in fishing mortality on either the exploitable or pre-recruit population are unknown.

There are insufficient data to assess resource status.

Div. 4R Inshore

Biomass

Post-season trap survey catch rates show that the exploitable biomass declined from 2004–06 and changed little since (Fig. 45).

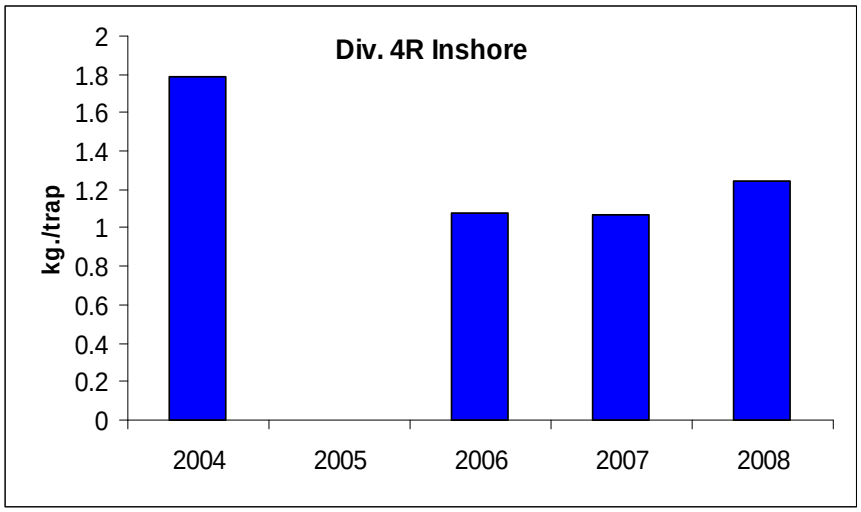


Figure 45: Catch rates of legal-sized crabs from the collaborative post-season trap survey in inshore Div. 4R.

Recruitment

Recruitment is expected to change little over the next 2-3 years. The post-season trap survey catch rate of undersized crabs (Fig. 46) has changed little after it decreased between 2004 and 2006.

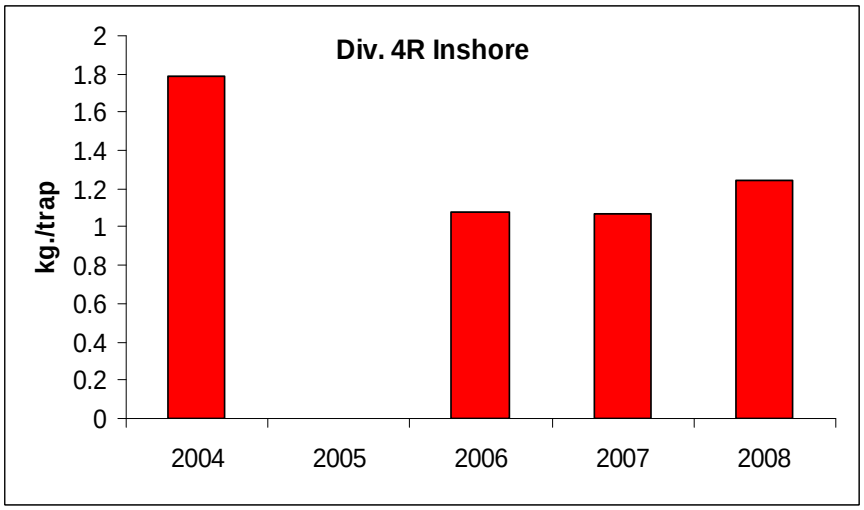


Figure 46: Catch rates of undersized (< 95mm CW) crabs from the collaborative post-season trap survey in inshore Div. 4R.

Mortality

Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2009.

Sources of Uncertainty

A major source of uncertainty is a lack of reliable fishery-independent indices, or limited time series, in some divisions, particularly Div. 3NO and offshore Div. 4R.

The CPUE series are not standardized. There is uncertainty regarding the effects of changes in some fishing practices (e.g., location, seasonality, soak time, trap mesh size and high-grading) on catch rates and their interpretation. The reliability of the logbook data is uncertain with respect to effort and areas fished.

Pre-recruit fishing mortality indices based on observer data are uncertain due to low observer coverage, and more importantly, seasonal and spatial variation in the distribution of observer coverage.

There is also uncertainty about pre-recruit indices based on undersized crabs, from observer as well as post-season collaborative trap surveys, because of unknown and variable proportions of undersized adults (terminally molted) that will never recruit to the fishery. This is especially prevalent in Subdiv. 3Ps where a large component of the total discards is comprised of undersized crabs.

Exploitable biomass and recruitment indices from multi-species trawl surveys may be affected by variation in catchability of crabs by the survey trawl. Furthermore, important strata in Div. 3L were not surveyed in 2004 and most of Subdiv. 3Ps was not surveyed in 2006.

There is uncertainty in interpreting trends in exploitable biomass and recruitment from the industry-DFO collaborative trap survey data because the time series is short. There is additional uncertainty related to limited spatial coverage, especially in Div. 2J and 3NO.

ADDITIONAL STAKEHOLDER PERSPECTIVES

Division 2J

CPUE improved for the fourth consecutive year and is the highest CPUE observed since 2000. Harvesters feel that these positive signs can be attributed to measures they have taken in recent years, including, but not exclusive to reductions in TAC. Harvesters see the stock as improving based on positive recruitment, very little soft shell, and high catch rates.

Division 3K

2008 CPUEs continued to improve in the offshore and most inshore areas. Harvesters observed that abundance is increasing and there were no significant occurrences of soft shelled animals.

Division 3LNO

Inshore CPUEs improved for the third consecutive year based on increases in most Crab Management Areas (CMAs) and the exploitable biomass appears healthy. Harvesters are encouraged by the recruitment indicators stemming from the large numbers of undersized animals observed. Harvesters have stressed that variation in population structure between CMAs must be considered when making management decisions.

Subdivision 3Ps

Landings and CPUEs increased significantly in 2008. Harvesters have not observed significant soft-shelled animals in the past three seasons and do not believe it will be a problem in 2009. Recruitment continues to seem exceptional as harvesters are seeing large numbers of undersized animals. This coupled with previous years strong recruitment, have harvesters very optimistic about the fishery in the near future.

Division 4R

Landings have declined in recent years, especially in the inshore areas. CPUE in the offshore however, has remained relatively stable since 2003.

CONCLUSIONS AND ADVICE

Division 2H

The exploitable biomass has decreased in recent years. Recruitment has decreased since 2004 and is expected to be low over the next several years.

Maintaining the current level of fishery removals would likely result in an increase in the exploitation rate in 2009.

Division 2J

The exploitable biomass decreased in 2008. Recruitment is expected to decrease in 2009 and remain relatively low in the short term. Fishery-induced mortality has changed little since 2005.

Maintaining the current level of fishery removals would likely result in an increase in the exploitation rate in 2009.

Division 3K

Offshore

The exploitable biomass remains relatively high and recruitment remains promising for the next several years. The exploitation rate index has declined slightly over the past 3 years while the pre-recruit fishing mortality index has changed little since 2006.

Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

Inshore

The exploitable biomass remains relatively high but recruitment prospects are uncertain. The exploitation rate index has changed little since 2005.

Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

Division 3L

Offshore

The exploitable biomass remains low. Recruitment has been increasing and is expected to increase further over the next two to three years. The exploitation rate index remained at a high level in 2008 while the pre-recruit fishing mortality rate index decreased to about the long-term average. The fishery has become increasingly dependent upon immediate recruitment.

The ratio of pre-recruits to exploitable crab is expected to increase to a high level due to the low biomass and increasing recruitment. This could pose a risk of high fishery-induced mortality to soft-shelled immediate pre-recruits in 2009.

Inshore

The exploitable biomass has changed little since 2006 and recruitment prospects are uncertain. The exploitation rate index changed little since 2005.

Maintaining the current level of fishery removals would not likely substantially change the exploitation rate in 2009.

Divisions 3NO

Trends in the exploitable biomass are uncertain as survey indices are unreliable. Recruitment has been increasing and is expected to increase further over the next two to three years.

The abundance of pre-recruits is expected to increase in 2009. This could pose a risk of high fishery-induced mortality to soft-shelled immediate pre-recruits in 2009.

Subdivision 3Ps

Offshore

The exploitable biomass remains low. Recruitment has been increasing and is expected to increase further over the next two to three years. Exploitation rate indices have shown no consistent trend over the past 4 years. The pre-recruit fishing mortality index has declined sharply since 2003 to a very low level.

Maintaining the current level of fishery removals would not likely result in a substantial change in fishery-induced mortality.

Inshore

The exploitable biomass has recently increased and recruitment prospects remain promising in the short-term.

Fishery removals could likely be increased in 2009 without increasing the exploitation rate.

Division 4R

Offshore

There are insufficient data to assess resource status.

Inshore

The exploitable biomass declined from 2004–06 and changed little since. Recruitment is expected to change little over the next two to three years.

Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2009.

OTHER CONSIDERATIONS

Reproductive Biology

The percentage of mature females carrying full clutches of viable eggs has remained high throughout the time series.

Fishery-induced mortality on undersized males may adversely affect insemination of females, especially when abundance of larger adults is low.

Bitter Crab Disease (BCD)

This disease, which is fatal to crabs, occurs in new-shelled crab of both sexes and appears to be acquired during molting. There had been a broadly-distributed incidence of bitter crab disease during 1996-2006, but the distribution contracted primarily to Div. 3K in 2007. Prevalence has changed little overall in 2008, but there is considerable spatial variability in its distribution.

Management Considerations

Negative relationships between bottom temperature and snow crab CPUE have been demonstrated at lags of 6-9 years, suggesting that cold conditions in early life favor survival and promote subsequent recruitment to the fishery, as they did in the late 1990's (Dawe et al. 2008). A warm oceanographic regime has persisted over the past decade (Colbourne et al. 2009) suggesting relatively poor long-term recruitment.

Reproductive potential is largely protected by conservation measures that exclude females and males smaller than 95 mm CW, including a portion of the adult (large-clawed) males, from the fishery. Therefore exploitation has been considered to have minimal impact on reproductive potential. However fishery-induced mortality on small (< 95 mm CW) males may adversely affect insemination of females, especially when abundance of larger adults is low.

Fishery-induced mortality on pre-recruits can impair future recruitment. Options for reducing this mortality include early fishing seasons, increasing mesh size and soak time, improving handling practices, and reducing high-grading, as well as trap modifications such as escape mechanisms and biodegradable panels.

Wastage of pre-recruits in the fishery would increase sharply as a recruitment pulse begins to enter the legal size range as new-shelled immediate pre-recruits, especially when the exploitable biomass is low. This wastage negatively affects recruitment and future yield. It increases as the exploitable biomass declines due to an increase in both the relative abundance of pre-recruits and their catchability by traps. Recruitment could be promoted by not allowing the exploitable biomass to become critically low.

SOURCES OF INFORMATION

Colbourne, E., Craig, J., Fitzpatrick, C., Senciall, D., Stead, P., and Bailey, W. 2009. An assessment of the physical oceanographic environment on the Newfoundland and Labrador Shelf during 2008. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/032 iv + 20 p.

Dawe, E., Mullowney, D., Stansbury, D., Taylor, D., Colbourne, E., Hynick, E., Veitch, P., Drew, J., O'Keefe, P., Fiander, D., Stead, R., Maddock-Parsons, D., Higdon, P., Paddle, T., Noseworthy, B., and Kellend, S. *In prep*. An Assessment of Newfoundland and Labrador Snow Crab in 2007. DFO Can. Sci. Advis. Sec. Res. Doc. *In preparation*

FOR MORE INFORMATION

Contact: Earl G. Dawe
Fisheries and Oceans Canada
P.O. Box 5667
St. John's, NL A1C 5X1
Tel: (709) 772-2076
Fax: (709) 772-4105
E-Mail: Earl.Dawe@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice
Newfoundland and Labrador Region
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL A1C 5X1

Telephone: (709) 772-8892/2302
Fax: (709) 772-6100
E-Mail: vanessa.sutton-pande@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1919-5079 (Printed)
ISSN 1919-5087 (Online)

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2009. Assessment of Newfoundland and Labrador Snow Crab. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/045.