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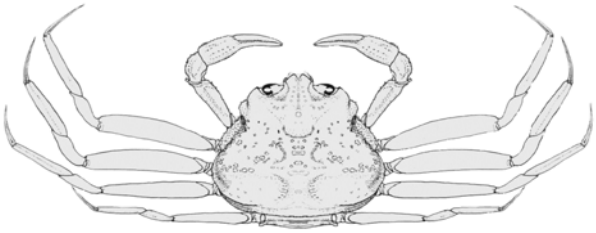
Newfoundland and Labrador Region **Stock Status Report 2004/012**



Newfoundland and Labrador Snow Crab

Background

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 but stock structure is unclear. 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.

Crabs grow by molting, in spring. Females cease molting when they achieve sexual maturity between 40 amd 75 mm carapace width (CW), whereas males may continue to molt until their terminal molt to adulthood, between about 40 and 115 mm CW.

Crab harvesters use fleets of conical baited traps. The minimum legal size is 95 mm CW. This regulation excludes females from the fishery while ensuring that a portion of the adult males in the population remain available for reproduction. The minimum legal mesh size of traps is 135 mm., to allow small crabs to escape. Under-sized and soft-shelled males that are retained in the traps must be returned to the sea and an unknown proportion of these die.

The fishery began in 1968 and was limited to NAFO Divisions 3KL until the mid 1980's. It has since expanded throughout Divisions 2J3KLNOP4R and is prosecuted by several fleet sectors. Management of the fishery led to the development of multiple quota-controlled management areas (Fig.1) with over 3300 licence holders under enterprise allocation in 2003. Stock status is not assessed at this fine management scale.

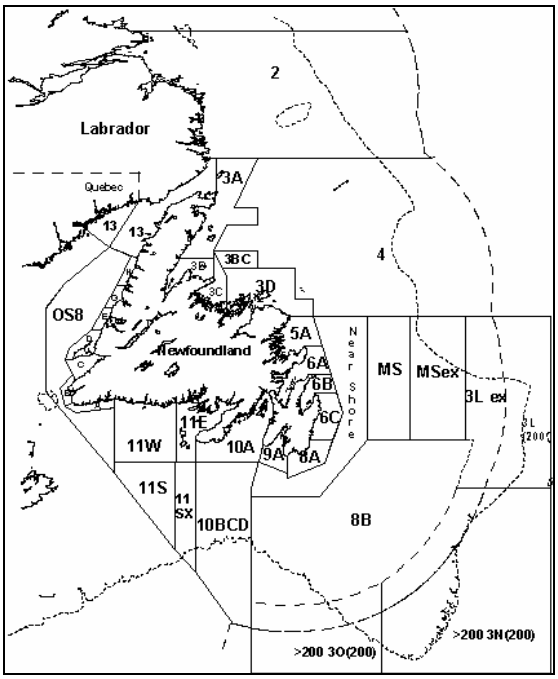


Figure 1: Newfoundland and Labrador Snow Crab Management Areas.

Summary

- Resource status was evaluated based on trends in fishery catch per unit of effort **(CPUE),** exploitable **biomass**, **recruitment** prospects and **mortality**. Data were derived from fall Div. 2J3KLNO multi-species bottom trawl surveys, inshore Div. 3KL trap surveys and fishery data from logbooks as well as observer catch-effort and biological sampling data.

- Low overall observer coverage, reduced in recent years, limited the usefulness of the observer data.

Canada

Division 2J

- **Landings** declined by 54% from 5400 t in 1999 to 2500 t in 2003, due to reductions in TAC imposed in 2000 and 2003, while **effort** increased by about 80%.

- The **exploitable biomass index**, as determined from fall multi-species surveys, decreased steadily, by 94%, from 1998-2002 and changed little in 2003. Spatial distribution of the exploitable resource contracted steadily during 1998-2002 with no further contraction in 2003.

- **Commercial CPUE** has declined steadily and by 70% since 1998.

- The fall survey **pre-recruit index** and observer discard pre-recruit index both decreased from 1998 to a lower level during 1999-2001. The survey index decreased in 2002 and remained relatively low in 2003. The observer discard pre-recruit index increased in 2002 but could not be updated for 2003 due to low observer coverage.

- The disagreement between the pre-recruit indices in 2002 and especially low observer coverage in 2003 create uncertainty about short-term **recruitment** prospects. Longer-term recruitment prospects are unknown.

- The **exploitation rate index** increased from 1999-2001, changed little in 2002, then increased sharply in 2003. The percentage of the total catch discarded increased sharply in 2002, implying increased **handling mortality** on pre-recruits during the 2002 fishery. Estimates could not be updated for 2003 due to low observer coverage.

- **Fishery-induced mortality** is expected to remain high in 2004 if the current catch level is maintained and poor handling practices continue.

Division 3K

- **Landings** declined by 29% from 21,400 t in 1999 to 15,300 t in 2001, due to a reduction in TAC imposed in 2000. They increased by 8% to 16,500 t in 2003 due to increases in TAC. **Effort** decreased during 1999-2001 then increased by 13% during 2001-2003.

- The **exploitable biomass index**, as determined from fall multi-species surveys, has declined by 68% over the past 3 years (2001-2003). Spatial distribution of the offshore exploitable resource contracted during 1998-2001, but changed little in 2002-2003.

- The **offshore commercial CPUE** has remained at a relatively low level following a 32% decline during 1998-2001. An **inshore trap survey index** and **inshore commercial CPUE** have increased since 2000.

- The fall survey **pre-recruit index** and the observer discard pre-recruit index declined from 1997-1999. The observer discard pre-recruit index has since varied at a relatively low level while the survey index declined further during 2000-2003. **Recruitment** is expected to remain relatively low in the short term. Longer-term recruitment prospects are unknown.

- The **exploitation rate index** increased steadily from 1997 to 2000 then remained relatively high. The percentage of the total catch discarded in the fishery increased from 1998-2001 then remained relatively high, at about 30%, during 2001-2003, implying relatively high **handling mortality** on pre-recruits during the fishery in 2001-2003.

- **Fishery-induced mortality** is expected to remain high in 2004 if the current

catch level is maintained and poor handling practices continue.

Division 3L

- **Landings** increased by 11% from 23,500 t in 2001 to 26,200 t in 2003, due to increased TACs, while **effort** increased by 46%.

- The **exploitable biomass index**, as determined from fall multi-species surveys, declined by 70% from 1996-2000 and has since remained relatively low. The spatial distribution of the offshore exploitable resource has contracted slightly since 1998.

- **Inshore and offshore CPUE** had been relatively stable during 2000-2002 but decreased by 21% inshore and 12% offshore in 2003.

- The fall survey **pre-recruit index** declined from 1996-1999 and remained at a relatively low level over the past 5 years. The observer discard pre-recruit index declined since 1997. **Recruitment** is expected to remain relatively low in the short term. Longer-term recruitment prospects are unknown.

- The **exploitation rate index** increased steadily from 1997-2001, decreased slightly in 2002, then remained unchanged in 2003. The percentage of the total catch discarded decreased sharply in 1998 and continued to decline gradually until 2003, implying reduced **handling mortality** on pre-recruits.

- The effect on **exploitation rate** of maintaining the current catch level remains unclear, because trends in the exploitable biomass index and CPUE do not agree. Both inshore and offshore CPUE decreased in 2003.

Divisions 3NO

- The fishery has been concentrated along the shelf edge. **Landings** increased by 17% from 4700 t in 2001 to 5500 t in 2003 due to increased TACs while **effort** increased by 25%.

- Because estimates of the **exploitable biomass index**, as determined from fall multi-species surveys, have wide margins of error, no inferences about biomass trends can be made from these data.

- **CPUE** has remained high in recent years although it did decrease by 10% in 2003.

- Wide margins of error introduce uncertainty in interpreting the fall multi-species survey **pre-recruit index**. However, the survey index has declined since 1998 while the observer pre-recruit index has declined since 1999. **Recruitment** is expected to remain relatively low in the short term. Longer-term recruitment prospects are unknown.

- Trends in the **exploitation rate index** are unclear because of uncertainties associated with the exploitable biomass index. The percentage of the total catch discarded in the fishery declined by more than half since 1999, implying reduced **handling mortality** on pre-recruits.

- The effects of maintaining the current catch level on the **exploitation rate** are unknown.

Subdivision 3Ps

- **Landings** decreased by 20% from 7600 t in 2002 to 6100 t in 2003, due to a reduction in TAC, while **effort** increased by 9%.

- No **exploitable biomass index** is available as there are no reliable research survey data from this area.

- **Inshore and offshore CPUE** have declined from 1999-2003 by 40% and 67% respectively.

- The observer discard **pre-recruit index** has remained stable over the past five years (1999-2003). **Recruitment** is expected to change little in the short term.

- The percentage of the total catch discarded in the fishery increased from 26% in 2001 to 48% in 2002 and remained at that level in 2003, implying high **handling mortality** on pre-recruits during the 2002 and 2003 fisheries.

- Assuming that CPUE reflects the exploitable biomass, and the declining trend continues, **exploitation rate** and **pre-recruit mortality** will likely increase if the current catch level is maintained.

Division 4R and Subdivision 3Pn

- **Landings** increased by 88% from 930-1750 t during 1997-2002 due to increases in TAC then dropped by 10% to 1570 t in 2003 despite a further increase in TAC. Effort increased steadily until 2001 and then decreased by 24% in 2002-2003.

- There are no reliable fishery independent data from this area.

- It is not possible to infer trends in **exploitable biomass** from **commercial CPUE** data because of recent changes in the spatial distribution of fishing effort**.** CPUE is consistently low relative to other divisions.

- The observer data for this area are insufficient to estimate a reliable **pre-recruit index** or infer levels of **handling mortality.**

- The effects of maintaining the current catch level on the **exploitation rate** are unknown.

Overall Resource Status

- A decline in the Newfoundland and Labrador snow crab resource is evident in some divisions.

- **Commercial CPUE** has declined steadily over 5 years to very low levels in Div. 2J and Subdiv. 3Ps.

- The fall multi-species surveys indicate a decline in both **exploitable biomass** and **recruitment** in Div. 2J3KL and contraction of the resource within these divisions in recent years.

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, but at about 40 mm CW (~ 4 years of age) they may become sexually mature.

Females cease molting after sexual maturity is achieved at about 40-75 mm CW and so they 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 at 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 and are considered to be pre-recruits until

the following year when they begin to contribute to the exploitable biomass as older-shelled adults. Crabs may live about 5-6 years as adults after the terminal molt.

Ecology

Negative relationships between bottom temperature and snow crab CPUE have been demonstrated at lags of 6-10 years (Fig. 2) suggesting that cold conditions early in the life history are associated with the production of strong year classes.

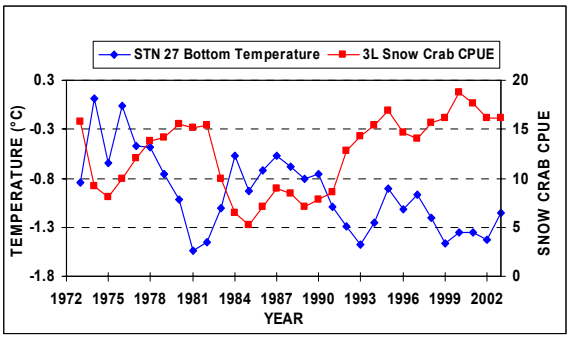


Figure 2: Trends in Div. 3L CPUE and lagged (8 years) Station 27 bottom temperature.

Temperatures on the Newfoundland Shelf were below normal in most years from the mid-1980's to about 1995. These were years of high crab productivity that led to high commercial catch rates during the 1990's. Warmer conditions since 1996 might have led to reduced productivity during this more recent period and could negatively impact future commercial catch rates.

Productivity of crab during early life history has also been linked to the winter and spring sea ice cover on the Newfoundland Shelf. The formation and melting of sea ice greatly influences the layering of the water column and, hence, the maintenance of primary and secondary production during spring within the near-surface layer (<50 m). It has been hypothesized that an important mechanism determining snow crab larval survival is a combination of nutrient supply, production of zooplankton, and physical oceanographic processes.

Correlation between the commercial CPUE in Div. 3L and ice cover at a time lag (10 years) approximating the mean age of crabs in the fishery provides a forecast of future fishery performance (Fig. 3). The model predicts a decline in CPUE up to 2006 and gradual recovery thereafter. However uncertainty in the forecast, illustrated in the 95% confidence intervals (C.I.), increases with time.

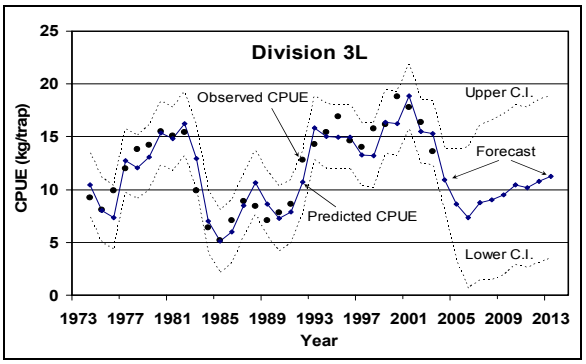


Figure 3: Comparison of observed Div. 3L CPUE values with those predicted by a model that includes ice cover 10 years earlier as an explanatory variable.

The Fishery

The fishery began in Trinity Bay (Management area 6A) in 1968. Initially, crab were taken as gillnet by-catch but within several years there was a directed trap fishery in inshore areas along the northeast coast of Div. 3KL during spring through fall.

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 1982-1987 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. Since the late 1980's the resource has increased in these areas. 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.

Landings for Div. 2J3KLNOP4R (Fig. 4) increased steadily from about 10,000 t annually during the late 1980's to 69,000 t in 1999 largely due to expansion of the fishery to offshore areas. They decreased by 20% to 55,300 t in 2000, in association with a 17% reduction in TAC, before increasing slightly to 59,300 t in 2002. They declined slightly to 58,300 t in 2003, in association with a reduction in TAC.

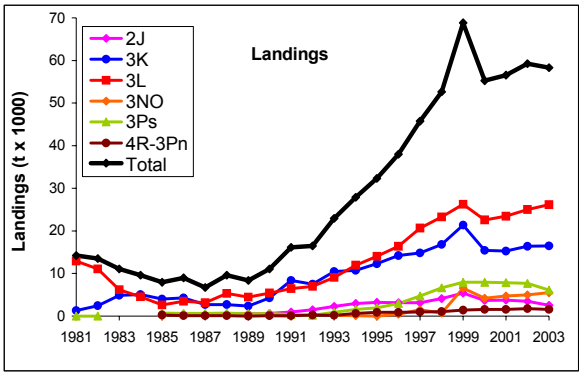


Figure 4: Trends in annual landings by NAFO Division.

Effort, as indicated by estimated trap hauls, has approximately tripled throughout the 1990's. It declined in 2000 and increased slightly thereafter. Increasing effort in the 1990's was primarily due to vessels <35 feet with temporary seasonal permits. Effort has been broadly distributed in recent years (Fig. 5).

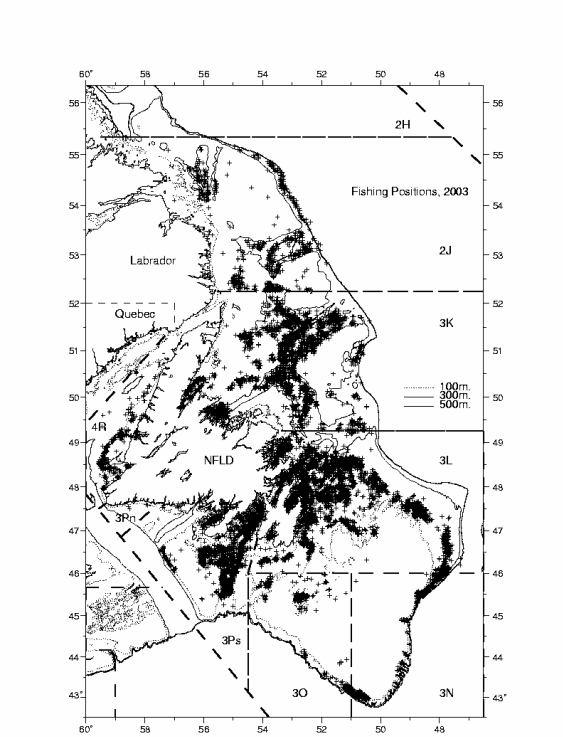


Figure 5: Spatial distribution of commercial fishing effort during 2003.

Resource Assessment

Resource status was evaluated based on trends in indices of **biomass, recruitment,** and **mortality** from multi-species trawl surveys, inshore trap surveys, fishery performance, and observer at-sea sampling.

Fall multi-species bottom trawl surveys (post-season surveys with respect to snow crab) provide an index of the exploitable biomass (older-shelled adults of legal size) that is expected to be available for the fishery in the following year for Div. 2J3KLNO.

This index, based on offshore survey strata, is used together with offshore commercial CPUE to evaluate trends in the exploitable biomass. Inshore commercial CPUE is compared with catch rates from inshore trap surveys, where available.

Fall bottom trawl surveys also provide data on adolescents larger than 75 mm that are used to calculate an index of pre-recruit legal-sized males that would result from imminent molting in spring. These new-shelled crabs would begin to recruit to the fishery, as older hard-shelled adults, one year later.

This survey index is compared to observer-based catch rates (kg/trap haul) of total crabs discarded. Both the survey pre-recruit index and the observer discard pre-recruit index reflect catch rates of undersized and new-shelled legal-sized pre-recruits.

Evidence of progression of smallest males (< 41 mm CW) to larger sizes from size frequency data is lacking. Therefore, longer-term (~ 5 years) recruitment prospects are unknown.

Trends in exploitation rate are inferred from changes in the ratio of commercial catch to the exploitable biomass index from the fall multi-species survey of the previous year.

The percentage discarded by weight of the total catch, as estimated from observer data, is interpreted as an index of handling mortality. Poor handling practices persist in the fishery resulting in high handling mortality on discarded crabs. Handling mortalities of pre-recruits will impact short-term (about 1-3 years) recruitment. Also, handling mortality of small (<95 mm CW) adults may adversely affect insemination of females, especially when abundance of larger males is low.

Division 2J

Commercial Fishery

Landings increased slightly from 330 t in 1985 to 600 t in 1990, before increasing to about 3200 t during 1995-1997**.** They peaked in 1999 at 5400 t but declined to 2500 t in 2003, due to reductions in TAC imposed in 2000 and 2003, while **effort** increased by about 80%.

Commercial catch rates (CPUE) have oscillated over the time series (Fig. 6), initially decreasing during 1985-1987, increasing to a peak in 1991, decreasing again to 1995, and increasing to peak again in 1998. CPUE has since declined steadily to its lowest observed value in 2003.

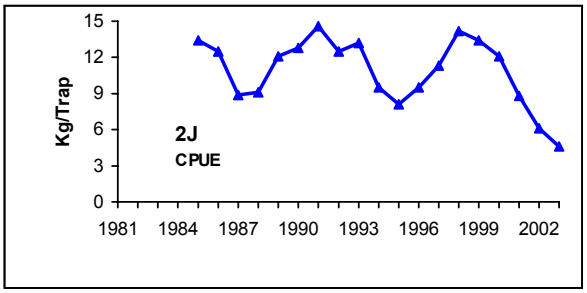


Figure 6: Annual trends in Div. 2J commercial CPUE.

Resource Status

Biomass

The **exploitable biomass index** (Fig. 7) increased steadily during 1995-1998, decreased by 94% from 1998-2002, and changed little in 2003.

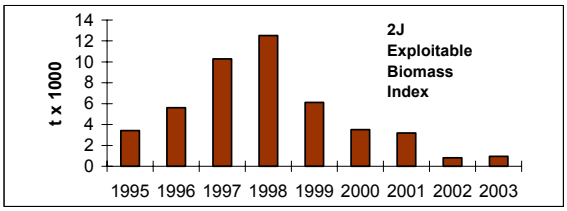


Figure 7: Annual trends in the Div. 2J fall multi-species survey exploitable biomass index.

Commercial catch rates (CPUE) have declined steadily from 1998-2003, in agreement with the decline in the exploitable biomass index.

The distribution of the exploitable biomass, based on fall multi-species surveys, contracted during 1998-2002, as indicated by a decrease in the proportion of the survey area accounting for 95% of the exploitable biomass. There was no further contraction in 2003.

Recruitment Prospects

The fall **survey pre-recruit index** (Fig. 8) increased steadily from 1995-1998 but then decreased by 66% in 1999. It changed little during 1999-2001, decreased in 2002 to its lowest value in the time series, and remained relatively low in 2003.

The **observer discard pre-recruit index** (kg/trap haul, Fig. 8) also increased overall during 1995-1998, dropped in 1999, and remained stable through 2001. This index doubled in 2002, in contrast to the survey pre-recruit index, but could not be updated for 2003 due to low observer coverage level. The disagreement between the pre-recruit indices in 2002 and especially low observer coverage in 2003 create uncertainty about short-term **recruitment** prospects**.** Longer-term recruitment prospects are unknown.

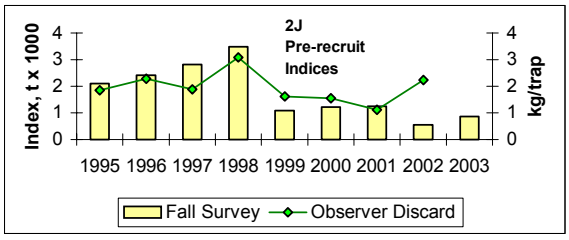


Figure 8: Annual trends in two Div. 2J pre-recruit indices.

Mortality

The **exploitation rate index** decreased from 1996-1998 (Fig. 9), was unchanged in 1999, then increased from 1999-2001. It changed little in 2002 but increased sharply in 2003.

The percentage of the total catch discarded in the fishery (Fig. 9) increased sharply in 2002, implying increased **handling mortality** on pre-recruits in the 2002 fishery. This index could not be updated for 2003 due to low observer coverage.

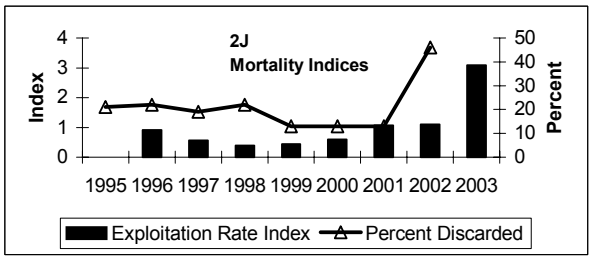


Figure 9: Annual trends in two Div. 2J mortality indices.

Outlook

Trends in both the fall survey exploitable biomass index and fishery CPUE indicate that the biomass has declined steadily since 1998. The exploitation rate index increased sharply in 2003 despite a decrease in landings.

Because of disagreement between indices of observer and survey pre-recruit biomass, and especially low observer coverage in 2003, recruitment prospects in the short term are uncertain.

Fishery-induced mortality is expected to remain high in 2004 if the current catch level is maintained and poor handling practices continue.

Division 3K

Commercial Fishery

Landings averaged about 3300 t during 1985-1990 then increased to about 21,400 t in 1999 before declining by 29% to 15,300 t in 2001, due to a reduction in TAC

imposed in 2000. They increased by 8% to 16,500 t in 2003 due to increases in TAC. **Effort** decreased during 1999-2001 and increased by 13% during 2001-2003.

Inshore landings averaged 18% of the total over the past five years.

Commercial catch rates oscillated over the time series (Fig. 10). **Offshore CPUE** declined by 32% from 1998-2001 and has since remained at a relatively low level. **Inshore CPUE** declined from 1993-1999, was unchanged in 2000, increased sharply in 2001, and has since remained relatively high. An **inshore trap survey biomass index** has also increased since 2000.

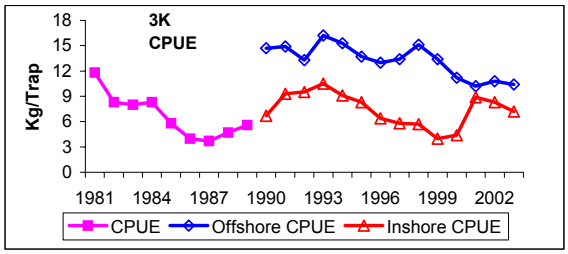


Figure 10: Annual trends in Div. 3K commercial CPUE.

Resource Status

Biomass

The **exploitable biomass index** increased sharply in 1996 (Fig. 11) and remained at a high level during 1996-1998. It dropped by more than half in 1999, increased slightly during 2000 and 2001 and has since declined by 68%. However there is greater uncertainty in 2003 due to unusually late timing of the survey.

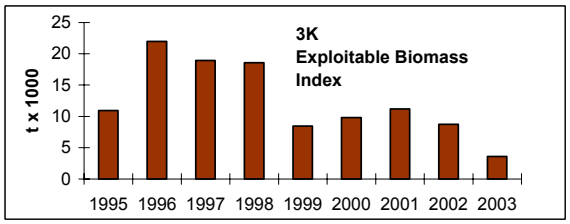


Figure 11: Annual trends in the Div. 3K fall multi-species survey exploitable biomass index.

The distribution of the offshore exploitable biomass has contracted during 1998-2001, as indicated by a decrease in the proportion of the survey area accounting for 95% of the exploitable biomass. This index increased slightly in 2002 and was unchanged in 2003.

Offshore commercial CPUE declined steadily from 1998-2001 and remained relatively low in 2002-2003 (Fig. 10).

Inshore commercial CPUE has been consistently lower than offshore CPUE (Fig. 10). Inshore CPUE declined during 1993-1999, changed little in 2000, increased sharply in 2001, and has since remained relatively high. An **inshore trap survey**, conducted since 1994, also suggests an increase in biomass since 2000.

Recruitment Prospects

Both the fall **survey pre-recruit index** and the **observer discard pre-recruit index** increased between 1995 and 1997 (Fig. 12) before declining during 1997-1999. The observer discard pre-recruit index has since varied at a relatively low level while the survey index declined during 2000-2003. **Recruitment** is expected to remain relatively low in the short term. However there is greater uncertainty in 2003 due to unusually late timing of the survey. Longer-term recruitment prospects are unknown.

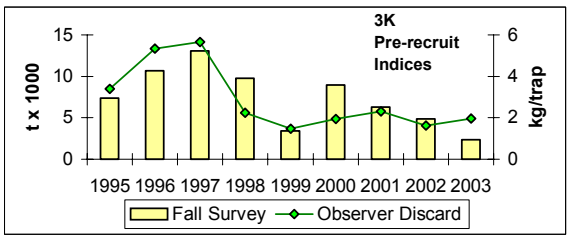


Figure 12: Annual trends in two Div. 3K pre-recruit indices.

Mortality

The **exploitation rate index** decreased from 1996-1997 (Fig. 13), steadily

increased from 1997 to 2000, and has remained relatively high over the past 4 years.

The percentage of the total catch discarded in the fishery increased from 1998-2001 (Fig. 13) and remained relatively high, at about 30%, during 2001-2003, implying relatively high **handling mortality** on pre-recruits during the fishery in 2001-2003.

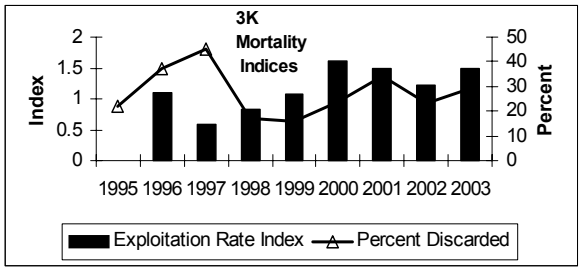


Figure 13: Annual trends in two Div. 3K mortality indices.

Outlook

The fall survey exploitable biomass index declined by 68% over the past 3 years while offshore CPUE has remained relatively low. Inshore commercial CPUE and trap survey data suggest an increase in biomass inshore since 2000.

Offshore survey and fishery indices agree in indicating that recruitment is expected to remain relatively low in the short term.

Fishery-induced mortality is expected to remain high in 2004 if the current catch level is maintained and poor handling practices continue.

Division 3L

Commercial Fishery

Landings increased from about 1300 t in 1975 to 13,000 t in 1981, before decreasing to 2600 t in 1985. They increased steadily to peak at 26,200 t in 1999, before declining to 22,600 t in 2000, due to a reduction in TAC. They increased by 11% from 23,500 t in 2001 to 26,200 t in 2003, due to increased TACs, while **effort** increased by 46%.

Inshore landings have averaged 24% of the total over the past 5 years.

Commercial catch rates (Fig. 14) in the offshore increased sharply from 1991-1992 and have since remained high. **Inshore CPUE** has been consistently lower than **offshore CPUE**. Both indices were relatively stable during 2000-2002 but declined by 21% inshore and 12% offshore in 2003.

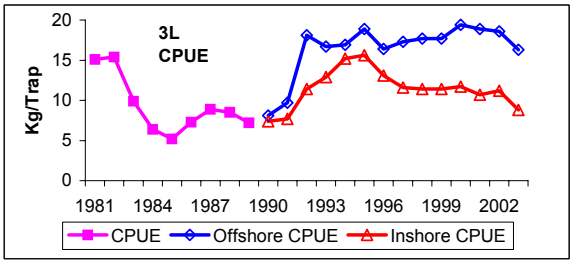


Figure 14: Annual trends in Div. 3L commercial CPUE.

Resource Status

Biomass

The **exploitable biomass index** declined by about 70% from 1996-2000 (Fig. 15) and has since remained at a relatively low level in contrast with the **offshore CPUE** trend. The distribution of the offshore exploitable biomass has contracted slightly since 1998, as indicated by a decrease in the proportion of the survey area accounting for 95% of the exploitable biomass. Disagreement between the exploitable biomass index and CPUE, since 1996, introduces uncertainty regarding recent trends in biomass.

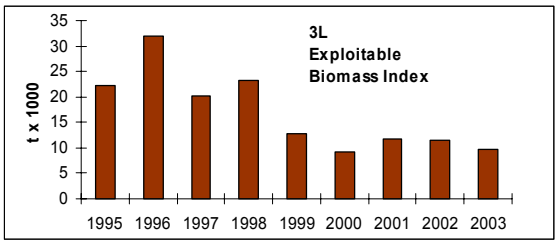


Figure 15: Annual trends in the Div. 3L fall multi-species survey exploitable biomass index.

Recent trends in **trap survey catch rates** from 3 localized inshore areas did not agree with corresponding commercial CPUE trends. However 2 of the 3 surveys showed a decrease in 2003, consistent with the broader-scale **inshore CPUE**.

Recruitment Prospects

The fall **survey pre-recruit index** declined from 1996-1999 (Fig. 16) and has remained at a relatively low level over the past 5 years. The observer **discard pre-recruit index** increased from 1995-1997 (Fig. 16), and declined thereafter. **Recruitment** is expected to remain relatively low in the short term. Longer-term recruitment prospects are unknown.

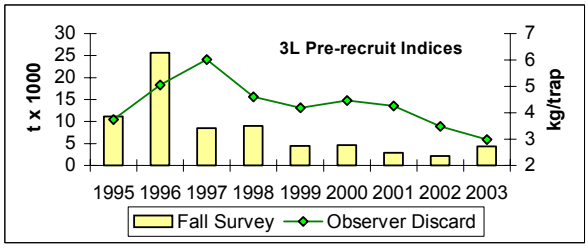


Figure 16: Annual trends in two Div. 3L pre-recruit indices.

Mortality

The **exploitation rate index** increased from 1997-2001 (Fig. 17), decreased slightly in 2002, and remained unchanged in 2003.

The percentage of the total catch discarded in the fishery (Fig. 17) increased from 1995-1997, decreased sharply in 1998, then declined gradually until 2003, implying decreased **handling mortality** on pre-recruits.

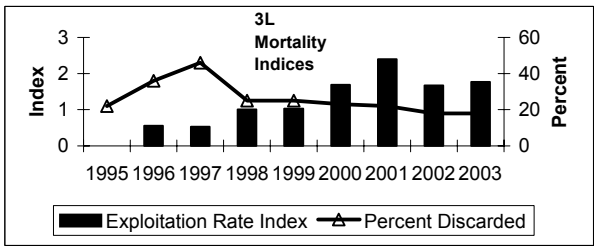


Figure 17: Annual trends in two Div. 3L mortality indices.

Outlook

The fall multi-species survey exploitable biomass index and the offshore commercial CPUE do not agree. Whereas the survey data suggest a decline since 1996, the offshore fishery continues to perform at a high level.

The effect on **exploitation rate** of maintaining the current catch level remains unclear. However, both inshore and offshore CPUE decreased in 2003.

Divisions 3NO

Commercial Fishery

The fishery began in 1995. **Landings** peaked in 1999 at 6500 t, then dropped by 35% to 4200 t in 2000, due to a TAC reduction. They increased by 17% from 4700 t in 2001 to 5500 t in 2003, due to increased TACs, while **effort** increased by 25%.

Commercial **CPUE** (Fig. 18) increased by about 60% from 1996-2002 but decreased by 10% in 2003.

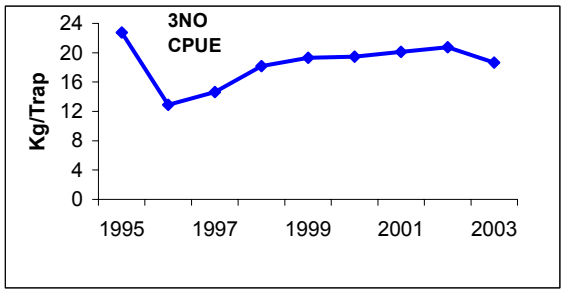


Figure 18: Annual trends in Div. 3NO commercial CPUE.

Resource Status

Biomass

The resource has been concentrated along the shelf edge in these divisions. Estimates of the **exploitable biomass index**, as determined from the fall multi-species survey data, have wide margins of error, and show no clear trend (Fig. 19). Therefore no inferences about biomass can be made from these data. **CPUE** has remained high in recent years although it did decrease by 10% in 2003.

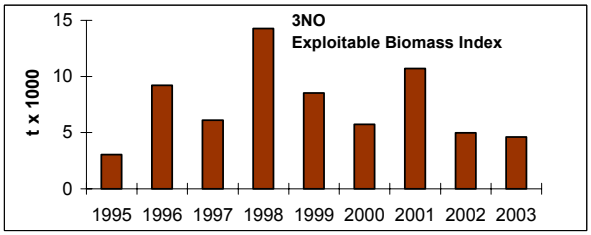


Figure 19: Annual trends in Div. 3NO fall multi-species survey exploitable biomass index.

Recruitment Prospects

Wide margins of error introduce uncertainty in interpreting the fall multi-species **survey pre-recruit index**. However, the survey index (Fig. 20) has shown a declining trend since 1998 while the observer **discard pre-recruit index** (Fig. 20) has declined since 1999. **Recruitment** is expected to remain relatively low in the short term. Longer-term recruitment prospects are unknown.

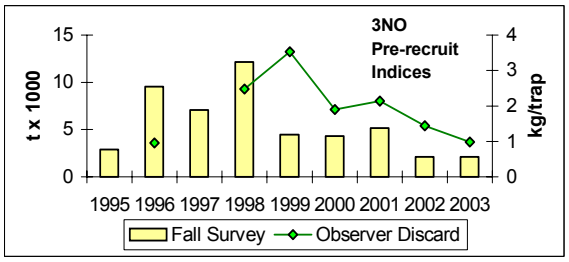


Figure 20: Annual trends in two Div. 3NO pre-recruit indices.

Mortality

Trends in **exploitation rate index** are unclear because of uncertainties associated with the exploitable biomass index. The percentage of the total catch discarded in the fishery (Fig. 21) declined by more than half since 1999, implying reduced **handling mortality** on pre-recruits.

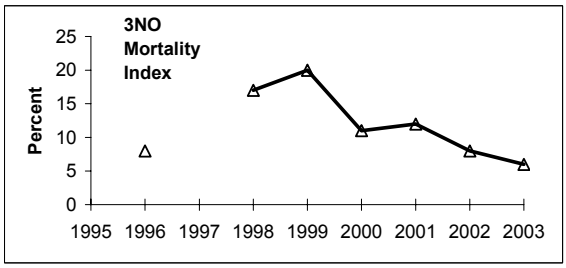


Figure 21: Annual trends in observer percent discarded in the Div. 3NO fishery.

Outlook

Trends in the exploitable biomass index are unclear, but the fishery continues to perform at a high level. However CPUE decreased in 2003.

The effects of maintaining the current catch level on the **exploitation rate** are unknown.

Subdivision 3Ps

Commercial Fishery

The fishery began in 1985 with **landings** not exceeding 1000 t until 1994 when the offshore fishery began. Landings rose

steadily until 1999 due to increased TACs and averaged 7800 t during 1999-2002. They decreased by 20% from 7600 t in 2002 to 6100 t in 2003, due to a reduction in TAC, while **effort** increased by 9%.

Inshore landings have averaged 43% of the total over the past 5 years.

Inshore and offshore commercial CPUE have declined from 1999-2003 (Fig. 22) by 40% and 67% respectively.

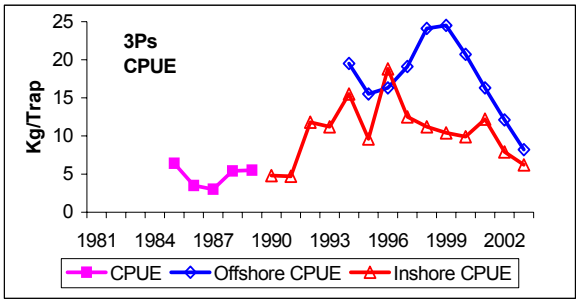


Figure 22: Annual trends in Subdiv. 3Ps commercial CPUE.

Resource Status

Biomass

No estimates of an **exploitable biomass index** are available as there are no reliable research survey data from this area. **Inshore and offshore CPUE** have declined from 1999-2003 by 40% and 67% respectively.

Recruitment Prospects

The observer **discard pre-recruit index** (Fig. 23) has remained stable over the past 5 years (1999-2003). **Recruitment** is expected to change little in the short term. Longer-term recruitment prospects are unknown.

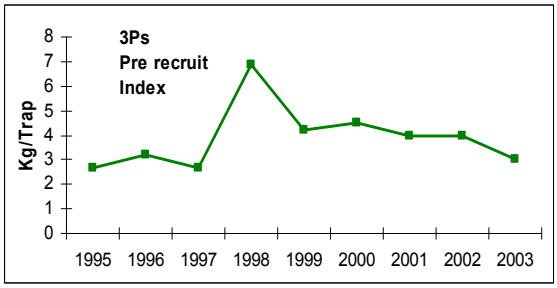


Figure 23: Annual trends in the Subdiv. 3Ps observer discard pre-recruit index.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 24) increased from 26% in 2001 to 48% in 2002 and remained at that level in 2003, implying high **handling mortality** on pre-recruits during the 2002 and 2003 fisheries.

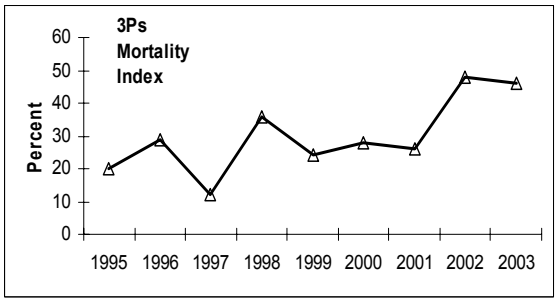


Figure 24: Annual trends in the Subdiv. 3Ps percent discarded.

Outlook

Assuming that CPUE reflects the exploitable biomass, and the declining trend continues, **exploitation rate** and **pre-recruit mortality** will likely increase if the current catch level is maintained.

Division 4R and Subdivision 3Pn

Commercial Fishery

The fishery began in the early 1990's with **landings** not exceeding 1000 t until 1998. They increased by 88% from 930-1750 t during 1997-2002, due to increases in

TAC, and dropped by 10% to 1570 t in 2003, despite a further increase in TAC. **Effort** increased steadily until 2001 and then decreased by 24% to 2003. There has been a pronounced change in the distribution of effort from north to south in recent years. **CPUE** is consistently low relative to other divisions (Fig. 25).

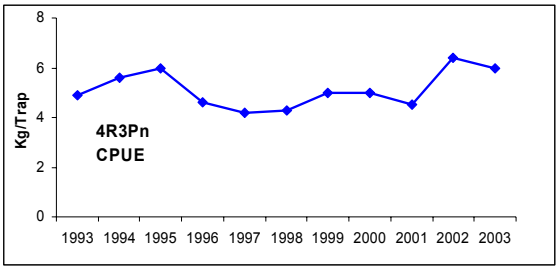


Figure 25: Annual trends in Div. 4R and Subdiv. 3Pn commercial CPUE.

Resource Status

Biomass

There are no reliable fishery independent data from this area. It is not possible to infer trends in **biomass** from **CPUE** data because of recent changes in the spatial distribution of fishing effort**.**

Recruitment Prospects

Observer coverage levels have been low for this area. New analysis showed that the data were not representative of the seasonal distribution of effort. Therefore the observer data are considered insufficient to estimate a reliable **pre-recruit index** and short-term recruitment prospects are unknown. Longer-term recruitment prospects are also unknown.

Mortality

The observer data are insufficient to infer levels of **handling mortality** on pre-recruits.

Outlook

The effects of maintaining the current catch level on the **exploitation rate** and **pre-recruit mortality** are unknown.

Overall Resource Status, Divisions 2J3KLNOP4R

A decline in the Newfoundland and Labrador snow crab resource is evident in some divisions. Commercial CPUE has declined steadily over 5 years to very low levels in Div. 2J and Subdiv. 3Ps. The fall multi-species surveys indicate a decline in both exploitable biomass (Fig. 26) and recruitment (Fig. 27) in Div. 2J3KL and contraction of the resource within these divisions in recent years. Also, the recent warm oceanographic regime may have impaired snow crab productivity.

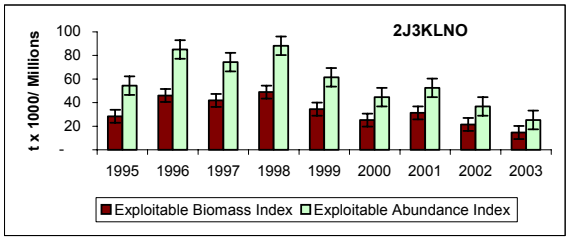


Figure 26: Annual trends in the fall multi-species survey exploitable biomass and abundance indices, with 95% confidence intervals, for Div. 2J3KLNO.

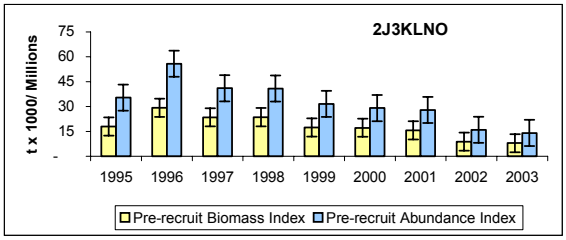


Figure 27: Annual trends in the fall multi-species survey pre-recruit biomass and abundance indices, with 95% confidence intervals, for Div. 2J3KLNO.

Exploitation rate indices are near their highest levels within each division of Div. 2J3KL. However comparisons cannot be made across divisions due to unquantified

effects of spatial variation in substrate type on catchability of crabs by the survey trawl.

The percentage of crabs discarded in the fishery is near its highest level in several divisions, implying high handling mortality.

The Div. 3NO fishery continues to perform at a high level and handling mortality has been reduced in recent years.

Resource status could not be evaluated in Div. 4R and Subdiv. 3Pn due to inadequate data.

Sources of Uncertainty

There is uncertainty regarding the effects of changes in some fishing practices (e.g. soak time, trap mesh size, bait quality, and high-grading) on catch rates and their interpretation as indicators of resource status. The reliability of the logbook data is uncertain with respect to reported effort and areas fished.

Exploitable biomass and recruitment indices from multi-species trawl surveys are affected by uncertainties associated with variation in catchability of crabs by the survey trawl, as well as biological parameters such as proportion molting, growth rate, and natural mortality. There is additional uncertainty in the indices for Div. 3K due to unusually late timing of the survey in 2003 and unknown seasonal effects on catchability of crabs by the survey trawl.

Recruitment and handling mortality indices that are estimated using observer data are uncertain due to low observer coverage that has deteriorated in recent years. Furthermore, poor handling practices are known to persist, resulting in high fishing mortality on discarded crabs, but it is uncertain how handling practices may have changed over time.

Other Considerations

Reproductive biology

Abundance of **mature females** throughout Div. 2J3KLNO was much higher during 1995-1998 than during 1999-2003, implying reduced egg production in recent years. Also, handling mortality on small (< 95 mm CW) adult males may adversely affect insemination of females, especially when abundance of larger adults is low.

Bitter crab disease (BCD)

There has been a broadly distributed incidence of **bitter crab disease** during 1996-2003. This disease, which is fatal to crabs, appears to be acquired during molting. The fall multi-species surveys indicate that it occurs in Div. 2J3KL, especially in 30-80 mm CW crabs of both sexes. It is most prevalent in Div. 3K but appears to be virtually absent in Div. 3NO. Spatial and temporal trends are unclear and implications for mortality are unknown.

Indirect effects of fisheries

Gillnet fisheries for groundfish impose an unquantified fishing mortality on snow crab. Snow crab and shrimp fisheries occur on common grounds in Div. 2J3K, but the mortality on snow crab due to shrimp trawling remains unknown. Ghost fishing by lost gillnets and crab traps has been reported but the associated snow crab mortality is unquantified.

Predation

The abundance of **predatory groundfish** species has remained low since the early 1990's but the implications for mortality are unknown. **Cannibalism** is known to occur but there are no data on spatial or annual variation in its prevalence.

Management Considerations

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 any increase in exploitation rate has been considered to have minimal impact on reproductive potential. However **handling mortality** on small (< 95 mm CW) adult males may adversely affect insemination of females, especially when abundance of larger adults is low.

Handling mortality on pre-recruits can impair future recruitment. Options for reducing handling mortality include early fishing seasons, increasing mesh size and soak time, good handling practices, reducing high-grading and trap modifications.

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