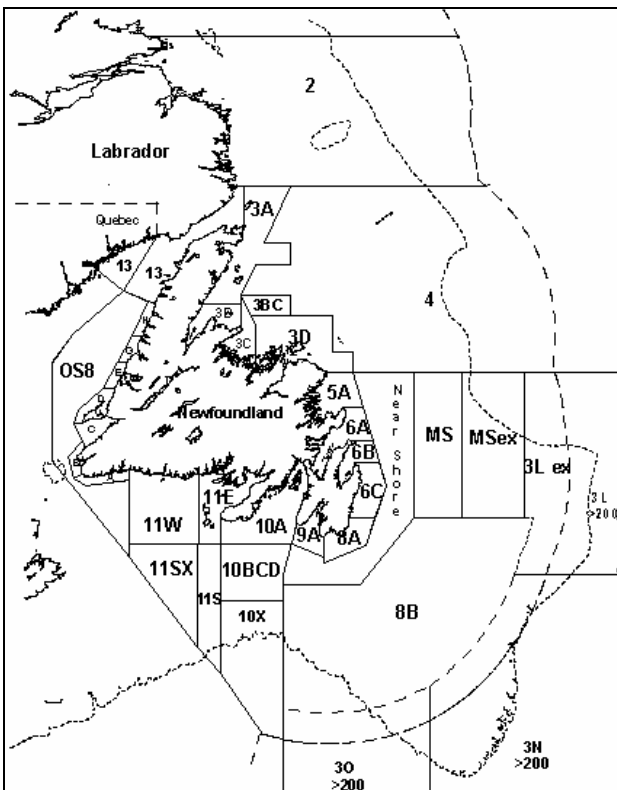
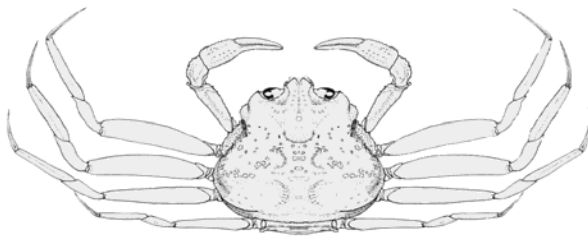




# STOCK ASSESSMENT REPORT ON NEWFOUNDLAND AND LABRADOR SNOW CRAB



## 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 multi-species bottom trawl surveys in Divisions 2J3KLNO, inshore trap surveys in Divisions 3KL, fishery data from logbooks, and observer catch-effort data, as well as biological sampling data from multiple sources.
- A decline in the Newfoundland and Labrador snow crab resource is evident in some divisions.
- **Commercial CPUE** in Division 2J and Subdivision 3Ps has declined steadily over 6 years to very low levels.
- The fall multi-species surveys in Divisions 2J3KLNO indicate a decline in **exploitable biomass** since 1998. **Recruitment** declined from 1996-2002 and has since remained at a low level.

## Division 2J

- **Landings** declined by 65% from 5400 t in 1999 to 1900 t in 2004 due to reductions in TAC, while **effort** increased by 42%.
- The **exploitable biomass index** as determined from fall multi-species surveys, decreased steadily, by 94%, from 1998-2002 and has remained low during 2002-2004. **Commercial CPUE** has declined steadily by 77% since 1998 to a record low level in 2004.
- 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, remained low in 2003, and increased sharply in 2004. The observer index increased in 2002, was unchanged in 2003, and increased slightly in 2004.
- The fall survey and observer pre-recruit indices agree that **recruitment** appears promising in the short term. The survey data indicate an increase in abundance of sub-legal sized males that will begin to achieve legal size in 2005, as new-shelled immediate pre-recruits, and will recruit to the fishery as older-shelled crabs predominately in 2006-2007.
- Longer-term recruitment prospects are unknown.
- The **exploitation rate index** increased from 1999-2001, changed little in 2002 and increased sharply in 2003. It decreased in 2004 to its second highest level in the time series. The percentage of the total catch discarded increased sharply in 2002, was unchanged in 2003, and further increased to a record high level in 2004 implying increased **handling mortality** on pre-recruits in the 2004 fishery.
- Continued exploitation, in the short term, would likely impose a very high **mortality** on immediate pre-recruits that would seriously impair recovery of the exploitable biomass.

### Division 3K

- **Landings** declined by 29% from 21,400 t in 1999 to 15,300 t in 2000 and 2001, due to a reduction in TAC imposed in those years. They increased to 16,500 t in 2002-2004 due to an increase in TAC. **Effort** decreased during 1999-2001, then increased by 17% to 2003, and further increased by 37% in 2004.
- The **exploitable biomass index**, as determined from fall multi-species surveys, declined by 68% from 2001-2003 and remained low in 2004. The **offshore commercial CPUE** decreased 32% from 1998-2001, remained at this relatively low level until 2003, and decreased sharply in 2004. **Inshore commercial CPUE** has declined since 2001 to about the long-term average.
- The fall survey **pre-recruit index** and the observer discard pre-recruit index declined from 1997-1999. The observer index has since varied at a relatively low level. The survey index declined during 2000-2003 before increasing in 2004 to about the 10-year average. **Offshore recruitment** is expected to remain unchanged in the short-term. An **inshore trap survey index of immediate pre-recruits** increased during 2000-2003 and decreased in 2004 to about the 11-year average.
- Longer-term recruitment prospects are unknown.
- The **exploitation rate index** increased steadily from 1997 to 2000 and changed little to 2003, before increasing sharply in 2004. The percentage of the total catch discarded in the fishery increased from 1999-2001 and remained relatively high, at about 30%, during 2001-2003. It then increased to about 40%, implying relatively high **handling mortality** on small and new-shelled pre-recruits during the fishery in 2004.
- **Fishery-induced mortality** is expected to remain high in 2005 if the recent catch level is maintained and current fishing practices persist.

### Division 3L

- **Landings** increased by 16% from 22,600 t in 2000 to 26,200 t in 2003, and decreased to 25,800 t in 2004 due to changes in TAC. Meanwhile **effort** has increased by 75% since 2000.
- The **exploitable biomass index**, as determined from fall multi-species surveys, declined from 1996-2000 and remained relatively low until it further decreased in 2004. **Offshore CPUE** remained at a high level despite a decrease of 24% between 2002 and 2004. **Inshore CPUE** decreased by 21% in 2003 and remained unchanged in 2004.
- The fall survey **pre-recruit index** has been low since 1997. The observer discard pre-recruit index has 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 from 1996-2000 and remained high thereafter. The percentage of the total catch discarded decreased sharply in 1998 and continued to decline gradually until 2004, 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.

### Divisions 3NO

- The fishery has been concentrated along the shelf edge. **Landings** increased sharply in 1999 and averaged 5200 t over the past six years.
- 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. **Commercial CPUE** has remained high in recent years relative to other areas, but decreased by 26% between 2002 and 2004.
- Wide margins of error introduce uncertainty in interpreting the fall multi-species survey **pre-recruit index**. However, biological data from the survey, as well as data from at-sea observers, indicate that **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 has remained steady during the last 3 years at a low level, implying low **handling mortality** on pre-recruits.
- The effects of maintaining the current catch level on the **exploitation rate** are unknown.

### Subdivision 3Ps

- Landings decreased by 38% from 7600 t in 2002 to 4700 t in 2004, due to reductions in TAC. **Effort** increased by 64% from 2001-2003 before decreasing by 10% in 2004.
- No **exploitable biomass index** is available as there are insufficient fishery independent data from this area. **Inshore CPUE** declined from 2001-2004 by 67%. **Offshore CPUE** declined by 67% from 1999-2003 and remained unchanged in 2004.
- The observer discard **pre-recruit index** has changed little over the past six years (1999-2004). **Recruitment** is expected to change little in the short term.
- The percentage of the total catch discarded in the fishery decreased from 46% in 2003 to 34% in 2004 implying reduced **handling mortality** on pre-recruits during the 2004 fishery.
- Assuming that recent CPUE reflects low exploitable biomass, **exploitation rate** and **pre-recruit mortality** will likely remain high if the current catch level is maintained.

## Division 4R and Subdivision 3Pn

- **Landings** increased by 88% from 930 t in 1997 to 1750 t in 2002 due to increases in TAC then dropped by 17% to 1450 t in 2004. The TAC was not fully taken in the past two years. **Effort** increased steadily until 2001, decreased in 2002, and increased in 2003-2004.
- There are insufficient 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.

## DESCRIPTION OF THE ISSUE

### 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 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.

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

A warm oceanographic regime persisted in 2004 implying poor long-term recruitment prospects.

### 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 Divisions 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 Divisions 3K and 3L while new fisheries started in Division 2J, Subdivision 3Ps and offshore Division 3K. A snow crab fishery began in Division 4R in 1993.

Licences supplemental to groundfishing were issued in Division 3K and Subdivision 3Ps in 1985, in Division 3L in 1987, and in Division 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.

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 Divisions 2J3KLNOP4R (Fig. 2) 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, increased slightly to 59,000 t in 2002 and 2003 and declined to 55,600 t in 2004, due to changes in TAC's. Most of the landings have been from Divisions 3KL.

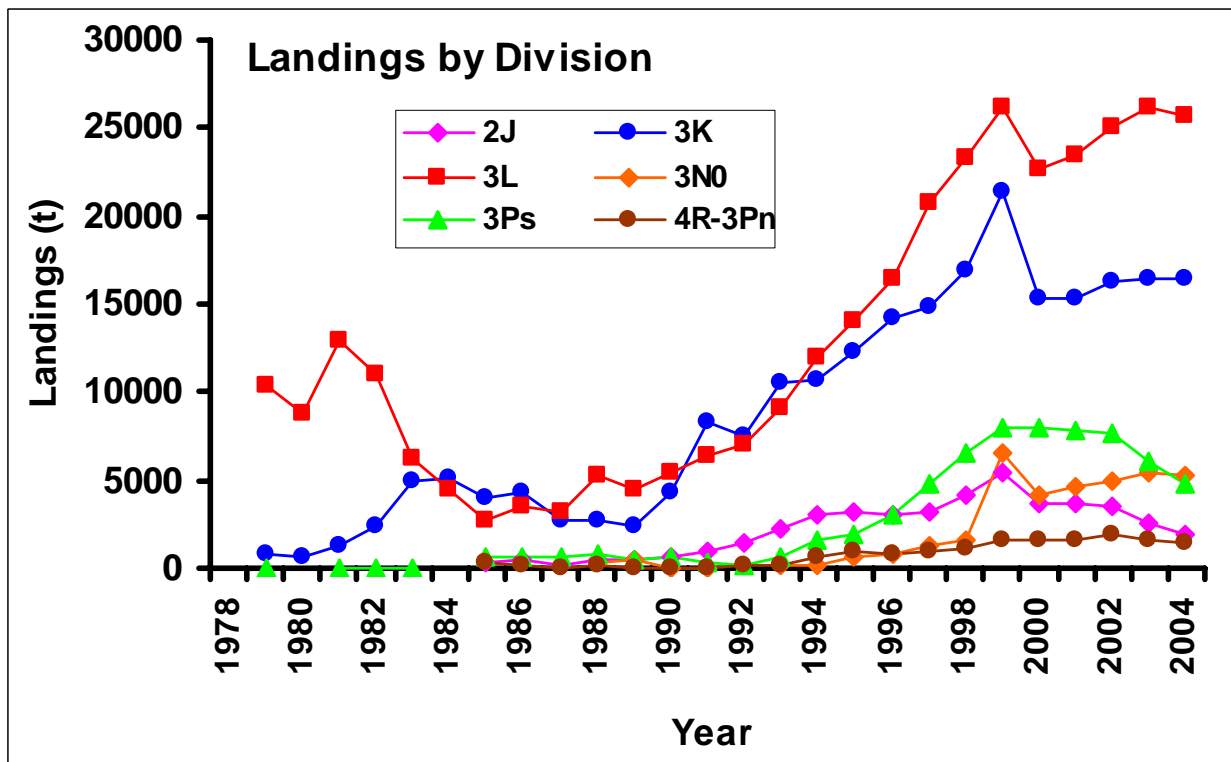
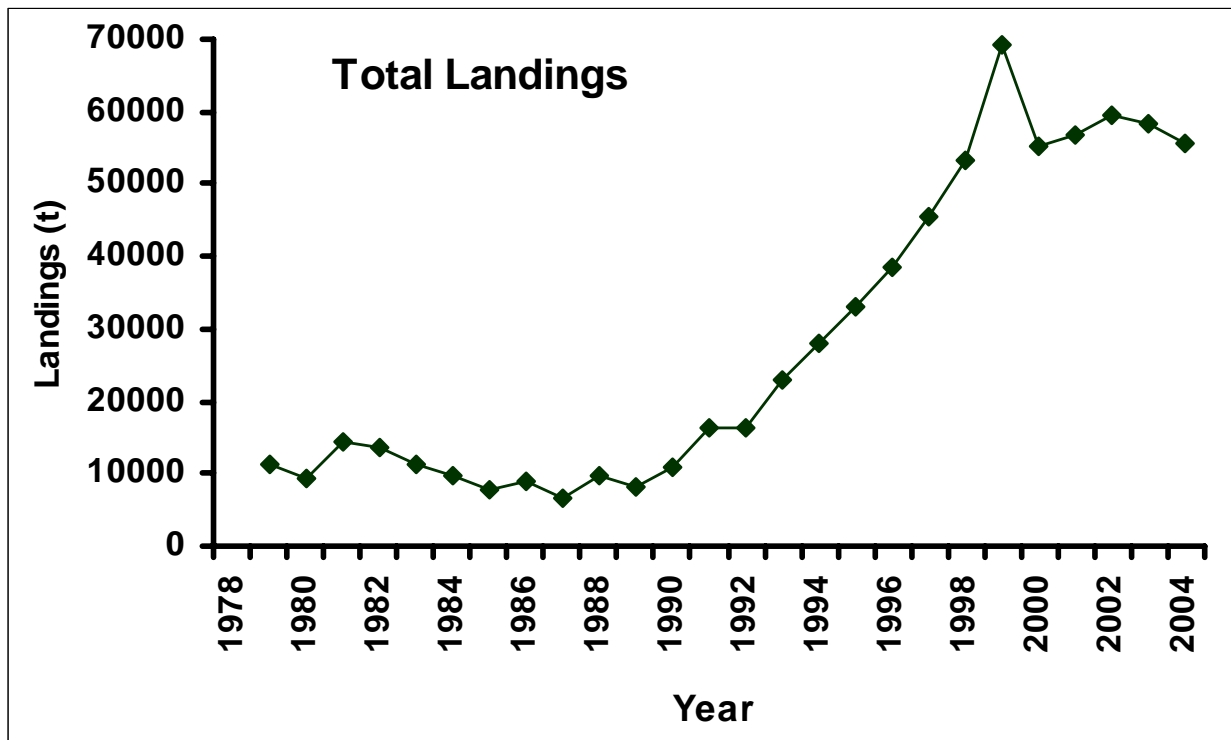


Figure 2: Trends in annual total landings (above) and by NAFO Division (below).

Effort has increased since the 1980's and has been broadly distributed in recent years (Fig. 3).

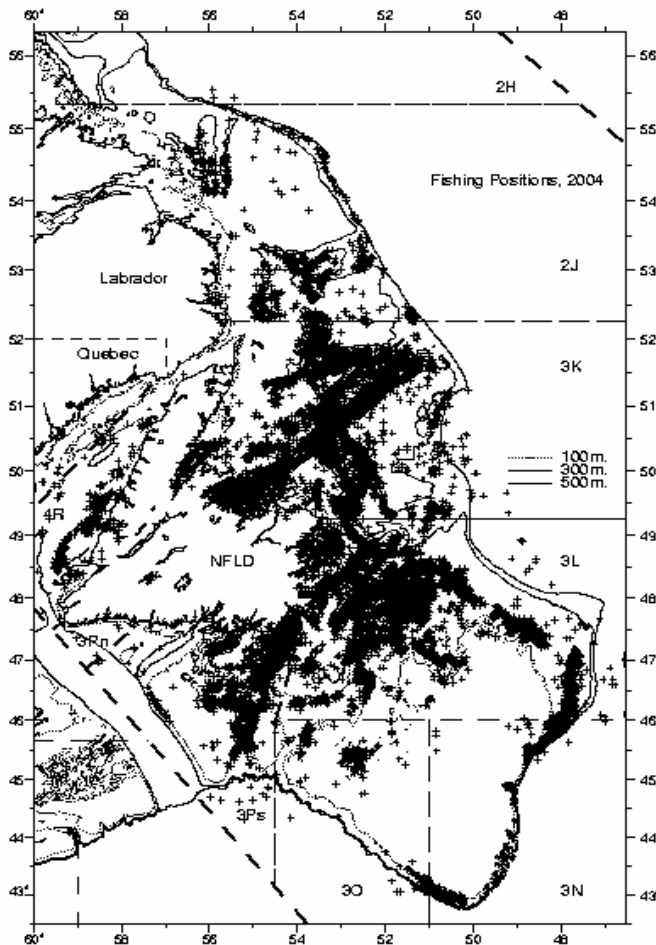


Figure 3: Spatial distribution of commercial fishing effort during 2004.

## RESOURCE ASSESSMENT

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

Fall multi-species bottom trawl surveys (post-fishery 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 Divisions 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-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 (> 3 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 previous year's fall multi-species survey.

The percentage discarded by weight of the total catch, as estimated from observer data, is interpreted as an index of handling mortality. Handling mortalities on pre-recruits will impact short-term (about 1-3 years) recruitment. Also, handling 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 2J3KLNOP4R

A decline in the Newfoundland and Labrador snow crab resource is evident in some divisions. **Commercial CPUE** in Division 2J and Subdivision 3Ps has declined steadily over 6 years to very low levels. The fall multi-species surveys in Divisions 2J3KLNOP4R indicate a decline in **exploitable biomass** since 1998 (Fig. 4).

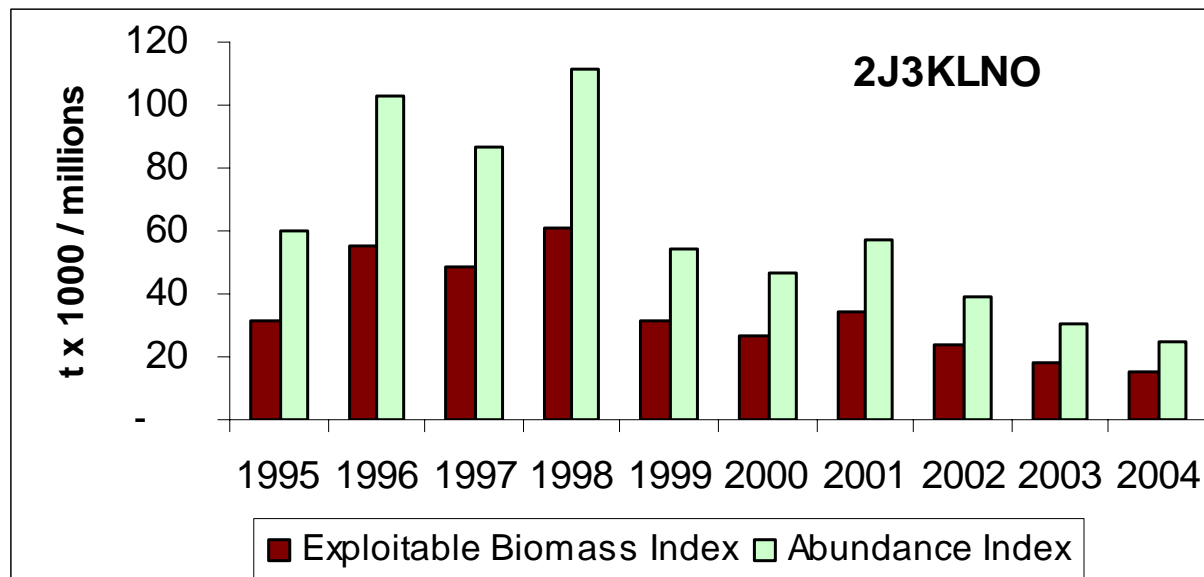


Figure 4: Annual trends in the fall multi-species survey exploitable biomass and abundance indices, for Div. 2J3KLNOP4R.

**Recruitment** declined from 1996-2002 and has since remained at a low level (Fig. 5).

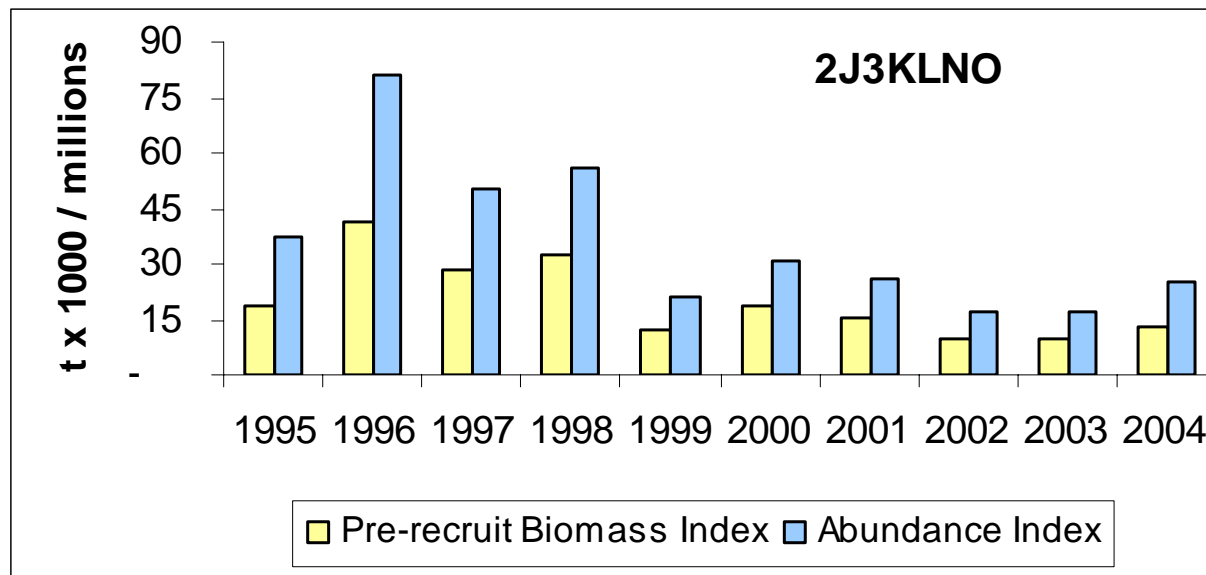


Figure 5: Annual trends in the fall multi-species survey pre-recruit biomass and abundance indices for Div. 2J3KLNO.

**Exploitation rate indices** are near their highest levels within each of Divisions 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, which is used as an index of **handling mortality**, is near its highest level in Divisions 2J3KPs but near its lowest level in Divisions 3LNO.

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

## **Resource Status, 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 1900 t in 2004 due to reductions in TAC, while **effort** increased by 42%.

**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 2004.

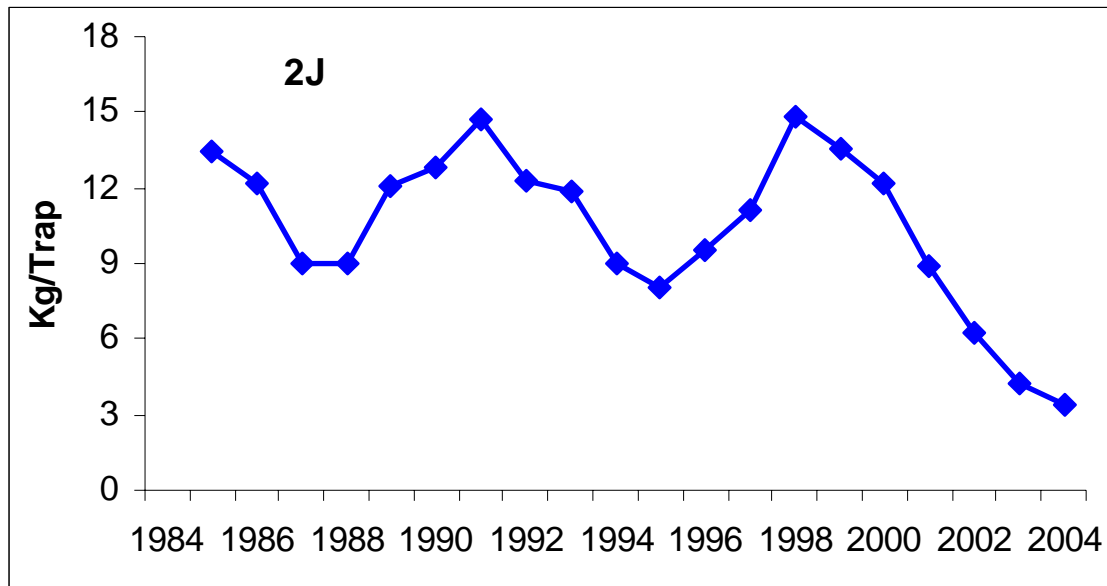


Figure 6: Annual trends in Div. 2J commercial CPUE.

### Biomass

The **exploitable biomass index** (Fig. 7) decreased steadily, by 94%, from 1998-2002 and has remained low during 2002-2004.

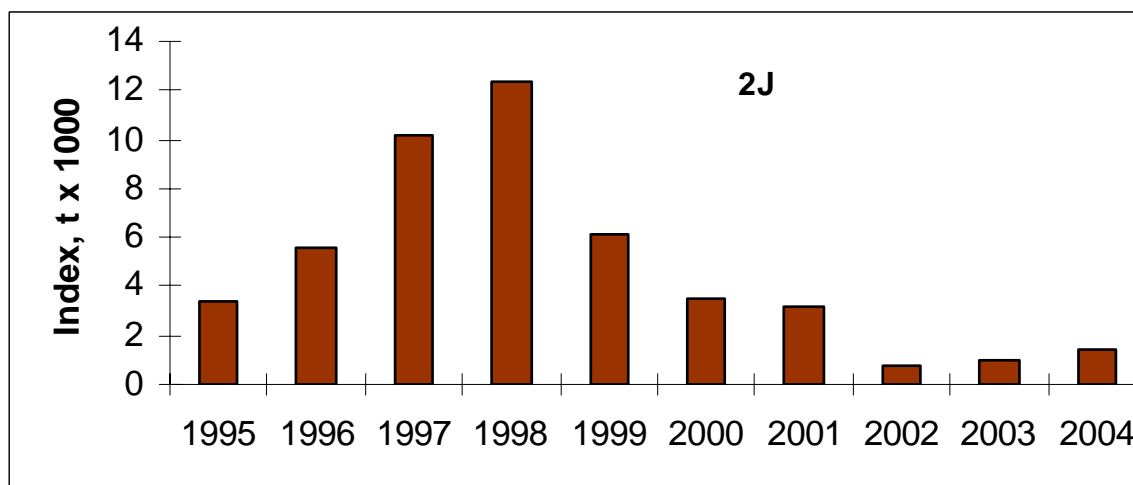


Figure 7: Annual trends in the Div. 2J fall multi-species survey exploitable biomass index.

**Commercial catch rates (CPUE)** have declined steadily by 77% since 1998 to a record low level in 2004 (Fig. 6), in agreement with the decline in the exploitable biomass index.

### Recruitment Prospects

The fall survey **pre-recruit index** and observer discard pre-recruit index (Fig. 8) both decreased from 1998 to a lower level during 1999-2001. The survey index decreased in 2002, remained low in 2003, and increased sharply in 2004. The observer index increased in 2002, was unchanged in 2003, and increased slightly in 2004.

The fall survey and observer pre-recruit indices agree that **recruitment** appears promising in the short term.

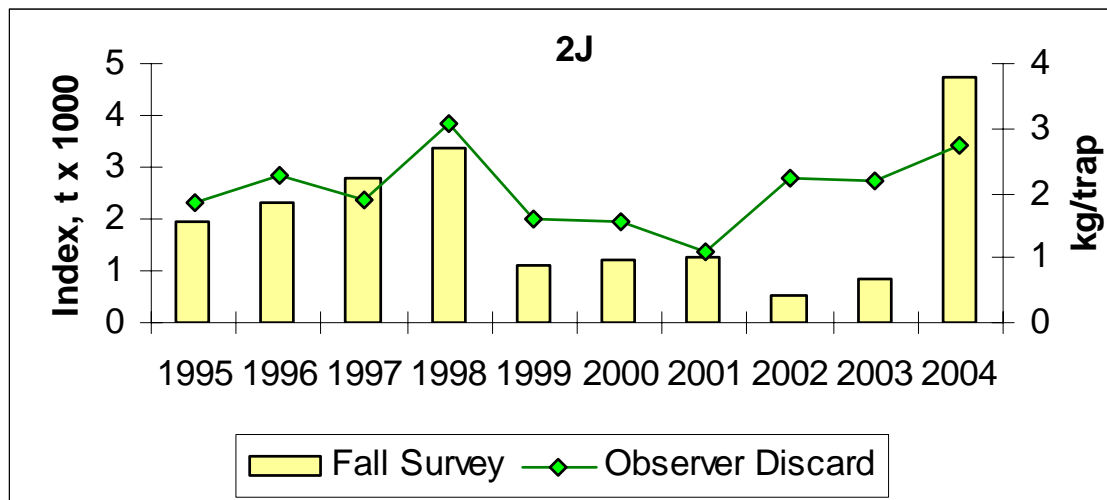


Figure 8: Annual trends in two Div. 2J pre-recruit indices.

The survey data indicate an increase in abundance of sub-legal sized males that will begin to achieve legal size in 2005, as new-shelled immediate pre-recruits, and will recruit to the fishery as older-shelled crabs predominately in 2006-2007.

Longer-term recruitment prospects are unknown.

### Mortality

The **exploitation rate index** increased from 1999-2001, changed little in 2002 and increased sharply in 2003. It decreased in 2004 to its second highest level in the time series.

The percentage of the total catch discarded (Fig. 9) increased sharply in 2002, was unchanged in 2003 and further increased to a record high level in 2004, implying increased **handling mortality** on pre-recruits in the 2004 fishery.

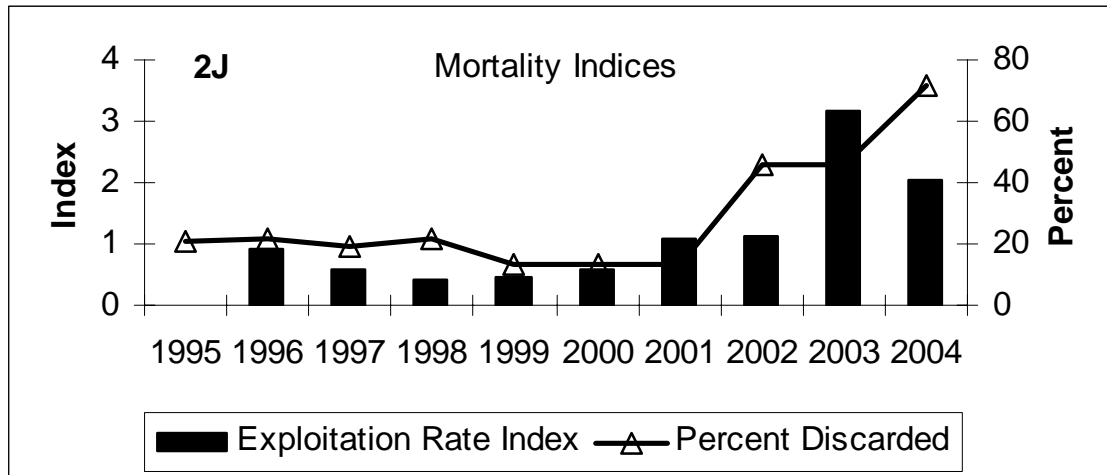


Figure 9: Annual trends in two Div. 2J mortality indices.

An area of the Hawke Channel has been closed to all fisheries except snow crab during 2002-2004. It would be premature to draw any conclusions regarding the impact of this closure on the snow crab resource.

## **Resource Status, Division 3K**

### Commercial Fishery

**Landings** averaged about 3300 t during 1985-1990 then increased to about 21,400 t in 1999. They declined by 29% to 15,300 t in 2000 and 2001, due to a reduction in TAC imposed in those years. They increased to 16,500 t in 2002-2004 due to an increase in TAC. **Effort** decreased during 1999-2001, then increased by 17% to 2003, and further increased by 37% in 2004.

The percentage of the total landings derived from inshore increased from 8% to 23% over the past four years.

**Commercial catch rates** have oscillated over the time series (Fig. 10). The **offshore commercial CPUE** decreased 32% from 1998-2001, remained at this relatively low level until 2003, and decreased sharply in 2004. **Inshore commercial CPUE** has declined since 2001 to about the long-term average.

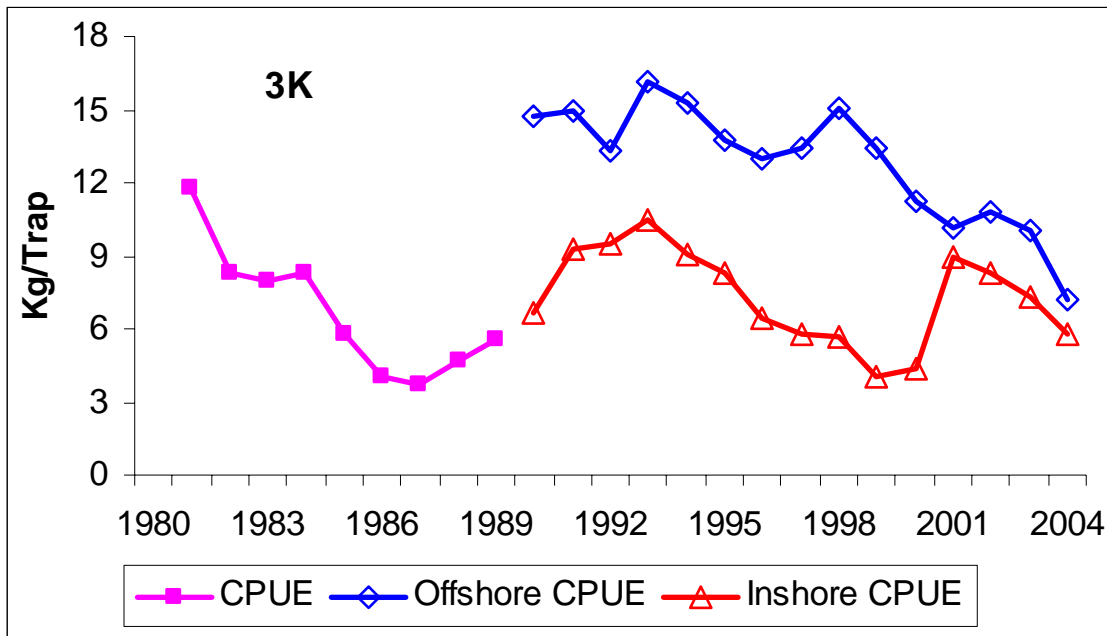


Figure 10: Annual trends in Div. 3K commercial CPUE.

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 and increased slightly during 2000 and 2001. It declined by 68% from 2001-2003 and remained low in 2004.

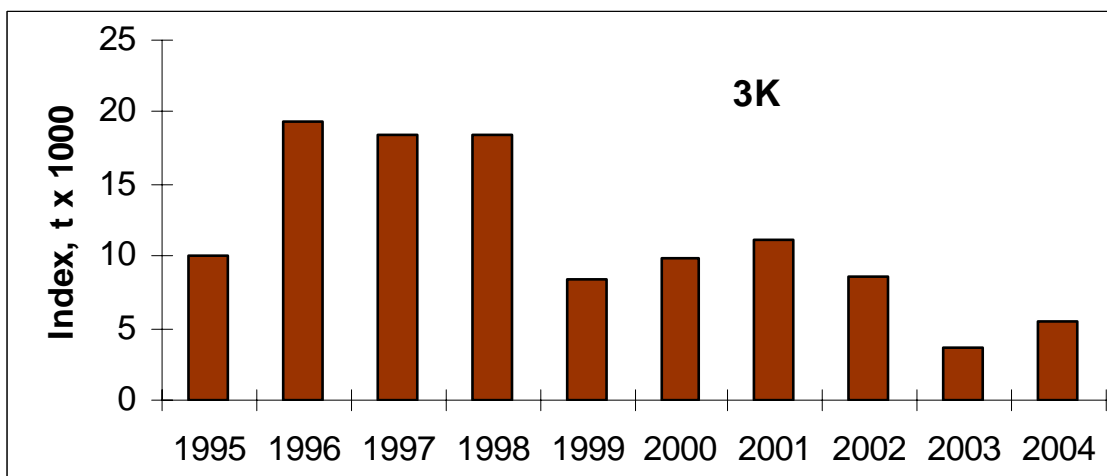


Figure 11: Annual trends in the Div. 3K fall multi-species survey exploitable biomass index.

**Offshore commercial CPUE** (Fig. 10) had remained at a relatively low level during 2001-2003 following a 32% decline from 1998 and decreased sharply in 2004.

**Inshore commercial CPUE** has been consistently lower than offshore CPUE (Fig. 10). Inshore CPUE declined during 1993-2000, increased sharply in 2001, and has since declined to about the long-term average.

### Recruitment Prospects

Both the fall survey pre-recruit index and the observer discard pre-recruit index increased between 1995 and 1997 (Fig. 12), and declined to 1999. The observer index has since varied at a relatively low level. The survey index declined during 2000-2003 before increasing in 2004 to about the 10-year average. Offshore recruitment is expected to remain unchanged in the short-term.

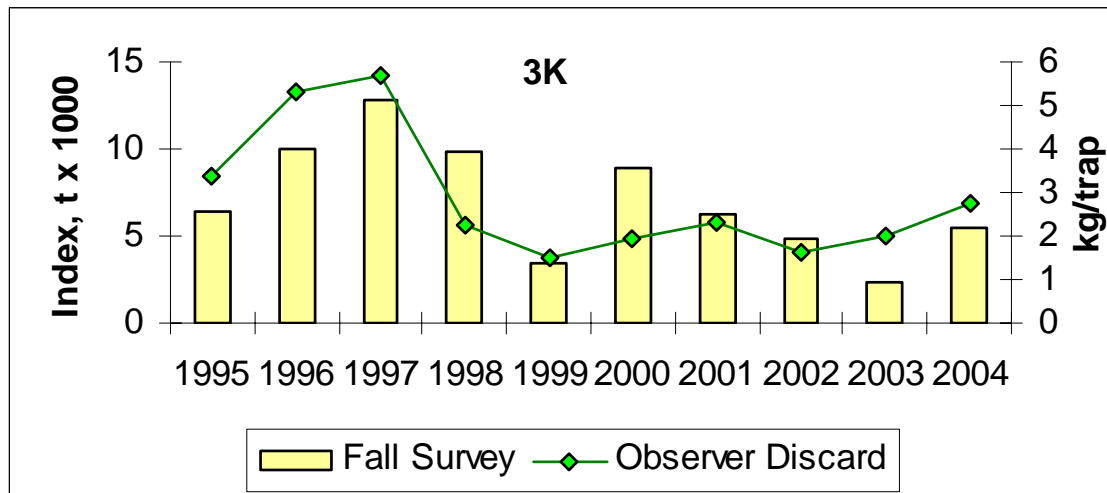


Figure 12: Annual trends in two Div. 3K pre-recruit indices.

An **inshore trap survey index of immediate pre-recruits** increased during 2000-2003 and decreased in 2004 to about the 11-year average.

Longer-term recruitment prospects are unknown.

### Mortality

The **exploitation rate index** decreased from 1996-1997 (Fig. 13) and increased steadily from 1997 to 2000. It changed little to 2003, before increasing sharply in 2004.

The percentage of the total catch discarded in the fishery (Fig. 13) increased from 1999-2001 and remained relatively high, at about 30%, during 2001-2003. It then increased to about 40%, implying relatively high **handling mortality** on small and new-shelled pre-recruits during the fishery in 2004.

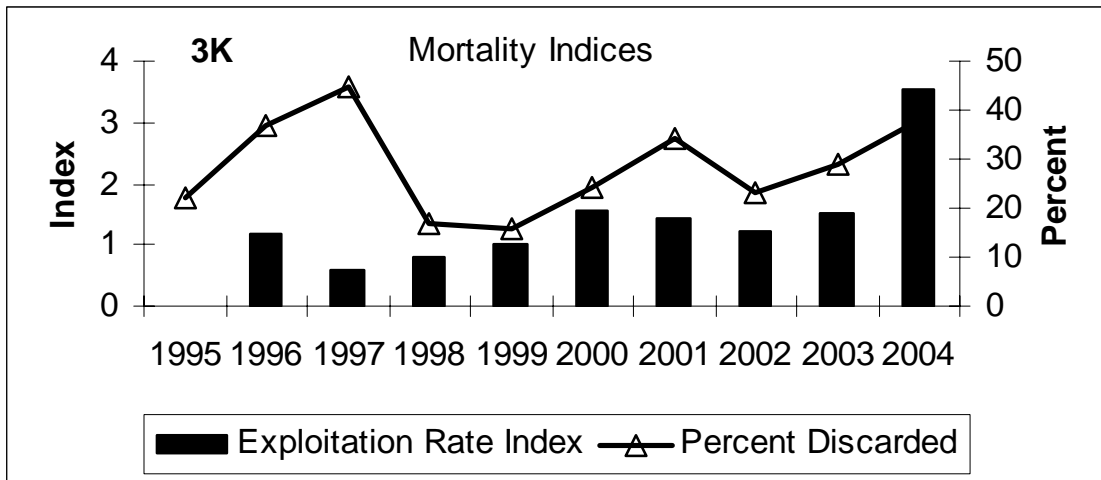


Figure 13: Annual trends in two Div. 3K mortality indices.

### Resource Status, 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. They increased by 16% to 26,200 t in 2003, and decreased to 25,800 t in 2004 due to changes in TAC. Meanwhile **effort** has increased by 75% since 2000.

Inshore landings have represented 25% of the total in the past three years.

**Commercial catch rates** (Fig. 14) in the offshore increased sharply from 1991-1992 and have since remained high. **Offshore CPUE** declined by 24% between 2002 and 2004. **Inshore CPUE** decreased by 21% in 2003 and remained unchanged in 2004. **Inshore CPUE** has been consistently lower than **offshore CPUE**.

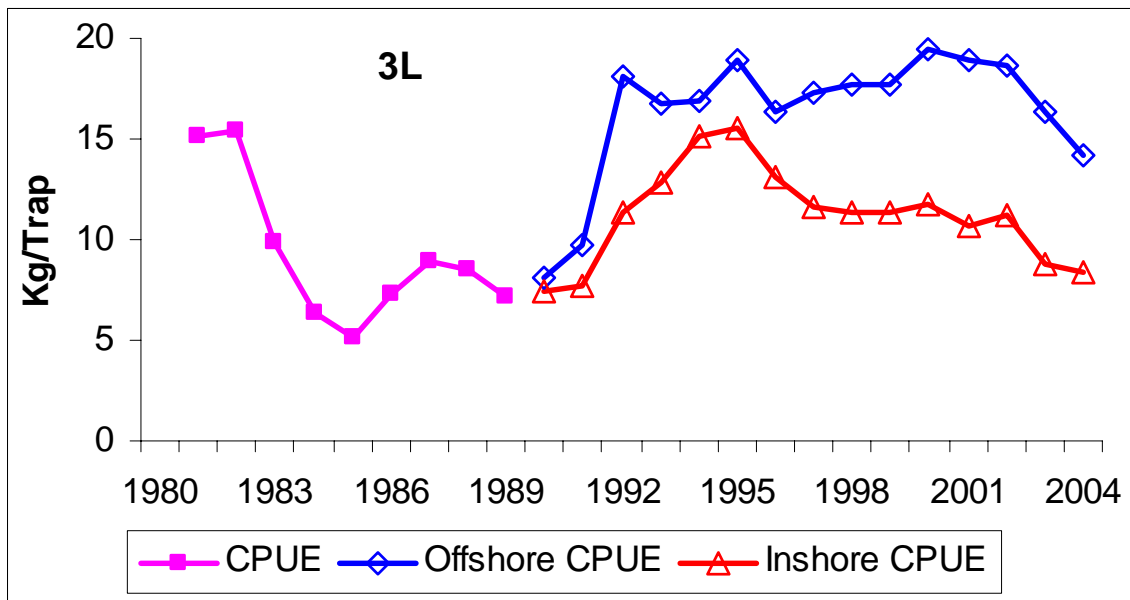


Figure 14: Annual trends in Div. 3L commercial CPUE.



Biomass

The **exploitable biomass index** (Fig. 15), as determined from fall multi-species surveys, declined from 1996-2000 and remained relatively low until it further decreased in 2004. **Offshore CPUE** (Fig. 14) remained at a high level despite a decrease of 24% between 2002 and 2004, in agreement with observer data. Disagreement between the exploitable biomass index and CPUE throughout most of the time series introduces uncertainty regarding trends in biomass.

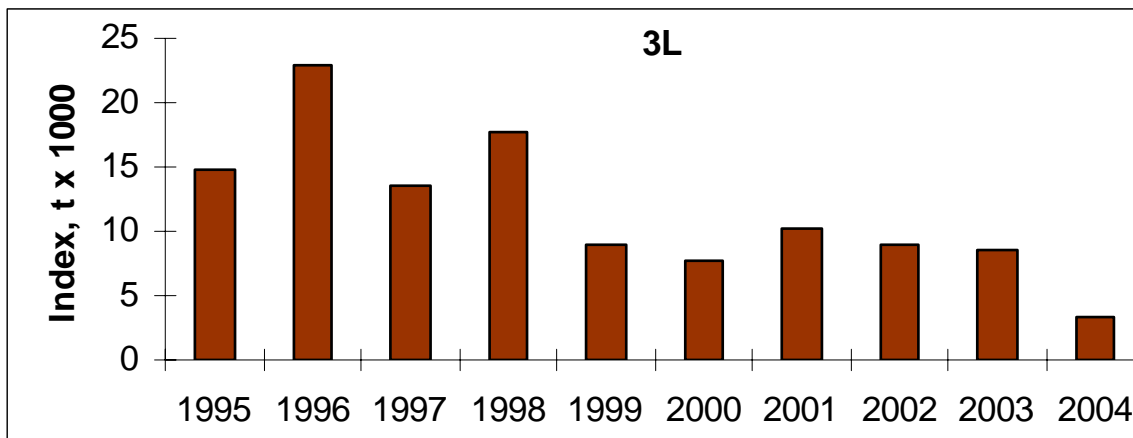


Figure 15: Annual trends in the Div. 3L fall multi-species survey exploitable biomass index.

**Inshore CPUE** decreased by 21% in 2003 and remained unchanged in 2004 (Fig. 14).

Catch rates from **trap surveys** in 3 localized inshore areas have declined since the 1990's.

Recruitment Prospects

The fall survey **pre-recruit index** has been low since 1997 while the observer discard pre-recruit index has declined since 1997 (Fig. 16). **Recruitment** is expected to remain relatively low in the short term.

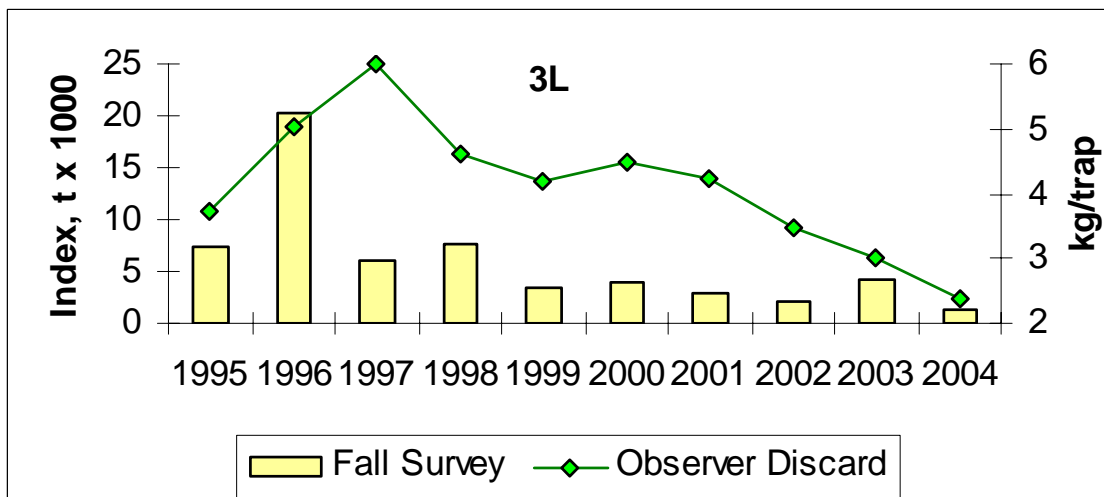


Figure 16: Annual trends in two Div. 3L pre-recruit indices.

Longer-term recruitment prospects are unknown.

Mortality

The **exploitation rate index** increased from 1996-2000 and remained high thereafter (Fig. 17).

The percentage of the total catch discarded in the fishery (Fig. 17) increased from 1995-1997, decreased sharply in 1998, then declined gradually until 2004, implying decreased **handling mortality** on pre-recruits.

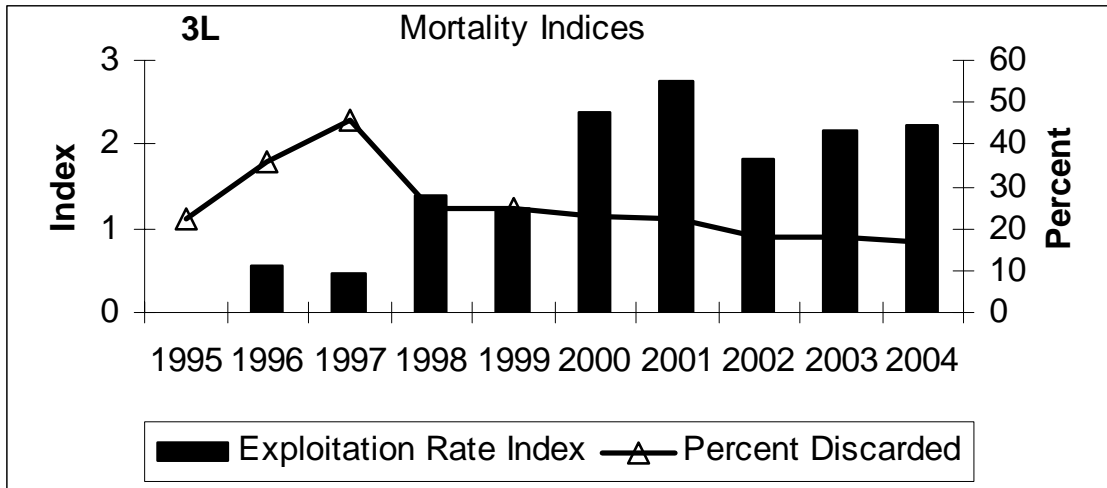


Figure 17: Annual trends in two Div. 3L mortality indices.

**Resource Status, Divisions 3NO**

Commercial Fishery

The fishery began in the mid-1980's in Division 3O and expanded along the shelf edge in 1999. **Landings** increased sharply in 1999 and averaged 5200 t over the past six years

Commercial **CPUE** (Fig. 18) has remained high in recent years relative to other areas. It decreased by 26% between 2002 and 2004.

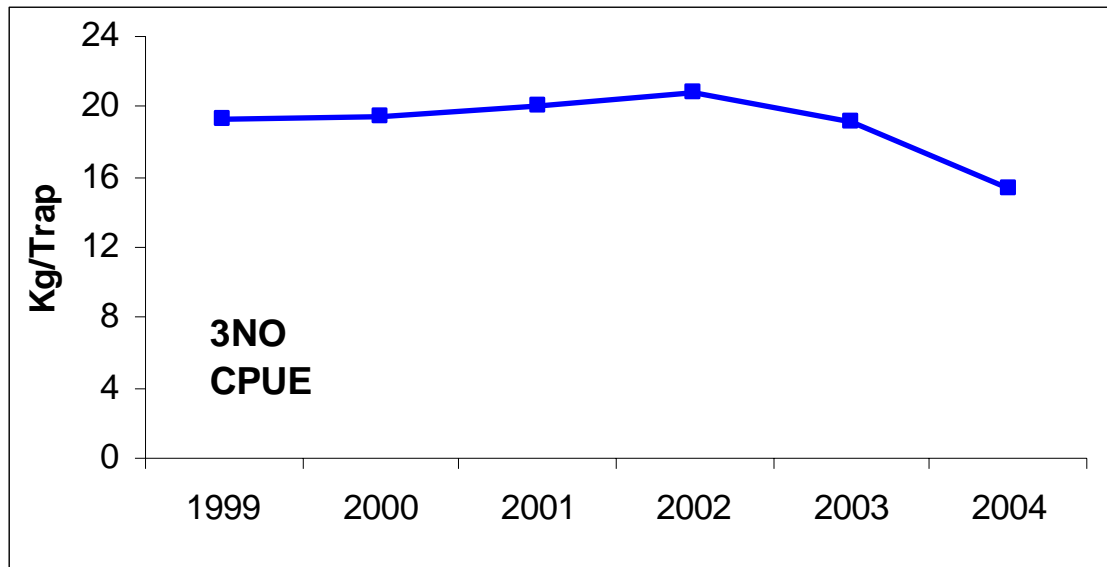


Figure 18: Annual trends in Div. 3NO commercial CPUE.

### 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. Therefore no inferences about biomass can be made from these data. **CPUE** has remained high in recent years relative to other areas although it did decrease by 26% between 2002 and 2004.

### Recruitment Prospects

Wide margins of error introduce uncertainty in interpreting the fall multi-species survey **pre-recruit index**. However, biological data from the survey, as well as data from at-sea observers, indicate that **recruitment** is expected to remain relatively low in the short term. This agrees with the observer discard pre-recruit index, which has declined since 1999 (Fig. 19).

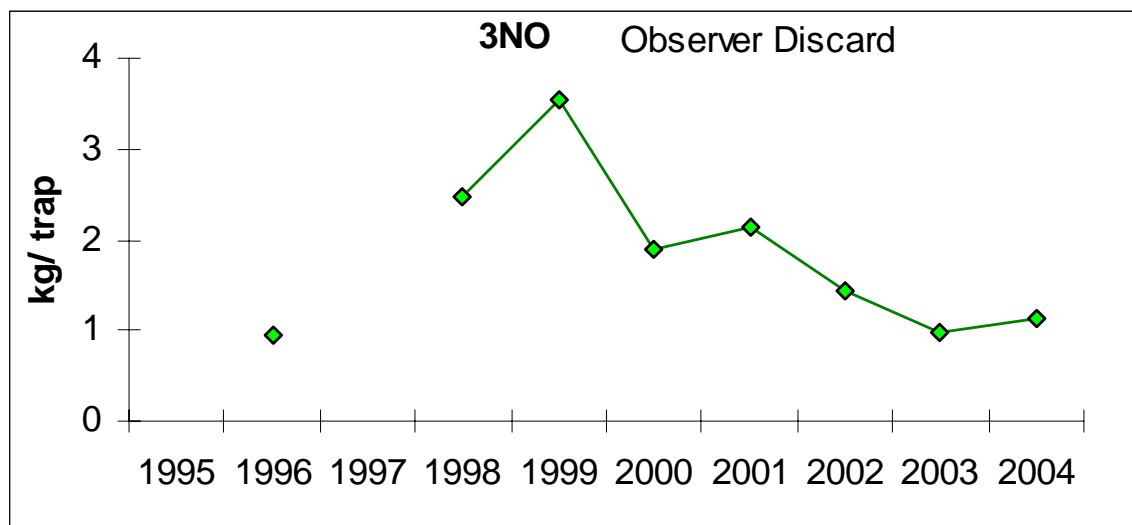


Figure 19: Annual trends in the Div. 3NO observer discard pre-recruit index.

Longer-term recruitment prospects are unknown.

### Mortality

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 (Fig. 20) declined by more than half from 1999-2002 and has remained steady during the last 3 years at a low level, implying low **handling mortality** on pre-recruits.

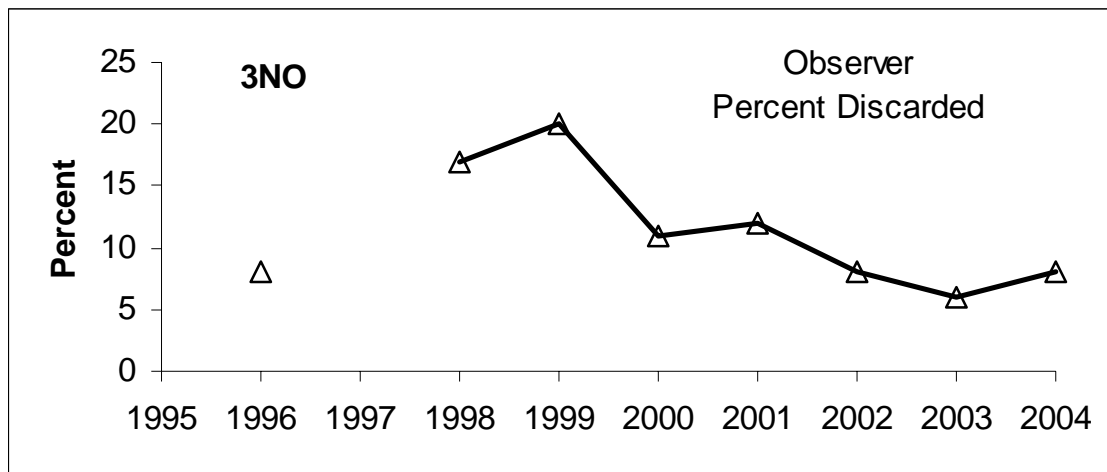


Figure 20: Annual trends in observer percent discarded in the Div. 3NO fishery.

## Resource Status, 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 38% from 7600 t in 2002 to 4700 t in 2004, due to reductions in TAC. **Effort** increased by 64% from 2001-2003 before decreasing by 10% in 2004.

The percentage of the total catch taken inshore declined from 39% to 29% over the past 3 years.

**Inshore CPUE** declined from 2001-2004 by 67% whereas **offshore CPUE** declined by 67% from 1999 to 2003 and remained unchanged in 2004 (Fig. 21).

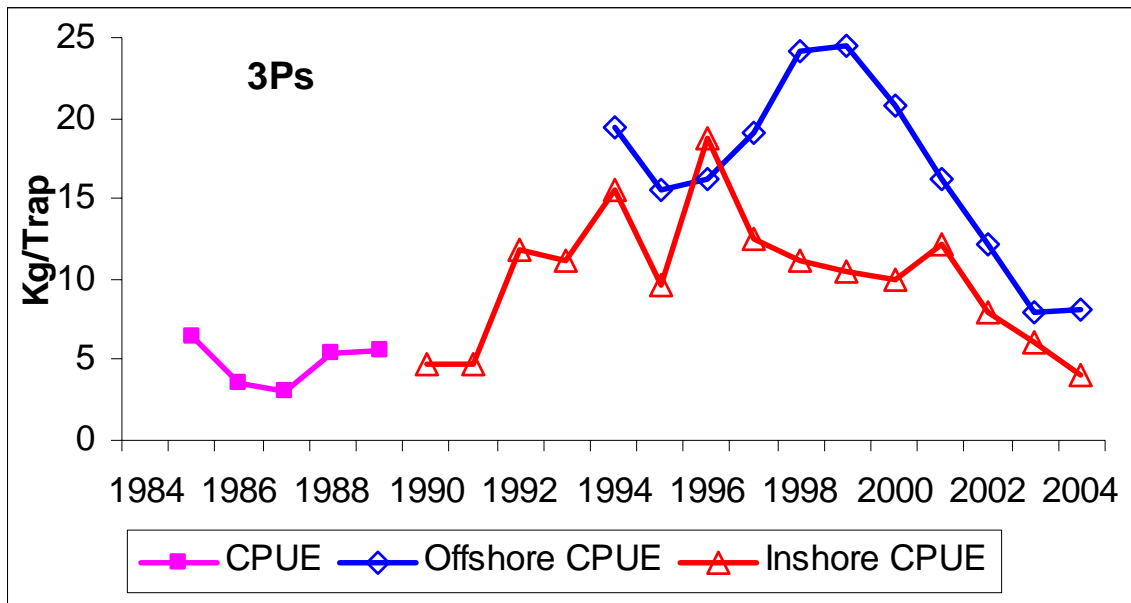


Figure 21: Annual trends in Subdiv. 3Ps commercial CPUE.

Biomass

No estimates of an **exploitable biomass index** are available as there are no reliable trawl survey data from this area. For unknown reasons, indices from spring surveys are highly variable. **Inshore CPUE** declined from 2001-2004 by 67% (Fig. 21). **Offshore CPUE** declined by 67% from 1999 to 2003 and remained unchanged in 2004 (Fig. 21).

Recruitment Prospects

The observer **discard pre-recruit index** (Fig. 22) has changed little over the past six years (1999-2004). **Recruitment** is expected to change little in the short term.

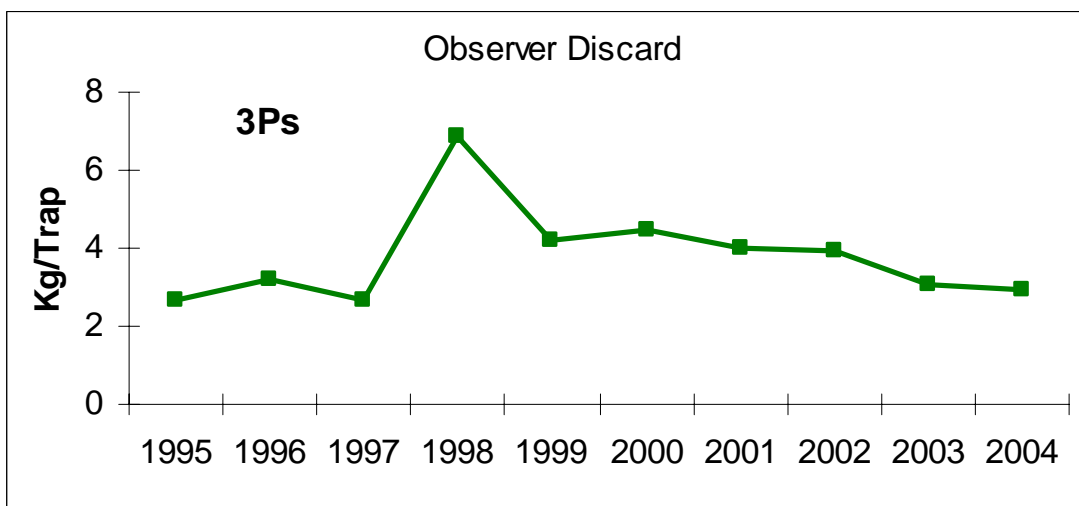


Figure 22: Annual trends in the Subdiv. 3Ps observer discard pre-recruit index.

Longer-term recruitment prospects are unknown.

Mortality

The percentage of the total catch discarded in the fishery (Fig. 23) decreased from 46% in 2003 to 34% in 2004, implying reduced **handling mortality** on pre-recruits during the 2004 fishery.

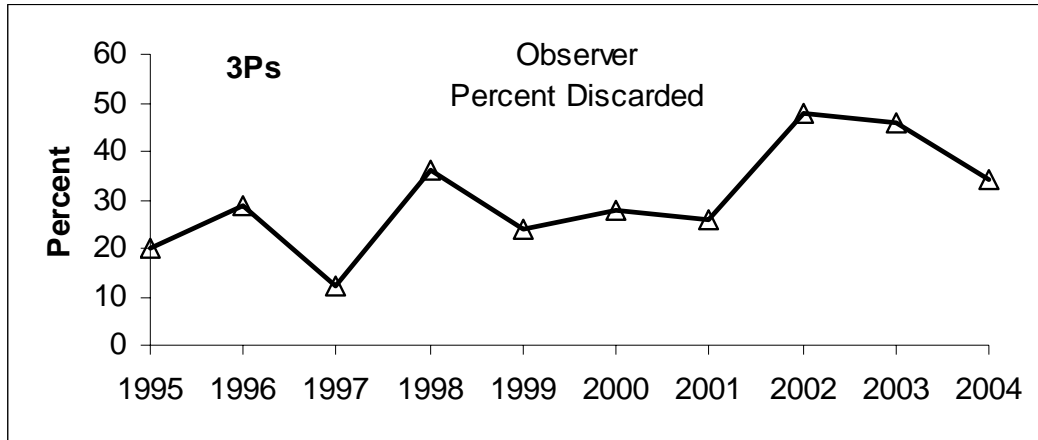


Figure 23: Annual trends in the observer percent discarded in the Subdiv. 3Ps fishery.

**Resource Status, Division 4R and Subdivision 3Pn**

Commercial Fishery

**Landings** increased by 88% from 930 t in 1997 to 1750 t in 2002, due to increases in TAC, and then dropped by 17% to 1450 t in 2004. The TAC was not fully taken in the past two years. **Effort** increased steadily until 2001, decreased in 2002, and increased in 2003-2004. There has been a pronounced change in the distribution of effort in recent years. **CPUE** is consistently low relative to other divisions (Fig. 24).

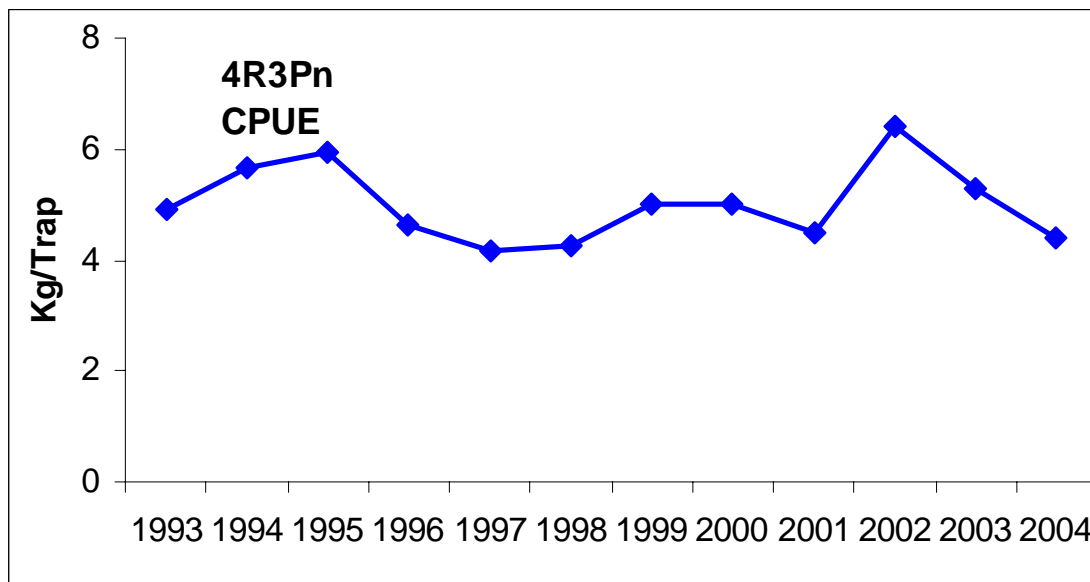


Figure 24: Annual trends in Div. 4R and Subdiv. 3Pn commercial CPUE.

### Biomass

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. Furthermore, there are insufficient fishery independent data from this area.

### Recruitment Prospects

The observer data for this area are insufficient to estimate a reliable **pre-recruit index**. Therefore, 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.

## 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. The full implementation of VMS in 2004 should improve reliability in the future.

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 Divisions 3KL due to unusually late timing of the survey in 2002-2004 and unknown seasonal effects on catchability of crabs by the survey trawl. Furthermore, two important strata in Division 3L were not surveyed in 2004.

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, handling imposes a high mortality on discarded crabs. It is uncertain how handling practices have changed over time, although they have reportedly improved recently.

## **CONCLUSIONS AND ADVICE**

### Division 2J

Trends in both the fall survey exploitable biomass index and fishery CPUE indicate that the biomass has declined steadily since 1998. Although landings decreased in the past two years, the exploitation rate index has been relatively high.

The fall survey and observer pre-recruit indices agree that **recruitment** appears promising in the short term but handling mortality is expected to increase.

Continued exploitation, in the short term, would likely impose a very high **mortality** on immediate pre-recruits that would seriously impair recovery of the exploitable biomass.

### **Division 3K**

The fall survey exploitable biomass index remained low in 2004, following a 68% decline, while offshore CPUE decreased sharply. The exploitation rate index increased sharply in 2004.

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

Handling mortality is expected to remain high in the short term.

Inshore CPUE is at the long term average but recruitment prospects are unclear.

**Fishery-induced mortality** is expected to remain high in 2005 if the recent catch level is maintained and current fishing practices persist.

### **Division 3L**

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 has continued to perform at a high level.

**Recruitment** is expected to remain relatively low in the short term.

**Handling mortality** is expected to remain low in the short term.

The effect on **exploitation rate** of maintaining the current catch level remains unclear.

### **Divisions 3NO**

Trends in the exploitable biomass index are unclear, but the fishery continues to perform at a high level. However CPUE decreased in 2003 and 2004.

**Recruitment** is expected to remain relatively low in the short term.

**Handling mortality** is expected to remain low in the short term.

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

### **Subdivision 3Ps**

Assuming that recent CPUE reflects low exploitable biomass, **exploitation rate** and **pre-recruit mortality** will likely remain high if the current catch level is maintained.

### **Division 4R and Subdivision 3Pn**

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



## OTHER CONSIDERATIONS

### Reproductive Biology

The percentage of mature females carrying full clutches of viable eggs has remained high throughout the time series, despite reduced abundance of legal sized adults.

Handling mortality on undersized 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 1996-2004. This disease, which is fatal to crabs, occurs in new-shelled crab of both sexes and appears to be acquired during molting. Prevalence increases with size within new-shelled adolescent (i.e., non-terminally molted) males. It is uncommon in Divisions 3NOP4R and has been most prevalent in Division 3K. Prevalence has recently increased, particularly in Division 3L.

### Indirect Effects of Fishing

Gillnet fisheries for groundfish impose an unquantified fishing mortality on snow crab. Snow crab and shrimp fisheries occur on common grounds in Divisions 2J3K, but the mortality on snow crab due to shrimp trawling remains unknown.

An area of the Hawke Channel has been closed to all fisheries except snow crab during 2002-2004. It would be premature to draw any conclusions regarding the impact of this closure on the snow crab resource.

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 exploitation has been considered to have minimal impact on reproductive potential. However **handling mortality** on small (< 95 mm CW) 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, and reducing high-grading, as well as trap modifications such as escape mechanisms and biodegradable panels.

Handling mortality 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. Mortality on immediate pre-recruits 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

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