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An assessment of Newfoundland and Labrador snow crab in 2005

Évaluation du crabe des neiges à Terre-Neuve et au Labrador en 2005

E.G. Dawe, D. Mullowney, D. Stansbury, D.G. Parsons, D.M. Taylor, H.J. Drew, P.J. Veitch, E. Hynick, P.G. O'Keefe, and P.C. Beck

Science Branch
Fisheries and Oceans Canada
80 East Whitehills Road
P. O. Box 5667
St. John's NL
A1C 5X1

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ABSTRACT

Resource status was evaluated, by NAFO Div., based on trends in biomass, recruitment prospects and mortality. Data were derived from the fall Div. 2J3KLNO and the spring Subdiv. 3Ps multispecies bottom trawl surveys, inshore Div. 3KL trap surveys, and fishery data from logbooks as well as at-sea observer data. The fall multispecies survey is conducted near the end of the fishing season and so is considered to provide an index of the exploitable biomass that will be available to the fishery in the following year. Trends in biomass within Div. 2J3KLNO were inferred based on comparison of trends in the fall survey exploitable biomass indices with offshore fishery catch per unit effort (CPUE) trends. Short-term recruitment prospects were inferred from comparison of fall survey pre-recruit indices with an observer-based index of crabs discarded in the fishery. Long-term recruitment trends were based on annual progression of male size groups through survey size frequency distributions. Mortality was inferred from exploitation rate indices, pre-recruit mortality indices and prevalence of Bitter Crab Disease (BCD). No fishery-independent data were available for Div. 4R. In Div. 2J the exploitable biomass indices increased slightly in 2005 and recruitment is expected to increase in 2006. Fishery-induced mortality, on the exploitable as well as the pre-recruit populations, has decreased since 2003. Although fishery-induced mortality has decreased, the exploitable biomass remains low. Increase in exploitation in 2006 may impair further recovery. In Div. 3K, the exploitable biomass remains low and offshore recruitment is expected to remain unchanged or increase slightly in the short term. The exploitation rate index, as well as pre-recruit mortality index, were similar in 2005 to the long-term average. Any increase in exploitation in 2006 would further impair recovery. In Div. 3L the fall survey biomass index and the commercial CPUE do not agree. The exploitable biomass index declined from 1996-2000 and remained relatively low thereafter. Offshore CPUE decreased between 2002 and 2004 and changed little to remain at a high level in 2005 relative to other divisions. Inshore CPUE decreased in 2003 and has changed little since. Recruitment is expected to remain relatively low in the short term. The exploitation rate index increased from 1996 to 2000 and has since changed little. The pre-recruit mortality index increased gradually to 2001, doubled to 2003, and then decreased to the 2001 level. 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. However, the current level of fishery removals would not likely result in increased mortality on either the exploitable or pre-recruit population. In Div. 3NO, estimates of the fall survey exploitable biomass and pre-recruit indices have wide margins of error. Therefore, no inferences about trends can be made from these data. Commercial CPUE has remained high in recent years relative to other areas, but decreased by 31% between 2002 and 2005. The percentage of the total catch discarded in the fishery has remained steady during the last 4 years at a low level, implying little wastage of pre-recruits. The effects of maintaining the current catch level on fishery-induced mortality are unknown. In Subdiv. 3Ps CPUE trends indicate that the exploitable biomass has become depleted but recruitment prospects have improved. Exploitation, in the short term, would likely impair recovery of the exploitable biomass. In Div. 4R, 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. The observer data for this area are insufficient to estimate a reliable pre-recruit index or the percentage of the catch discarded. The effects of maintaining the current catch level on the exploitation rate or pre-recruit mortality are unknown. The percentage of mature females bearing full clutches of viable eggs has remained high with no clear trend throughout Div. 2J3KLNO since 1995. Spatial and temporal trends in the prevalence of BCD are unclear and implications for mortality are unknown.

RÉSUMÉ

On a évalué l'état des ressources par division de l'OPANO, d'après les tendances de la biomasse, les perspectives de recrutement et la mortalité. Les données provenaient des relevés plurispécifiques au chalut de fond réalisés à l'automne dans les divisions 2J3KLNO et au printemps dans la sous-division 3Ps, des relevés au casier effectués dans les eaux côtières des divisions 3KL, des données sur les pêches consignées dans les journaux de bord, ainsi que des données recueillies par les observateurs en mer. Les relevés plurispécifiques au chalut de fond menés à l'automne ont lieu vers la fin de la saison de pêche et sont donc considérés comme fournissant un indice de la biomasse exploitable qui sera disponible pour la pêche l'année suivante. Les tendances de la biomasse dans les divisions 2J3KLNO ont été déduites en comparant les tendances de l'indice de la biomasse exploitable établie selon le relevé d'automne avec les tendances des prises par unité d'effort (PUE) de la pêche hauturière. Les perspectives de recrutement à court terme ont été déduites en comparant les indices des pré-recrues des relevés d'automne avec un indice des rejets de crabes établi d'après les données des observateurs au cours de la pêche. Les tendances de recrutement à long terme sont fondées sur la progression annuelle des groupes de taille des mâles le long de l'échelle des fréquences de taille fournies par les relevés. La mortalité est fonction de l'indice du taux d'exploitation, des indices de la mortalité des pré-recrues et de la prévalence de la maladie du crabe amer. Aucune donnée indépendante de la pêche n'était disponible pour la division 4R. Dans la division 2J, l'indice de la biomasse exploitable a augmenté légèrement en 2005 et le recrutement devrait augmenter en 2006. Depuis 2003, la mortalité par pêche a diminué tant chez les populations exploitables que chez celles des prérecrues. Malgré tout, la biomasse exploitable demeure faible. L'augmentation du taux d'exploitation en 2006 pourrait nuire encore davantage au rétablissement. Dans la division 3K, la biomasse exploitable demeure faible et le recrutement hauturier devrait demeurer inchangé ou augmenter légèrement à court terme. En 2005, l'indice du taux d'exploitation, de même que l'indice de la mortalité chez les pré-recrues étaient semblables à la moyenne à long terme. Toute augmentation du taux d'exploitation en 2006 nuirait davantage au rétablissement. Dans la division 3L, l'indice de la biomasse dérivé du relevé d'automne et les PUE de la pêche commerciale ne concordent pas. L'indice de la biomasse exploitable a diminué de 1996 à 2000 et est demeuré relativement faible par la suite. Les PUE de la pêche hauturière ont diminué en 2002 et 2004, puis ont peu changé pour demeurer à un niveau élevé en 2005 par rapport aux autres divisions. Les PUE de la pêche côtière ont diminué en 2003 et ont peu changé depuis. Le recrutement devrait demeurer relativement faible à court terme. L'indice du taux d'exploitation a augmenté de 1996 à 2000 et a peu changé depuis. L'indice de la mortalité chez les pré-recrues a augmenté graduellement jusqu'en 2001, a doublé jusqu'en 2003 et est ensuite revenu au niveau de 2001. Les effets du maintien du niveau de prises actuel sur le taux d'exploitation demeurent incertains du fait que les tendances de l'indice de la biomasse exploitable et des PUE ne concordent pas. Toutefois, le niveau actuel de prises ne donnera probablement pas lieu à une augmentation de la mortalité chez les populations exploitables ou les pré-recrues. Dans la division 3NO, les estimations de l'indice de la biomasse exploitable dérivé du relevé d'automne et les indices des pré-recrues comportent de grandes marges d'erreur; on ne peut donc pas en déduire de tendances. Les PUE de la pêche commerciale sont demeurées élevées au cours des dernières années par rapport à d'autres secteurs, mais ont diminué de 31 % entre 2002 et 2005. Le pourcentage des prises totales rejetées par les pêcheurs est demeuré à un faible niveau au cours des quatre dernières années, ce qui suppose peu de gaspillage de pré-recrues. Les effets du maintien du niveau de prises actuel sur la mortalité par la pêche sont inconnus. Dans la sous-division 3Ps, Les tendances des PUE indiquent que la biomasse exploitable est épuisée. Les perspectives de recrutement se sont toutefois améliorées. L'exploitation, à court terme, nuira probablement au rétablissement de la biomasse exploitable. Dans la division 4R, Il n'est pas possible de dégager de tendances de la biomasse exploitable à partir des données sur les PUE de la pêche commerciale en raison de changements récents dans la répartition spatiale de l'effort de pêche. Il n'y a pas suffisamment de données provenant des observateurs concernant ce secteur pour que l'on établisse un indice des pré-recrues fiable ou le pourcentage de prises rejetées. Les effets du maintien du niveau de prises actuel sur le taux d'exploitation ou la mortalité par la pêche sont inconnus. Le pourcentage des femelles adultes portant de pleines couvées d'œufs viables est demeuré élevé, mais sans tendance particulière, dans les divisions 2J3KLNO, depuis 1995. Les tendances spatiales et temporelles de la prévalence de la maladie du crabe amer sont imprécises et les répercussions sur la mortalité sont inconnues.

INTRODUCTION

The Newfoundland and Labrador snow crab (*Chionoecetes opilio*) fishery began in 1968 and was limited to NAFO Div. 3KL until the mid 1980's. It has since expanded throughout Div. 2J3KLNOP4R and is prosecuted by several fleets. The resource declined during the early 1980's but then recovered and remained very large throughout the 1990's. Resource declines have become evident in some areas in recent years (Dawe et al. 2005). Management of the increasingly diverse fishery led to the development of many quota-controlled areas with over 3500 licence/permit holders under enterprise allocation by 1999. Management areas (Fig. 1) hold no relationship with biological units.

The fishery is prosecuted using conical baited traps set in longlines. 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 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 are returned to the sea and an unknown proportion of those die.

This document presents research survey data and fishery data toward evaluating the status of the Newfoundland and Labrador snow crab resource throughout NAFO Div. 2J3KLNOP4R in 2005. Data from the Div. 2J3KLNOPs 1995-2005 multispecies bottom trawl surveys are presented to provide information on trends in biomass, recruitment, and mortality over the time series. The fall survey data have been used in annual snow crab assessments since 1997 (Dawe et al. 2005). Multispecies survey indices are compared with other relevant indices derived from fisher logbook data, observer data, and inshore Div. 3KL trap survey data, toward inferring changes in resource status for 2006 and beyond.

METHODOLOGY

MULTISPECIES SURVEY DATA

Data on total catch numbers and weight were acquired from the 1995-2005 fall stratified random bottom trawl surveys, which extended throughout NAFO Div. 2J3KLNO The 1996-98 fall surveys also extended to NAFO Div. 2GH and to inshore strata, not included in the 1995 and 1999 surveys. Inshore strata were also surveyed during 2000-05. These surveys utilized the Campelen 1800 survey trawl in standard tows of 15 min. duration. Survey data are selected from a standard set of strata common to all years, that does not include inshore or deep slope strata. However, the 2004 Div. 3L offshore survey was not fully completed and a sub-set of data has been used for analyses in that year.

Spring multispecies bottom trawl survey data for 1996-2005 were available for Div. 3LNOPs. Biomass indices from these surveys have not been used because of questionable reliability. However spring survey data for Subdiv. 3Ps were used specifically to infer recruitment prospects from annual size distributions.

Snow crab catches from each set were sorted, weighed and counted by sex. Catches were sampled in their entirety or sub-sampled by sex. Individuals of both sexes were measured in carapace width (CW, mm) and shell condition was assigned one of three categories: (1) new-shelled-these crab had molted in spring of the current year, have a low meat yield throughout most of the fishing season, and are generally not retained in the current fishery until fall; (2) intermediate-shelled – these crab last molted in the previous year and are fully recruited to the fishery throughout the current fishing season; (3) old-shelled – these crab have been available to the fishery for at least 2 years. Males that undergo their terminal molt in the spring will remain new-shelled throughout the fishery season of that year and will not be fully hardened until the following year. Therefore new-shelled legal-sized crabs are not considered to be part of the exploitable biomass, in the current year, although it is recognized that some of these males are retained by the fishery late in the season (in fall). It is assumed that all males with small chelae molt each spring and so remain new-shelled between molts. In reality, however, an annually variable proportion of small-clawed males will not molt in any given year ('skip molters') and so will develop 'older shells' between molts. For each year that a crab skips a molt, its eventual recruitment is delayed by a year.

Males were also sampled for chela height (CH, 0.1 mm). Males develop enlarged chelae when they undergo a final molt, which may occur at any size larger than about 40 mm CW. Therefore only males with small chelae will continue to molt and subsequently recruit to the fishery. A model which separates two 'clouds' of chela height on carapace width data ($CW = 0.0806CH^{1.1999}$) was applied (Dawe et al. 1997) to classify each individual as either adult (large-clawed) versus adolescent or juvenile (small-clawed).

Maturity status was determined for females and relative fullness and stage of development of egg clutches were assessed. Occurrence of advanced stages of BCD was noted in both sexes based on macroscopic examination. In cases of unclear external characteristics, crabs were dissected and classified based on observation of the hemolymph. Observation of cloudy or milky hemolymph was taken as support for classification of such specimens as infected.

We examined annual changes in abundance indices of legal-sized males, by shell condition toward evaluating the internal consistency of the data series. Males enter the legal-size group as new-shelled crabs, after the spring molt, and they begin to contribute to the legal old-shelled group in the following year. Hence we would expect annual changes in abundance to be first seen in new-shelled legal-sized males and to be followed by similar trends in old-shelled males

Indices were calculated from post-season fall surveys using STRAP (Smith and Somerton 1981), to represent the exploitable biomass and pre-recruit biomass in the following year. The exploitable biomass index was calculated as the fall survey biomass index of adult (large-clawed) legal-sized (>95 mm CW) males, regardless of shell condition. Adult males are terminally molted, so that no members of this category would molt in spring and all adults in the fall survey (including new-shelled adults) would be fully recruited to the fishery in the following year. The pre-recruit index was calculated by applying a 19 mm CW growth increment (Hoenig et al. 1994) to all adolescent (small-clawed) males larger than 75 mm CW caught in the fall survey, before applying STRAP. The resultant pre-recruit index represented a component of legal-sized (>95 mm CW) males that would be recently-molted, new-shelled and not recruited to the fishery of the next year, but would begin to recruit (as older-shelled males) in the following year. However, some of these recently-molted males would have remained adolescent, and so would molt one more time before achieving adulthood and subsequently recruiting to the fishery, as older-shelled males, one additional year later (i.e. 3 years after the survey year).

These exploitable and pre-recruit biomass indices were calculated using the raw survey data. It is known that catchability of crabs by the survey trawl (i.e. trawl efficiency) is lower than 1 and varies with substrate type and crab size (Dawe et al. 2002a). However, trends in raw ('unstandardized') indices are comparable to those in 'standardized' indices (Dawe et al. 2003), that partially account for effects of substrate type and crab size.

Projection of biomass indices from the survey year does not account for annual variability in natural mortality or in the proportion of adolescent males that do not molt in the following spring (skip-molters). Biomass indices are comparable among years because only those survey strata common among all years were included in the analysis. Inshore survey strata were not included in calculating biomass indices because they were not surveyed in some years.

Spatial distribution was compared among years for Div. 2J3KLNO using the fall survey abundance index data. ACON (G. Black, pers. com.) was used to describe the distribution of exploitable (>94 mm CW adults) and pre-recruit (>75 mm CW adolescents) males as described above.

The ratio of the annual landings to the exploitable biomass index (projected from the fall survey of the previous year) was calculated by NAFO Division to provide an index of exploitation rate. This index underestimates absolute exploitation rate because the survey index underestimates absolute biomass .However long-term changes in these ratios may be interpreted as reflecting trends in exploitation rate within each Division. It is recognized that annual changes in these ratios may be due to changes in catchability (i.e. trawl efficiency) rather than exploitation rate. However we feel that long-term trends (since 1996) provide a useful indication of trends in exploitation rates. Inshore commercial catches and data from inshore survey strata were not included in calculating the ratios because inshore survey strata were not surveyed in all years.

To examine size composition of males, survey catches by carapace width were grouped into 3 mm CW intervals and adjusted up to total population abundance indices. Each size interval was partitioned, based on chela allometry, between juveniles plus adolescents (small-clawed) versus adults (large-clawed).

FISHERY LOGBOOK DATA

Data on commercial catch (kg) and fishing effort (number of trap hauls) were obtained from vessel logbooks. These data were compiled by the Statistics Division, Policy and Economics Branch, Newfoundland Region of the Department of Fisheries and Oceans. CPUE (kg/trap haul) was calculated by year and NAFO Division. CPUE is used as an index of biomass, but it is unstandardized in that it does not account for variation in fishing practices (eg. soak time and mesh size). Long-term trends in logbook CPUE are presented here as a fishery-based index of trends in biomass, separately for inshore and offshore areas. Annual offshore values, for recent years, are also used here for comparison with the offshore exploitable biomass indices from fall multispecies surveys. Trends in inshore CPUE are compared with trends in inshore research trap survey catch rate indices.

OBSERVER CATCH-EFFORT DATA

Data were available from the Observer Program for the same time series as those from the fall multispecies surveys (1995-2005). The observer set and catch database included details, for each set observed, of number of traps, landed catch (kg) and discarded catch (kg). An observer-based CPUE index (kg. landed/trap haul) was calculated for comparison with offshore logbook CPUE.

A discard pre-recruit index (DPI; kg. discarded/trap haul) was calculated to compare with the pre-recruit biomass index (PBI), from fall multispecies surveys. Although the discard index and the survey pre-recruit biomass index are defined differently, they both include contributions by sub-legal-sized crabs (undersized males versus >75 mm CW adolescents respectively) as well as by recently-molted males (‘soft’-shelled males >94 mm CW versus adolescents >75 mm CW).

A pre-recruit fishing mortality index (PFMI) was developed based on the ratio of the observed catch rate of pre-recruits discarded in the fishery to the fall survey pre-recruit index of the previous year. This index is defined as:

$$PFMI = S \times (DPI_t / PBI_{t-1})$$

Where:
DPI is the catch rate (kg/trap haul) of pre-recruits (undersized + soft-shelled) discarded in the fishery from observer data.

PBI is the pre-recruit biomass index (t x 1000) from the fall survey of the previous year.

And:
S is an adjustment factor to standardize for incomplete and annually variable levels of observer coverage, defined as;

$$S = \text{Total landings (t)} / \text{Observed landings (t)}$$

The PFMI underestimates pre-recruit mortality because the PBI underestimates pre-recruit biomass, as a result of low catchability of pre-recruits by the survey trawl However we feel that long-term trends (since 1996) in this index provide a useful indication of trends in pre-recruit fishing mortality. The percent discarded (by weight) is viewed as an index of wastage in the fishery. It provides an indication of the level of wastage associated with catching and releasing pre-recruits in the fishery that is not necessarily proportional to the fishing mortality rate on the pre-recruit population.

Data were also available from at-sea biological sampling of trap catches by observers. Entire trap catches of males were sampled for carapace width (mm) and shell condition. Shell condition categories differed slightly from those described above for fall surveys, in that new-shelled males (recently-molted) were partitioned between soft-shelled (chela easily shattered) and new hard-shelled (chela not easily shattered). Also categories of crabs not recently molted (intermediate-shelled and old-shelled in fall surveys) were pooled into a single category. These biological sampling data were used to identify specific categories of discards (i.e. ‘undersized’ and ‘soft’ legal-sized) for comparison with total discards from observer set and catch data. Also seasonal trends in the percentage of soft-shelled crabs were described. Discarding is believed to impose a high mortality on recently-molted (especially ‘soft’) immediate pre-recruits. A soft-shell protocol was implemented in 2004, to close specific small fishing areas when the percentage of soft-shell crab achieved 20%.

INSHORE TRAP SURVEYS

Data were available from an inshore Div. 3K trapping survey that has been carried out in White Bay and Notre Dame Bay during 1994-2005, with the exception of 2001. The survey has consistently been conducted in September and it occupies 5 of the inshore fall multispecies survey strata with a target of 8 sets per stratum. Each set includes 6 traps, with crabs sampled from two large-meshed (commercial, 135 mm) traps and two small-meshed (27 mm) traps. Catch rate indices (kg/trap haul) were calculated, for legal sized males, by shell category (new-shelled recently-molted versus older-shelled), as well as by claw type (small clawed juveniles plus adolescents versus large-clawed adults).

Data were also available from three inshore trap surveys (1979-2005) within Div. 3L. These surveys were conducted in different seasons; spring (Northeast Avalon), summer (Bonavista Bay), and fall (Conception Bay). For each seasonal survey series catch rate indices (kg/trap haul) were calculated, for legal-sized males (excluding new-shelled males) and compared with fishery logbook CPUE trends for the relevant local crab management area.

RESULTS AND DISCUSSION

THE FISHERY

The fishery began in Trinity Bay (Management area 6A, Fig. 1) in 1968. Initially, crabs 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 1982-87 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. 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 3350 licence holders.

In the late 1980's quota control was initiated in all management areas (Fig. 1) 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 fishing area regulations.

Landings for Div. 2J3KLNOP4R (Table 1, 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 55,400 t in 2000, in association with a 17% reduction in TAC, before increasing slightly to 59,400 t in 2002 and declined to 55,700 t in 2004, due to changes in TAC's. They decreased by 21% to 43,900 t in 2005, primarily due to a sharp decrease in Div. 3K, where the reduced TAC was not taken. Historically, most of the landings have been from Div. 3KL.

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. 3).

DIVISION 2J3KLNO

Spatial distribution from fall multispecies surveys.

The fall distribution of exploitable males (legal-sized adults, Fig. 4-5) as well as immediate pre-recruits (>75 mm adolescents, Fig. 6-7) throughout NAFO Div. 2J3KLNO in 2005 was generally similar to the distribution pattern observed throughout 1997-2004, as previously described (Dawe et al. 2004, Dawe and Colbourne 2002). Large males were virtually absent from the deepest sets (>500 m) along the Div. 3K slope, but they extended to greater depths along the more northern Div. 2J slope and along the more southern Div. 3LN slope. They were virtually absent over a broad area of the shallow (<100 m) southern Grand Bank. Survey catches of exploitable males in 2005 (Fig. 5) were higher in inshore Div 3L and lower along the Div. 3N slope than they were in 2004. Survey catches of pre-recruit males (Fig. 6-7) in 2005 were generally comparable to 2004 with decreases in 2005 observed in northern Div. 2J and in portions Div. 3K. Any change in distribution in offshore Div. 3L from 2004-05 is unclear due to incomplete survey coverage in 2004 (Fig. 5 and 7).

Trends in distribution over the 1995-2000 period were reviewed by Dawe et al. (2003) and Dawe and Colbourne (2002). These trends included gradual spatial shifts in highest densities of most size groups, but also sharp annual and area-specific changes in survey catch rates. Such sharp area-specific annual changes in density that occur across both sexes and the entire broad male size range imply spatial and annual variability in catchability by the survey trawl (Dawe and Colbourne 2002).

Biomass and Abundance

The fall multispecies survey is considered to represent a post-fishery survey, although a small proportion of the annual catch was taken during the September-December survey period in some years. Therefore the biomass index from any survey year is considered to represent an index of the exploitable biomass available to the fishery of the following year.

The exploitable biomass index and associated abundance index (Fig. 8) have both declined since 1998, by more than a factor of 3, to their lowest levels during 2003-05.

Recruitment

The fall survey pre-recruit biomass index (Fig. 9) declined by 73% from 1996 to 2002 and has since remained at a low level .The pre-recruit abundance index similarly declined from 1996 to 2002 and has since remained at a low level.

We feel there is higher uncertainty associated with the pre-recruit index than with the exploitable biomass index. This difference in uncertainty is not due to differences in precision of estimates but is primarily related to differences in molt status between the two groups. The exploitable biomass index is comprised exclusively of males that were terminally-molted adults in the fall survey, whereas the pre-recruit index includes a large component of males that were adolescents as small as 76 mm CW during the survey. The projection of the pre-recruit index assumes that all those adolescents will molt, survive, grow by 19 mm CW and subsequently recruit (over the following two years, involving yet an additional molt for those that remained legal-sized adolescents), as older-shelled males. In reality, the biomass of new-shelled pre-recruit crabs is greatly affected by annual variability in natural mortality, growth increment and proportions that fail to molt. These variables currently cannot be predicted and so are not accounted for.

Negative relationships between bottom temperature and snow crab CPUE have been demonstrated at lags of 6-10 years (Fig. 10) suggesting that cold conditions early in the life history are associated with the production of strong year classes. Temperatures on the Newfoundland Shelf were below normal in most years from the mid-80's to about 1995. These were years of high crab productivity that led to high commercial catch rates during the 1990's. A warm oceanographic regime has persisted over the past decade (Colbourne et al. 2006) implying poor long-term recruitment prospects.

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. The model (Fig. 11) 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.

Mortality

Natural Mortality; BCD: BCD has been observed in snow crab, based on macroscopic observations, at low levels throughout 1996-2005. The prevalence and distribution of this parasitic disease throughout the Newfoundland-southern Labrador Continental Shelf (Div. 2J3KLNO) has been described in detail by Dawe (2002).

BCD appears to have extended southward during 1999-2005 (Fig. 12 -13) with highest prevalence having moved from Div. 2J in 1999, to Div. 3K in 2000, and having much of its distribution shifted from Div. 3K into Div. 3L during 2001-04. This shift into Div. 3L, beginning in 2001 was coincident with a great increase in survey catch rates of smallest males in Div. 3L in 2001 (Dawe et al. 2002b). Annual changes in prevalence of BCD are presented later, on a divisional basis.

BCD occurs in both sexes and all sizes of snow crab. Its prevalence in mature females is comparable to that in males of similar size (Dawe 2002). It is unknown how well disease prevalence in trawl-caught samples, especially based on recognition of external characteristics in chronic cases, represents true prevalence in the population, but it seems likely that our observations underestimate true prevalence. Relationships of prevalence with density are unclear (Dawe 2002) and implications for mortality are unknown.

DIVISION 2J

The Fishery

Landings (Fig. 14) increased slightly from 330 t in 1985 to 600 t in 1990, before increasing to about 3200 t during 1995-97 and peaking in 1999 at 5400 t. They declined by 70% to 1600 t in 2005 due to reductions in TAC. Effort increased by 35% from 2001 to 2002, was unchanged in 2003, and then declined by 48% during 2004-05.

Biomass

Commercial catch rates (CPUE) have oscillated over the time series (Table 2, Fig. 15), initially decreasing during 1985-87, increasing to a peak in 1991, decreasing again to 1995, and increasing to another peak in 1998. They declined steadily by 76% during 1998-2004 to a record low level before increasing slightly in 2005. This decline was evident throughout Div. 2J but spatially the greatest reductions in CPUE have occurred in the northern portion of the Division around Cartwright Channel and along the slope edge in recent years (Fig. 16).

The logbook CPUE and observed CPUE agreed fairly well (Fig. 17). Trends in CPUE throughout the season (Fig. 18 and Fig. 19) indicated that initial CPUE decreased during 2002-04 but increased in 2005 to approximate the 2003 initial level. Late-season CPUE, at comparable removal levels,. was higher in 2005 than in 2004, at about the 2003 level (Fig. 19).

The fall multispecies survey exploitable biomass index (Table 3, Fig. 20) decreased steadily, by 94%, from 1998 to 2002. It increased during 2003-05, while remaining below the 2001 level.

Production

Recruitment: We examined annual changes in abundance indices of legal-sized males from fall multispecies surveys, by shell condition, toward evaluating the internal consistency of the data series (Fig. 21). Males enter the legal-size group as new-shelled crabs, after the spring molt, and they begin to contribute to the legal old-shelled group in the following year. Trends in the abundance index by shell condition reflect this process, in that the abundance index of new-shelled males peaked in 1998 whereas that of old-shelled males peaked one year later, in 1999. The abundance index of new-shelled males dropped sharply in 1999, whereas abundance of old-shelled crabs declined steadily during 1999-2002. The abundance of new-shelled crabs has increased since 2002 back above 1999-2001 levels while the abundance of old-shelled crabs has decreased further. This suggests that the resource has become increasingly dependent upon relatively weak annual recruitment.

The fall survey pre-recruit index and observer discard pre-recruit index (Table 4, Fig. 22) both decreased from 1998 to a lower level during 1999-2001. The survey index remained low until it increased sharply in 2004 and then decreased in 2005. The increase in the survey pre-recruit index in 2004 occurred predominately well north of the closed area (Hawke Box), around Cartwright Channel. The observer index increased in 2002 and changed little thereafter.

The size compositions from fall multispecies surveys are examined initially with the abundance index (ordinate) truncated for smallest males (<50 mm CW), so as to focus on trends in abundance for larger males (Fig. 23). The decline in commercial-sized males from 1998 to 2004, as well as in pre-recruits from 1998-2003 is well-reflected in these size frequencies. The increase in the pre-recruit index in 2004 is well-reflected by a prominent modal group of adolescents at about 75-92 mm CW. The survey data indicate that most of the relatively abundant sub-legal sized adolescent males evident in 2004 achieved legal size in 2005, as new-shelled immediate pre-recruits. Most of these will be recruited to the fishery as older-shelled crabs in 2006. Therefore recruitment is expected to increase in 2006.

The non-truncated size distributions (Fig. 24) suggest that indices of smallest males (<50 mm CW) increased during 1999-2001 and then decreased. While the modal group of 75-92 mm CW pre-recruits in 2004 that partially developed into exploitable biomass in 2005 may have been derived from the large modal group of <50 mm CW males in 2001, there has been no clear evidence of modal progression over the time series. Therefore long-term recruitment prospects are unknown.

Size distributions from at-sea sampling by observers (Fig. 25) indicate that modal CW decreased from about 110-113 mm in 2003 to 92 mm in 2004, suggesting an increase in abundance of legal-sized new-shelled immediate pre-recruits in 2004. Modal CW then increased to 101 mm in 2005, due primarily to an increase in catch rate of largest males These observations suggest that the leading tail of the modal group of sub-legal sized adolescents evident in the 2004 multispecies survey (but not evident at smaller size in the 2003 survey, Fig. 24) had already begun to achieve legal size as small (95-101 mm CW) soft and new-hard immediate pre-recruits in 2004 (Fig. 25). The remainder of this modal group of adolescent pre-recruits achieved legal size in 2005 as larger (mostly 101-110 mm CW) new-shelled pre-recruits (Fig. 25). The increase in small immediate pre-recruits in 2004 resulted in a slight increase in recruitment in 2005, as reflected by the slight increases in CPUE (Fig 15) and in catch rate of old-shelled crabs from observer sampling (Fig. 25-26). However, most of this group is expected to recruit as old-shelled crabs in 2006. This is consistent with the increased divergence of trends in total discards and undersized discards since 2003 (Fig. 27), which implies that an increasing proportion of total discards has been new-shelled immediate pre-recruits. However, this does not agree with the trend in catch rate of new-shelled immediate pre-recruits (Fig. 26), which shows no change over the past 4 years.

Reproduction: The percentage of mature females carrying full clutches of viable eggs (Fig. 28) remained above 90% until 2000 (excepting the anomalous 1999 value). It declined from 94% in 2000 to 74-78% in 2001-03 before increasing back to 94% in 2004 but subsequently decreased by 27% in 2005 to 67%. It is uncertain whether this apparent decline in mating success from 2001-03 and 2005 is due to the decline in availability of legal-sized males. Also, it is unknown whether declines in fecundity of this apparent level would affect subsequent abundance of settling megalopae.

Mortality

Exploitation: The exploitation rate index decreased from 1999 to 2001 (Fig. 29), changed little in 2002 and almost tripled in 2003, but has since declined to the 2001-02 level. The pre-recruit fishing mortality index (Fig. 29) increased six-fold from 2001 to 2003 and then dropped to the lowest level in the time series in 2005.

Indirect fishing mortality: Fishery-induced mortality, on the exploitable as well as the pre-recruit populations, has decreased since 2003. The percentage of the total catch discarded (Fig. 29) increased sharply in 2002, was unchanged in 2003, and further increased to a record high level in 2004. It decreased to the second highest level in 2005, implying continued high wastage of under-sized and new-shelled pre-recruits in the 2005 fishery.

Although wastage of pre-recruits (percent discarded) remained high in the 2005 fishery (Fig. 29), overall pre-recruit mortality decreased sharply due to increase in the pre-recruit biomass in 2004 and reduced landings in 2005. The total number of pre-recruits discarded (not shown) decreased more sharply than did the percent discarded in 2005 due to reduction in landings.

Snow crabs that are caught and released as under-sized or legal-sized soft-shelled males in the fishery are subject to multiple stresses and have unknown survival rates. Time out of water, air temperature, water temperature and shell hardness all influence the mortality level on discarded snow crab (Miller 1977). Other environmental factors such as wind speed, sunlight and size of the crab may also influence survivability (Dufour et al. 1997). Poor handling practices such as prolonged exposure on deck, dropping or throwing crab as well as inducing limb loss increases mortality levels associated with catching and discarding crabs. Recently-molted (soft-shelled) snow crab are more subject to damage and mortality than hard-shelled crab (Dufour et al. 1997, Miller 1977).

The percentage of soft-shelled crab present in the catch by week has been much higher during 2002-05 than in 2001 (Fig. 30). Peaks in percentage of soft-shell have been occurring progressively earlier each year. Peak soft-shell percentage occurred in week 17 in 2002, week 13 in 2003, week 10 in 2004, and week 9 in 2005 excepting an anomalous value in week 12. These trends may be due to depletion of recruited (older-shelled) crabs, earlier molting, or increased catchability of soft-shelled immediate pre-recruits in recent years. Regardless of the cause, this implies an increase in wastage of new-shelled crab in the fishery in recent years.

The bulk of the 2005 fishery occurred in the five weeks from week 7 through week 11 (Fig. 31) with about 87% of the total trap hauls executed in this period. Soft-shelled crab first exceeded 20% in week 9 when it comprised nearly 42% of the observed catch. Soft-shelled crab prevalence remained at about 20% in weeks 10 and 11 before observer sampling became sporadic. Observer sampling was relatively well distributed in relation to total fishing effort throughout the fishing season (Fig. 32), with highest sampling levels during the peak period of soft-shell crab.

Natural Mortality; BCD: BCD has been most prevalent in small crabs of 40-59 mm CW in Div. 2J (Fig. 33). Prevalence, in new-shelled males, has generally been low in this area, usually about 2-3 percent occurrence for that size range, excepting 1999, when 18.2% of new-shelled males in that size group were visibly infected. BCD prevalence increased in 2005, from a very low level in 2004, particularly in intermediate-sized males of 60-75 mm CW (from 0 to 3%).

Effects of other fisheries: An area of the Hawke Channel has been closed to all fisheries except snow crab during 2002-05 (Fig. 16). It would be premature to draw any conclusions regarding the impact of this closure on the snow crab resource. However, it is noted that the CPUE increased similarly inside and outside the closed area in 2005 (Fig. 34).

DIVISION 3K

The Fishery

Landings (Table 5, Fig. 35) averaged about 3300 t during 1985-90 then increased to peak in 1999 at 21,400 t. They decreased to 15,300-16,500 t in 2000-04, due to reduction in TAC. The TAC was further reduced by 18% in 2005, whereas landings dropped by 47% to 8,700 t. Effort increased by 33% in 2004 and decreased by 41% in 2005. The percentage of the total landings derived from inshore increased from 8% to 31% over the past five years. Offshore effort decreased by 47% from 2004-05 primarily due to a soft-shell induced early fishery closure.

Biomass

Commercial catch rates have oscillated over the time series (Table 5, Fig. 36). Offshore commercial CPUE has declined since 1998 and is well below the 1990-98 level. Inshore CPUE has been consistently lower than offshore CPUE. Inshore commercial CPUE declined during 2002-05 and is currently well below the long-term average. The spatial distribution of CPUE was reduced from 2004 (Fig. 37) and reflects the pre-mature fishery closure in the offshore and the reduction in CPUE inshore. The areas fished changed little from 1999-2003 (Dawe et al. 2004). There has been little fishing since 1999 east of 51W along the slope and southeast of the Funk Island Bank.

The offshore logbook CPUE and observed CPUE agreed well for the second consecutive year. The observed CPUE was higher than offshore logbook CPUE in 2005 (Fig. 38), for the first time since 1996. Both indices agreed that offshore CPUE declined during 1998-2001 and changed little until 2003. Logbook CPUE decreased sharply in 2004 while the observer CPUE changed little. Observer CPUE increased in 2005 while logbook CPUE continued to decline. There were clear annual differences in CPUE trends throughout the season (Fig. 39 and Fig. 40). While initial CPUE in 2005 was comparable with that of the previous three years, late-season CPUE, at comparable removal levels, was was lowest in 2005.

The fall survey exploitable biomass index increased sharply in 1996 (Table 6, Fig. 41) and remained at a high level during 1996-98. It dropped by more than half in 1999 and increased slightly during 2000 and 2001. It decreased by almost half from 2001 to 2004-05.

Production

Recruitment: Annual changes in the abundance index by shell condition do not show a consistent trend of peaks in new-shelled abundance preceding peaks in old-shelled abundance (Fig. 42), as was evident in Div 2J. This may be due to annual differences, particularly in 1998 and 1999, in catchability of crabs by the survey trawl. Such changes in catchability or trawl efficiency may be related to changes in trawl configuration or changes in distribution of crabs with respect to depth and substrate type (Dawe et al. 2002a). The decrease in both shell categories in 1999, followed by an increase suggests reduced catchability in the 1999 survey. This is reflected in the spatial distributions that show consistent relatively low 1999 catch rates across all size groups; most evident in small males (Fig 6).

Both the fall survey pre-recruit index (Table 7, Fig. 43) and the observer discard pre-recruit index (Fig. 43) increased between 1995 and 1997 and declined to a lower level during 1999-2002. The survey pre-recruit index changed little since then whereas the observer index increased gradually. Offshore recruitment should remain unchanged or increase gradually in the short term.

The truncated size compositions from fall multispecies surveys (Fig. 44) show a decline in commercial-sized males from 1996 to 2003, as well as of adolescent pre-recruits from 1997 to 2003. More recently, a group of adolescents in 2004 with modal CW at about 85 mm appears to have advanced in 2005, to larger sizes .This group may have contributed to increased abundance of smallest legal-sized adults in 2005, consistent with the possibility of a slight increase in recruitment in 2006. This modal group of pre-recruits is less distinct and much smaller than that observed in 1996-97 (Fig.44).

The un-truncated size distributions (Fig. 45) suggest that indices of smallest males (<50 mm CW) were relatively high during 2000-01 and decreased thereafter. However this is unreliable as an indication of long-term recruitment because there has been no evidence of modal groups progressing through the size range over the time series. Therefore, long-term recruitment prospects are unknown.

Size distributions from at-sea sampling by observers (Fig. 46) indicate that modal CW decreased from about 110 mm in 1999 to about 101 mm in 2000 as catch rates of small males increased, suggesting some increase in recruitment in 2000. There was little change in 2001, but modal CW increased to 110 mm CW in 2002 and was unchanged in 2003-05, consistent with the recent trend in the fall survey pre-recruit index. Sampling by observers shows that CPUE of old-shelled animals decreased greatly from 2000 to 2003 and has increased marginally since then (Fig. 47). The catch rate of total discards from observer set and catch records agreed well with the catch rate of under-sized discards from observer at-sea sampling during 2001-03 (Fig. 48), suggesting that discards were comprised mostly of under-sized crabs during that time. The catch rate of total discards increased from 2003 to 2005, while that of under-sized crabs remained unchanged, suggesting an increase in legal-sized new-shelled immediate pre-recruits. However, this is highly uncertain as it is not supported by the data on new-shelled immediate pre-recruits from observer sampling (Fig. 47), which has fluctuated without trend since 2000. As noted above, it is unclear whether offshore recruitment will remain unchanged or increase gradually in the short term.

Data from the inshore September (post-season) trap survey (Fig. 49) indicate a high level of spatial variability (Fig. 50). Catch rates of new-shelled males (immediate pre-recruits) increased in all 5 strata in 2000 (Fig. 50). They increased further in 2002-03 in the 3 White Bay strata, suggesting increasing recruitment, before decreasing in 2004. In 2005, catch rates decreased in all three White Bay strata from small-meshed traps but increased slightly in the two deepest strata from large-meshed traps. Catch rates of new-shelled males were lower in 2002-03 than in 2000 in the 2 Notre Dame Bay strata. They decreased sharply in 2004, especially in the deeper stratum (610, Fig. 50), before increasing sharply in 2005 back to 2002-03 levels, suggesting reduced catchability in the 2004 survey.

Size frequencies from survey small-meshed traps (Fig. 51 – Fig. 55) show much clearer trends in White Bay than in Notre Dame Bay. Size frequencies from White Bay (Fig. 51-53) clearly show an abundant group of small crab in 1998 (especially in shallowest stratum 615, Fig. 51) that progressed through the size range achieving legal size over the period 2000-03 (especially in deepest stratum 613, Fig. 53). The modal CW of legal-sized crabs increased in the two deeper strata during 2003-05 (Fig. 52 and 53) suggesting declining recruitment, while a prominent group of small males with modal CW about 55 mm appeared in shallowest stratum 615 in 2005 (Fig. 51). Notre Dame Bay (Fig. 54-55) also showed highest catch rates of sub-legal sized males in 1998, especially in the shallower stratum (Fig. 54), and a decline in catch rates of these small crabs during the next three years. However, there was no evidence of progression of these small crabs to recruitment in later years, as seen in White Bay. Catch rates of legal-sized crabs was also highest early in this time series and recruitment appeared to be highest in 1998 (Fig. 54-55). High exploitation and mortality on pre-recruits could possibly account for this apparent lack of recruitment. Notre Dame Bay also showed a sharp decrease in catch rates across the entire size range in both strata in 2004 followed by a sharp increase in 2005, reflecting changes in catchability. There was an apparent high abundance of sub-legal sized males in shallower stratum 611 in 2005 (Fig. 54), that may indicate improved recruitment prospects, but this is highly uncertain due to the recent changes in catchability by traps.

These size distributions (since 1997) are pooled across strata for each bay and broken down by chela category to better compare trends between the two bays (Fig. 56-57). Small, adolescent males that were most abundant in White Bay at about 60 mm modal CW in 1997 recruited to legal size during 2000-04 (Fig. 56), Small adolescents males and legal-sized males were most abundant in Notre Dame Bay in 1999 and 2000 and there was no apparent progression of adolescents to recruitment (Fig. 57). A group of pre-recruits of 50-95 mm CW in Notre Dame Bay and 40-80 mm CW in White Bay suggest increasing recruitment in the short and intermediate terms respectively but there is high uncertainty associated with a possible increase in catchability of small crabs as a function of reduced competition with large crabs.

Reproduction: The percentage of mature females carrying full clutches of viable eggs (Fig. 58) varied at a high level from 1995 to 2004, exceeding 80% in all years but 1996, but fell to 61% in 2005.

Mortality

Exploitation: The exploitation rate index decreased from 1996 to 1997 (Fig. 59) and increased steadily from 1997 to 2000. The pre-recruit mortality index decreased from 1996 to 1998 and increased to 2000. Both indices have since varied at this higher level. The exploitation rate index and the pre-recruit mortality index were similar in 2005 to the long-term average. The high mortality indices for 2004 may be due to anomalously low biomass indices from the 2003 survey.

Indirect fishing mortality: The percentage of the total catch discarded in the fishery (Fig. 59) increased since 2002 to about 40% in 2005, reflecting increased wastage of under-sized and new-shelled pre-recruits. The high wastage in 2005 is consistent with a high incidence of soft-shelled immediate pre-recruits in the catch, which resulted in a premature closure of the fishery and failure to achieve the TAC. Because of the greatly reduced landings, and associated catch of pre-recruits, fishery-induced mortality, on either the exploitable or pre-recruit population, did not increase in 2005.

The percentage of soft-shelled crab in the catch by week has been occurring progressively earlier and at progressively higher levels each year from 2001-05 (Fig. 60). In 2001, soft-shelled percentage of the catch did not approach 20% until week 14, twelve weeks into the fishery, and peaked in week 16 at about 30%. In 2004, soft-shelled percentage was close to 20% in week 9, four weeks into the fishery, and peaked in week 15 at about 35%. In 2005, soft-shelled percentage approached 20% in week 6, two weeks into the fishery, and peaked in week 11 at about 35%. These trends may be due to depletion of recruited (older-shelled) crabs, earlier molting, or increased catchability of soft-shelled immediate pre-recruits in recent years. Regardless of the cause, this implies an increase in mortality on new-shelled crab in the fishery in recent years.

The bulk of the 2005 fishery occurred in the five weeks from week 7 through week 11 (Fig. 61) with about 83% of the total trap hauls occurring in this period. Prevalence of soft-shelled crab was at about 20% in weeks 6-9 before increasing further. Observer coverage was distributed throughout the season relatively proportional to total fishing effort, and was relatively extensive during the period when soft-shelled crab prevalence was at about 20% (Fig. 62).

Natural Mortality; BCD: Prevalence of BCD, from multispecies trawl samples, has overall been higher in this division than in any other division, with maximum levels during 1996-98 in the order of 8% in 40-59 mm CW new-shelled males (Fig. 63). Annual trends in BCD prevalence (across all sizes) were similar to those in the exploitable biomass and pre-recruit indices, featuring highest values in 1997-98, a sharp drop to minimum levels in 1999, and generally lower levels during 2000-05 than during 1996-98. The very low prevalence levels, across all sizes, in 1999 may be an artifact related to the lower catchability of BCD-infected crabs by trawl than by traps, together with lower trawl efficiency (in Div. 3K) in 1999 than in other survey years. The relatively low observations in 2003 may also be an artifact of a later than normal trawl survey.

BCD has consistently occurred at much higher prevalence levels in the inshore Div. 3K trap survey samples (Fig. 64-67) than in the predominately offshore Campelen trawl samples. This may be due to differences in catchability of diseased animals between gear types, but it may also reflect higher prevalence in inshore than offshore areas. We believe that BCD was not prominent in inshore Div. 3K in the early 1990's because we detected no BCD in 1994, the first year of our survey. Furthermore, in White Bay, it was detected only in the shallowest stratum in 1995, especially in smallest males, despite our sampling in both deeper strata as well. Between 1995 and 1999 there was a clear progression of BCD to successively larger crabs and successively greater depths, such that about 12% of legal-sized new-shelled crabs in the deepest stratum were infected in 1999. This progression with size and depth until 1999 reflects both the observed size-related depth distribution pattern (Dawe and Colbourne 2002), as well as increasing recruitment over that time period. Prevalence in White Bay increased in 2003 in smallest new-shelled males within the shallowest stratum and subsequently increased in progressively larger crabs in this stratum during 2004-05 (Fig. 64). It also increased greatly in all sizes but especially in smallest males in the two deeper White Bay strata in 2005 (Fig.64). Prevalence in Notre Dame Bay was relatively high, especially in smallest males within the deeper stratum during 2002-04, whereas it increased steadily during this period in the shallower stratum (Fig. 65). It decreased overall in both Notre Dame Bay strata in 2005. It was most prevalent in smallest males in 2005 in all strata except the shallowest White Bay stratum (Fig 64 and 65), where it was most prevalent in largest (legal-sized) males. Prevalence of BCD within new-shelled males is clearly higher in adolescents than in both chela groups pooled (Fig. 66 and 67). There also appears to be an increase in prevalence with size in most years within this group, in all strata except Notre Dame Bay deeper stratum 610, where there is usually a decrease in prevalence with increasing size. Causative factors for these trends are unclear, and implications for mortality are unknown.

DIVISION 3L

The Fishery

Landings (Table 8, Fig. 68) 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 then increased by 15% to 26,000 t in 2003, and decreased to 24,900 t in 2005 due largely to changes in TAC. Meanwhile effort increased by 73% during 2000-04 and decreased by 3% in 2005. Inshore landings have represented 24% of the total in the past three years.

Biomass

Commercial catch rates (Table 8, Fig. 69) in the offshore decreased by 22% between 2002 and 2004 and changed little in 2005. Offshore CPUE remains at a high level relative to other divisions. Inshore CPUE has been consistently lower than offshore CPUE. Inshore CPUE decreased by 21% in 2003 and has changed little since. The spatial distribution of CPUE has changed little in the past three years (Fig. 70).

The observer CPUE index agreed with the offshore logbook CPUE (Fig. 71). Trends in these two indices generally agrred since 1998. Annual differences in initial CPUE during 2002-05 were unclear. (Fig. 72-73). However it was clear that late-season CPUE, at comparable removal levels (Fig. 73), had decreased during 2002-04 and was marginally lower in 2005.

The fall survey exploitable biomass index (Table 9, Fig. 74) declined from 1996-2000 and remained relatively low thereafter. Disagreement between the exploitable biomass index and CPUE throughout most of the time series introduces uncertainty regarding trends in biomass.

Catch rates from trap surveys in 3 localized inshore areas (Fig. 75-77) have declined since the 1990's. However, interpretation of year-to-year changes is uncertain. Survey catch rates have not agreed well with commercial CPUE from the local fisheries and have been highly variable in some areas

Production

Recruitment: Annual changes in the multispecies survey abundance index by shell condition (Fig. 78) reflected greater internal consistency than was evident in Div. 3K. Abundance of new-shelled legal-sized males declined from a peak in 1995 or earlier, whereas old-shelled legal-sized males peaked at least two years later, in 1997. Abundance of new-shelled males continued to decline to 1999 before stabilizing and subsequently increasing until 2005, whereas the decline in old-shelled males extended one year later, to 2000, before stabilizing until 2003 and declining from 2003 to 2005. These consistent trends show no clear evidence of strong changes in catchability or 'year effects', as were suggested in Div. 3K.

The fall survey pre-recruit index has been low since 1999 (Table 10, Fig. 79). The observer pre-recruit index declined from 1997 to 2004 and was unchanged in 2005 (Fig. 79).

The truncated size compositions from fall multispecies surveys (Fig. 80) show a decline in commercial-sized males, as well as of adolescent pre-recruits since 1996. The very low abundance-at-size in 2004, especially for legal-sized males, is largely due to the incomplete survey in that year that did not include some important commercial fishing grounds. There is no clear indication of any increase in recruitment in the short term, based on males larger than about 50 mm CW.

The un-truncated size distributions (Fig. 81) suggest that abundance indices of smallest males (<50 mm CW) were high during 2001-02, but abundance of this group has since decreased. This is unreliable as an indication of long-term recruitment because there has been no evidence of modal groups progressing through the size range over the time series. Therefore, long-term recruitment prospects are unknown.

Size distributions from at-sea sampling by observers (Fig. 82) became increasingly platykurtic over the past 7 years. Modal CW increased from 98 mm in 1999 to about 101-110 mm in 2005 as catch rates of small males decreased, suggesting declining recruitment. Observer sampling shows a clear pattern of recruitment decline in recent years, with declines in old-shelled exploitable males since 2002 (Fig. 83), in new-shelled immediate pre-recruits since 2001, and in under-sized crabs since 2000 (Fig. 84). Recruitment is expected to remain relatively low in the short term.

The mean sizes of commercial males caught in the Div. 3L inshore trap surveys have increased in all three locations since 2000 suggesting decreasing recruitment (Fig. 85). In all three locations, mean CW was about 104 mm in 2000. The mean CW in 2005 was 105 mm, 111 mm, and 111 mm, for North-east Avalon (NEA), Conception Bay (CB), and Bonavista Bay (BB), respectively. Male size distributions from the surveys (Fig. 86 and 88) showed no clear annual progression of modal groups of adolescents in any areas. All three areas showed declining catch rates across all sizes during 2001-03, suggesting declining catchability of crabs by traps. Catch rates in 2005, across all sizes, increased in one area in spring (Fig. 86) changed little in another area in summer (Fig. 87) and decreased in another area in fall. There was a large increase in CB in 2004 in the catch rate of adolescents that would achieve legal size after one molt (Fig. 88). However this did not result in increased catch rates of legal-sized crabs in 2005 (Fig. 88).

Reproduction

The percentage of mature females carrying full clutches of viable eggs declined overall throughout the time series to 50% in 2001 but increased to about 90% in 2002-03 and has since declined to about 80% in 2005 (Fig. 89).

Mortality

Exploitation: The exploitation rate index (Fig. 90) increased from 1996 to 2000 and has since changed little. The pre-recruit fishing mortality index (Fig. 90) increased gradually to 2001, doubled to 2003, and then decreased to the 2001 level in 2004. The anomalously high indices for 2005 reflect the incomplete survey in 2004. 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. However the current level of fishery removals would not likely result in increased mortality *on either the exploitable or the pre-recruit population.*

Indirect fishing mortality: The percentage of the total catch discarded in the fishery (Fig. 90) increased from 1995-97 and decreased sharply in 1998. It then declined gradually until 2002 and changed little since, implying relatively little wastage of under-sized and new-shelled pre-recruits in the fishery in recent years.

The survey mortality indices (Fig. 90) and landings have changed little in recent years, Therefore the sTable low pre-recruit wastage index, to 2005, implies that fishery-induced mortality has remained relatively low in recent years. However, unreliability of 2005 mortality indices introduces uncertainty.

The prevalence of soft-shelled crab in the catch throughout the season was lower in Div. 3L than it was in Div. 2J or 3K (Fig. 91). The percentage of soft-shelled crab in 2005 gradually increased as the season progressed but remained low throughout the fishing season as in previous years. Soft-shell crab comprised less than 10% of the weekly catch in 3L across most of the time series.

The 2005 fishery was prosecuted mostly within a 9-week period. Most of the trap hauls were executed from week 7 through week 16 (relative to April 1, Fig. 92). Observer coverage was generally distributed in proportion to total effort throughout the season (Fig. 93).

Natural Mortality; BCD: BCD occurs almost exclusively in recently-molted crabs (Dawe, 2002) and generally occurs at lower levels in Div. 3L than in Div. 3K. In Div. 3L, BCD prevalence from fall multispecies surveys (in new-shelled males) has been variable with maximum prevalence for any size group, of about 4% (Fig. 94) from 1996 to 2002; approximately half the level found in Div. 3K. Prevalence of infection increased overall over the past 4 years, and has progressed from 40-59mm CW crabs in 2003 through successively larger sizes in 2004-05. Maximum prevalence was about 8% in 40-75 mm CW crabs in 2004.

Trends in prevalence of BCD from Conception Bay fall surveys across all shell categories (Fig. 95) are consistent with those within new-shelled males from the fall multispecies trawl surveys in showing an increase over the past 3 years from a low level in 2002. Prevalence by sex, from both trap and trawl samples in Conception Bay, increased to 10-20% in 2005.

DIVISION 3NO

The Fishery

The fishery began in the mid-80's in Div. 3O and expanded along the shelf edge in 1999. It has since been concentrated along the shelf edge, and mostly in Div. 3N. Landings (Table 11, Fig. 96) increased sharply in 1999 and changed little to 2003. They declined by 16% from 5600 t in 2003 to 4700 t in 2005 while effort increased by 17% in 2004 and changed little in 2005.

Biomass

Commercial CPUE (Fig. 97) has remained high in recent years relative to other areas but decreased by 31% between 2002-05. The fishery has been concentrated along the shelf edge (Fig. 98) with no substantial change in areas fished during 2000-05.

Observed CPUE was consistently lower than logbook CPUE from 1996-2004, but showed a similar trend (Fig. 99). Logbook CPUE decreased in 2005 while observed CPUE increased marginally. The fishery began progressively later throughout 2002-05 in both Div. 3N (Fig. 100) and Div. 3O (Fig. 101). Annual differences in early-season CPUE are unclear (Fig. 100-103). However, at comparable removal levels, late-season CPUE in Div. 3N (Fig. 102) was similar to that in 2004 at a lower level than during 2002-03. Division 3O CPUE declined sharply early in the 2005 season so that late-season CPUE was lower than that in the previous three years.

Because the resource has been concentrated along the shelf edge in these divisions, estimates of the exploitable biomass indices (Table 12, Fig. 104-106), as determined from fall multispecies surveys, have wide margins of error and show no clear trend, therefore no inferences about biomass can be made from these data.

Production

*Recruitment: A*nnual changes in the multispecies survey catch rate by shell condition (Fig. 107-108) reflected greater internal consistency in Div. 3N than Div. 3O. In Div. 3N, catch rate of new-shelled legal-sized males increased from 1995 to a peak in 1998, whereas old-shelled legal-sized males peaked three years later, in 2001. Catch rate of new-shelled males declined from 1998-2001 whereas the catch rate of old-shelled crab declined later, from 2001 to 2003. New-shelled crab catch rate increased from 2001to 2004 and old-shell crab catch rate increased later, from 2003 to 2004. Both categories decreased in 2005. In Div. 3O the trends are not as consistent (Fig. 108) with new-shelled and old-shelled crab catch rates both peaking in 1998. More recently however a minor peak in new-shelled catch rate in 2001 was followed by a peak in old-shelled catch rate the following year. The catch rate of new-shelled crabs increased sharply in 2005 while that of old-shelled crabs changed little.

Wide margins of error introduce uncertainty in interpreting the fall multispecies survey pre-recruit indices (Table 13, Fig. 109-111). However, the Div. 3NO observer pre-recruit index indicates that recruitment has decreased and is expected to remain relatively low in the short term (Fig. 109).

Truncated size frequency distributions from the multispecies surveys suggest a decline in biomass and recruitment throughout the time series in both Div. 3N (Fig. 112) and 3O (Fig. 113), but as already noted, there is high uncertainty. The non-truncated size frequency distributions showed no trends for smallest males (<50 mm CW, Fig. 114-115). Therefore, long-term recruitment prospects are unknown.

Size distributions from observer sampling in 3N (Fig. 116) showed a gradual increase in modal CW over the past 7 years from 101 mm in 1999 to 113 mm in 2000 and 119 mm in 2003-05 as catch rates of small males steadily declined, indicating declining recruitment. The trend was not as consistent in Div. 3O (Fig. 117) in that there appeared to be some increase in recruitment during 2001 and 2004, based on decreasing modal CW and increasing catch rate of small new-shelled males. The increased recruitment in 2004 was associated with an increase in larger old-shelled crabs in 2005. However there is high uncertainty about these trends because the old-shelled recruits in 2005 were much larger and apparently more abundant than the new-shelled immediate pre-recruits in 2004 (Fig. 117). The increase in catch rate of old-shelled crabs in Div. 3O in 2005 is reflected in the overall Div. 3NO catch rate of old-shelled crabs (Fig. 118). Declining recruitment since 1999 in Div. 3NO is reflected by declines in new-shelled immediate pre-recruits (Fig. 118) as well as under-sized males (Fig. 119).

Reproduction: There was no clear trend in the percentage of females carrying full clutches of viable eggs in Div 3N (Fig. 120) or Div. 3O (Fig. 121). Division 3N had 100% of females carrying full clutches in 2003 and 2004 which decreased to about 60% in 2005 while 3O had about 75-80% of females carrying full clutches in the past three years. These percentages seem low relative to other areas in recent years, but are associated with very low sample sizes.

Mortality

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

Indirect fishing mortality: The percentage of the total catch discarded in the fishery (Fig. 122) declined by more than half from 1999 to 2002. It has remained steady during the last 4 years at a low level, implying little wastage of pre-recruits.

Prevalence of soft-shelled crab was consistently low in the Div. 3NO fishery in the past four years (Fig. 123 and Fig. 124). Maximum weekly soft-shelled crab prevalence throughout the season was about 5% in 2005 in both divisions.

The 2005 fishery occurred uniformly throughout weeks 7 through 16 in both Divisions (Fig. 125 and Fig. 126) The seasonal distribution of observer coverage better reflected that of total fishing effort in Div. 3N (Fig. 127) than in Div. 3O (Fig. 128). In both divisions observer coverage was relatively low at the start of the season and relatively high at the end of the season. (weeks12-18 for 3N and weeks 15-17 for 3O).

Natural Mortality; BCD: BCD has been virtually absent from Div. 3NO, based on fall multispecies survey trawl samples.

SUBDIVISION 3Ps

The Fishery

The fishery began in 1985 with landings (Table 14, Fig. 129) 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 declined by 58% from 7600 t in 2002 to 3200 t in 2005, while the TAC was reduced by 46%. Effort increased by 59% from 2001-03 before decreasing by 29% to 2005. The percentage of the total catch taken inshore declined from 39% to 21% over the past 4 years.

Biomass

Offshore CPUE declined by 75% from 1999 to its historical low in 2005. Inshore CPUE declined by 70% from 2001 to its historical low in 2005 (Fig. 130).

The spatial distribution of CPUE shows that the recent decline in CPUE had occurred in all areas (Fig. 131). It also shows that the recent decline in fishing effort was most pronounced in inshore areas.

Observed CPUE was generally lower than logbook CPUE throughout the time series. (Fig 132). Both indices show that CPUE declined from 1999-2003 with the logbook CPUE remaining unchanged and the observed CPUE increasing slightly in 2004. These indices agreed in the past two years and showed that offshore CPUE decreased to a record low level in 2005.

Trends in CPUE throughout the season (Fig. 133 and 134) indicated that initial CPUE was comparable to that of the past 3 years, but late-season weekly CPUE was lowest in 2005.

No estimates of the exploitable biomass index are available as there are no reliable research survey data from this area. For unknown reasons, biomass and abundance indices from spring surveys are highly variable.

Production

Immediate Recruitment: Annual changes in the spring multispecies survey catch rates by shell condition (Fig. 135) show internal consistency in the recent past with a peak in new-shell in 2002 followed by a peak in old-shell in 2003 and an increase in new-shell in 2004 followed by an increase in old-shell in 2005.

The truncated size distributions from spring multispecies surveys (Fig. 136) show great annual variability in abundance-at-size of largest males. There are no clear trends of progression of modal groups through the size range over time upon which to infer even short-term recruitment prospects. However, a clear modal group of about 60-80 mm CW adolescents is apparent in 2005 that may indicate increased recruitment in the near future. However, given the great annual variability it is important to verify this against other data sources. Due to high annual variability no inferences on long-term recruitment can be made from the non-truncated (Fig. 137) size distributions

Size distributions from at-sea sampling by observers (Fig. 138) in 2005 showed a sharp ('knife-edge') decrease in catch rate at 95 mm CW, reflecting effects of high exploitation on exploitable crabs as well as new-shelled immediate pre-recruits. Catch rates of sub-legal sized (76-94 mm CW) new-shelled pre-recruits increased in 2005, likely reflecting the leading tail of the modal group of adolescent pre-recruits observed in the spring survey size distributions (Fig. 136). A slight decrease in observer catch rate of new-shelled immediate pre-recruits in 2005 (Fig. 139) was due to a larger average size of immediate pre-recruits in 2004.

The observer discard pre-recruit index (Fig. 140) changed little during 1999-2004 but almost doubled in 2005 primarily due to an increase in under-sized crabs. Although spring survey biomass indices are considered unreliable, biological data from these surveys agree with observer data and suggest that recruitment should increase over the next 3 years.

Long-term Recruitment: No data.

Mortality

Exploitation: CPUE trends indicate that the exploitable biomass has become depleted.

Indirect fishing mortality: The percentage of the total catch discarded in the fishery (Fig. 141) more than doubled to about 80% in 2005 implying increased wastage of pre-recruits. Recruitment prospects have improved and abundance of new-shelled pre-recruits will likely increase in 2006, implying a continued high level of wastage of pre-recruits. Exploitation, in the short term, would likely impair recovery of the exploitable biomass.

The occurrence of soft shell crab in the weekly catch was much higher in 2005 than during 2001-04 (Fig. 142). Soft-shelled crab represented 5-15% of the catch in the early portion of the fishery (weeks 4-9) before it increased to >20% in week 10 and remained high for the duration of the fishery, peaking at about 50% in week 13.

Virtually all of the fishing effort was expended from weeks 7 through 14 (Fig. 143). Relatively intense fishing occurred on soft-shell crab levels exceeding 20% from weeks 10-14. Observer coverage was generally proportional to fishing effort throughout the fishery in 2005 (Fig. 144).

Natural Mortality; BCD: There are no data on BCD in this area.

DIVISION 4R and SUBDIVISION 3Pn

The Fishery

Landings (Table 15, Fig. 145) increased by 88% from 930 t in 1997 to peak in 2002 at 1850 t. They then declined, by 54%, to 860 t in 2005, while the TAC changed little. Effort increased by 13% during 2002-04 and dropped by 42% in 2005. CPUE is consistently low relative to other divisions (Fig. 146).

Biomass

The distribution of fishing effort has changed greatly since 2000, from being predominately offshore and in the North to becoming highly aggregated in two localized areas at the inshore-offshore boundary line in 2005 (Fig.147). CPUE has declined in all areas with the exception of two localized bays (Fig. 148). 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 (Fig. 147-148). Fishery independent data from this area are insufficient to assess resource status.

Observed CPUE and logbook CPUE differed greatly and showed no common trend (Fig. 149), due to inadequate observer coverage.

Production

Immediate Recruitment: The observer data for this area are insufficient to estimate a reliable pre-recruit index. Therefore, short-term recruitment prospects are unknown.

Long-term Recruitment: No data.

Mortality

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

The fishing season started and ended gradually, with most of the fishing effort expended during the middle of the season (Fig. 150). About 26% of the total fishing effort was expended by week 6 and 66% had been expended by week 8. Observer data on weekly soft-shelled crab percentages were insufficient to interpret any trend. Observer coverage was scanty and not well distributed throughout the season in proportion to total fishing effort being most concentrated in weeks 6 and 8 (Fig. 151).

There are no data on BCD from this area.

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Table 1. TAC (t) and Landings (t) by year for Division 2J3KLNOPs4R.

Year	TAC	Landings
1981		14,196
1982		13,498
1983		11,113
1984		9,555
1985		7,974
1986	8,825	8,968
1987	8,325	6,680
1988	8,526	9,588
1989	9,970	8,326
1990	12,800	11,026
1991	15,670	16,162
1992	14,470	16,437
1993	18,550	22,922
1994	23,650	27,917
1995	27,875	32,334
1996	34,864	37,967
1997	42,015	45,726
1998	46,525	52,640
1999	61,761	69,042
2000	51,169	55,350
2001	52,252	56,714
2002	56,981	59,397
2003	56,330	58,347
2004	53,590	55,653
2005	49,978	43,946

Table 2. TAC (t), Landings (t), Effort (trap hauls), and CPUE (kg/trap) by year for Division 2J.

Year	TAC	Landings	Effort	CPUE Total
1985		332	24,776	13.4
1986	925	468	38,361	12.2
1987	925	232	25,778	9
1988	926	456	50,667	9
1989	920	483	39,917	12.1
1990	920	602	47,031	12.8
1991	1,420	1,003	68,231	14.7
1992	1,420	1,494	121,463	12.3
1993	2,300	2,267	190,504	11.9
1994	2,900	2,971	330,111	9
1995	3,050	3,189	393,704	8.1
1996	2,800	3,102	326,526	9.5
1997	2,800	3,183	286,757	11.1
1998	3,500	4,098	276,892	14.8
1999	4,655	5,428	402,074	13.5
2000	3,411	3,673	303,554	12.1
2001	3,340	3,738	424,773	8.8
2002	3,381	3,521	577,213	6.1
2003	2,265	2,532	575,455	4.4
2004	1,780	1,925	534,722	3.6
2005	1,425	1,581	298,302	5.3

Table 3. Fall multispecies survey exploitable Biomass by Year for Division 2J.

Year	Biomass (t)	Confidence Intervals (+/-)		Mean kg/set
		Upper	Lower	
1995	3,367	4,742	1,991	1.13
1996	5,546	7,655	3,437	1.87
1997	10,196	16,238	4,155	3.44
1998	12,376	18,154	6,598	4.17
1999	6,117	8,159	4,075	2.06
2000	3,505	4,437	2,574	1.18
2001	3,161	3,775	2,346	1.06
2002	798	1,283	314	0.27
2003	945	1,600	291	0.32
2004	1,389	2,070	709	0.47
2005	2,005	10,441	-6,431	0.68

Table 4. Fall multispecies survey pre-recruit index by Year for Division 2J.

Year	Biomass (t)	Confidence Intervals (+/-)		Mean kg/set
		Upper	Lower	
1995	1,937	2,832	1,042	0.65
1996	2,339	3,467	1,211	0.79
1997	2,783	4,182	1,384	0.94
1998	3,384	4,523	2,244	1.14
1999	1,082	1,999	165	0.36
2000	1,211	1,759	663	0.41
2001	1,254	3,095	-587	0.42
2002	547	2,992	-1,897	0.18
2003	835	1,224	426	0.28
2004	4,716	34,239	-24,806	1.59
2005	1,542	3,591	-507	0.52

Table 5. TAC (t), Landings (t), Effort (trap hauls), and CPUE (kg/trap) by Year for Division 3K.

Year	TAC	Landings	Effort	CPUE Offshore	CPUE Inshore
1981		1,303	110,424		
1982		2,443	294,337		
1983		4,898	612,250		
1984		5,031	606,145		
1985		4,001	689,828		
1986	4,000	4,277	1,069,250		
1987	4,000	2,678	723,784		
1988	2,550	2,681	570,426		
1989	2,350	2,346	418,929		
1990	4,380	4,309	398,981	14.7	6.7
1991	7,650	8,353	673,629	14.9	9.3
1992	6,650	7,543	633,866	13.3	9.5
1993	8,575	10,463	721,586	16.2	10.5
1994	9,800	10,724	794,370	15.3	9.1
1995	11,450	12,326	1,018,678	13.7	8.3
1996	12,950	14,210	1,280,180	13	6.4
1997	14,300	14,796	1,395,849	13.4	5.8
1998	15,740	16,839	1,357,984	14.9	5.7
1999	18,192	21,386	2,138,600	13.3	4
2000	13,493	15,390	1,710,000	11	4.4
2001	13,693	15,288	1,544,242	10	8.9
2002	15,378	16,352	1,619,010	10.6	8.3
2003	15,608	16,502	1,737,053	10.3	7.3
2004	15,593	16,460	2,318,310	7.6	5.8
2005	12,860	8,685	1,378,571	6.9	5.2

Table 6. Fall multispecies survey Biomass index for Division 3K.

Year	Biomass (t)	Confidence Intervals (+/-)		Mean kg/set
		Upper	Lower	
1995	10,073	12,679	7,467	2.06
1996	19,373	23,470	15,276	3.97
1997	18,486	22,667	14,306	3.79
1998	18,457	22,938	13,976	3.78
1999	8,408	10,919	5,898	1.72
2000	9,791	12,192	7,390	2.01
2001	11,143	15,688	6,599	2.28
2002	8,615	11,232	5,998	1.76
2003	3,567	4,555	2,579	0.73
2004	5,479	6,938	4,020	1.12
2005	6,733	8,584	4,883	1.38

Table 7. Fall multispecies survey pre-recruit index for Division 3K.

Year	Biomass (t)	Confidence Intervals (+/-)		Mean kg/set
		Upper	Lower	
1995	6,412	8,932	3,893	1.31
1996	10,010	13,648	6,371	2.05
1997	12,880	17,255	8,505	2.64
1998	9,790	13,861	5,720	2.01
1999	3,400	4,811	1,990	0.7
2000	8,925	12,365	5,485	1.83
2001	6,287	8,517	4,058	1.29
2002	4,796	6,852	2,740	0.98
2003	2,340	4,193	488	0.48
2004	5,415	9,200	1,631	1.11
2005	5,678	7,835	3,521	1.16

Table 8. TAC (t), Landings (t), Effort (trap hauls) and CPUE (kg/trap) by Year for Division 3L.

Year	TAC	Landings	Effort	CPUE Offshore	CPUE Inshore
1981		12,855	851,325		
1982		11,041	716,948		
1983		6,211	627,374		
1984		4,524	706,875		
1985		2,638	507,308		
1986	3,300	3,506	480,274		
1987	2,800	3,133	352,022		
1988	4,450	5,319	625,765		
1989	6,000	4,423	614,306		
1990	6,800	5,394	719,200	8.1	7.4
1991	5,900	6,430	803,750	9.7	7.7
1992	5,900	6,992	568,455	18.1	11.4
1993	7,175	9,074	677,164	16.7	12.9
1994	10,100	11,944	785,789	16.9	15.2
1995	11,650	14,007	828,817	18.9	15.6
1996	14,775	16,416	1,124,384	16.4	13.1
1997	18,925	20,691	1,477,929	17.3	11.6
1998	19,975	23,289	1,464,717	17.6	11.4
1999	26,375	26,220	1,628,571	17.6	11.4
2000	22,710	22,600	1,221,622	19.2	11.7
2001	23,655	23,469	1,356,590	18.7	10.7
2002	26,448	25,013	1,583,101	18.3	11.2
2003	27,807	26,046	1,915,147	16.6	8.8
2004	27,288	25,746	2,110,328	14.2	8.4
2005	27,078	24,909	2,041,721	13.8	8.9

Table 9. Fall multispecies survey exploitable Biomass index by Year for Division 3L.

Year	Biomass (t)	Confidence Intervals (+/-)		Mean kg/set
		Upper	Lower	
1995	19,527	25,572	13,482	3.39
1996	31,093	38,009	24,176	5.36
1997	18,577	24,107	13,046	3.2
1998	22,054	28,023	16,085	3.8
1999	12,197	15,515	8,879	2.1
2000	9,101	13,256	4,947	1.57
2001	11,577	15,429	7,725	1.99
2002	11,044	16,243	5,845	1.9
2003	9,455	13,202	5,709	1.63
2004	3,965			
2005	9,363	18,131	594	1.62

Table 10. Fall multispecies survey pre-recruit Biomass index by Year for Division 3L.

Year	Biomass (t)	Confidence Intervals (+/-)		Mean kg/set
		Upper	Lower	
1995	9,061	12,743	5,379	1.57
1996	25,342	33,387	17,298	4.37
1997	8,011	10,736	5,286	1.38
1998	8,507	11,163	5,851	1.47
1999	4,454	6,708	2,200	0.77
2000	4,623	7,222	2,024	0.8
2001	2,915	4,587	1,244	0.5
2002	2,205	3,004	1,407	0.38
2003	4,277	6,842	1,713	0.74
2004	1,364			
2005	2,717	4,879	554	0.46

Table 11. TAC (t), Landings (t), Effort (trap hauls) and CPUE (kg/trap) by Year for Division 3NO.

Year	TAC	Landings	Effort	CPUE Total
1985		7		
1986				
1987				
1988		327		
1989		531		
1990		78		
1991		19		
1992				
1993		148		
1994		106		
1995		14	615	22.76
1996		427	33,126	12.89
1997		1,454	99,453	14.62
1998		730	40,176	18.17
1999	3,250	6,506	337,623	19.27
2000	2,425	4,173	216,330	19.29
2001	2,425	4,697	240,010	19.57
2002	2,425	5,023	245,864	20.43
2003	2,670	5,592	293,543	19.05
2004	2,670	5,283	343,722	15.37
2005	2,670	4,740	335,456	14.13

Table 12. Fall multispecies survey exploitable Biomass index by Year for Division 3NO.

Year	3N Biomass (t)	3N Confidence Intervals (+/-)		3O Biomass (t)	3O Confidence Intervals (+/-)		3N Mean kg/set	3O Mean kg/set
		Upper	Lower		Upper	Lower		
1995	1,952	3,265	639	1,056	2,953	-841	0.76	0.6
1996	6,404	10,934	1,875	1,371	7,963	-5,222	2.5	0.78
1997	4,292	8,204	381	1,683	2,933	431	1.68	0.96
1998	9,364	20,309	-1,580	3,234	6,051	416	3.66	1.85
1999	6,681	9,686	3,676	1,223	7,807	-5,362	2.61	0.67
2000	4,456	9,001	-89	1,105	1,575	633	1.74	0.63
2001	8,850	15,656	2,045	1,341	2,646	36	3.46	0.77
2002	4,021	5,718	2,324	959	9,017	-7,099	1.57	0.55
2003	4,226	6,874	1,579	383	734	31	1.65	0.22
2004	4,667	12,056	-2,722	234	507	-39	1.83	0.13
2005	745	1,666	-176	252	857	-353	0.29	0.14

Table 13. Fall multispecies survey pre-recruit Biomass index by Year for Division 3NO.

Year	3N Biomass (t)	3N Confidence Intervals(+/-)		3O BIOMASS (t)	3O Confidence Intervals(+/-)		3N Mean kg/set	3O Mean kg/set
		Upper	Lower		Upper	Lower		
1995	2,224	17,216	-12,767	678	4,940	-3,584	0.87	0.39
1996	7,515	21,733	-6,703	831	1,602	59	2.93	0.48
1997	5,798	46,530	34,933	1,269	3,200	-663	2.26	0.76
1998	9,838	66,516	-46,840	1,668	4,600	-1,263	3.84	0.96
1999	2,917	4,734	1,101	1,544	6,103	-3,016	1.14	0.84
2000	3,962	7,606	317	226	1,112	-661	1.55	0.13
2001	4,674	7,401	1,947	392	1,017	-233	1.82	0.22
2002	2,029	4,813	-755	81	827	-656	0.79	0.05
2003	1,894	3,687	101	241	633	-154	0.74	0.14
2004	1,279	12,071	-9,514	86	294	-124	0.5	0.05
2005	202	386	18	222	766	-322	0.08	0.13

Table 14. TAC (t), Landings (t), Effort (trap hauls) and CPUE (kg/trap) by Year for Division 3Ps.

Year	TAC	Landings	Effort	CPUE Offshore	CPUE Inshore
1981		38	2,533		
1982		14	9,333		
1983		4	263		
1984					
1985		705	110,156		
1986	600	584	166,857		
1987	600	587	195,667		
1988	600	723	133,889		
1989	700	528	96,000		
1990	700	597	124,375		4.8
1991	700	309	67,174		4.7
1992	500	170	16,832		11.8
1993	500	829	74,685		11.2
1994	850	1,538	103,919	19.5	15.5
1995	1,725	1,929	158,115	15.5	9.6
1996	3,050	2,974	177,024	16.3	18.8
1997	4,600	4,675	286,810	19.1	12.5
1998	6,000	6,624	399,036	24.1	11.2
1999	7,959	7,905	510,000	24.5	10.4
2000	7,700	7,887	559,362	20.7	9.9
2001	7,600	7,839	519,139	16.2	12.2
2002	7,600	7,637	763,700	12.1	7.9
2003	6,085	6,113	826,081	8.3	6.1
2004	4,395	4,720	737,500	8.2	4
2005	4,100	3,169	586,852	6.2	3.6

Table 15. TAC (t), Landings (t), Effort (trap hauls) and CPUE (kg/trap) by Year for Division 4R3Pn.

Year	TAC	Landings	Effort	CPUE Offshore	CPUE Inshore
1985		291			
1986		133			
1987		50			
1988		82			
1989		15			
1990		46			
1991		48			
1992		238			
1993		141	28,776		4.9
1994		634	112,411		5.6
1995		869	145,805	5.3	7.4
1996	1,289	838	180,603	3.9	5.3
1997	1,390	927	149,516	5.8	6.2
1998	1,310	1,060	252,381	3.6	5.5
1999	1,330	1,597	325,918	4.4	6.2
2000	1,430	1,627	332,041	5	4.8
2001	1,539	1,683	374,000	4.4	5.1
2002	1,749	1,851	293,810	5.1	8.8
2003	1,895	1,562	284,000	3.7	9.4
2004	1,864	1,462	332,273	3.2	7.6
2005	1,845	862	191,556	3.2	7.4

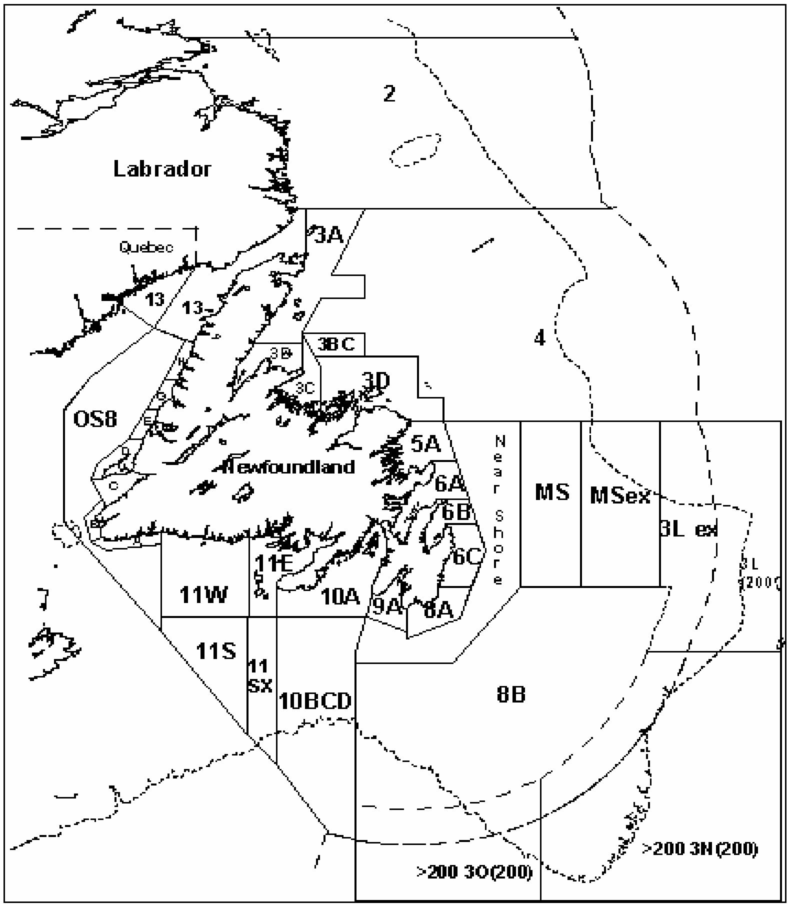

Figure 1. Newfoundland and Labrador Snow Crab Management areas.

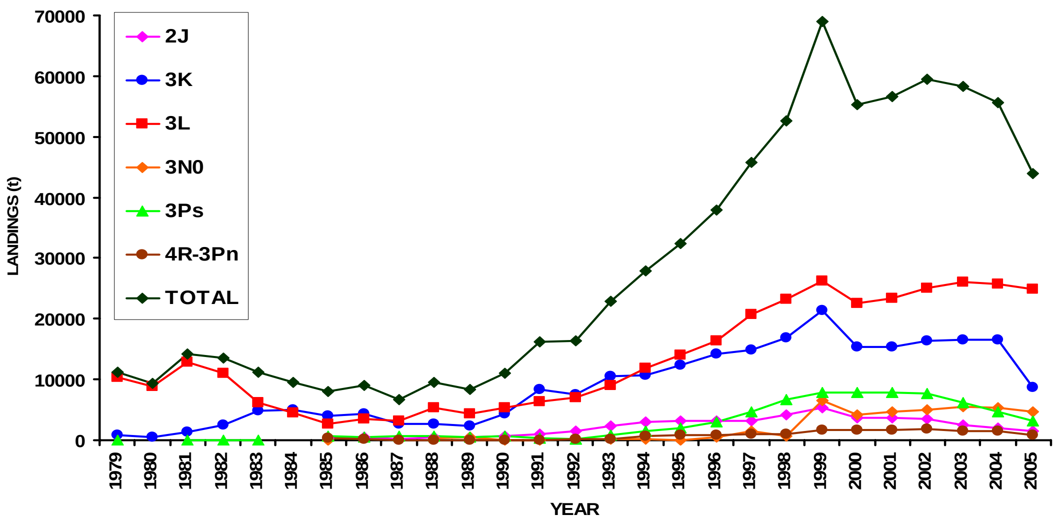

Figure 2. Trends in landings by NAFO Division and in total.

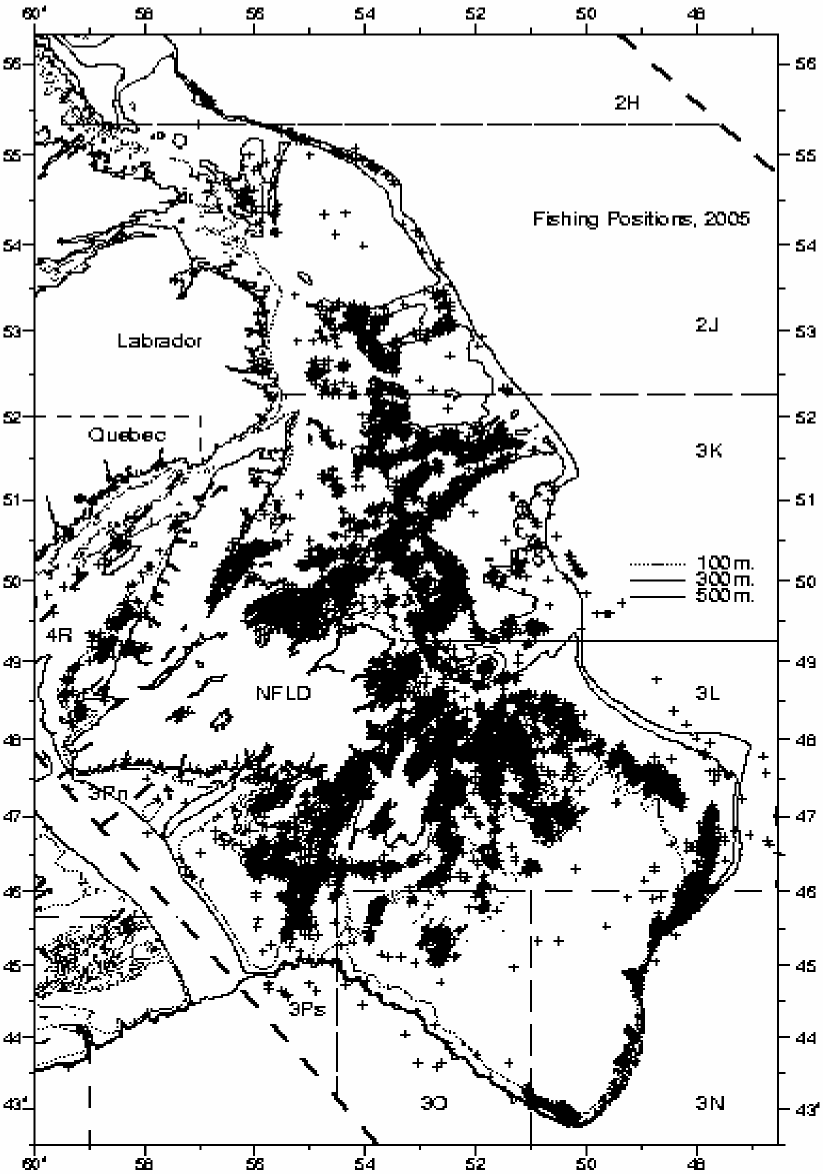

Figure 3. Spatial distribution of commercial fishing effort during 2005.

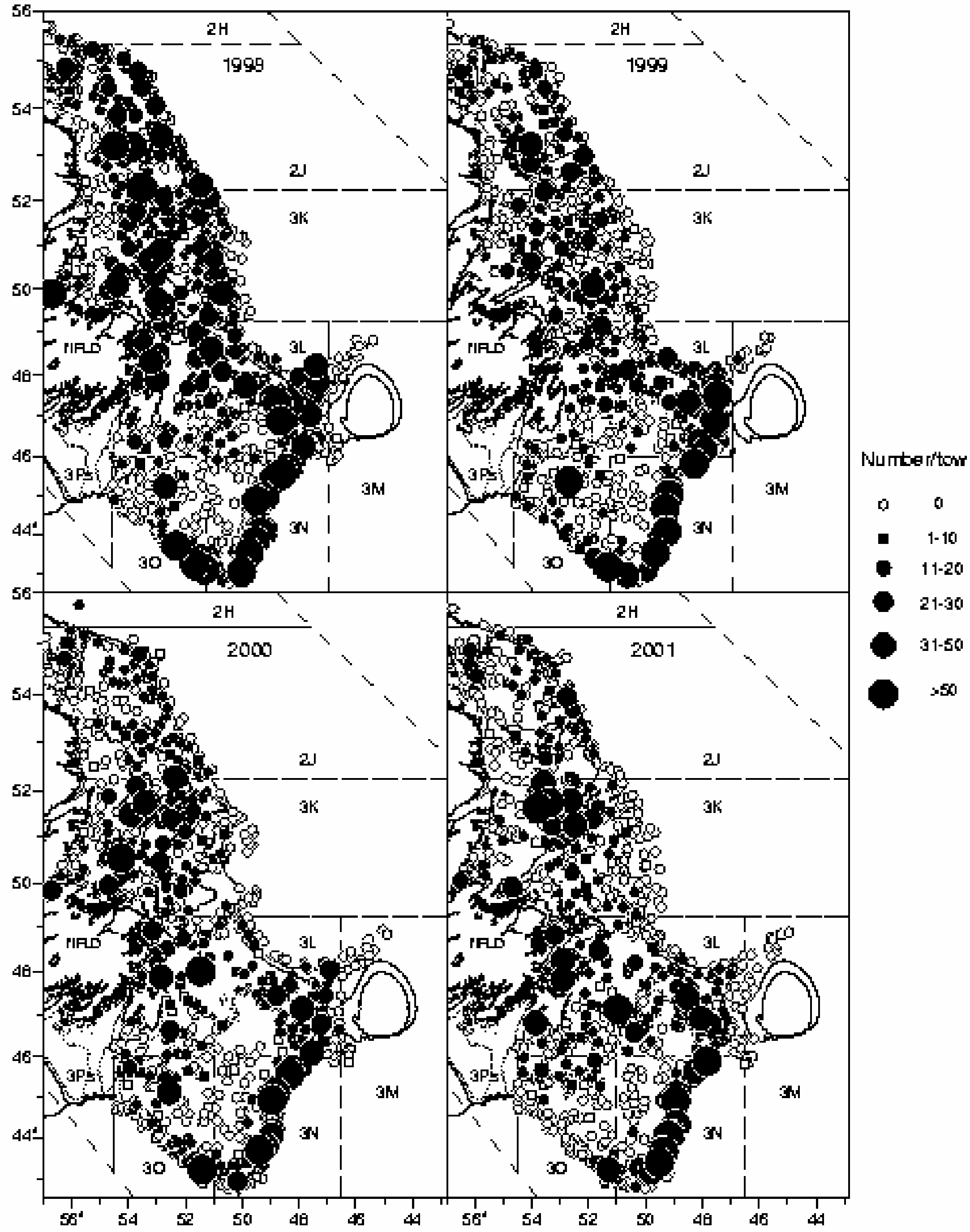

Figure 4. Distribution of exploitable males (>94 mm CW adults) from fall Division 2J3KLNO multi – species surveys from 1998 to 2001.

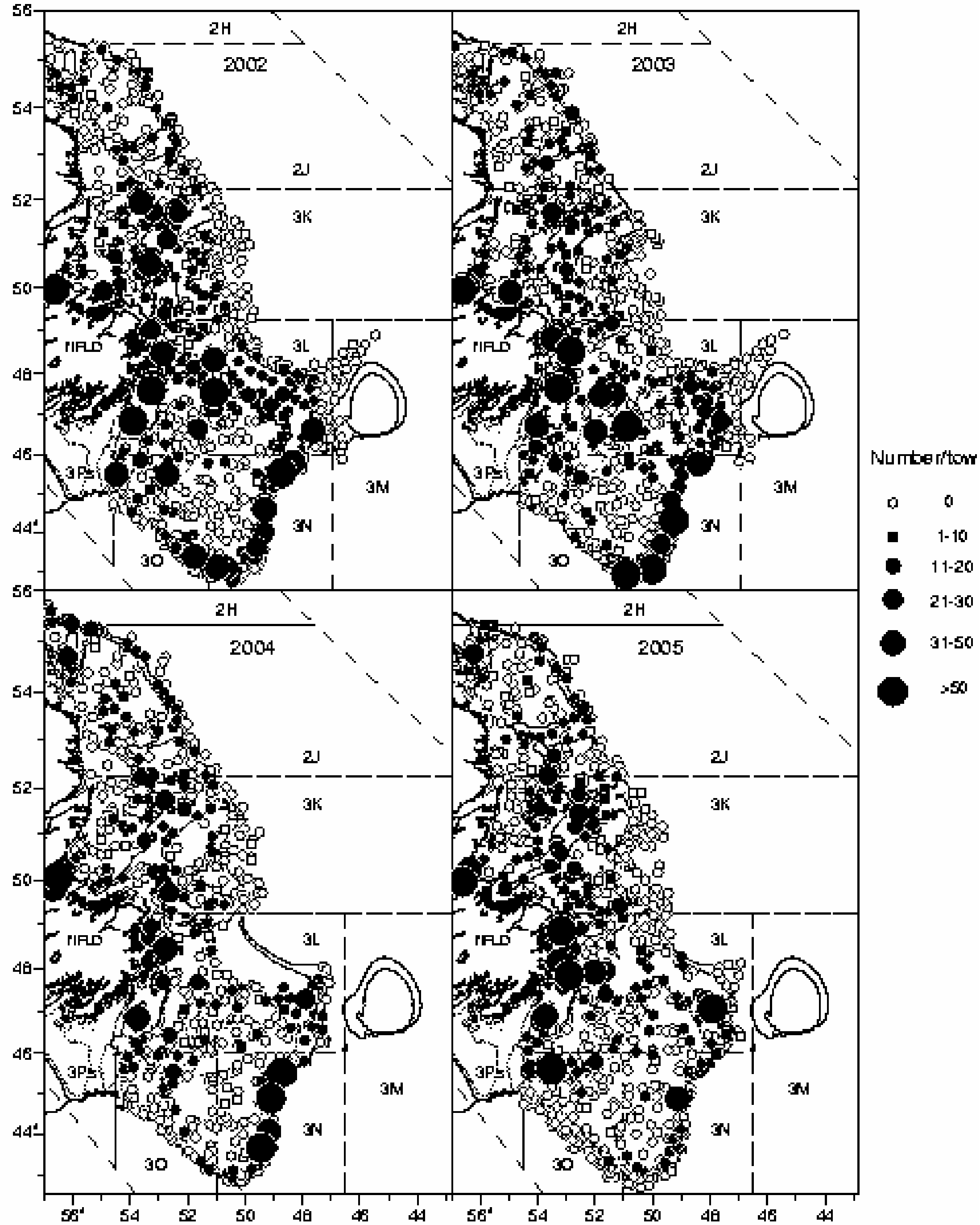

Figure 5. Distribution of exploitable males (>94 mm CW adults) from fall Division 2J3KLNO multispecies surveys from 2002 to 05.

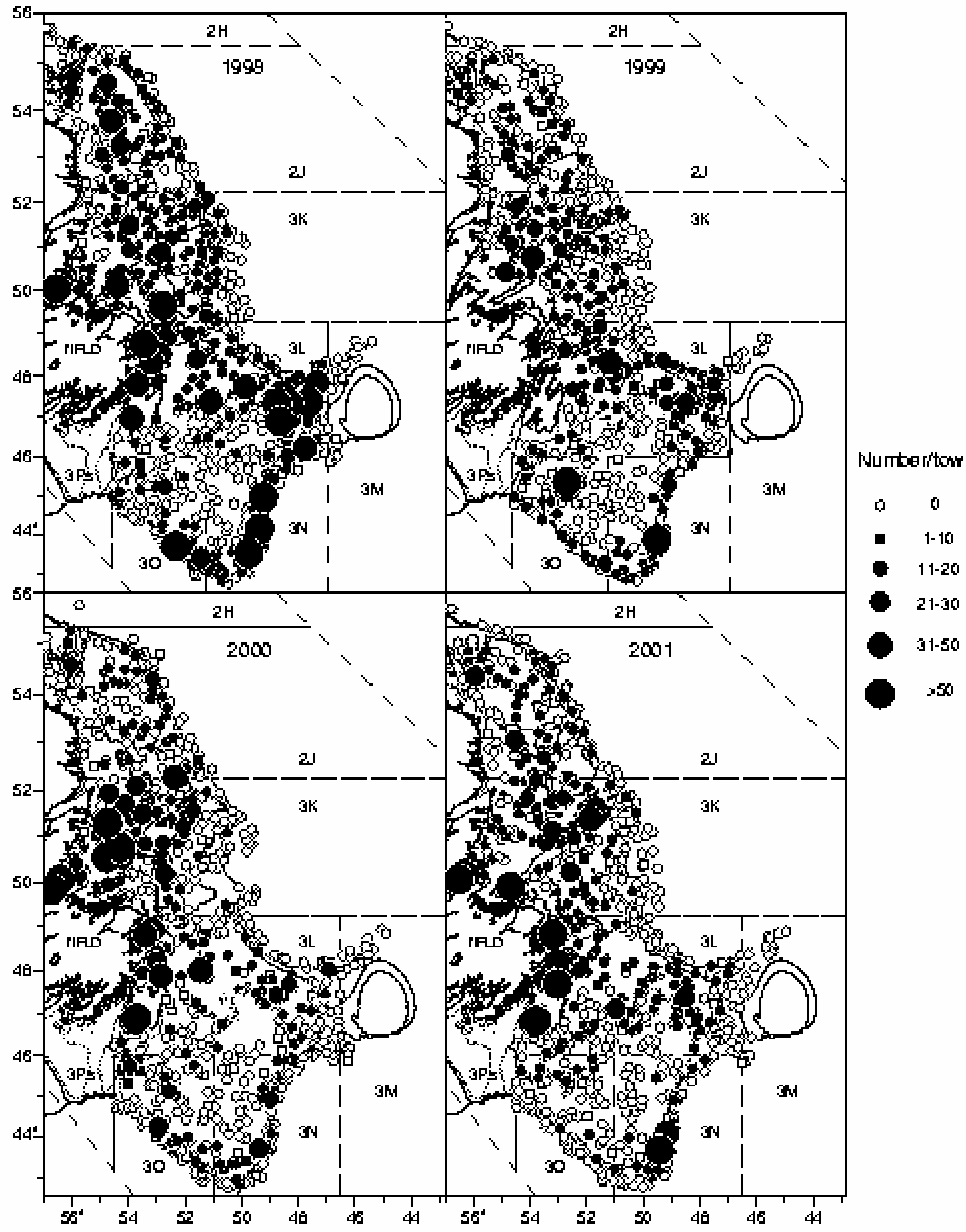

Figure 6. Distribution of pre-recruit males (>75 mm CW adolescents) from fall Division 2J3KLNO multispecies bottom trawl surveys from 1998 to 2001.

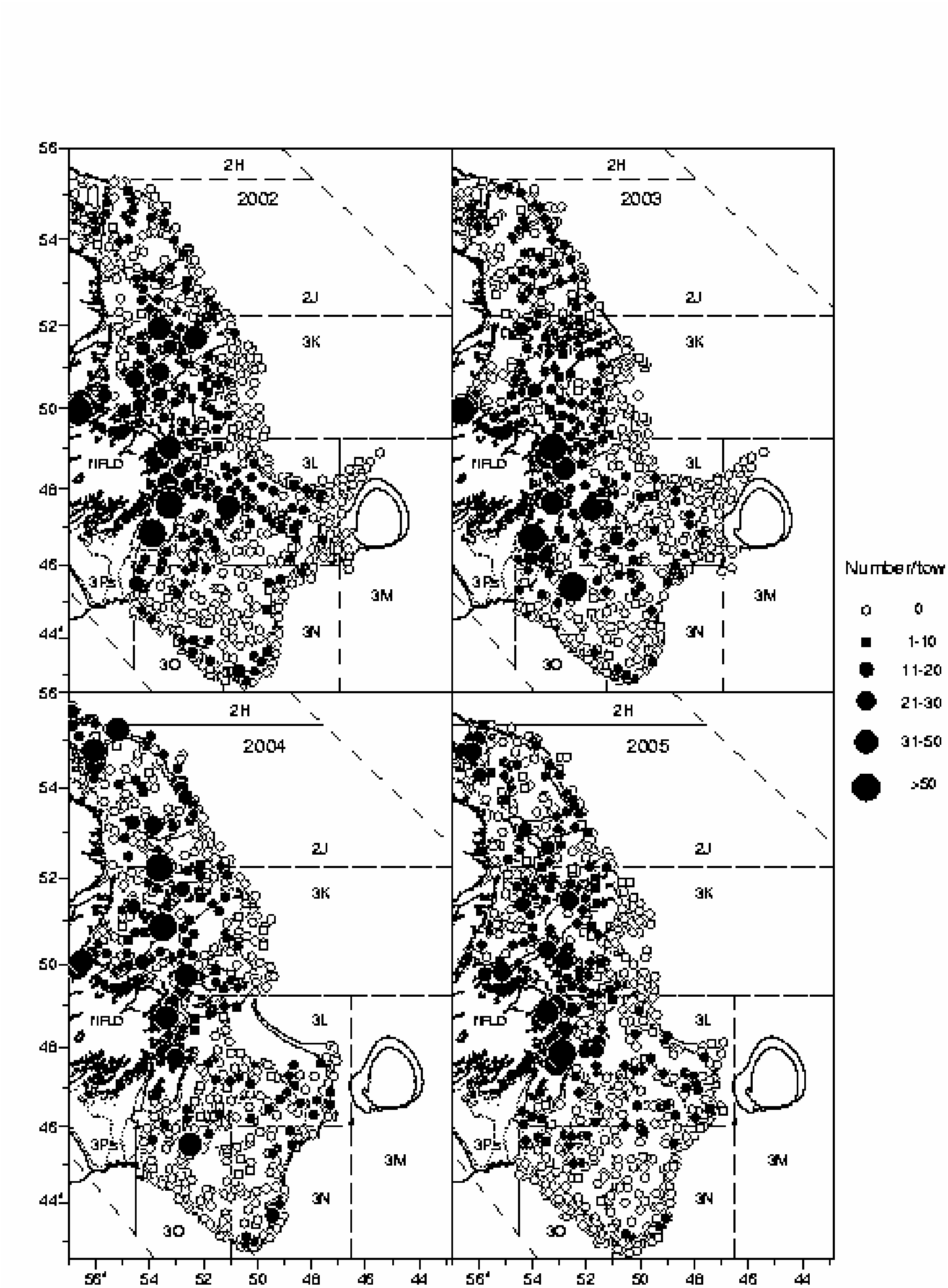

Figure 7. Distribution of pre-recruit males (>75 mm CW adolescents) from fall Division 2J3KLNO multispecies bottom trawl surveys from 2002 to 2005.

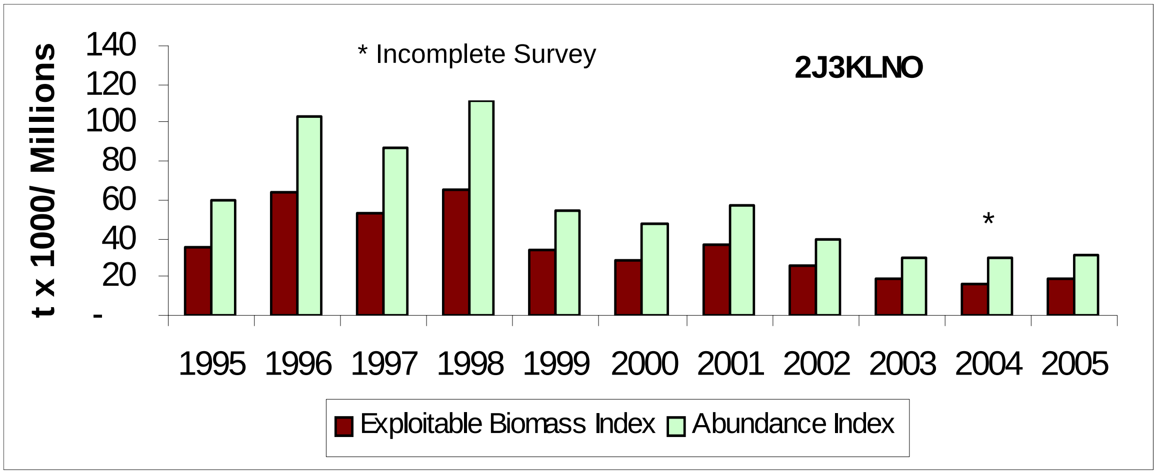

Figure 8. Trends in the fall multispecies survey exploitable Biomass and abundance indices, for Division 2J3KLNO.

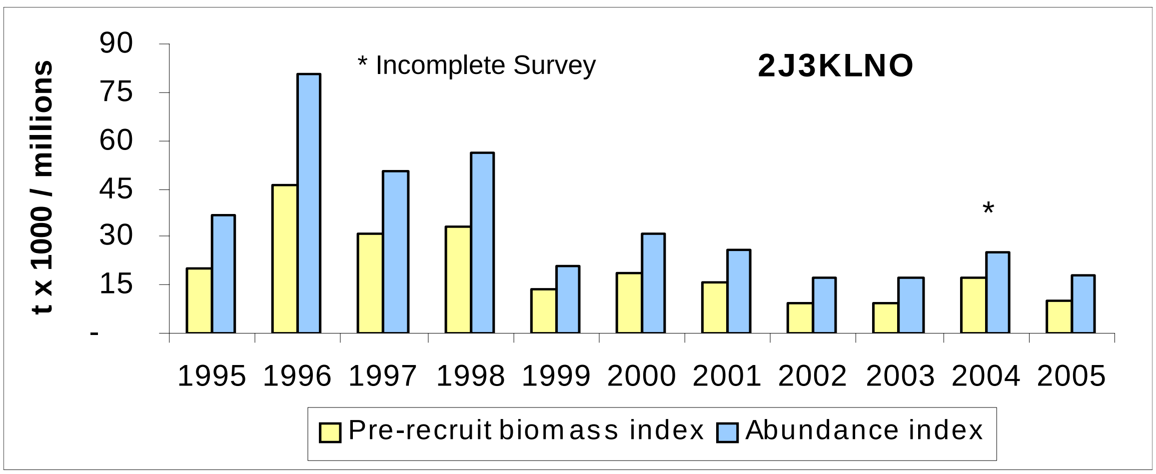

Figure 9. Trends in the fall multispecies survey pre-recruit Biomass and abundance indices, for Division 2J3KLNO.

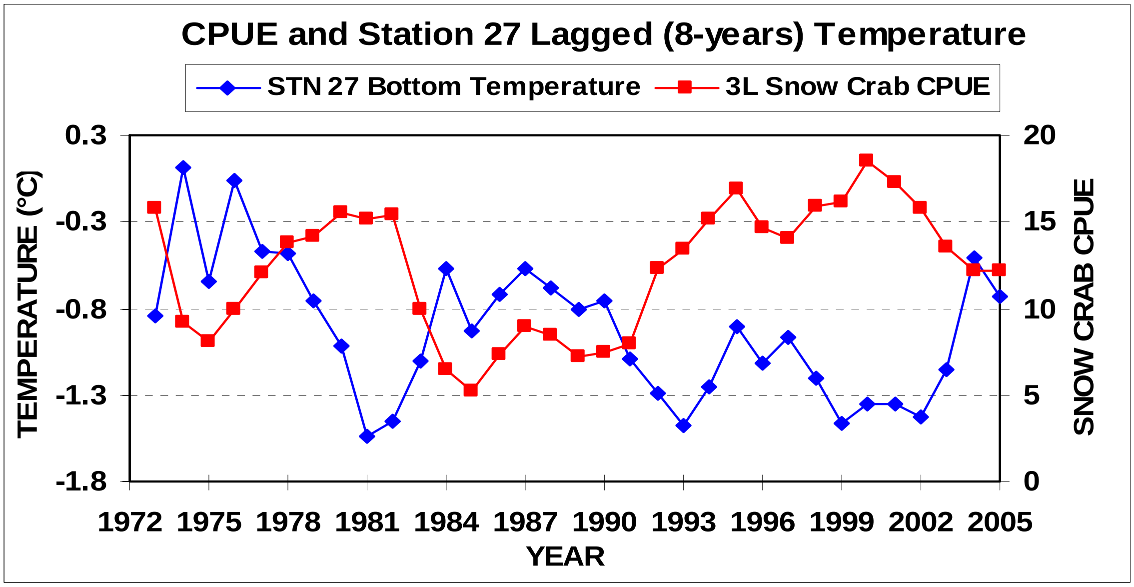

Figure 10. Trends in Division 3L CPUE and lagged (8 Years) Station 27 bottom temperature.

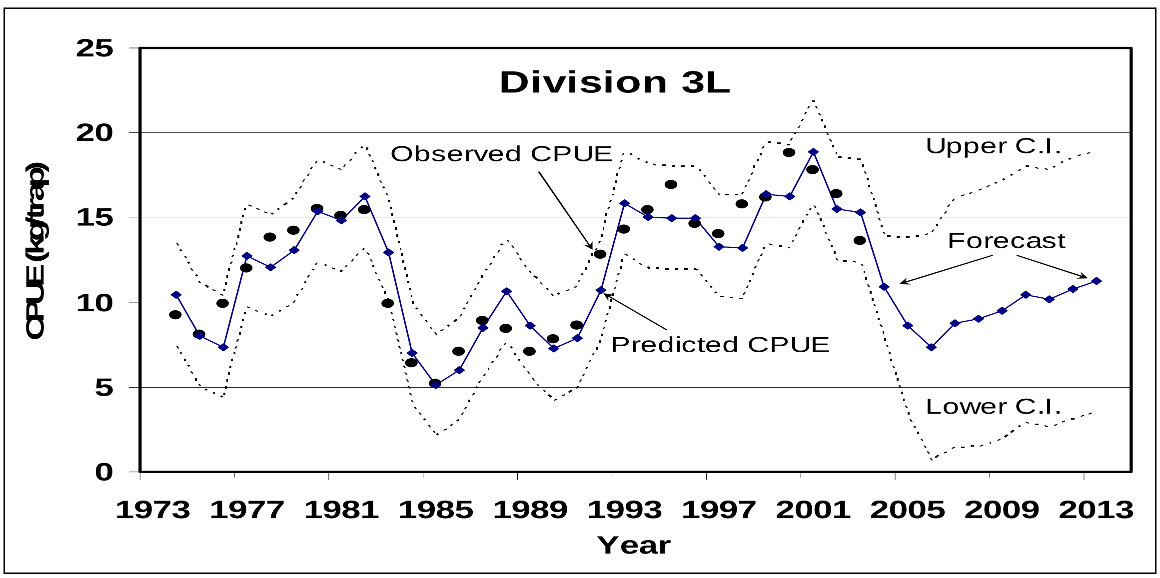

Figure 11. Comparison of observed Division 3L CPUE values with those predicted by a model that includes ice cover 10 Years earlier as an explanatory variable.

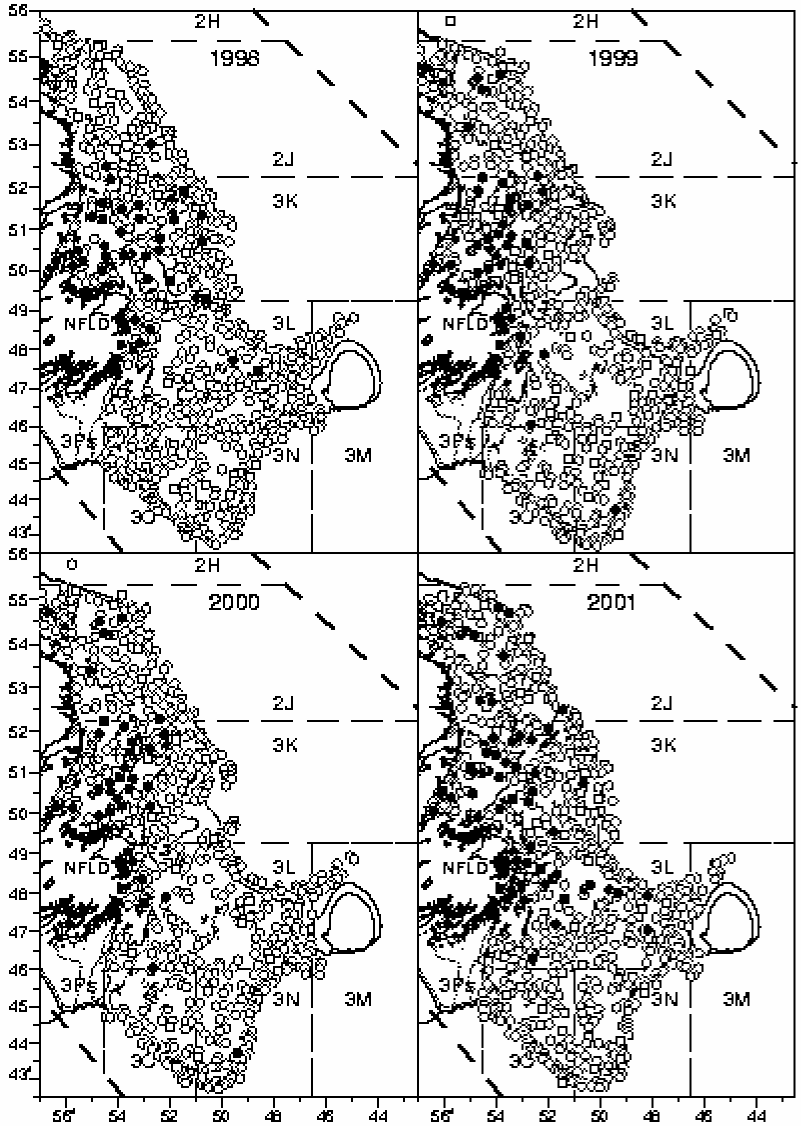

Figure 12. Distribution by Year of survey sets where BCD was encountered (closed circles) versus all other sets (open circles) from 1998 to 2001.

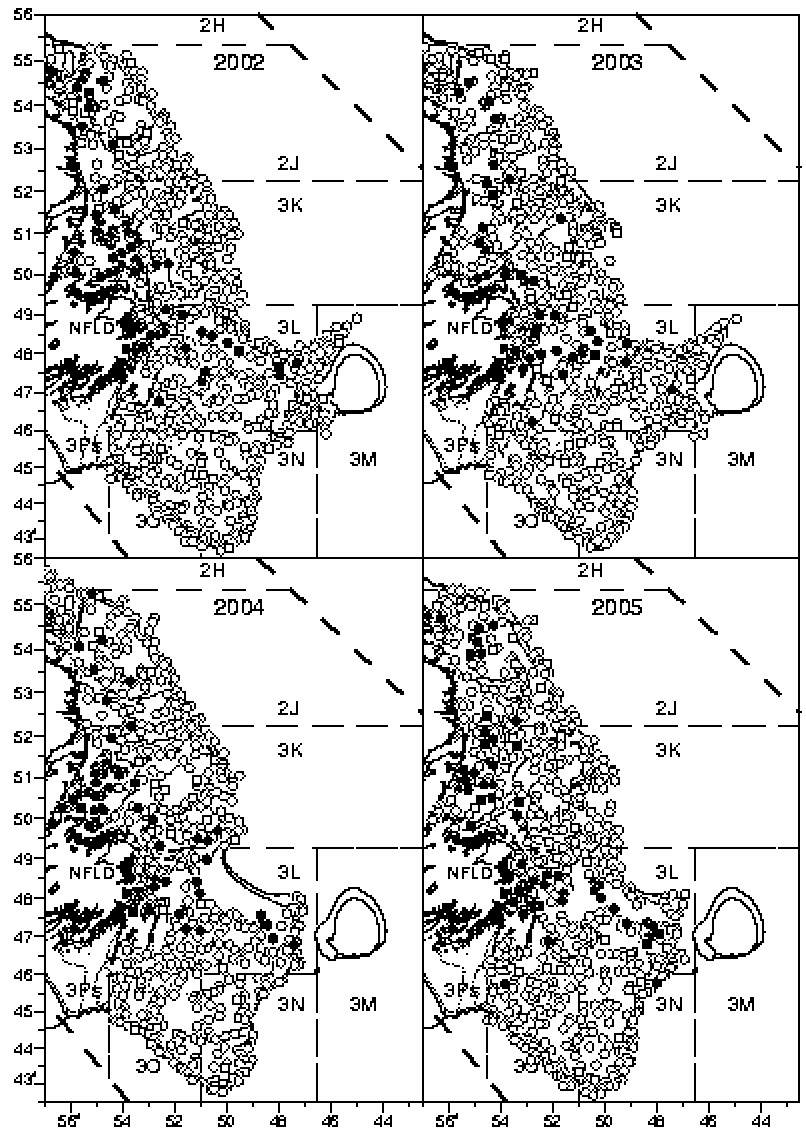

Figure 13. Distribution by Year of survey sets where BCD was encountered (closed circles) versus all other sets (open circles) from 2002 to 2005.

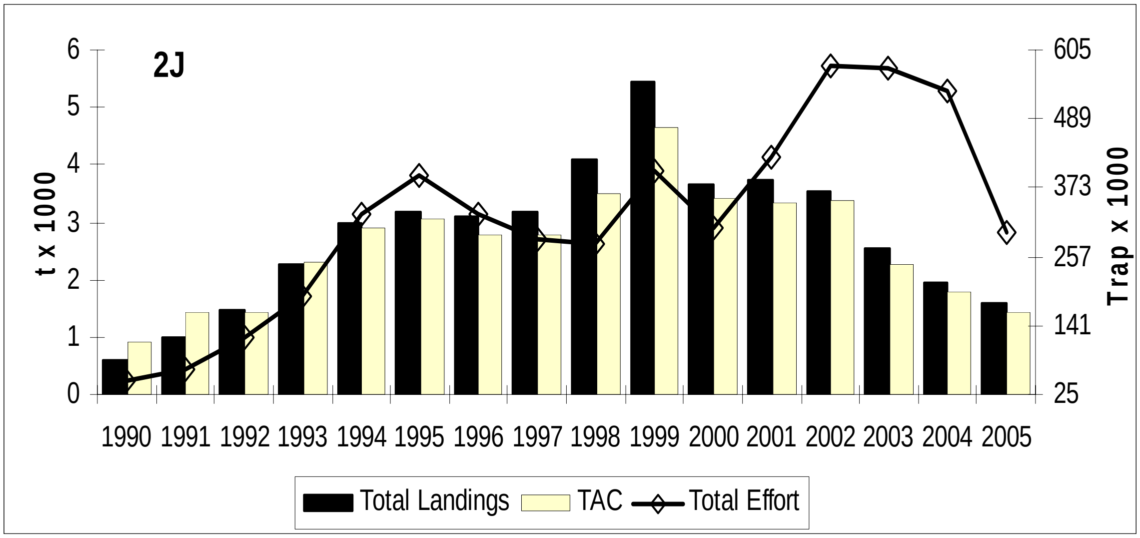

Figure 14. Trends in Division 2J landings, TAC, and fishing effort.

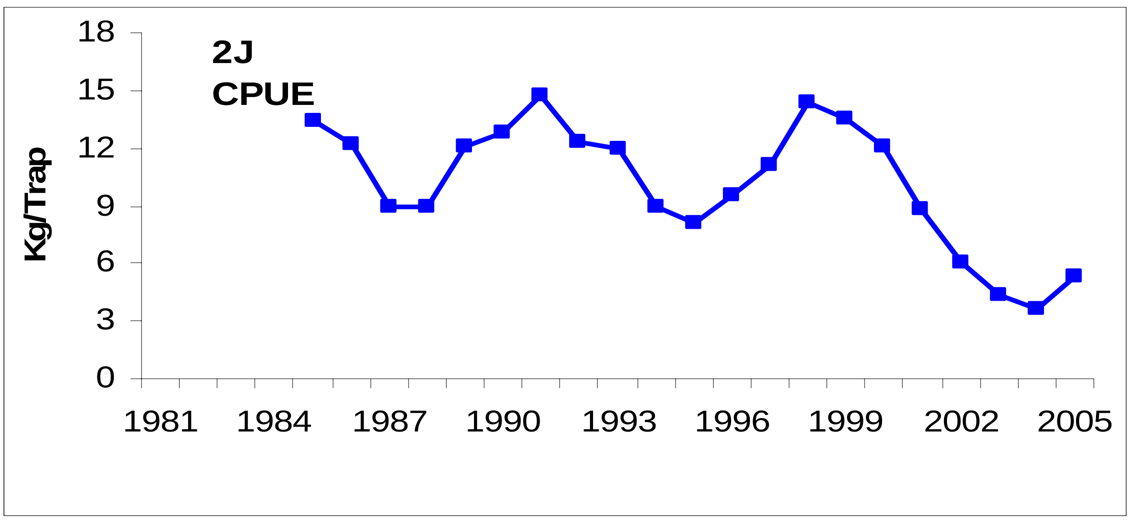

Figure 15. Trends in Division 2J commercial CPUE.

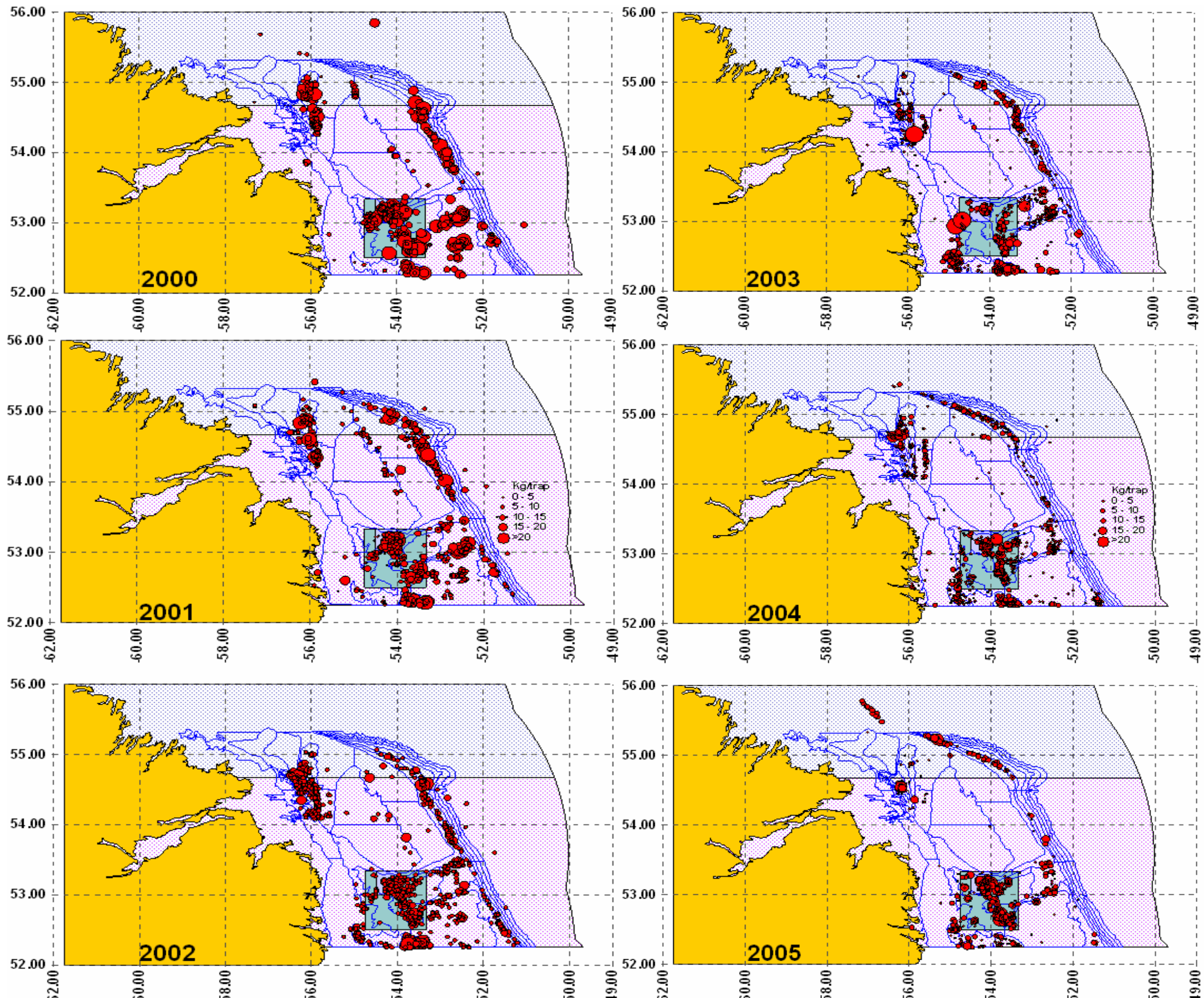

Figure 16. Spatial distribution of Div. 2J commercial CPUE by year showing the Hawke channel closed area.

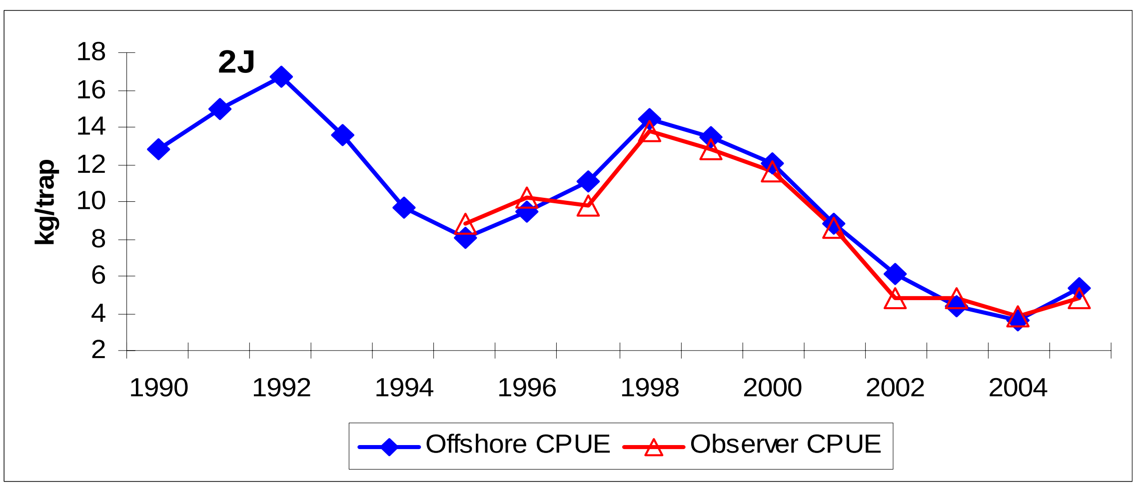

Figure 17. Annual trends in logbook-based CPUE vs. observer-based CPUE in the Division 2J fishery.

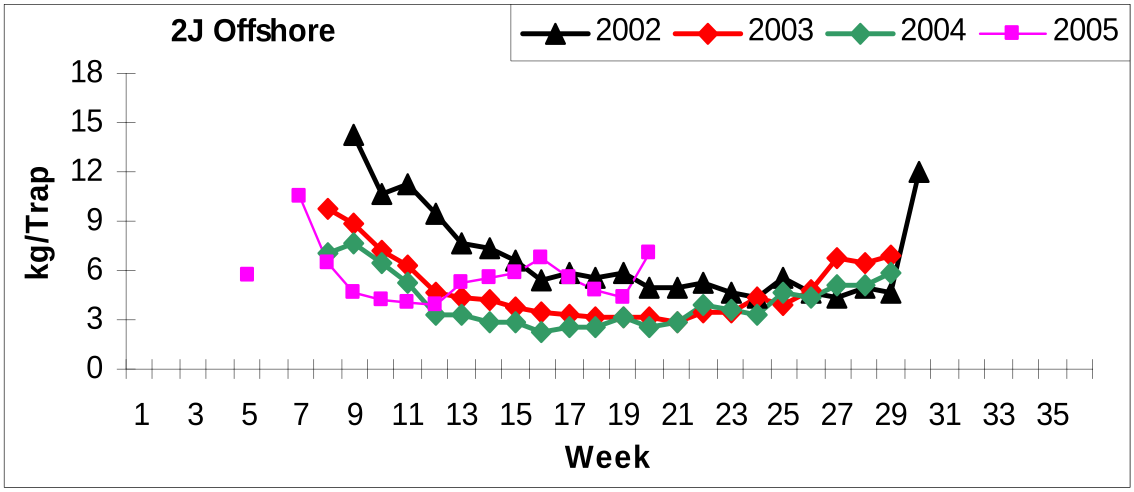

Figure 18. Seasonal trend in CPUE, by week, for Division 2J during 2002-05.

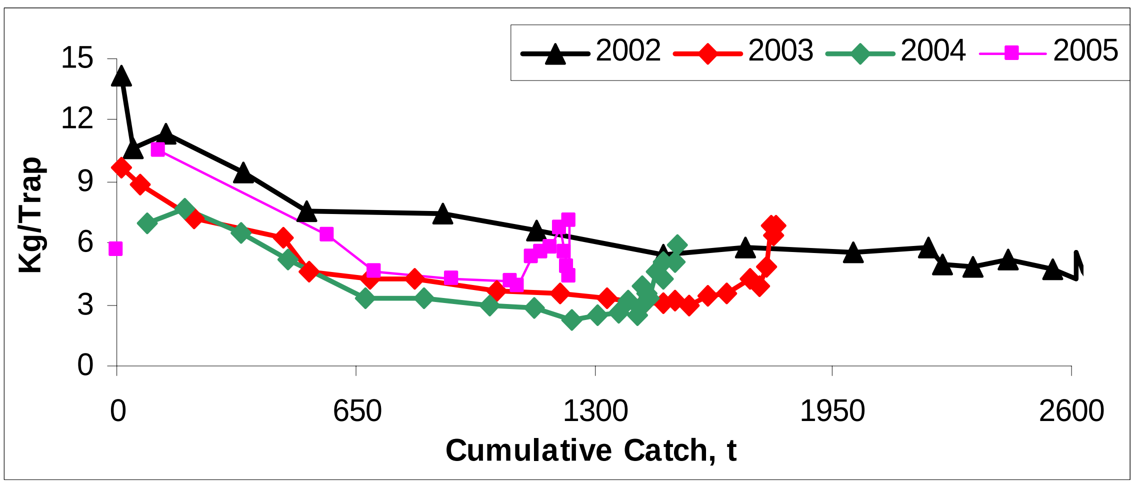

Figure 19. Seasonal trend in CPUE, in relation to cumulative catch, for Division 2J during 2002-05.

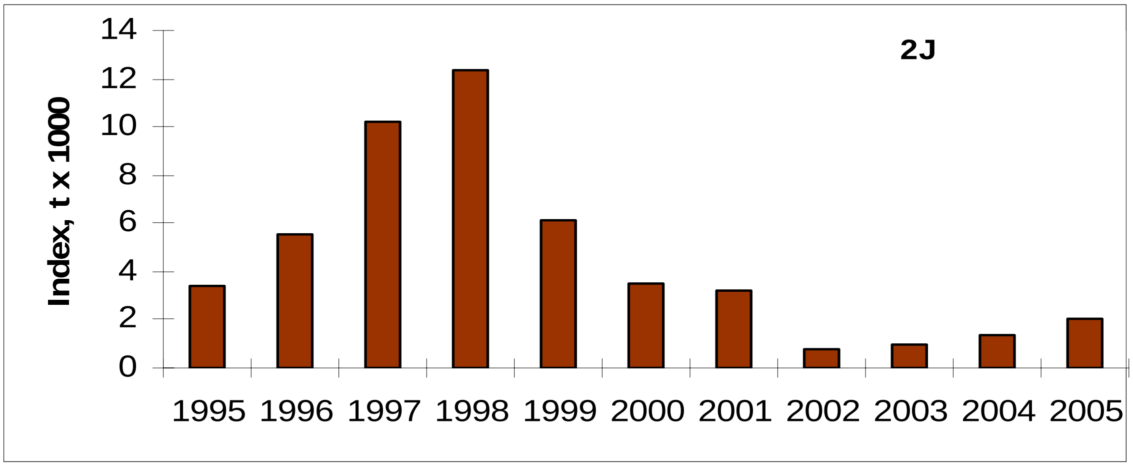

Figure 20. Trends in the Division 2J fall multispecies survey exploitable Biomass index.

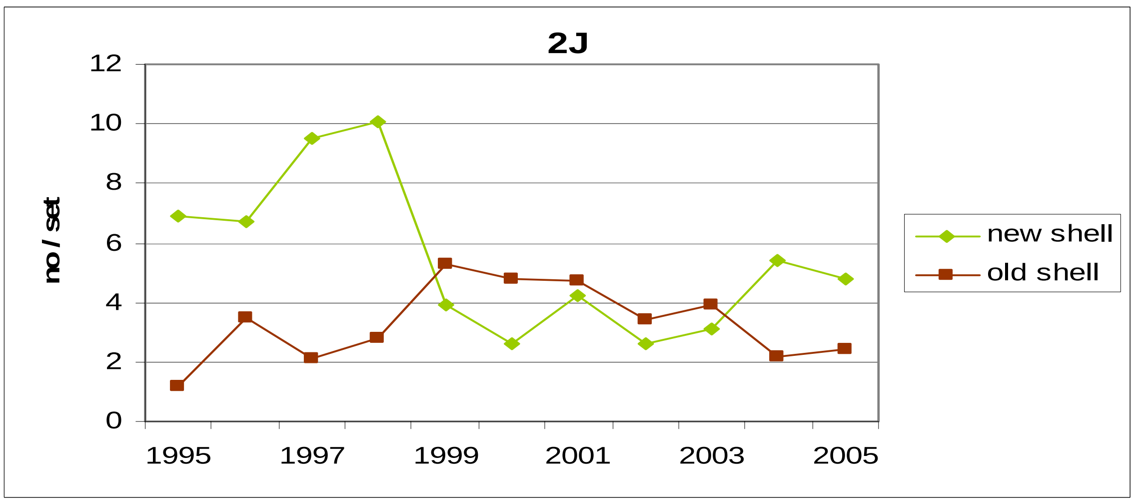

Figure 21. Trends, by shell condition, in abundance indices of legal-sized males for Division 2J from fall multispecies surveys.

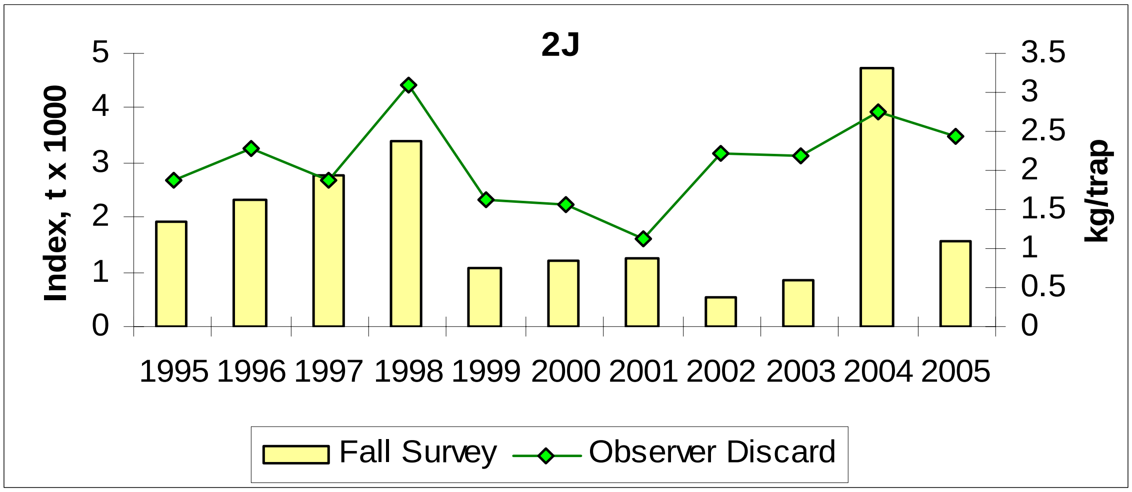

Figure 22. Trends in the Division 2J fall multispecies survey pre-recruit Biomass index and the observer discard catch rate index.

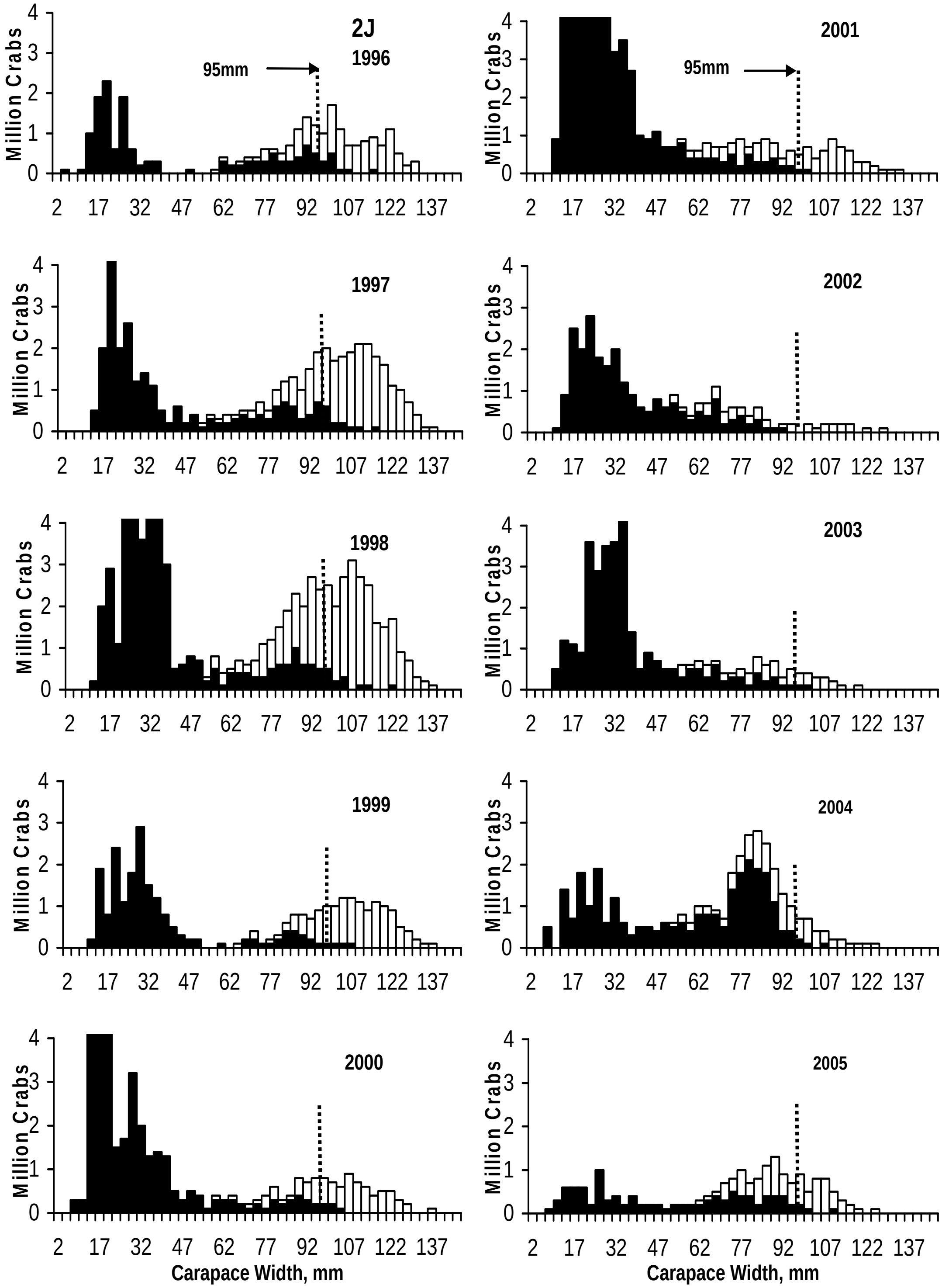

Figure 23. Truncated distribution of abundance (index) by carapace width for Division 2J juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

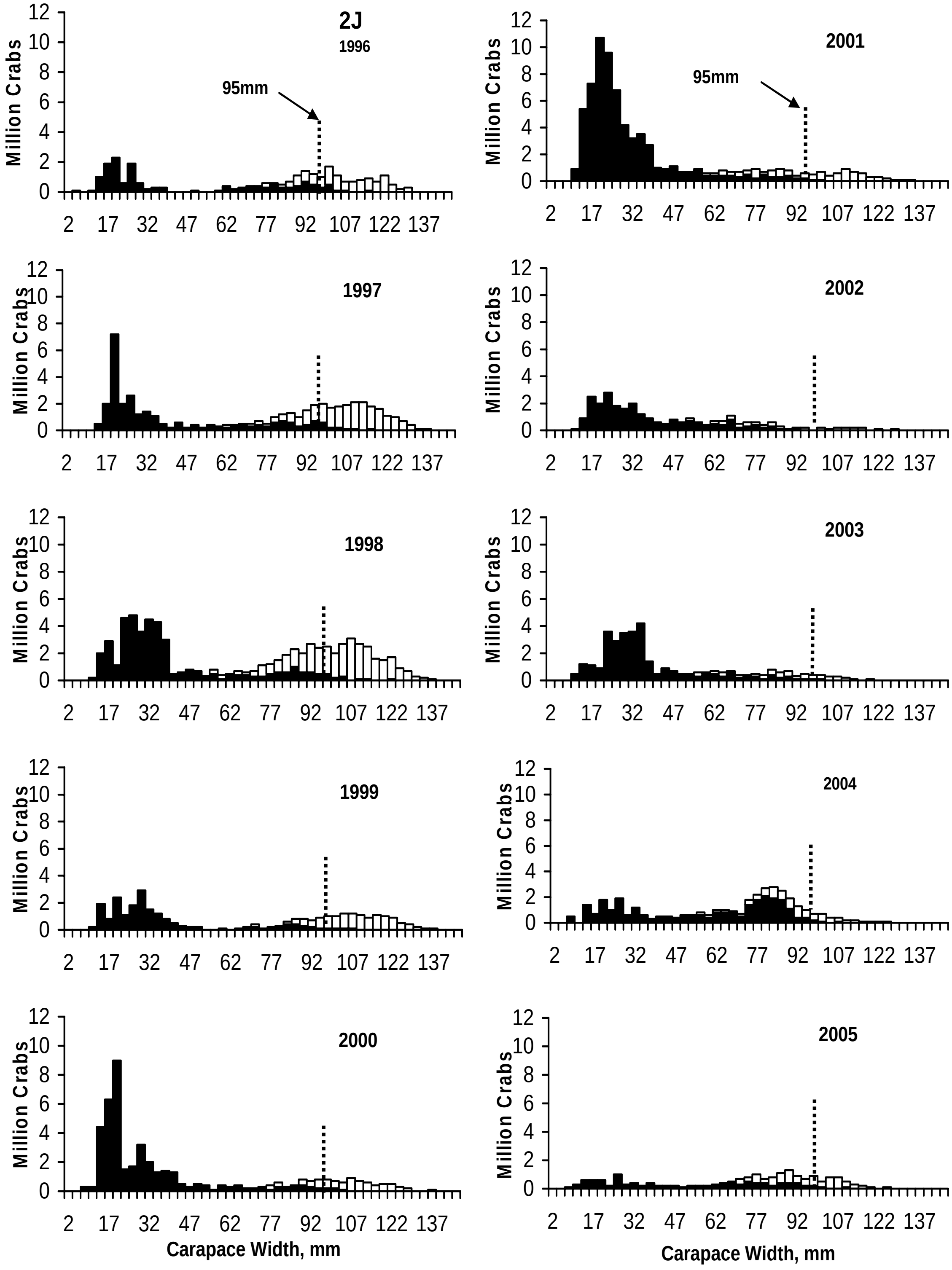

Figure 24. Distribution of abundance (index) by carapace width for Division 2J juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

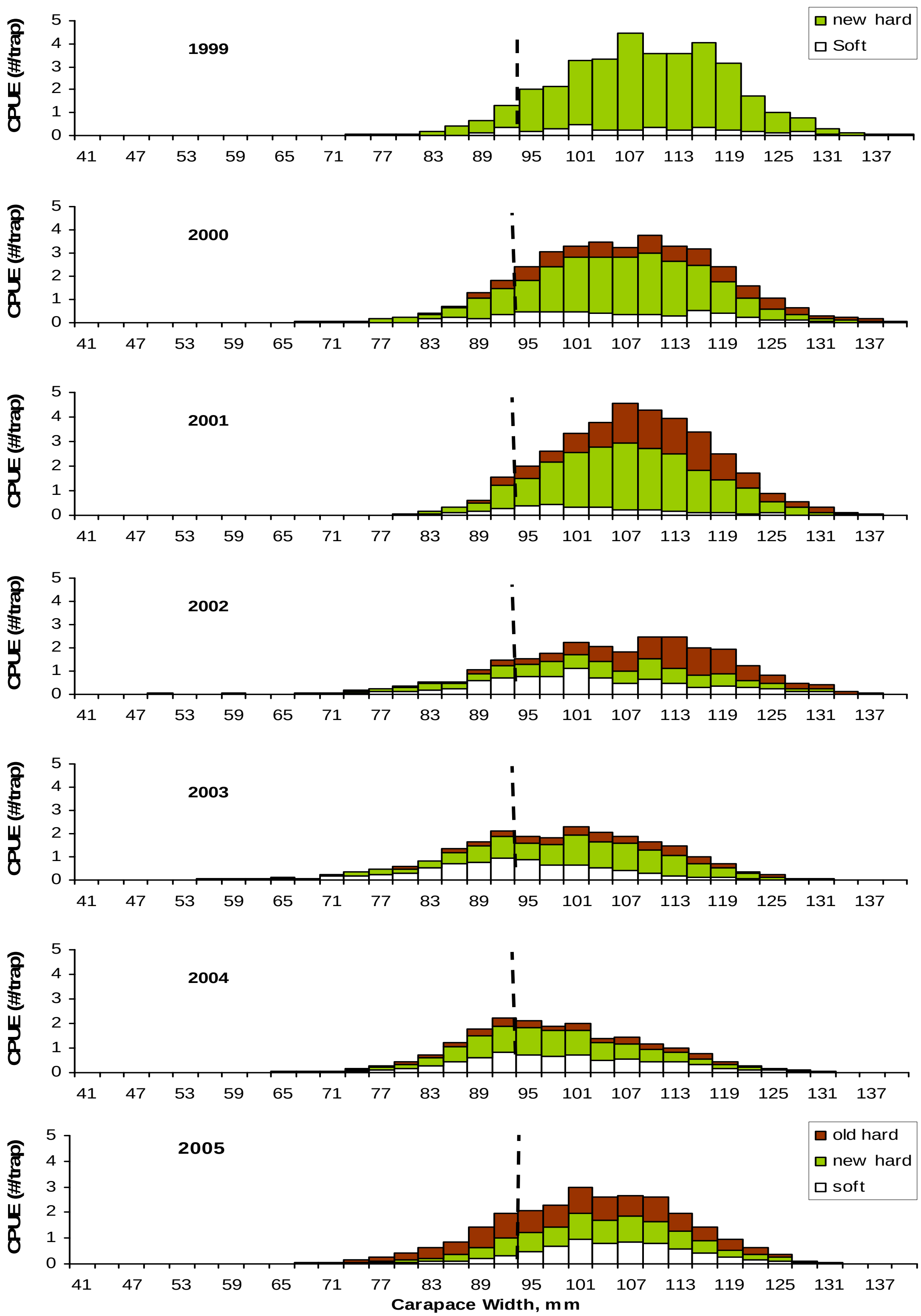

Figure 25. Trends in male carapace width distributions from observer at-sea sampling for Division 2J.

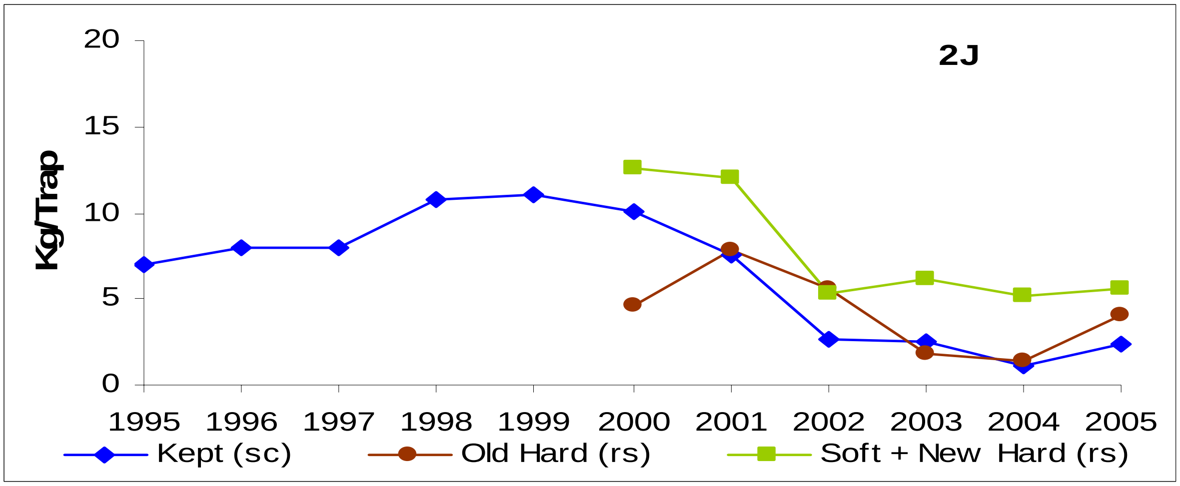

Figure 26. Trends in Division 2J observer catch rates of exploitable crabs since 1995 from set and catch records and of legal-sized crabs by shell category since 2000 from at-sea sampling.

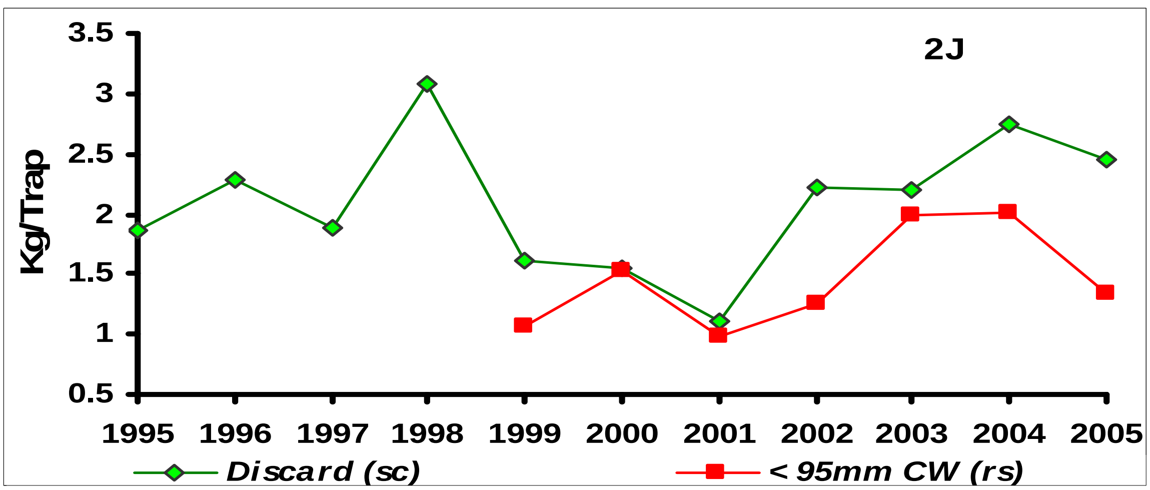

Figure 27. Trends in Division 2J observer catch rates of total discards since 1995 from set and catch records and of sub-legal sized crabs since 1999 from at-sea sampling.

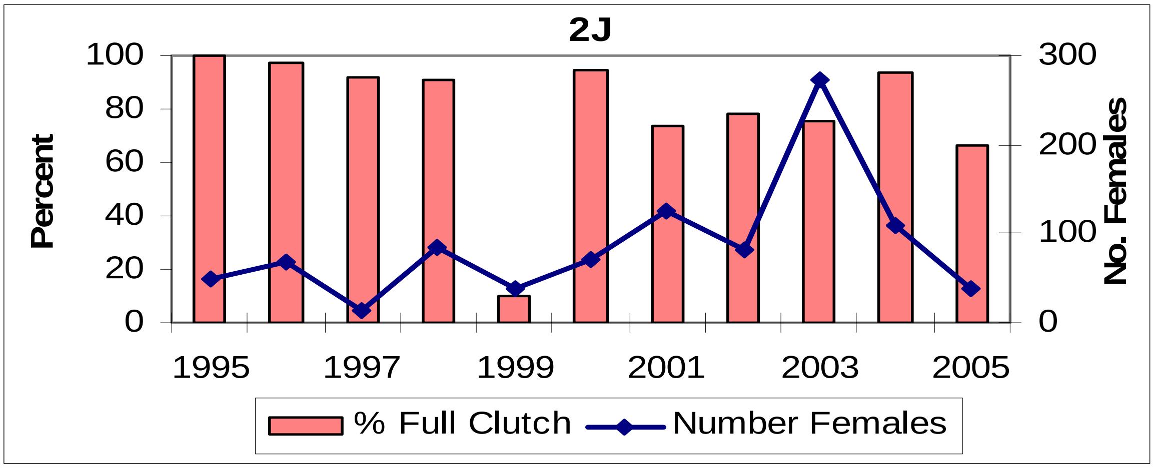

Figure 28. Trends in percent of mature females bearing full clutches of viable eggs and samples sizes in Division 2J from fall multispecies surveys.

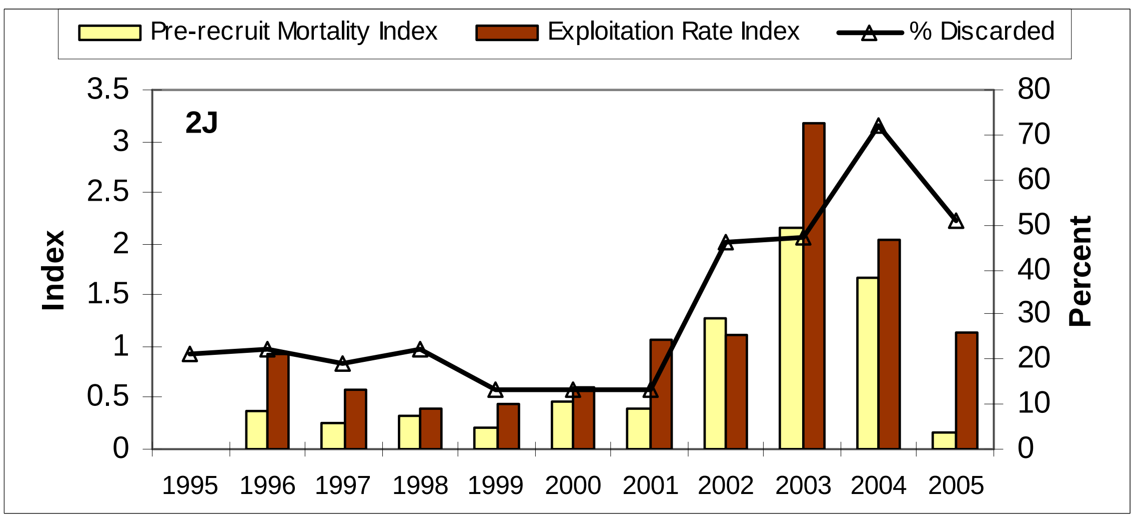

Figure 29. Trends in Division 2J mortality indices (the exploitation rate index and the pre-recruit fishing mortality index) and in the percentage of the catch discarded in the fishery.

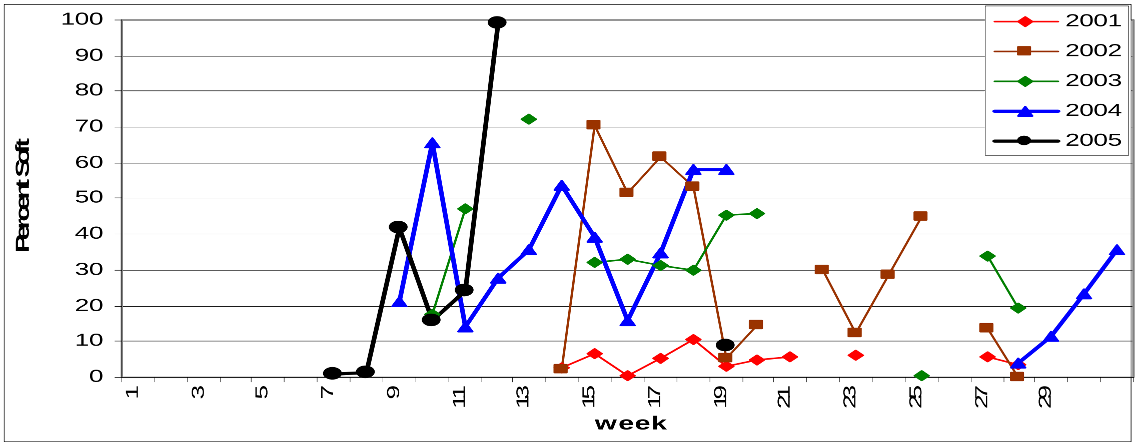

Figure 30. Seasonal trends (from April 01) in the percentage of legal-sized crabs that are soft-shelled by Year (2001-05), from at-sea sampling by observers in Division 2J.

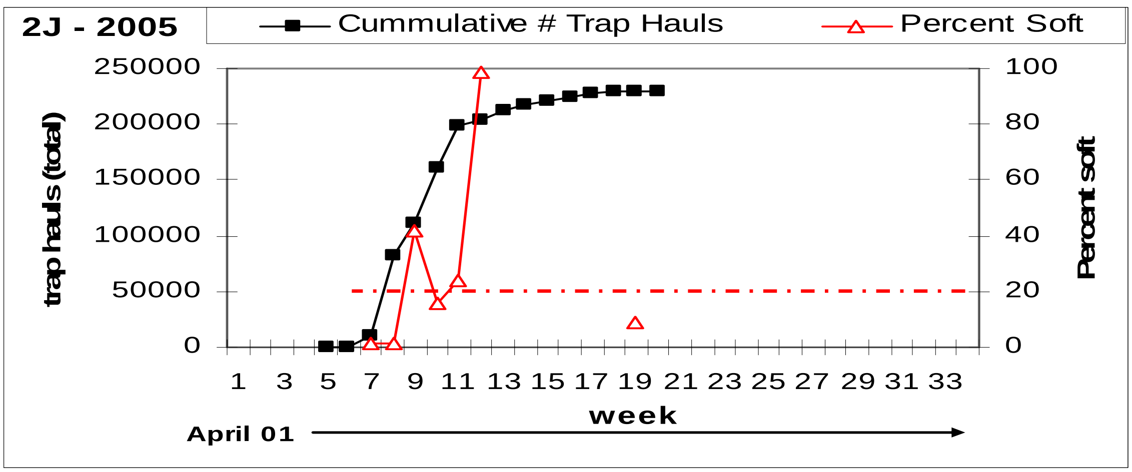

Figure 31. Cumulative distribution of weekly fishing effort in Division 2J during 2005 from logbooks in relation to weekly percentage of soft-shelled crabs from at-sea sampling by observers.

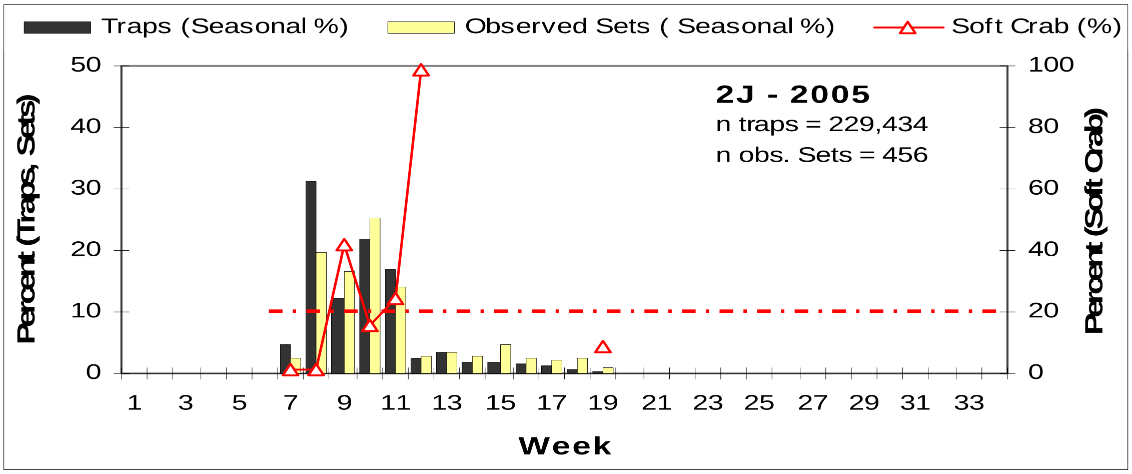

Figure 32. Percentage distribution of Division 2J total weekly fishing effort throughout the 2005 fishery and of weekly effort from observed sets in relation to weekly percentage of soft-shelled crabs from at-sea sampling by observers.

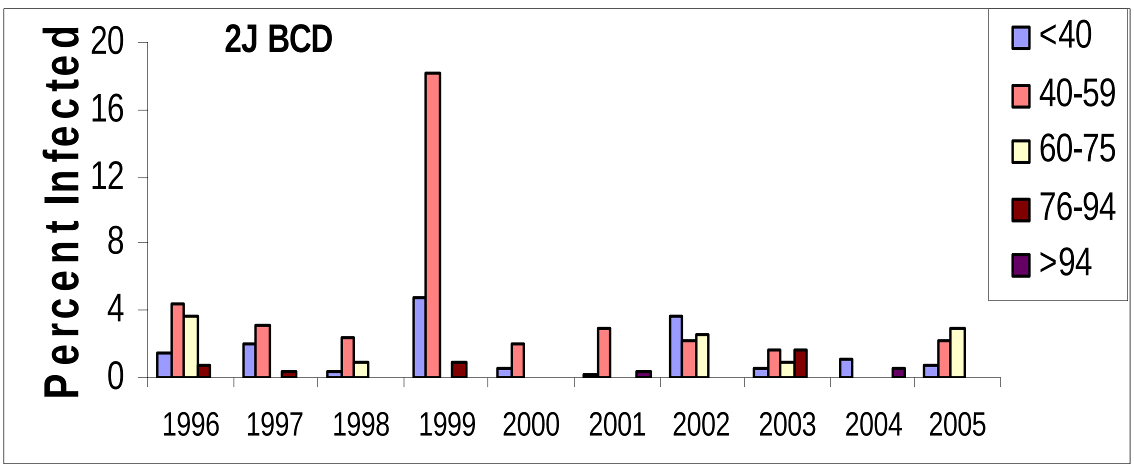

Figure 33. Trends in prevalence of BCD in Division 2J new-shelled males by size group from multispecies surveys.

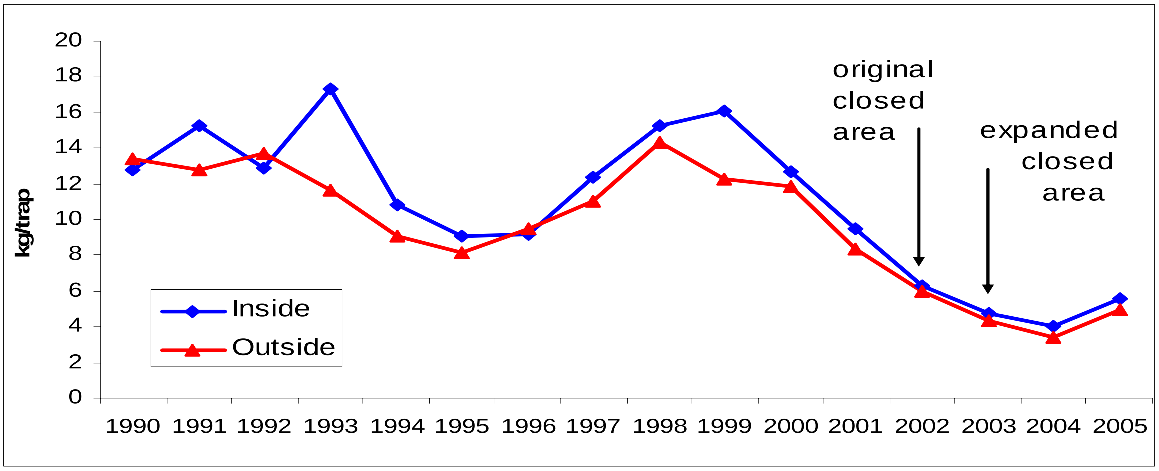

Figure 34. Division 2J commercial CPUE; inside vs. outside the Hawke Channel closed area.

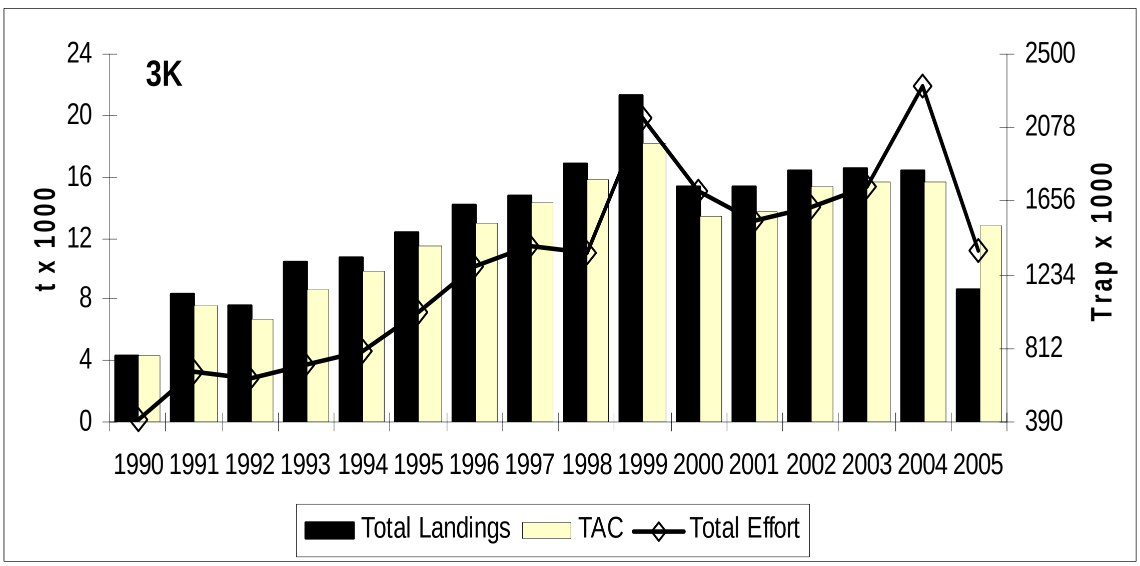

Figure 35. Trends in Division 3K landings, TAC, and fishing effort.

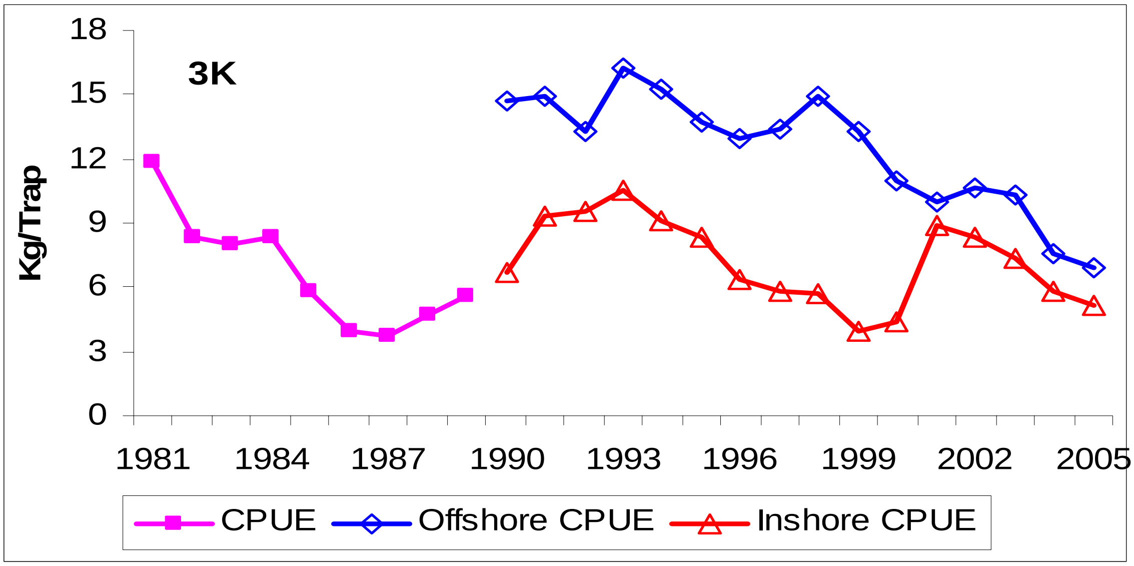

Figure 36. Trends in Division 3K commercial CPUE.

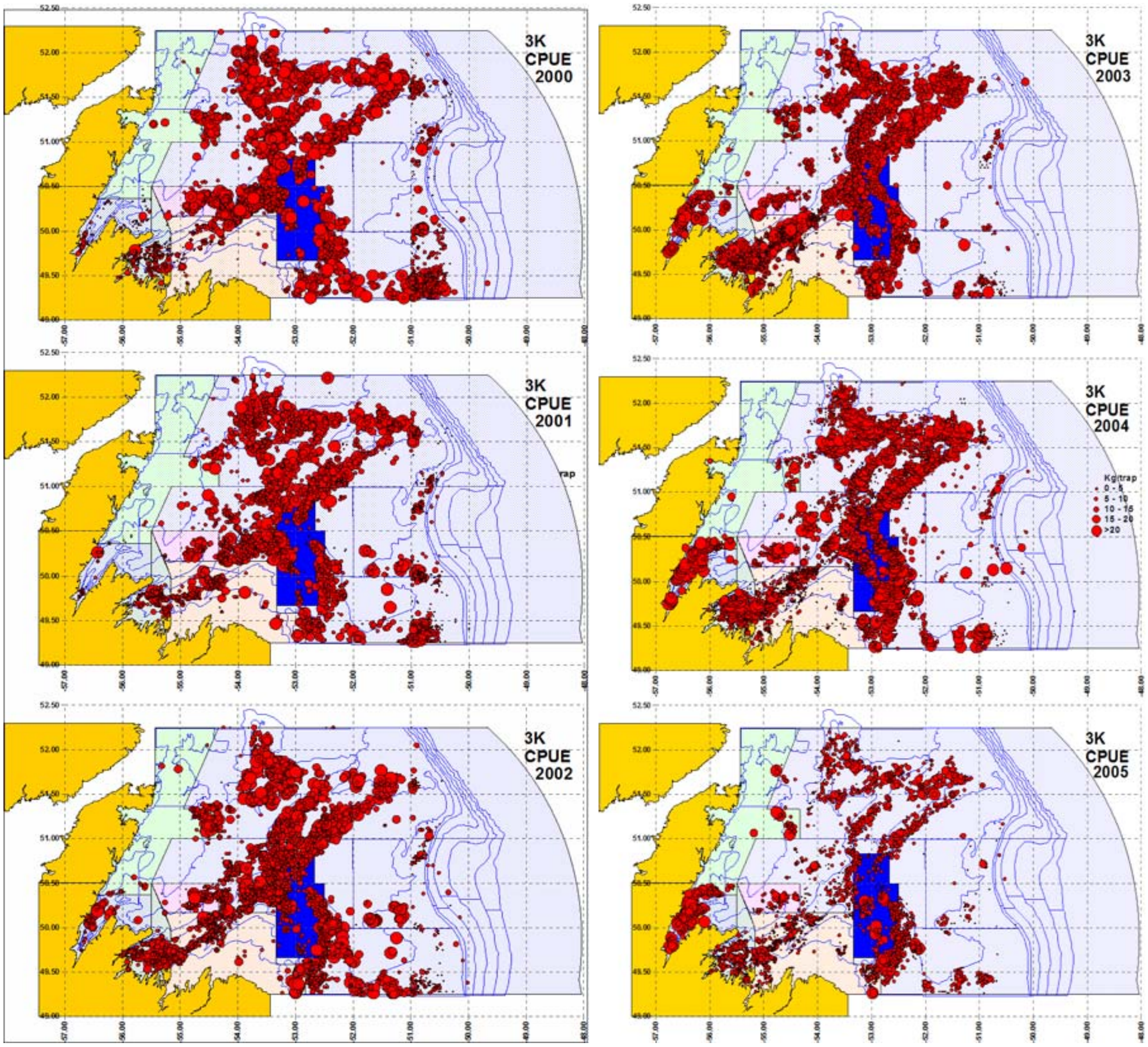

Figure 37. Spatial distribution of Division 3K commercial CPUE by Year showing the Funk Island Deep closed area.

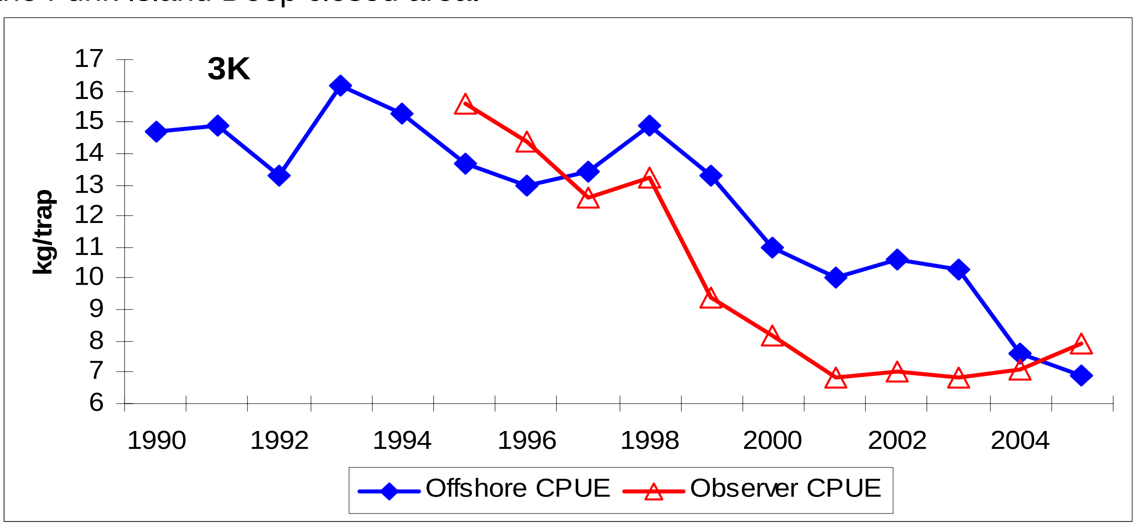

Figure 38. Trends in logbook-based CPUE vs. observer-based CPUE in the Division 3K fishery.

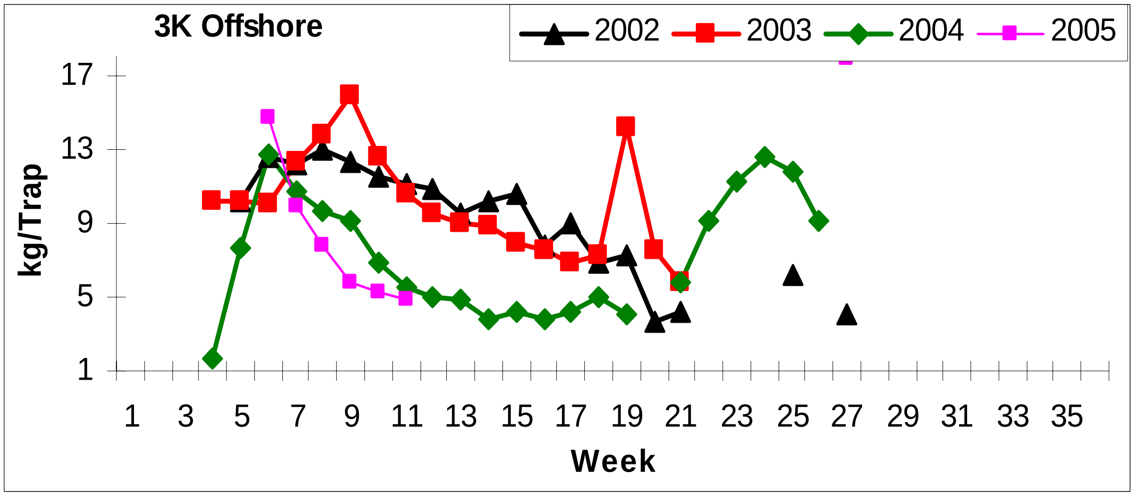

Figure 39. Seasonal trends in CPUE, by week, for Division 3K during 2002-05.

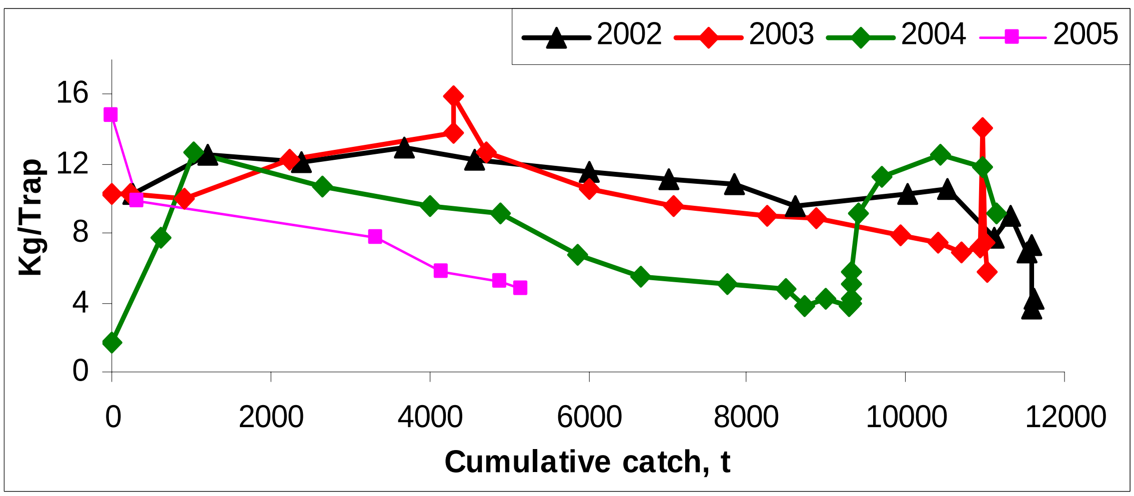

Figure 40. Seasonal trends in CPUE, in relation to cumulative catch, for Division 3K during 2002-05.

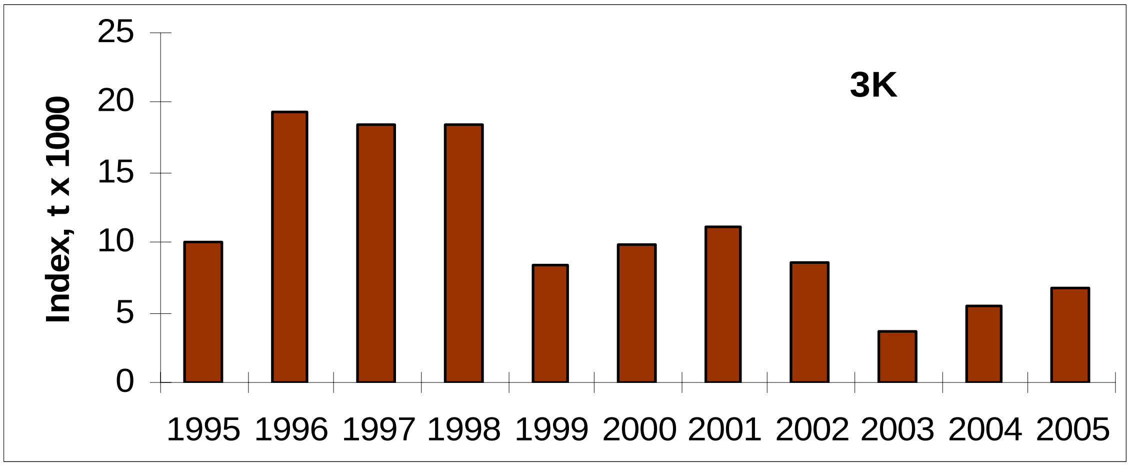

Figure 41. Trensd in the Division 3K fall multispecies survey exploitable Biomass index.

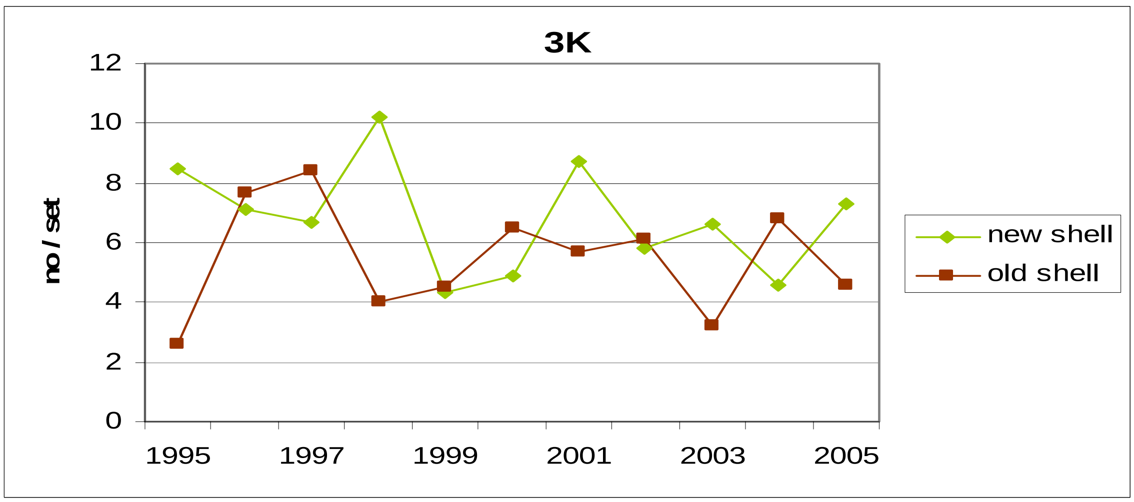

Figure 42. Trends, by shell condition, in abundance indices of legal-sized males for Division 3K from fall multispecies surveys.

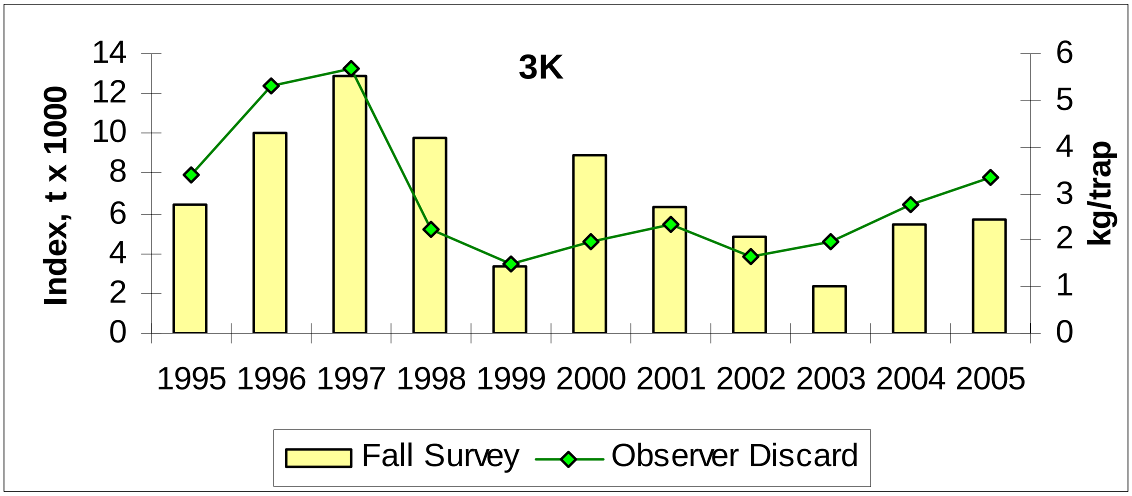

Figure 43. Trends in the Division 3K fall multispecies survey pre-recruit Biomass index and the observer discard catch rate index.

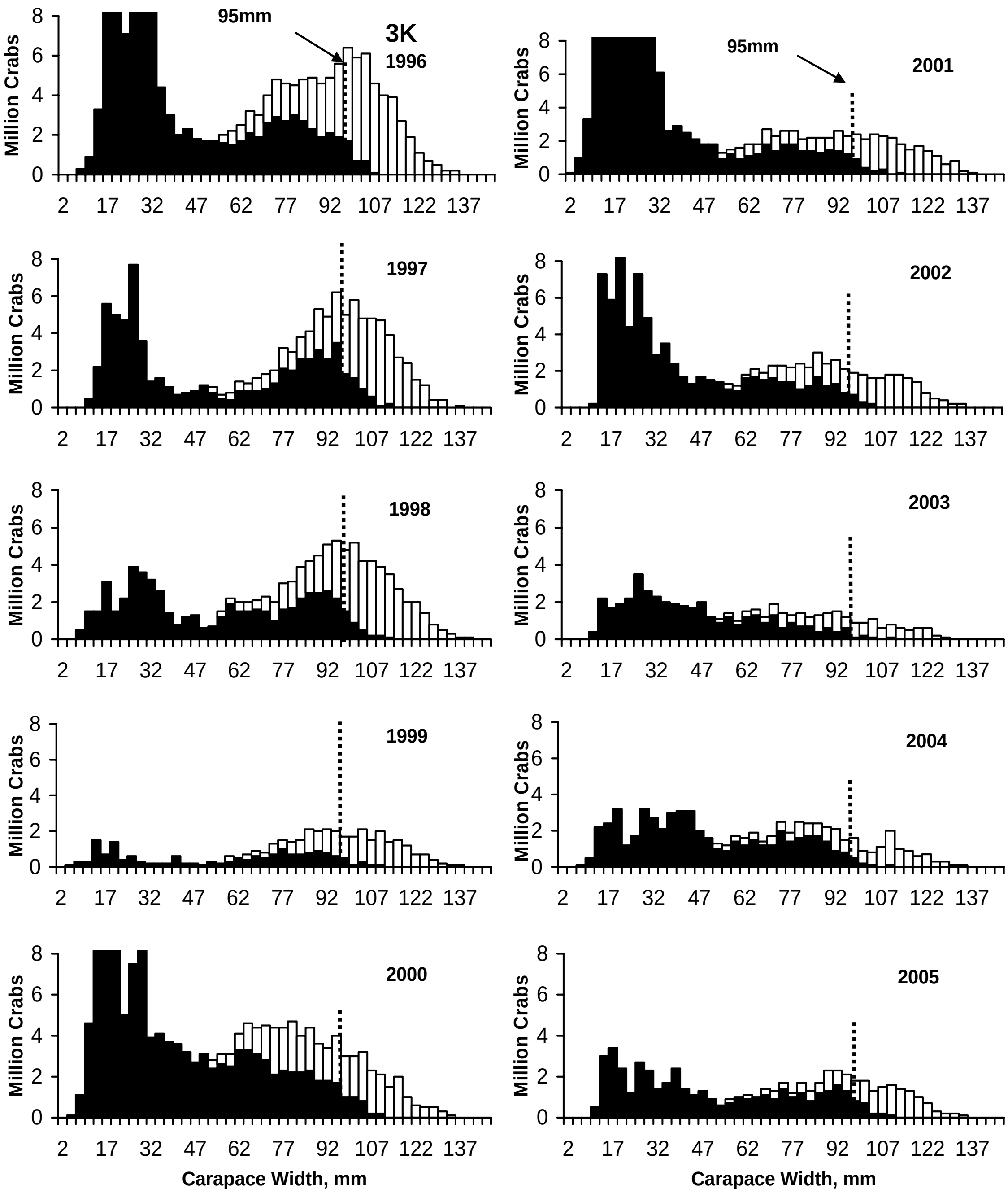

Figure 44. Truncated distribution of abundance (index) by carapace width for Division 3K juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

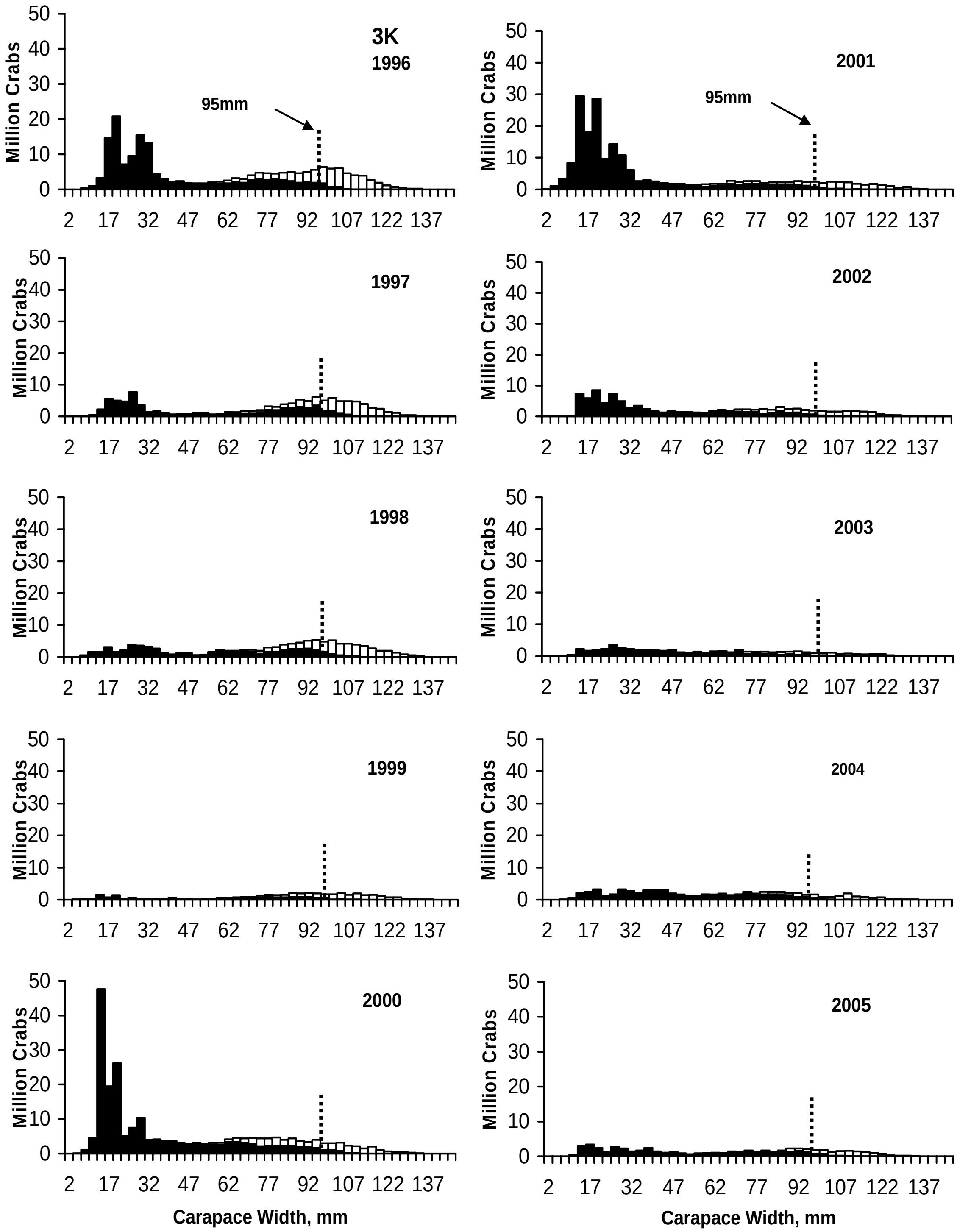

Figure 45. Distribution of abundance (index) by carapace width for Division 3K juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

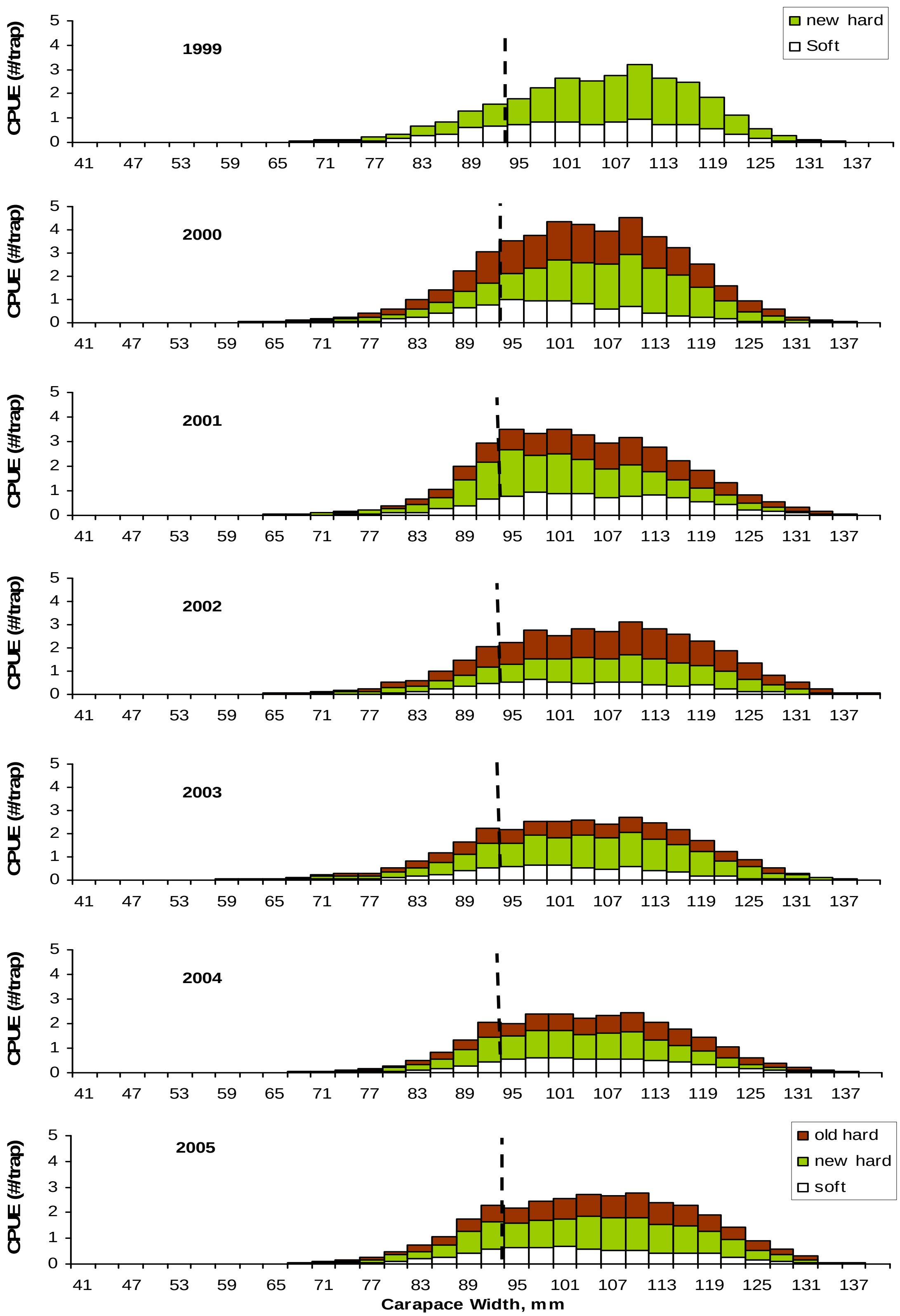

Figure 46. Trends in male carapace width distributions from observer at-sea sampling for Division 3K.

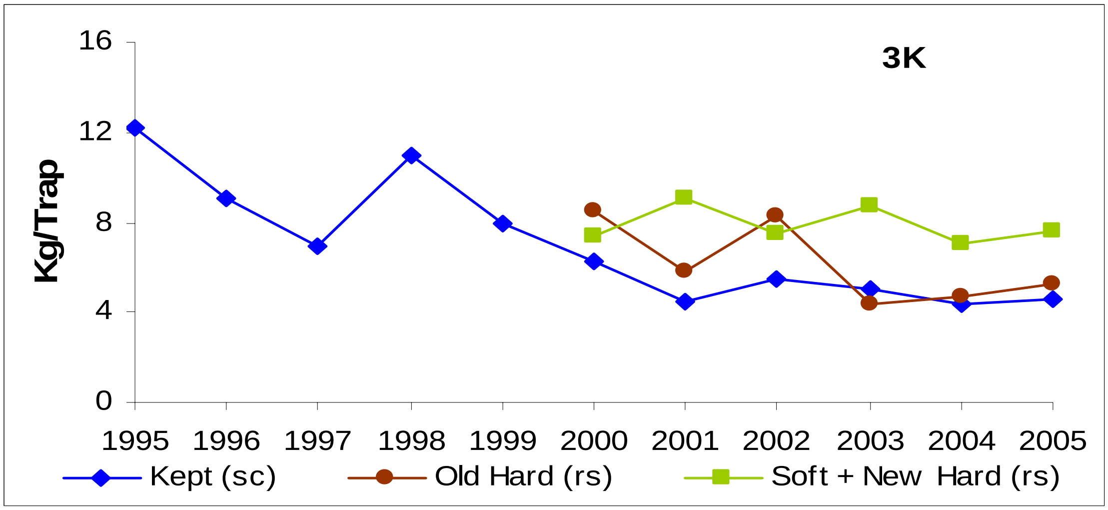

Figure 47. Trends in Division 3K observer catch rates of exploitable crabs since 1995 from set and catch records and of legal-sized crabs by shell category since 2000 from at-sea sampling.

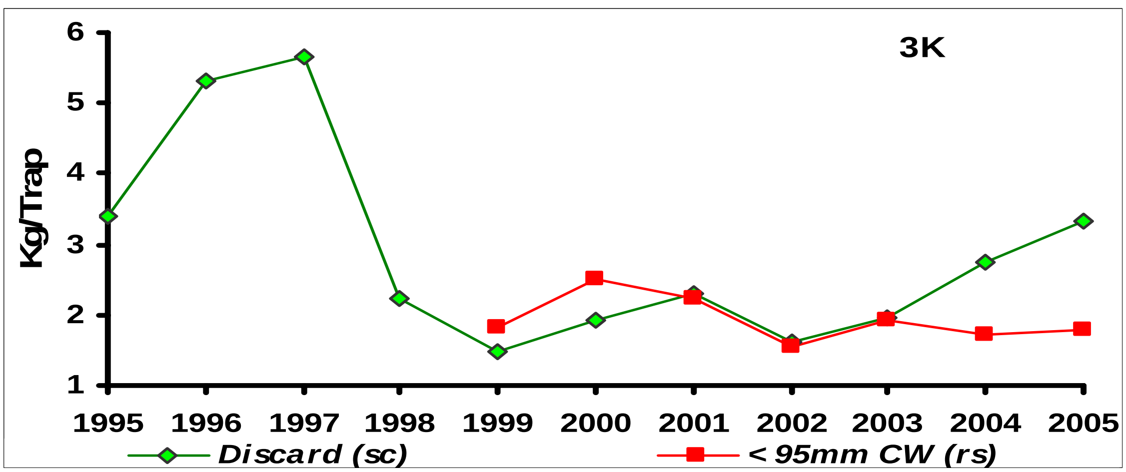

Figure 48. Trends in Division 3K observer catch rates of total discards since 1995 from set and catch records and of sub-legal sized crabs since 1999 from at-sea sampling.

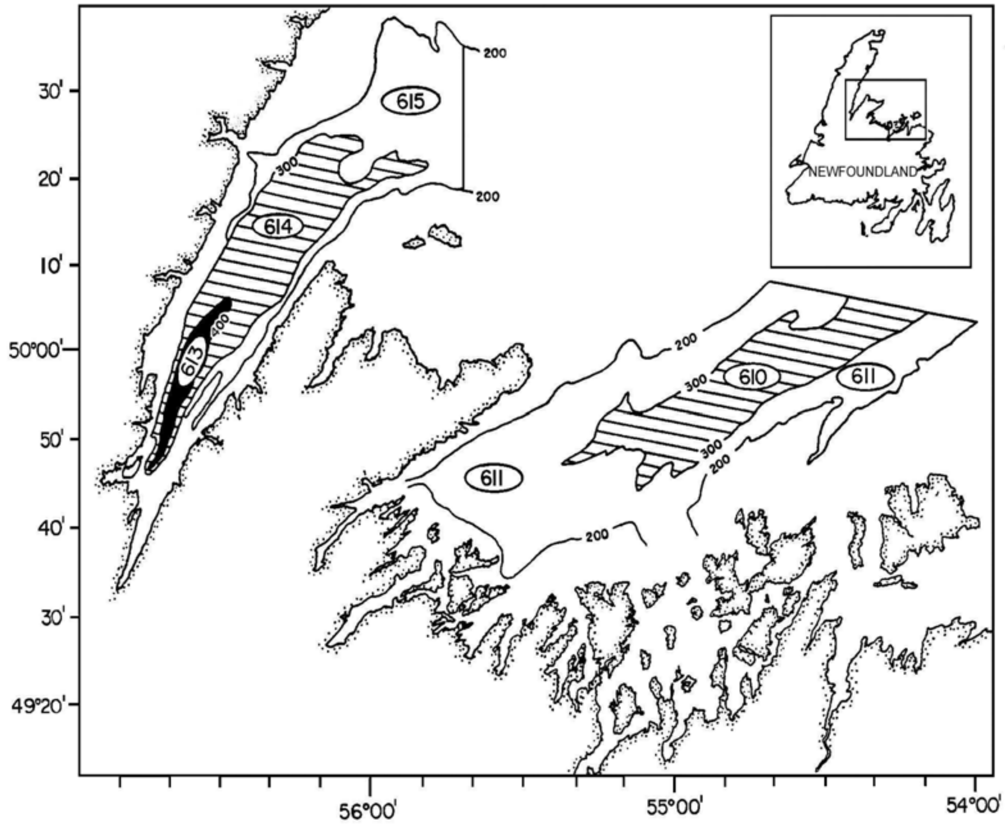

Figure 49. Location map showing inshore Division 3K strata sampled during White Bay / Notre Dame Bay September trapping surveys.

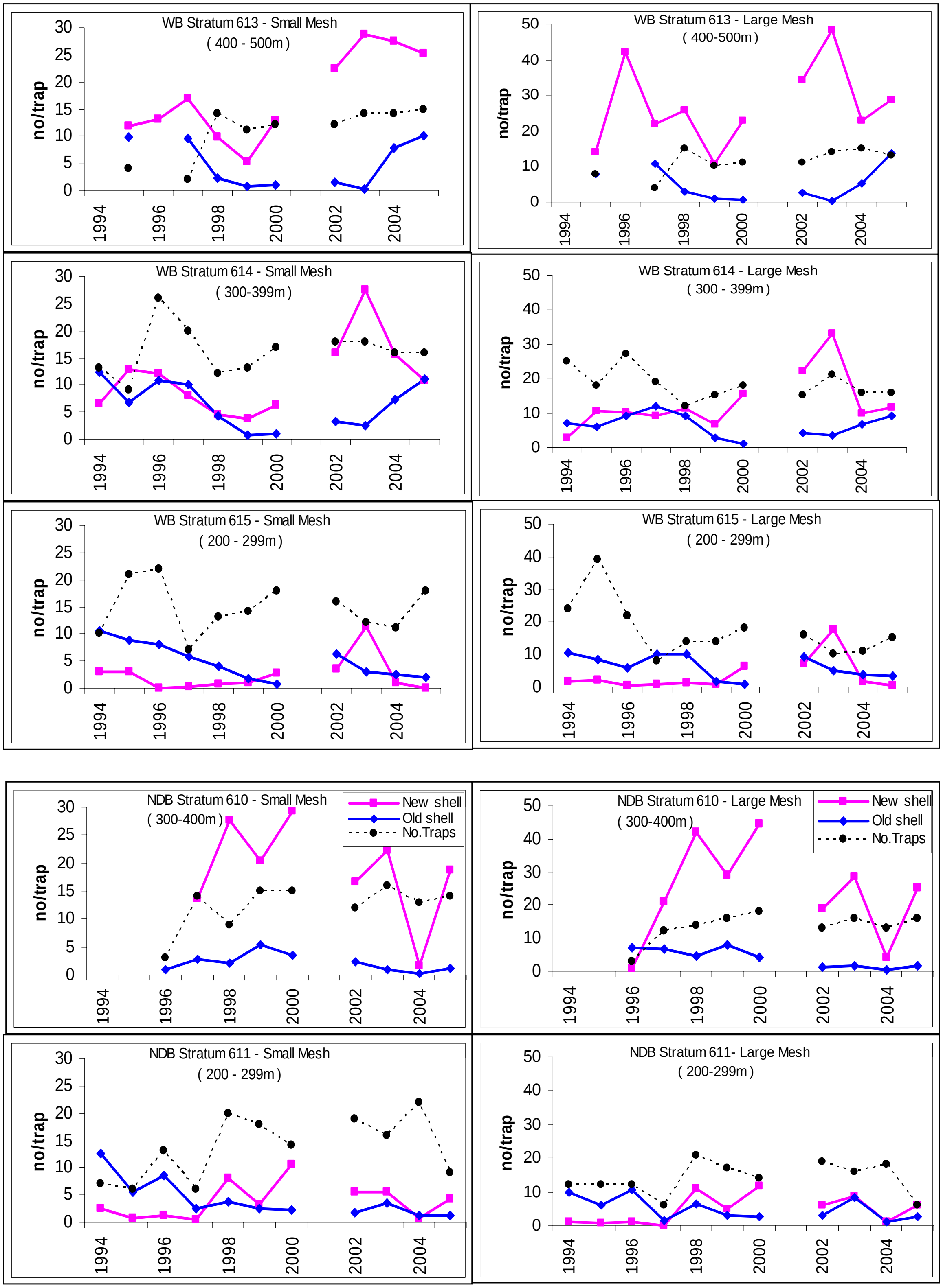

Figure 50. Trends in catch rates of legal-sized crabs by shell category and stratum from inshore Division 3K trap surveys in White Bay and Notre Dame Bay, 1994-2005; no survey was conducted in 2001.

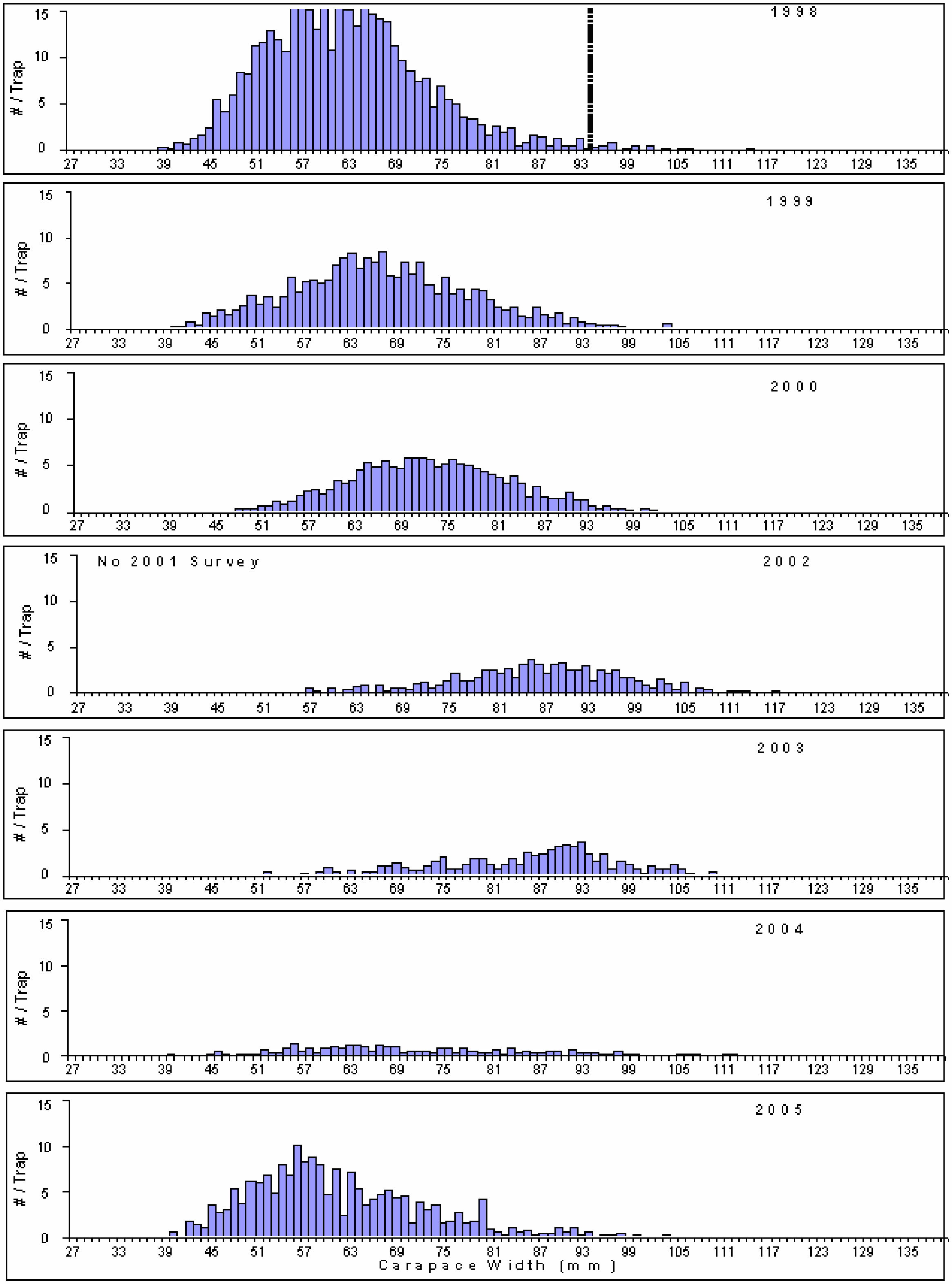

Figure 51. Inshore trap surveys; male size composition by Year within White Bay, Stratum 615 (200 – 299m).

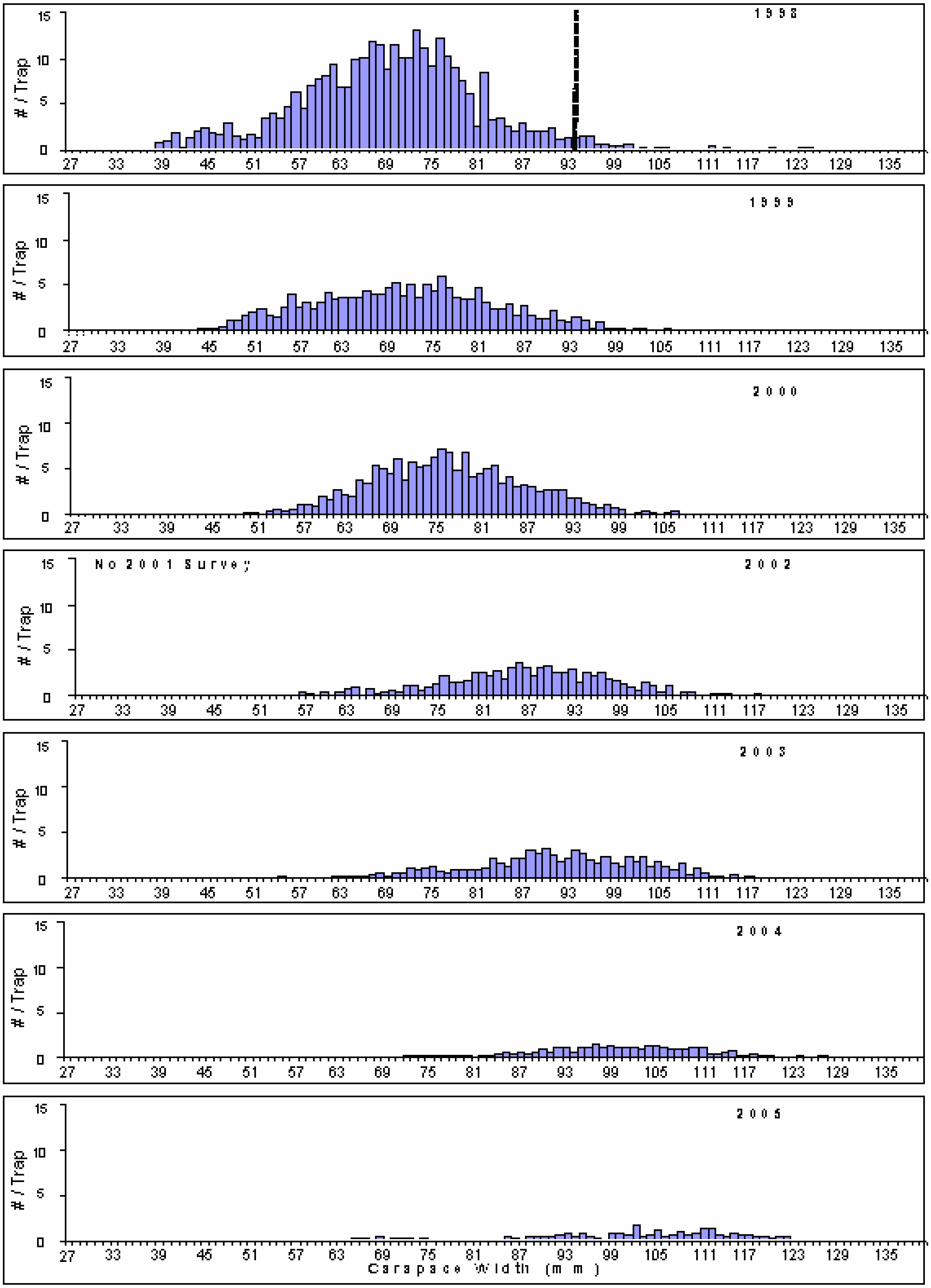

Figure 52. Inshore trap surveys; male size composition by Year within White Bay, stratum 614 (300 – 399m).

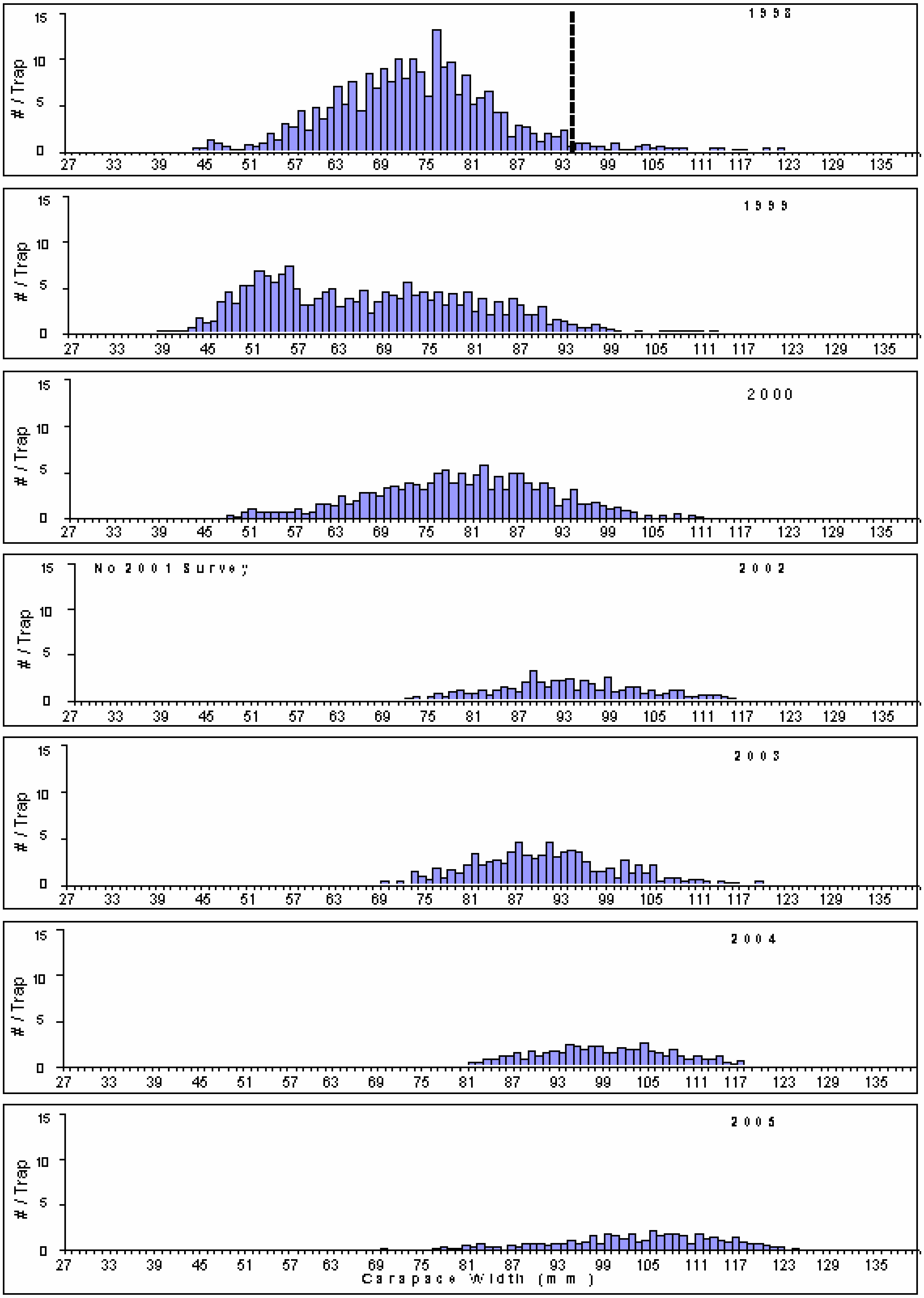

Figure 53. Inshore trap surveys; male size composition by Year within White Bay, stratum 613 (400 – 500m).

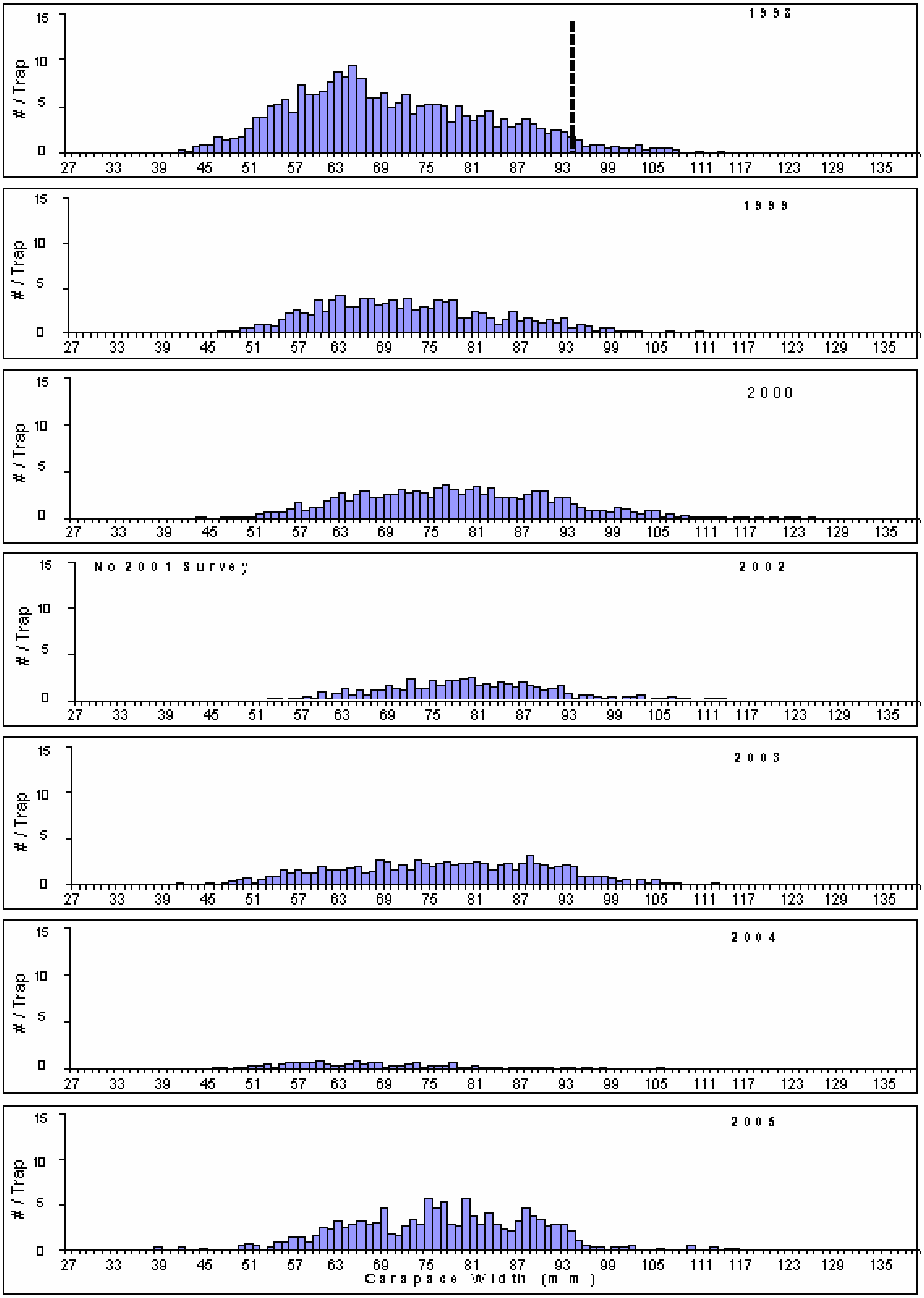

Figure 54. Inshore trap surveys; male size composition by Year within Notre Dame Bay, stratum 611 (200 – 299m).

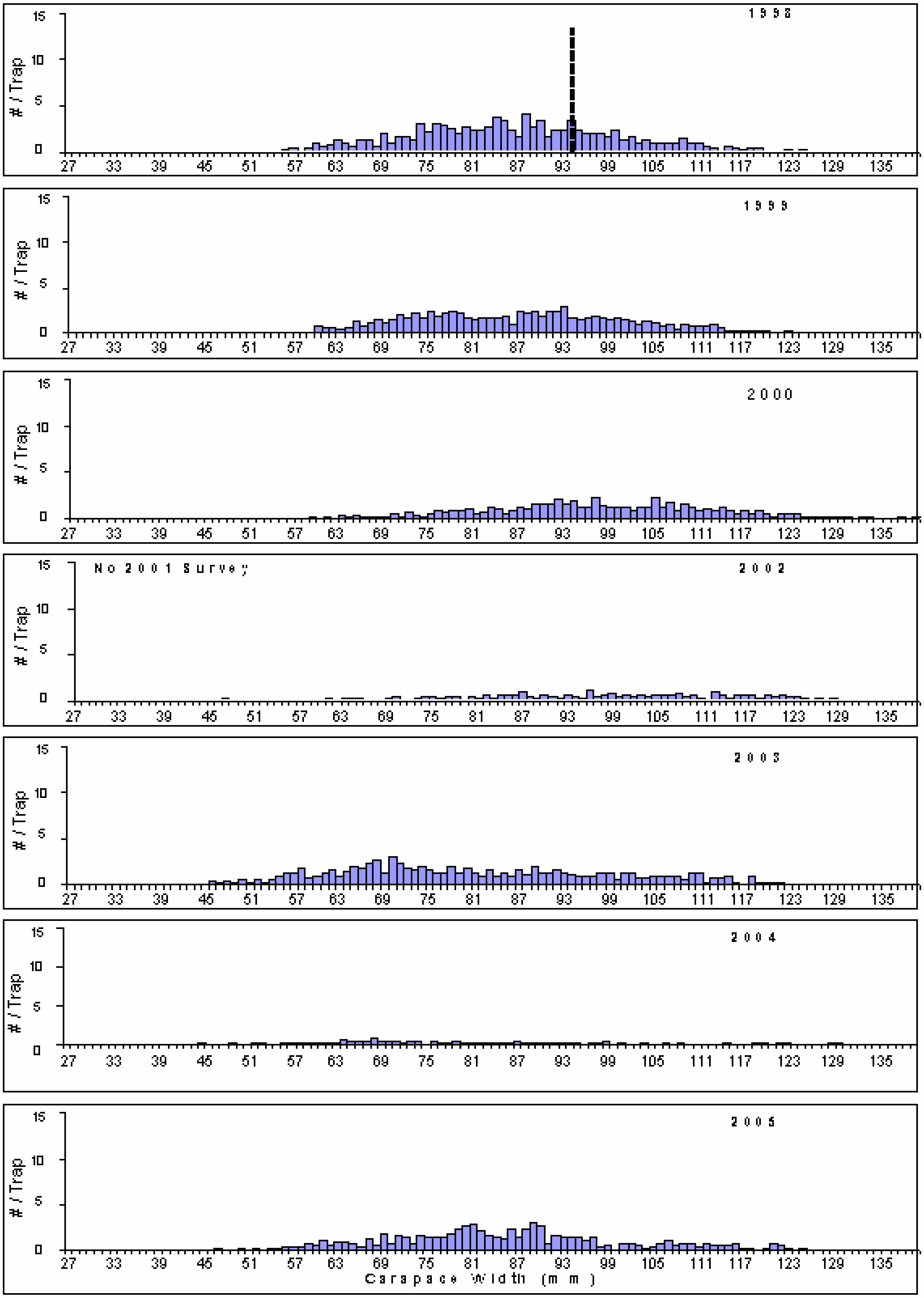

Figure 55. Inshore trap surveys; male size composition by Year within Notre Dame Bay, stratum 610 (300 – 400m).

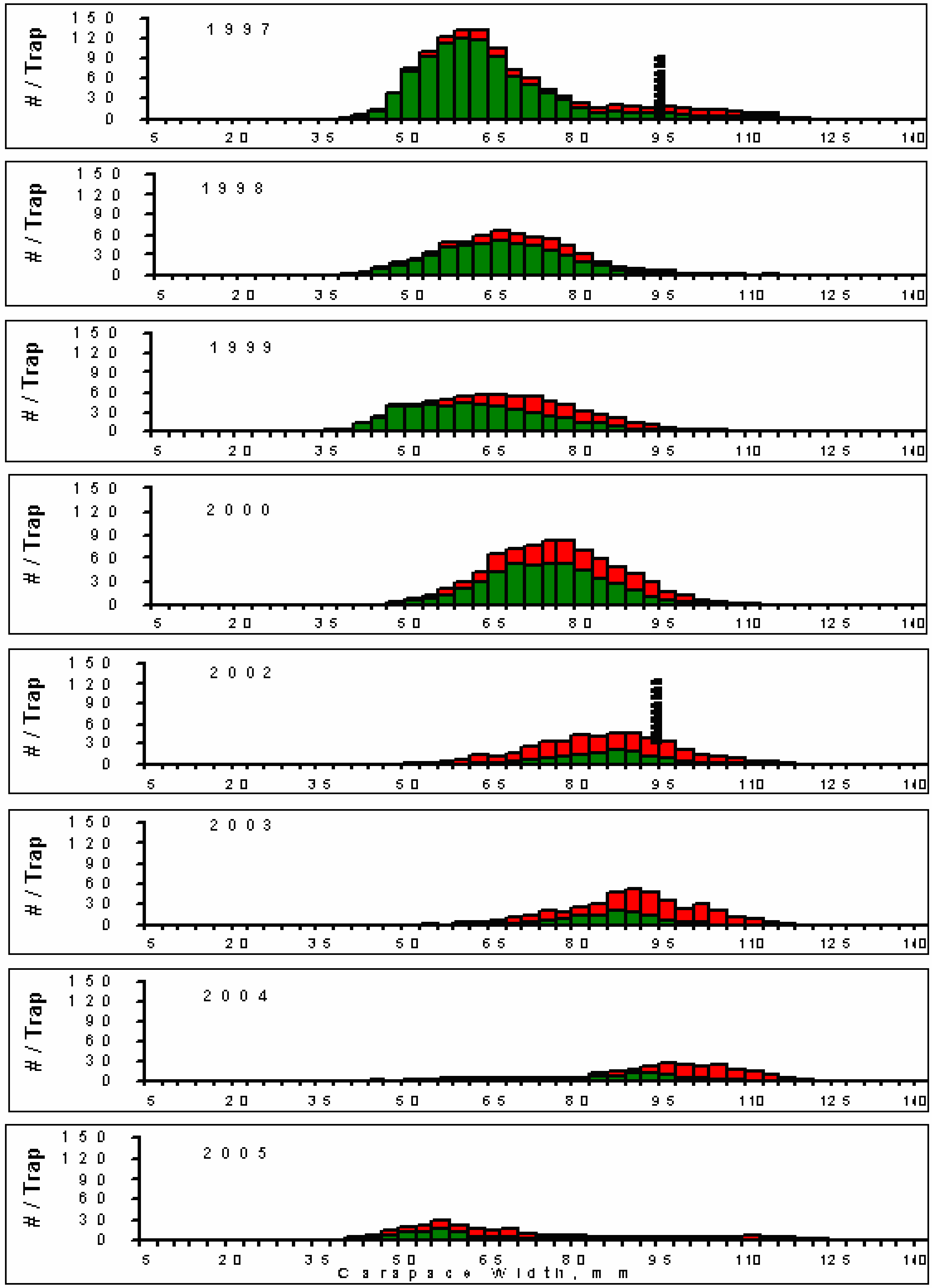

Figure 56. Inshore trap Surveys, White Bay (Stratum 613, 614, 615); adolescent (green) and adult (red) male crab size compositions by Year from small-mesh traps.

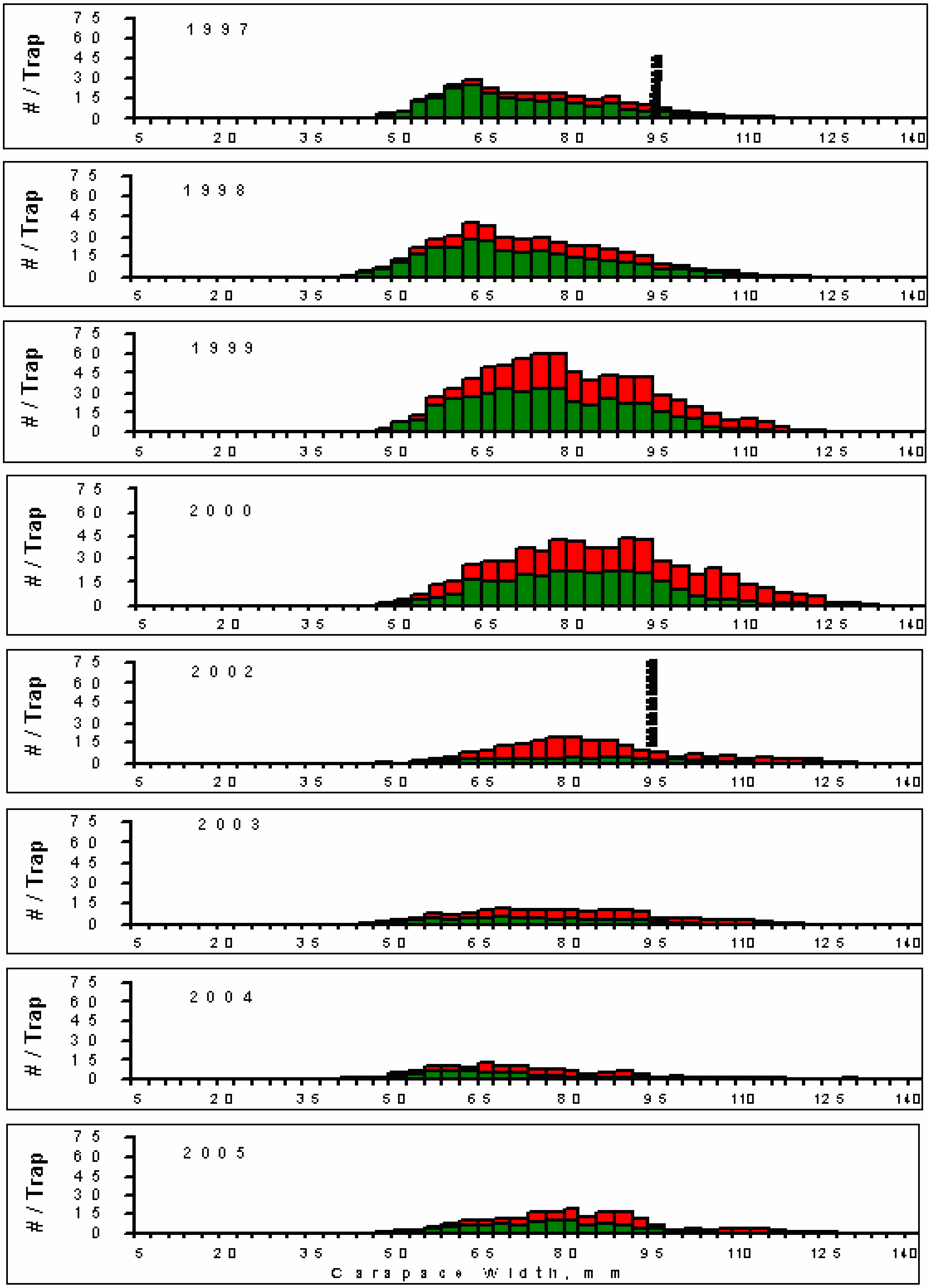

Figure 57. Inshore trap Surveys, Notre Dame Bay (Stratum 610, 611); adolescent (green) and adult (red) male crab size compositions by Year from small-mesh traps.

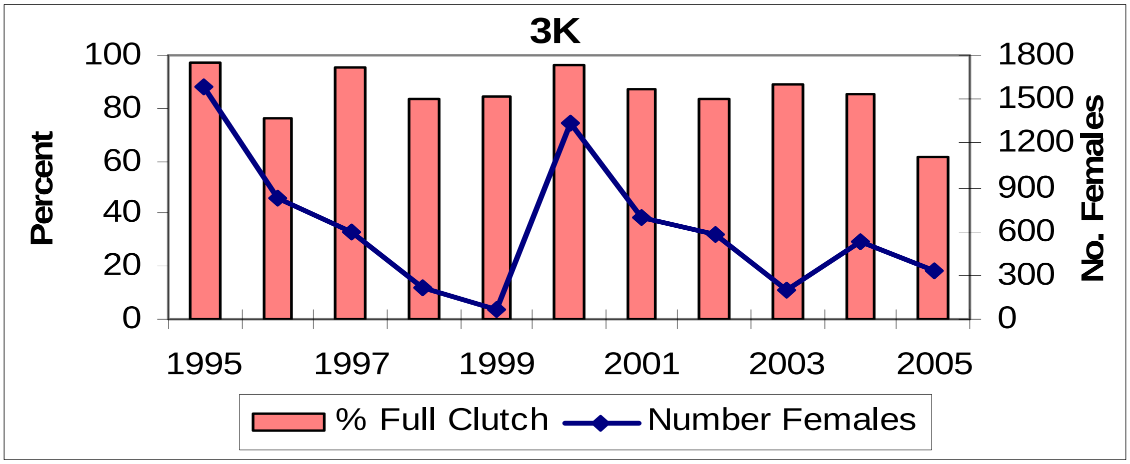

Figure 58. Trends in percent of mature females bearing full clutches of viable eggs and sample sizes in Division 3K from fall multispecies surveys.

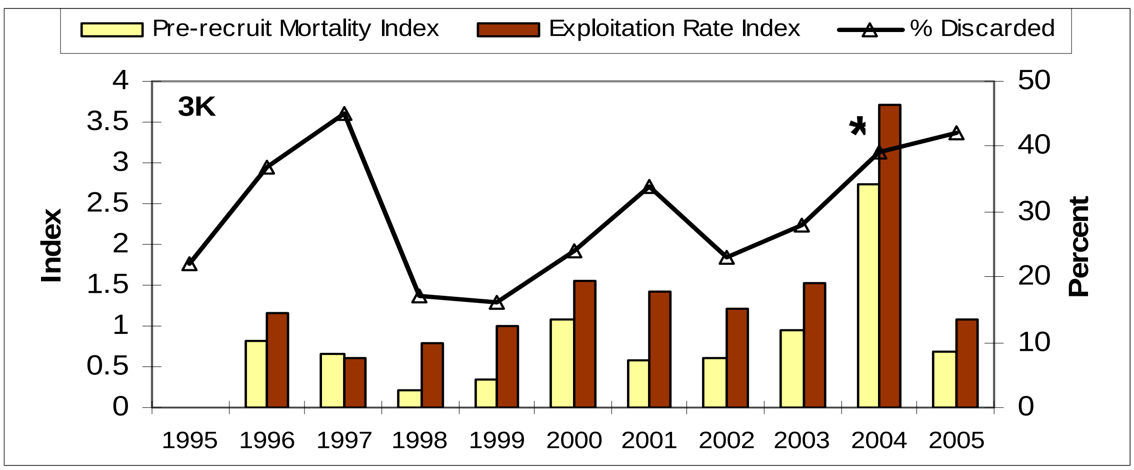

Figure 59. Annual trends in Division 3K mortality indices (the exploitation rate index and the pre-recruit fishing mortality index) and in the percentage of the catch discarded in the fishery.

* low catchability in 2003 survey

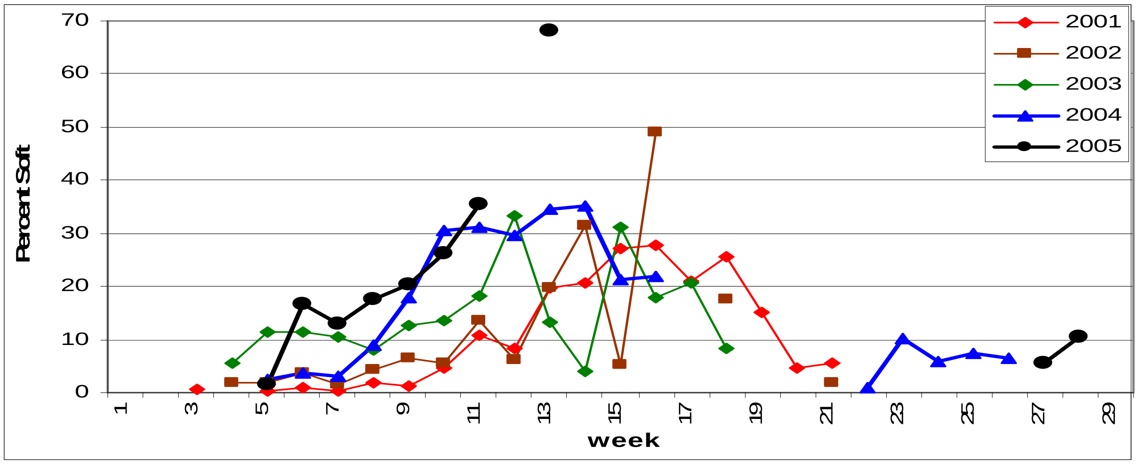

Figure 60. Seasonal trends (from April 01) in the percentage of legal-sized crabs that are soft-shelled by Year (2001-05), from at-sea sampling by observers in Division 3K.

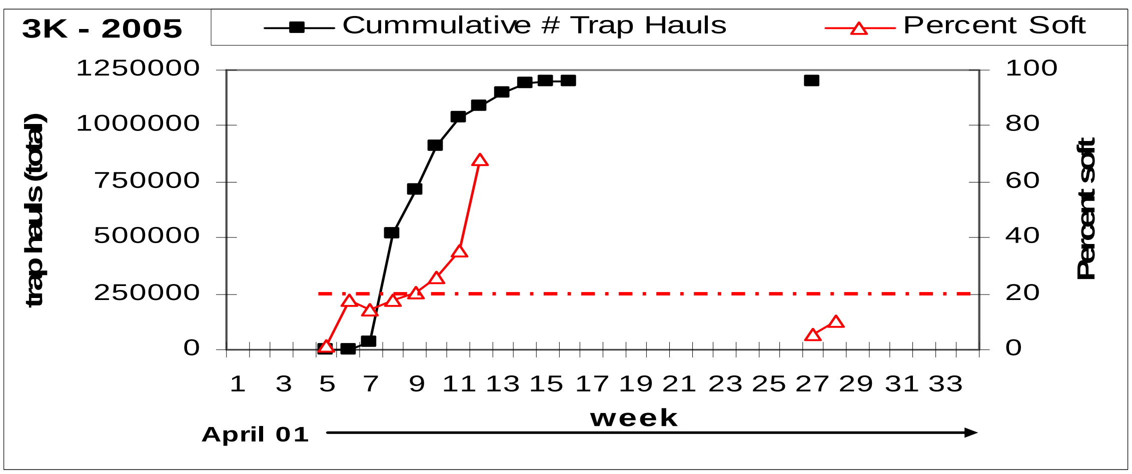

Figure 61. Cumulative distribution of weekly fishing effort in Division 3K during 2005 from logbooks in relation to weekly percentage of soft-shelled crabs from at-sea sampling by observers.

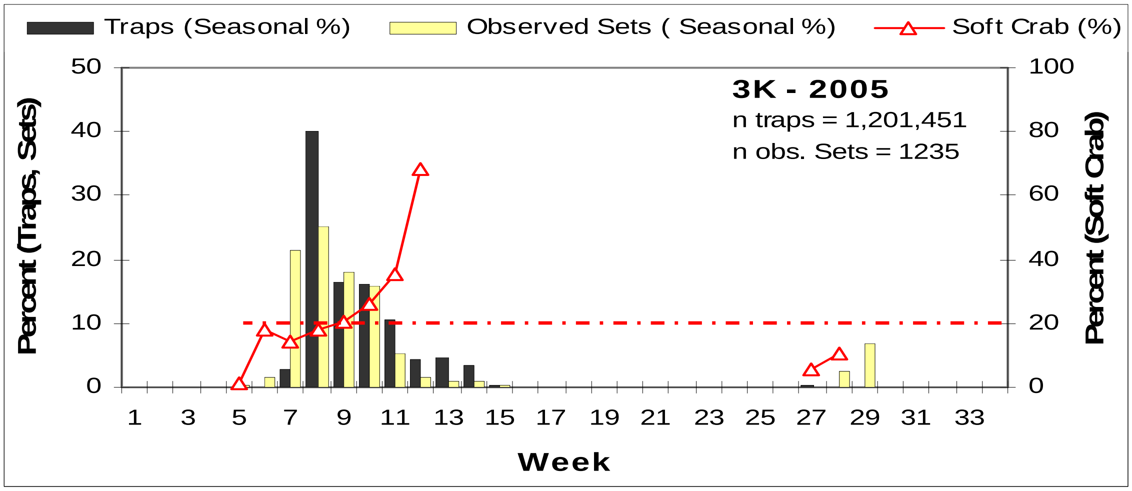

Figure 62. Distribution of Division 3K total fishing effort throughout the 2005 fishery and of effort from observed sets in relation to weekly percentage of soft-shelled crabs from at-sea sampling.

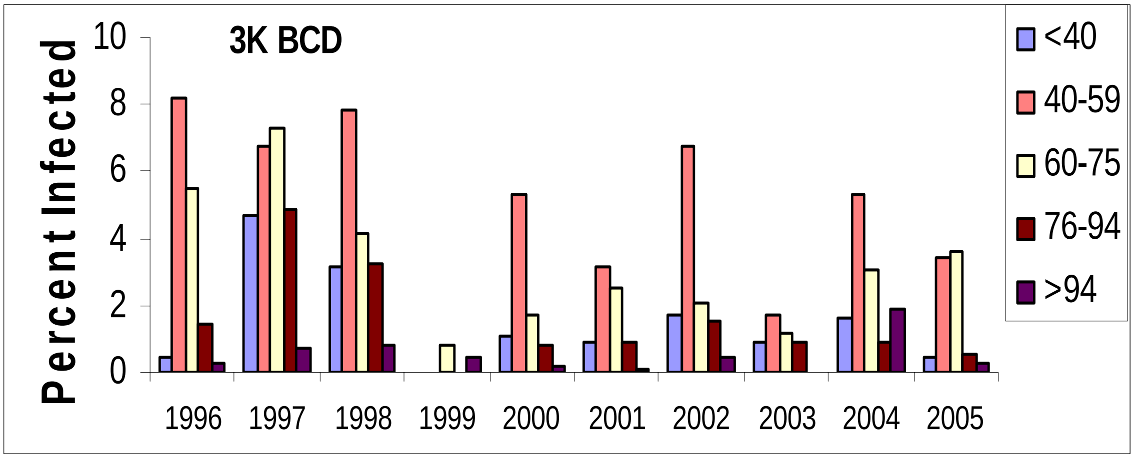

Figure 63. Trends in prevalence of BCD in Division 3K new-shelled males by size group from fall multispecies surveys.

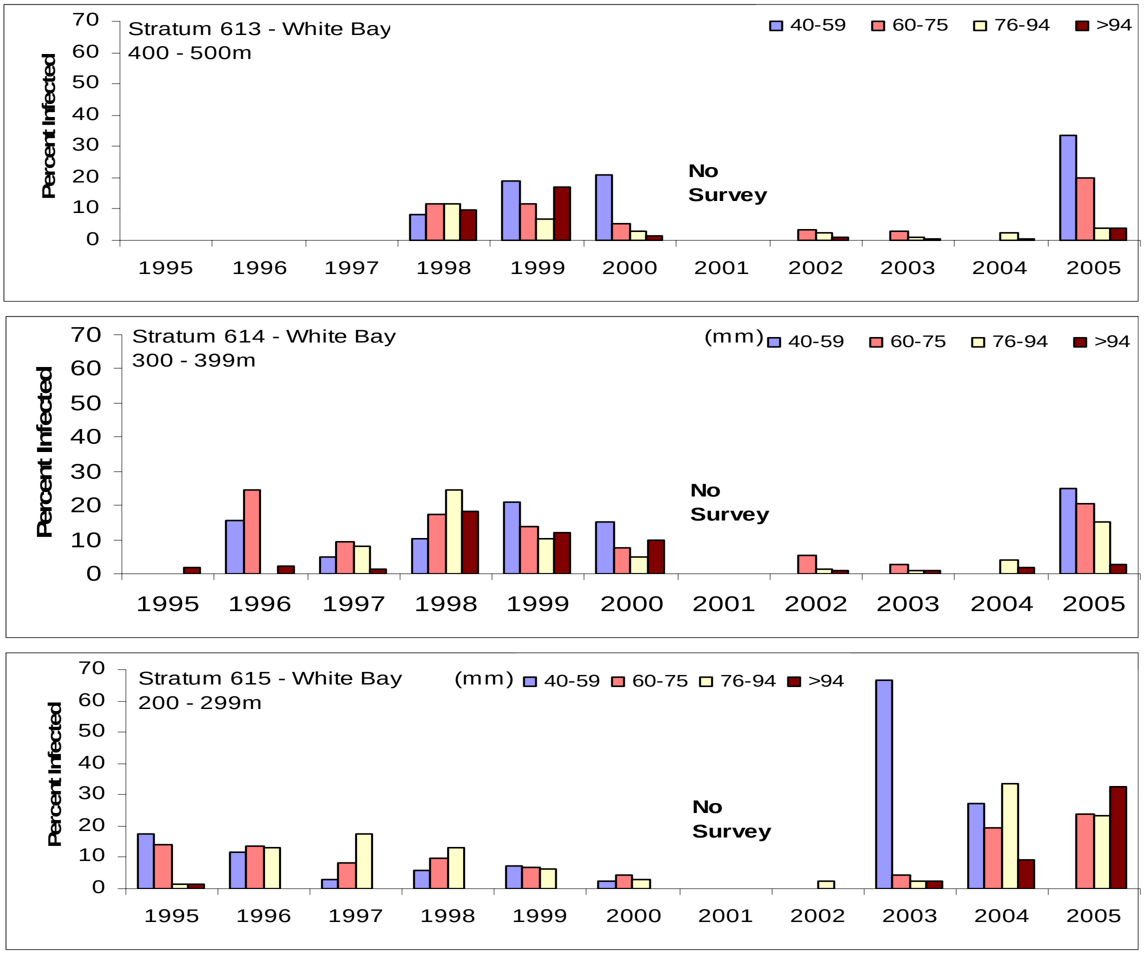

Figure 64. Incidence of BCD in new-shelled males by stratum, Year, and size group from trap surveys in White Bay.

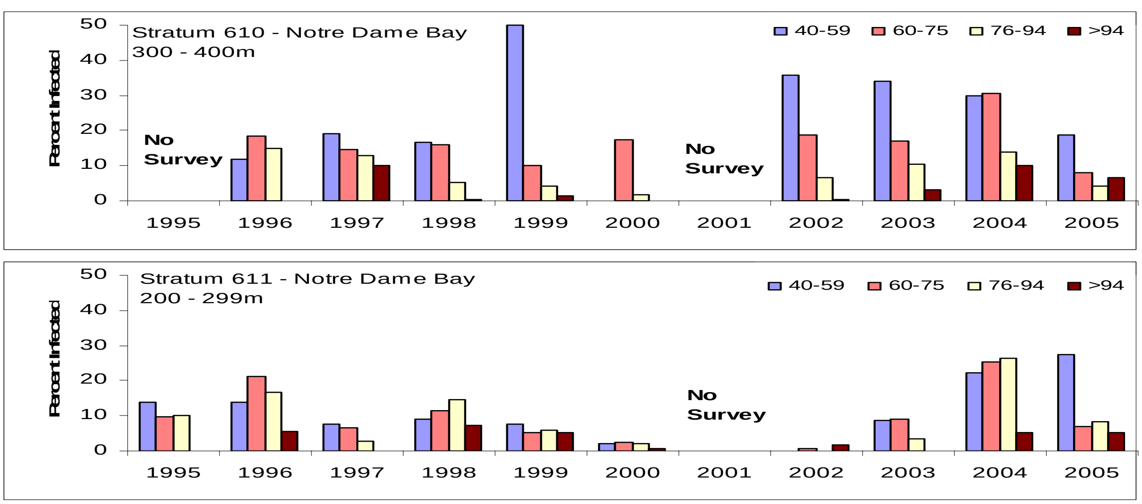

Figure 65. Incidence of BCD in new-shelled males by stratum, Year, and size group from trap surveys in Notre Dame Bay.

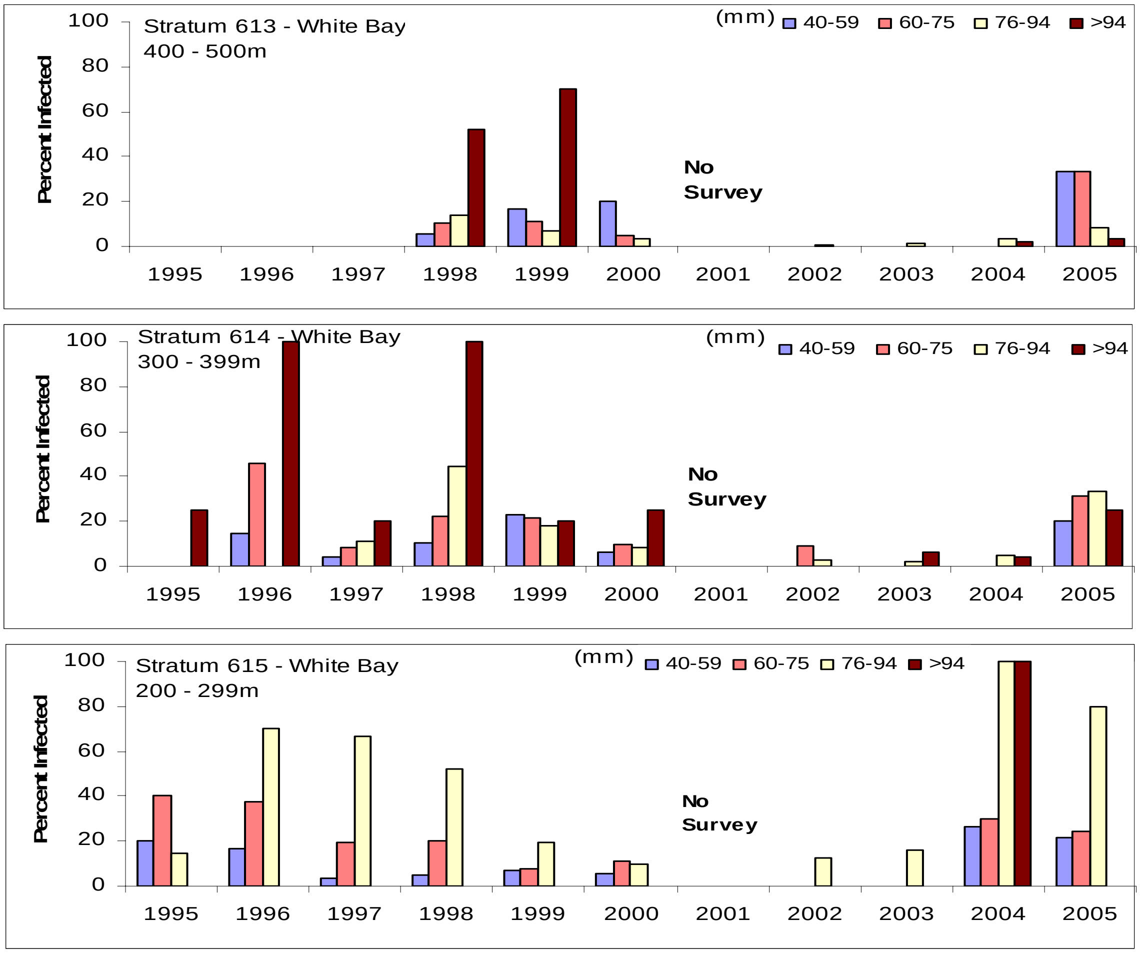

Figure 66. Incidence of BCD in new-shelled adolescent males by stratum, Year, and size group from trap surveys in White Bay.

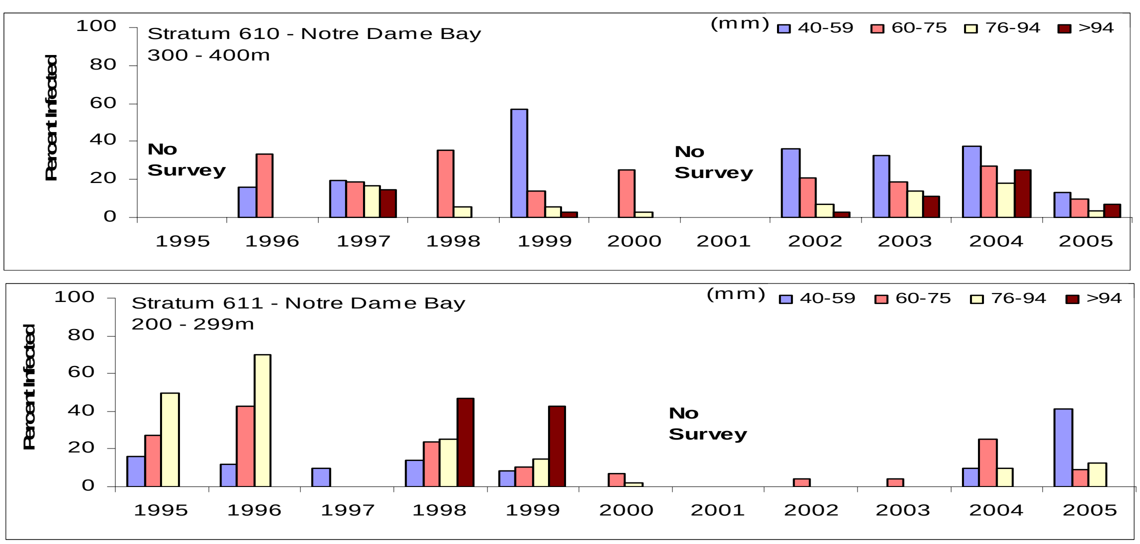

Figure 67. Incidence of BCD in new-shelled adolescent males by stratum, Year, and size group from trap surveys in Notre Dame Bay.

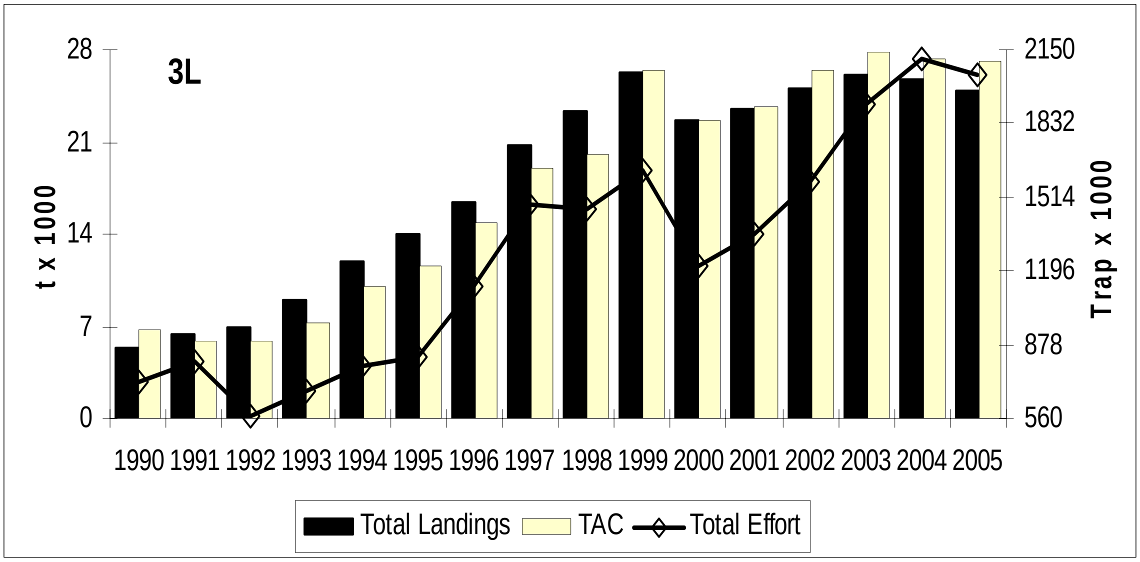

Figure 68. Trends in Division 3L landings, TAC, and fishing effort.

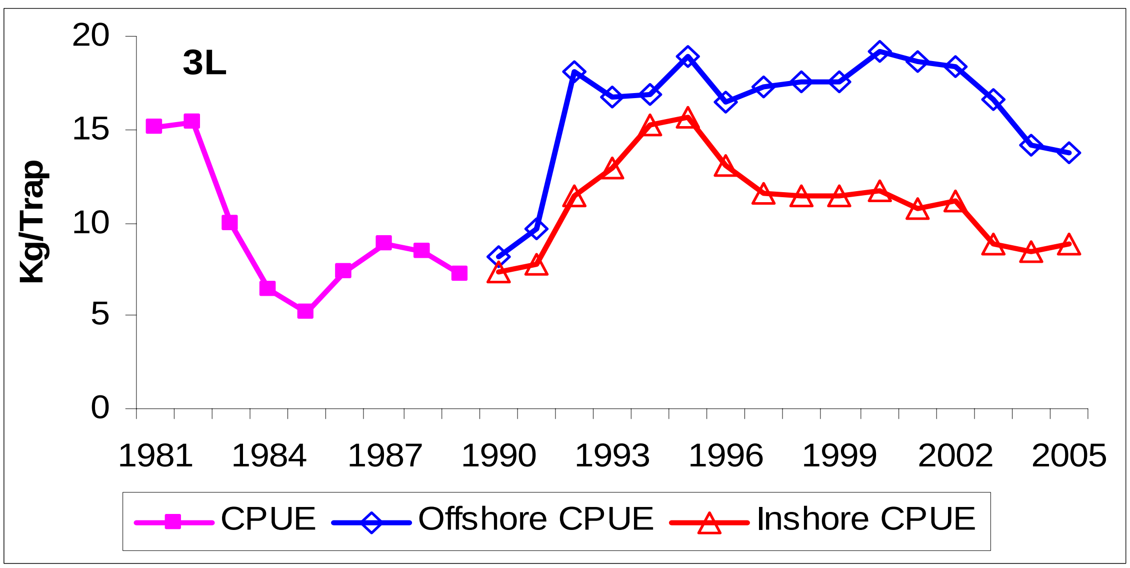

Figure 69. Trends in Division 3L commercial CPUE.

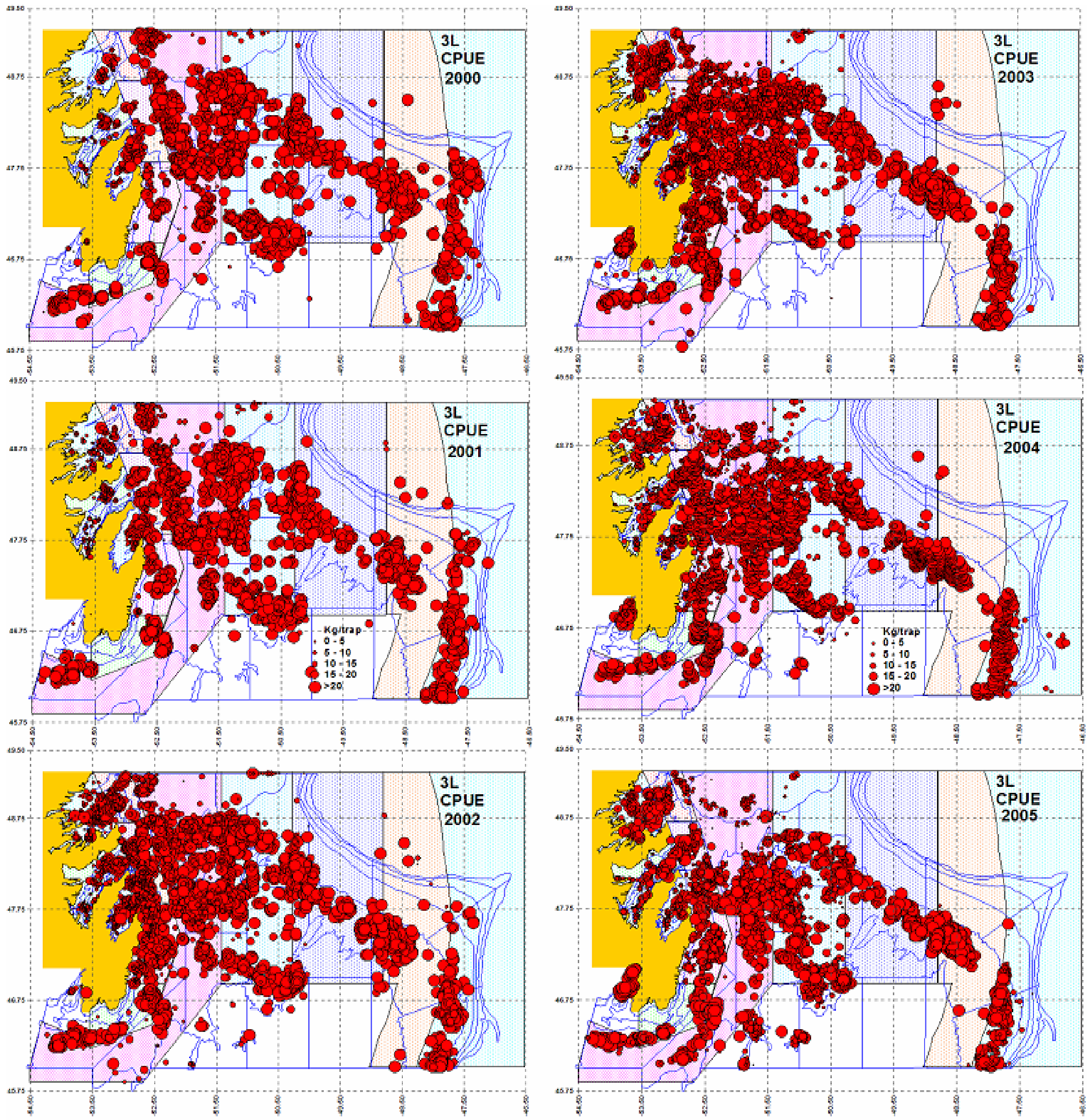

Figure 70. Spatial distribution of Division 3L commercial CPUE by Year.

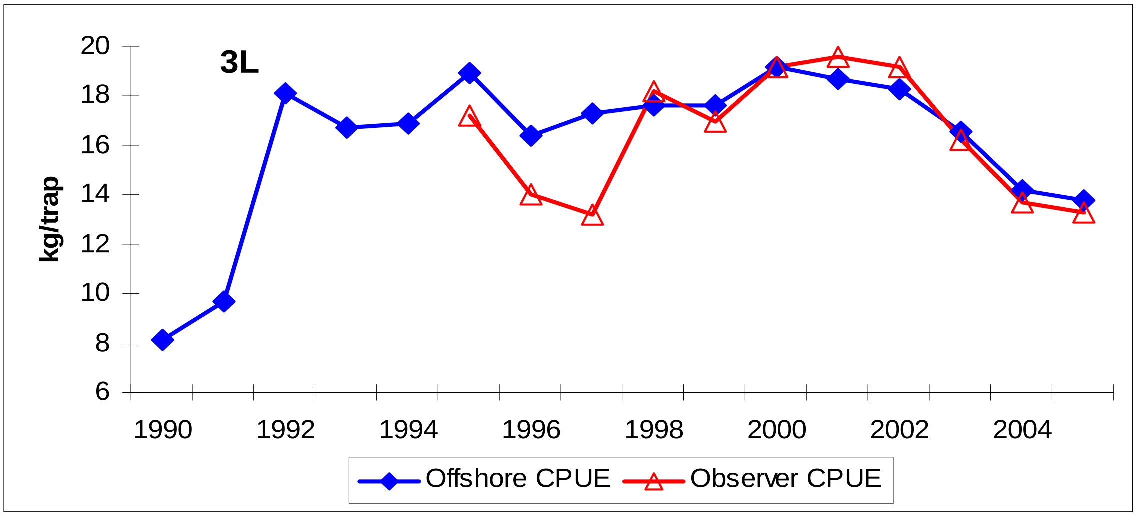

Figure 71. Trends in logbook-based CPUE vs. observer-based CPUE in the Division 3L fishery.

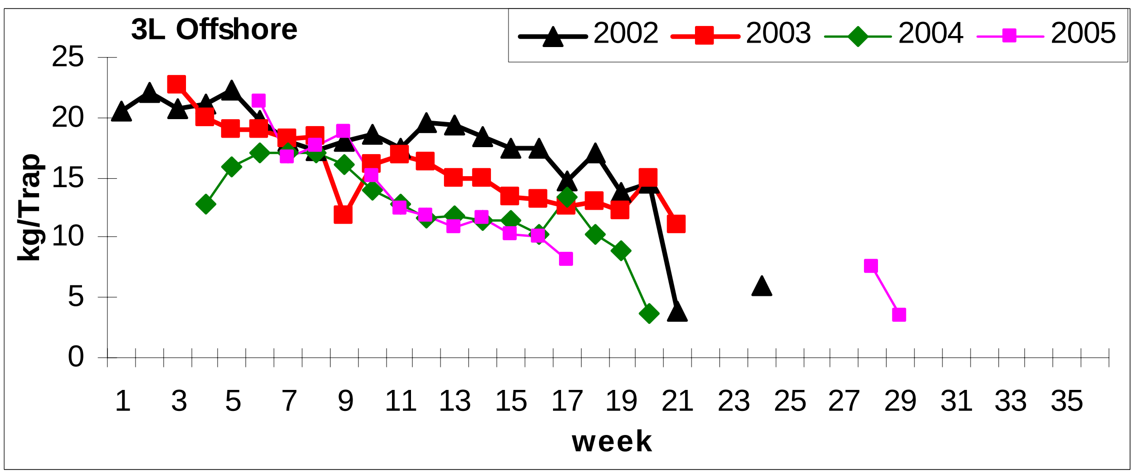

Figure 72. Seasonal trends in CPUE, by week, for Division 3L during 2002-05.

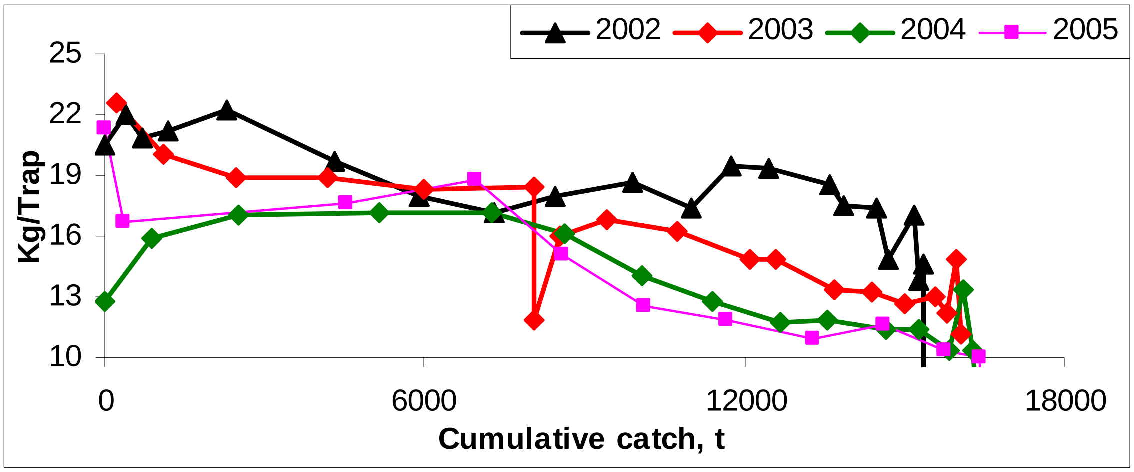

Figure 73. Seasonal trends in CPUE, in relation to cumulative catch, for Division 3L during 2002-05.

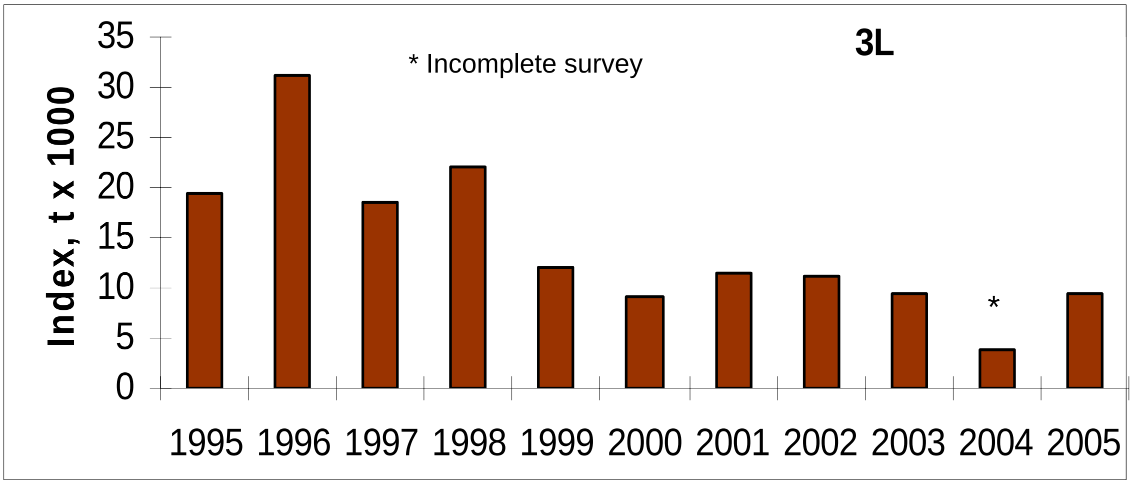

Figure 74. Trend in the Division 3L fall multispecies survey exploitable Biomass index.

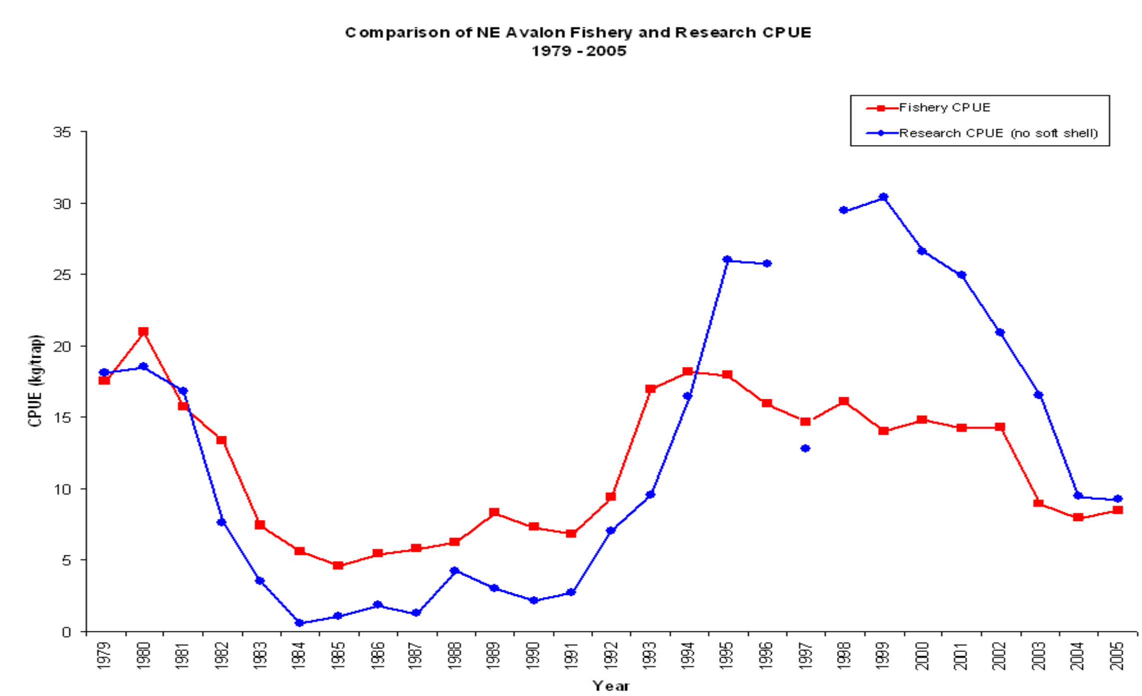

Figure 75. Comparison of fishery logbook CPUE with CPUE from inshore Division 3L spring trap surveys for North-east Avalon (NEA), 1979-2005.

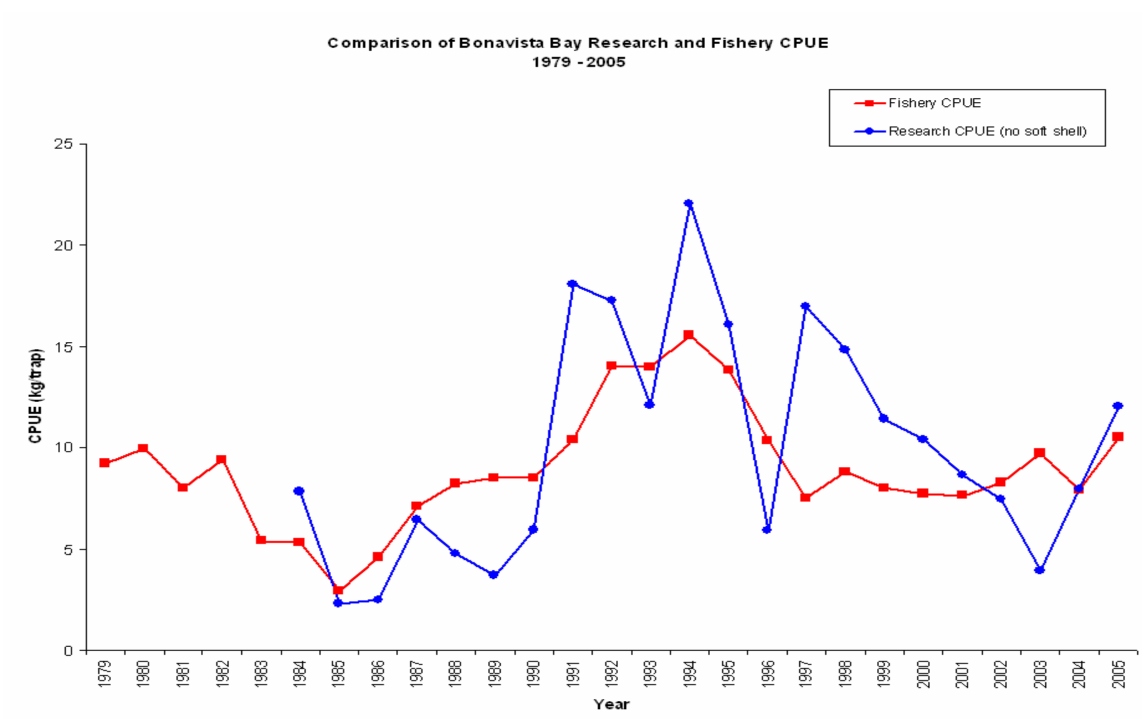

Figure 76. Comparison of fishery logbook CPUE with CPUE from inshore Division 3L summer trap surveys for Bonavista Bay (BB), 1979-2005.

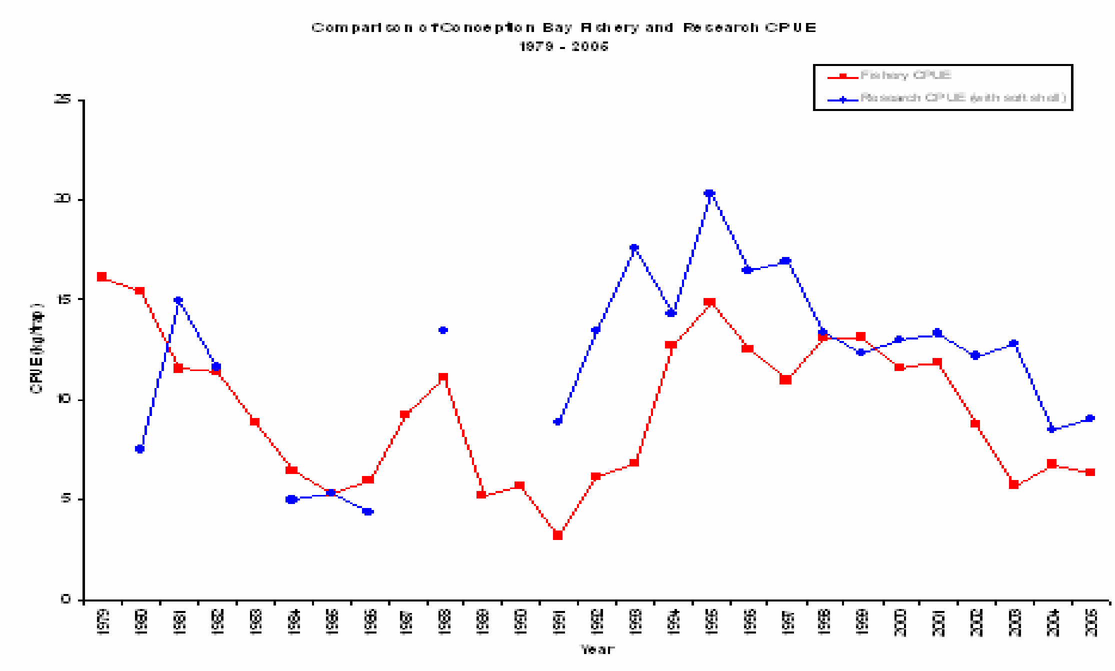

Figure 77. Comparison of fishery logbook CPUE with CPUE from inshore Division 3L fall trap surveys for Conception Bay (CB), 1979-2005.

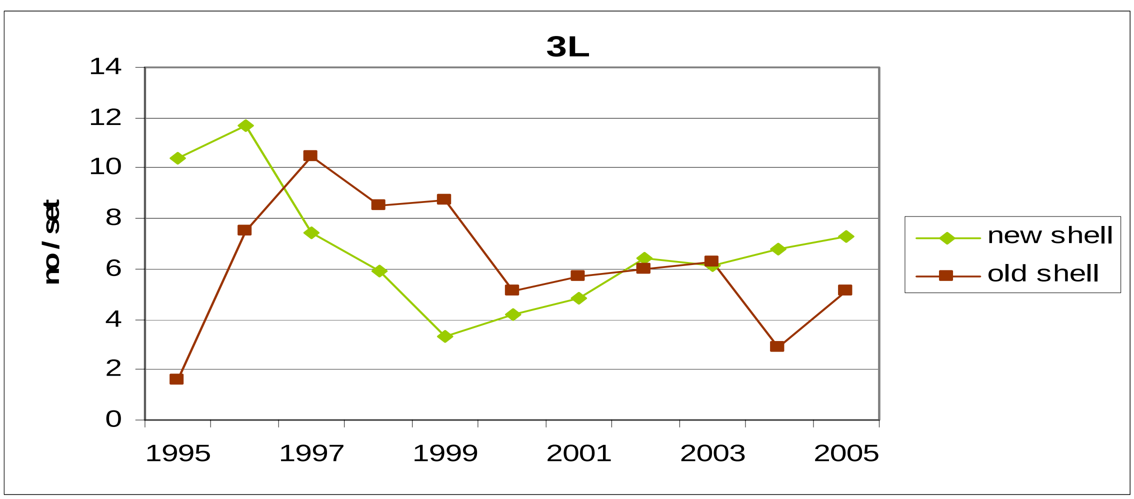

Figure 78. Trends, by shell condition, in abundance indices of legal-sized males for Division 3L from fall multispecies surveys.

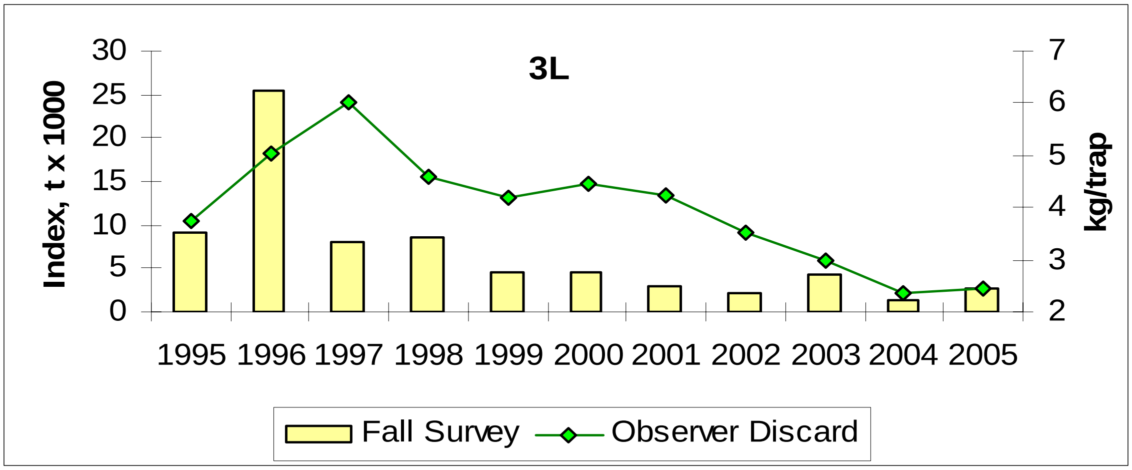

Figure 79. Trends in the Division 3L fall multispecies survey pre-recruit Biomass index and the observer discard catch rate index.

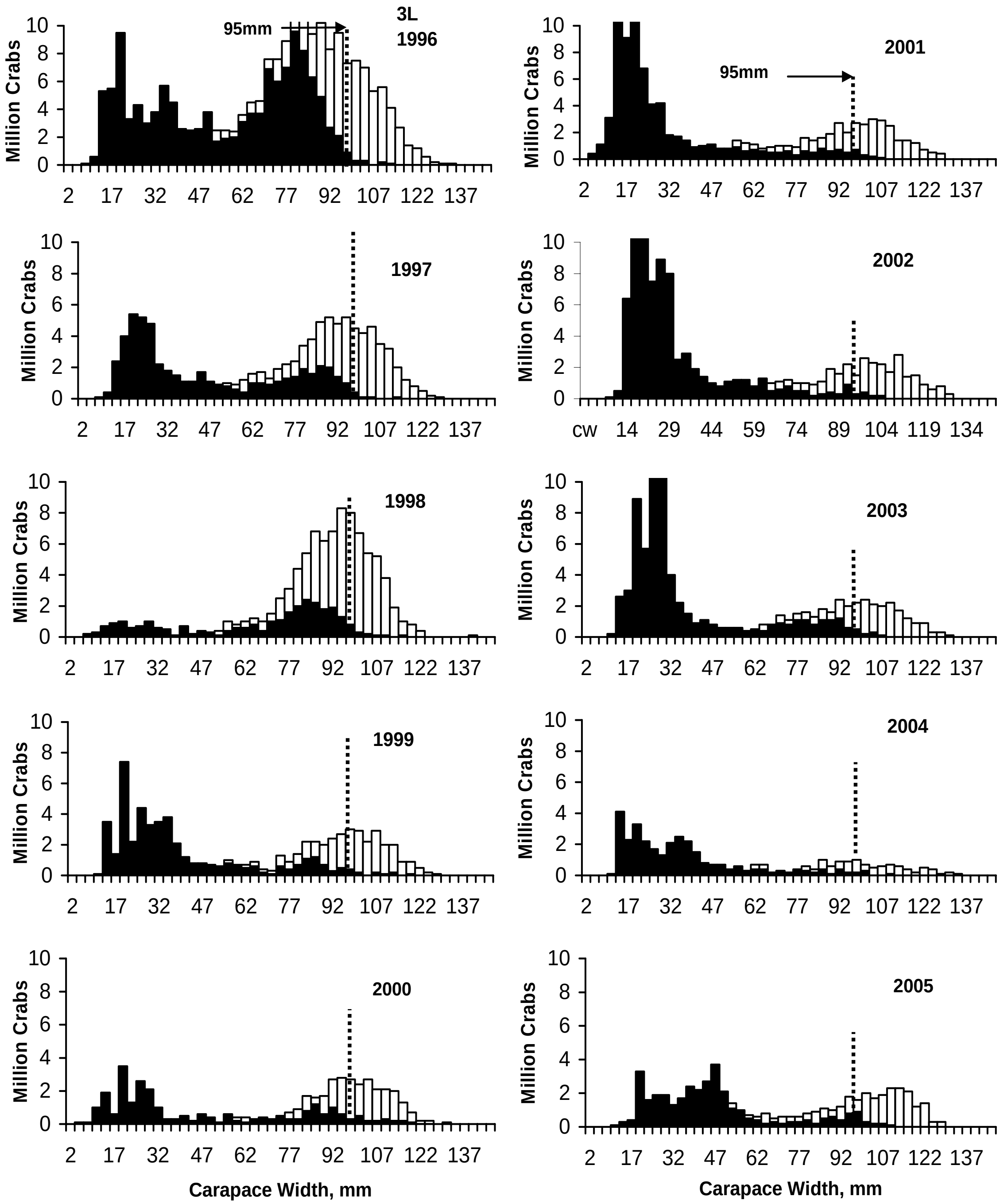

Figure 80. Truncated distribution of abundance (index) by carapace width for Division 3L juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

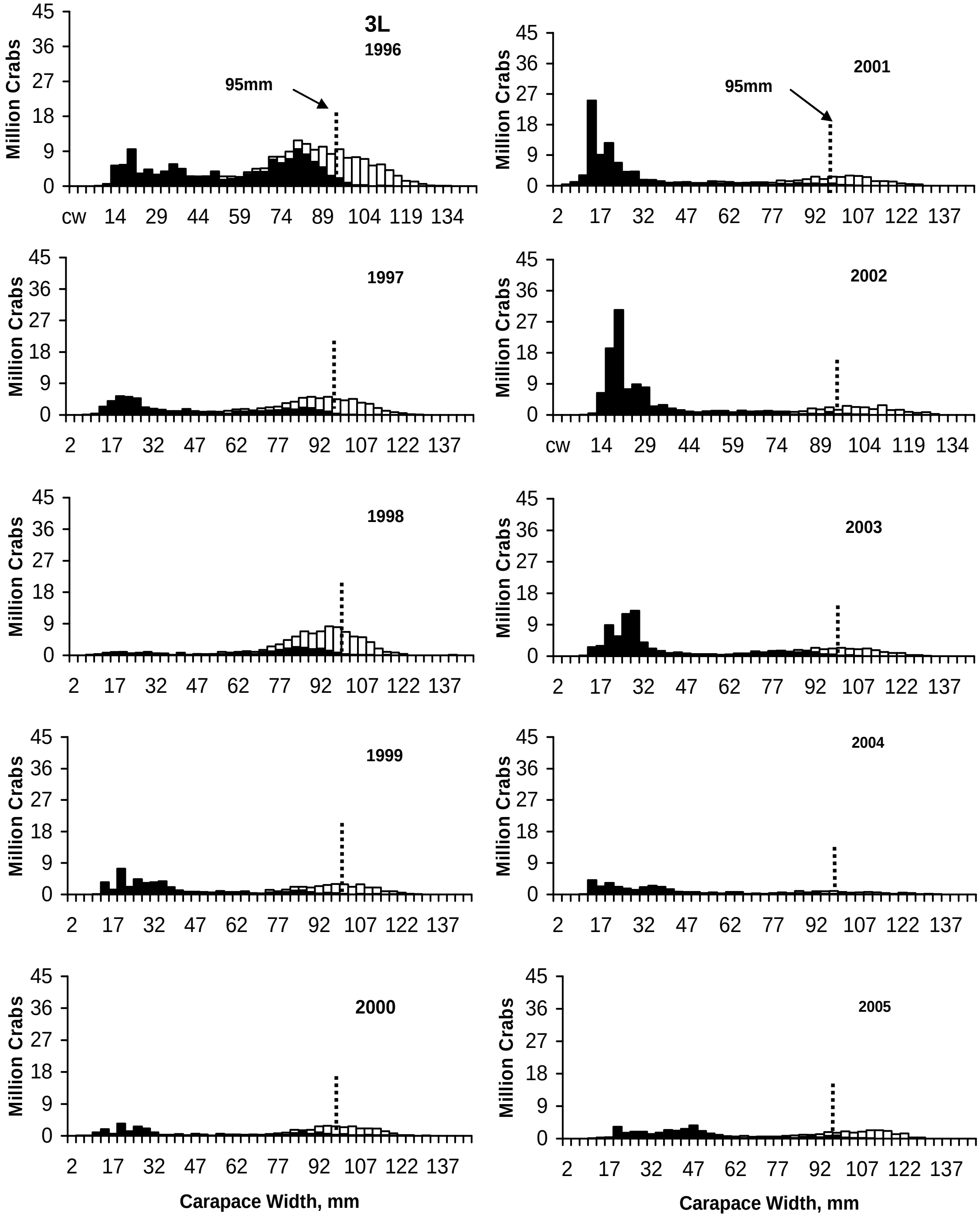

Figure 81. Distribution of abundance (index) by carapace width for Division 3L juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

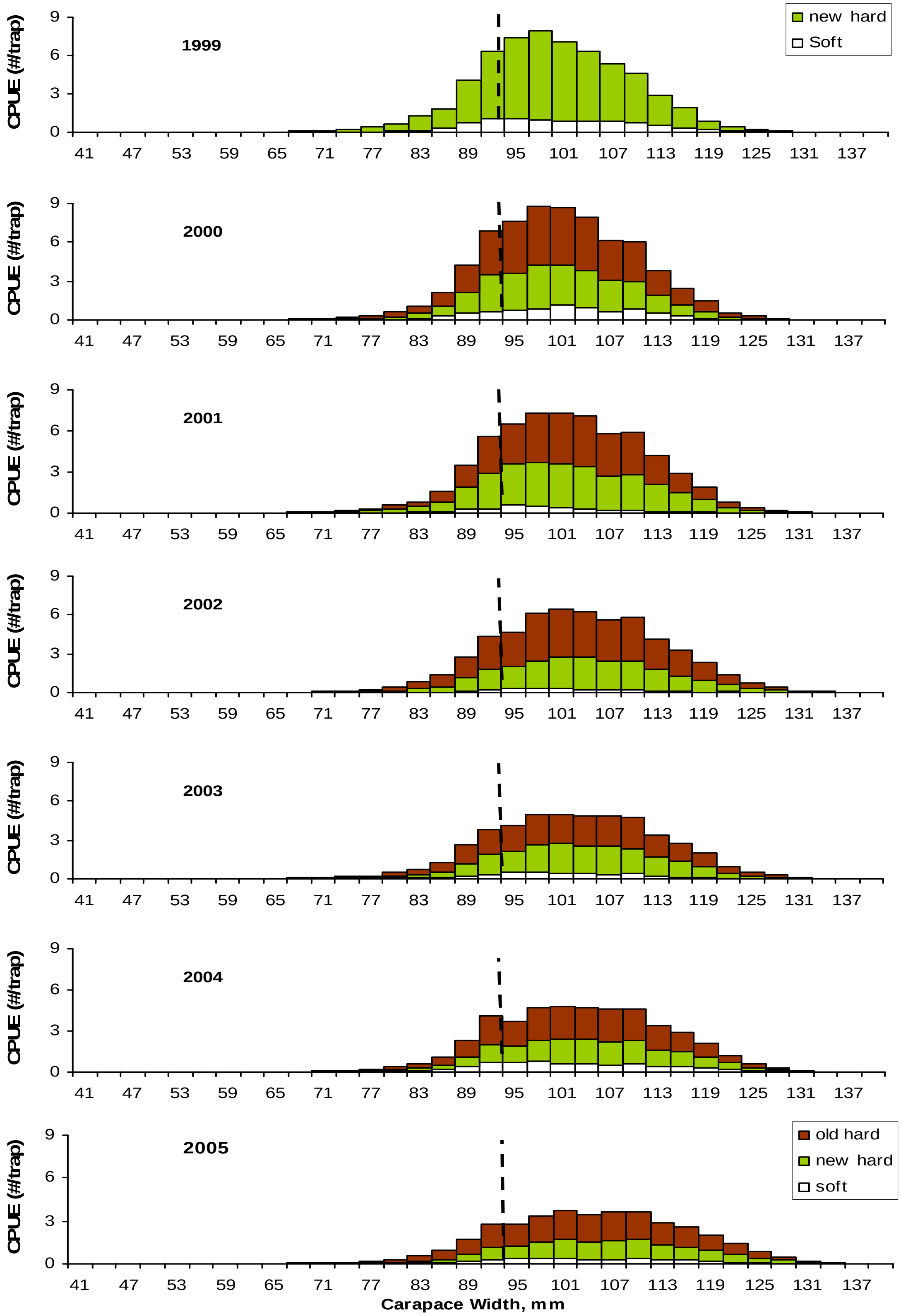

Figure 82. Trends in male carapace width distributions from observer at-sea sampling for Division 3L.

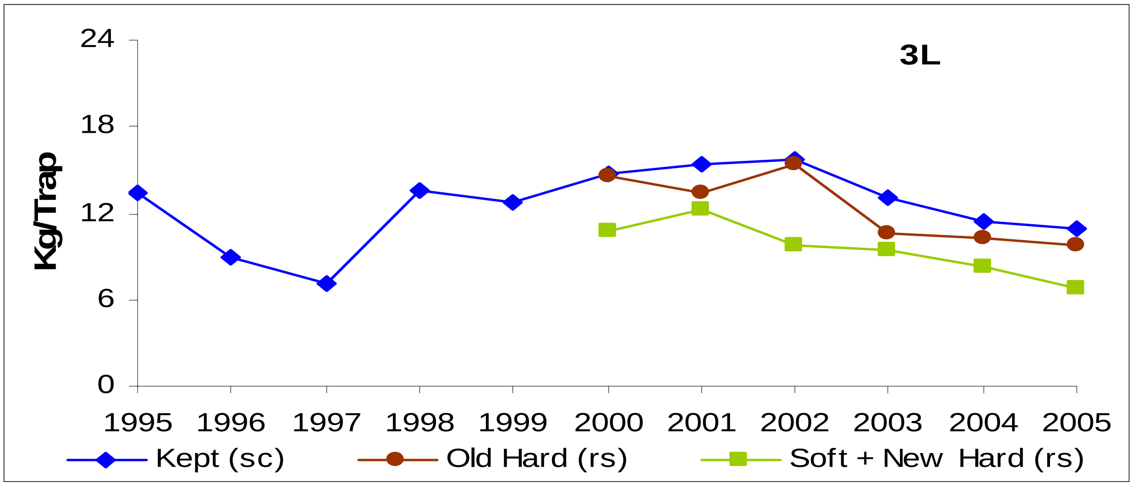

Figure 83. Trends in Division 3L observer catch rates of exploitable crabs since 1995 from set and catch records and of legal-sized crabs by shell category since 2000 from at-sea sampling.

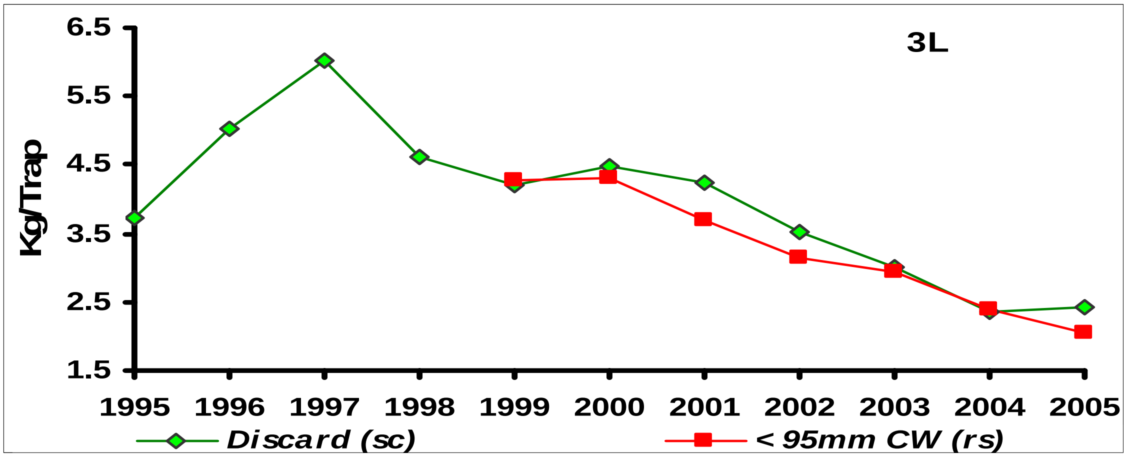

Figure 84. Trends in Division 3Lobserver catch rates of total discards since 1995 from set and catch records and of sub-legal sized crabs since 1999 from at-sea sampling.

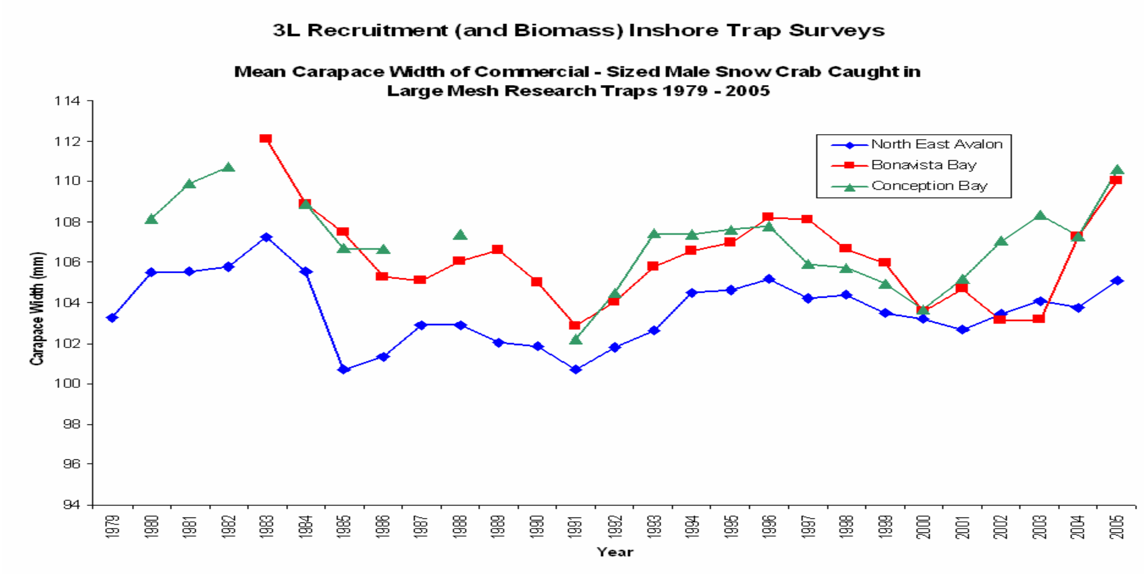

Figure 85. Mean Carapace Width (CW) of commercial-sized male snow crab caught in large-meshed research traps from North-East Avalon (NEA), Bonavista Bay (BB) and Conception Bay (CB). 1979-2005.

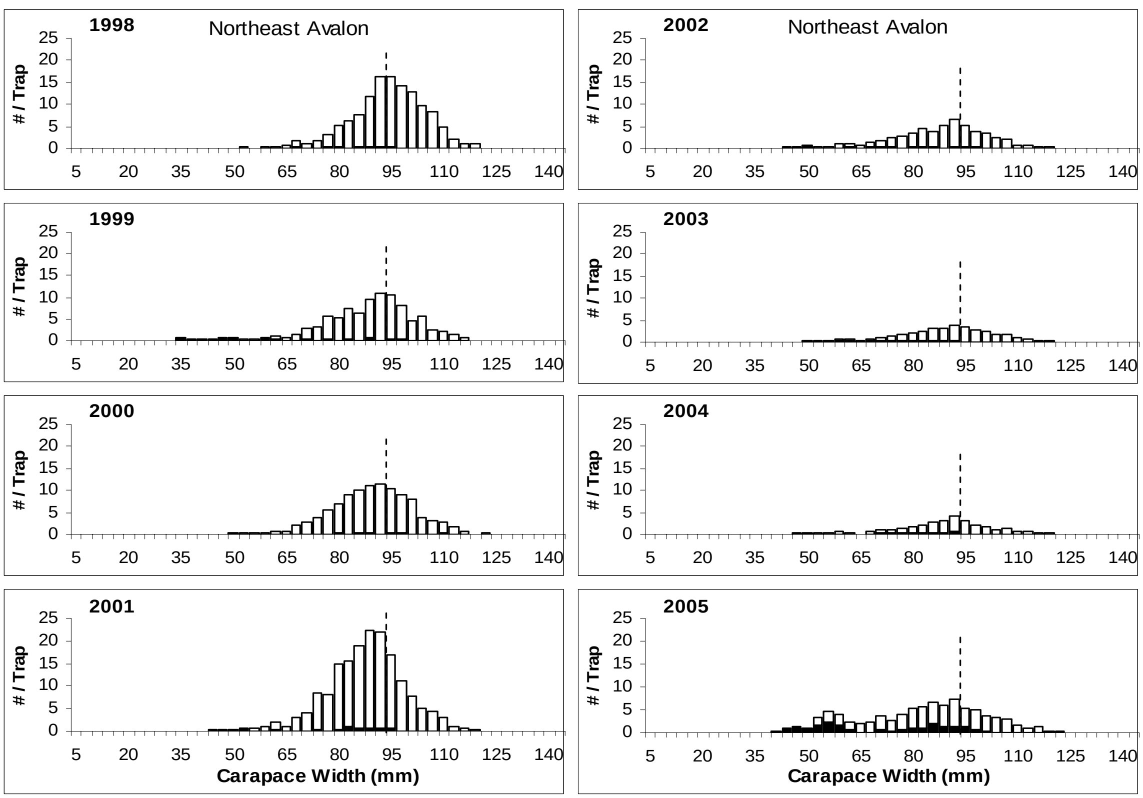

Figure 86. Male size composition from small-meshed traps by Year from inshore spring trap surveys off Northeast Avalon; adolescents (small-clawed) in black vs. adults (large-clawed) in white.

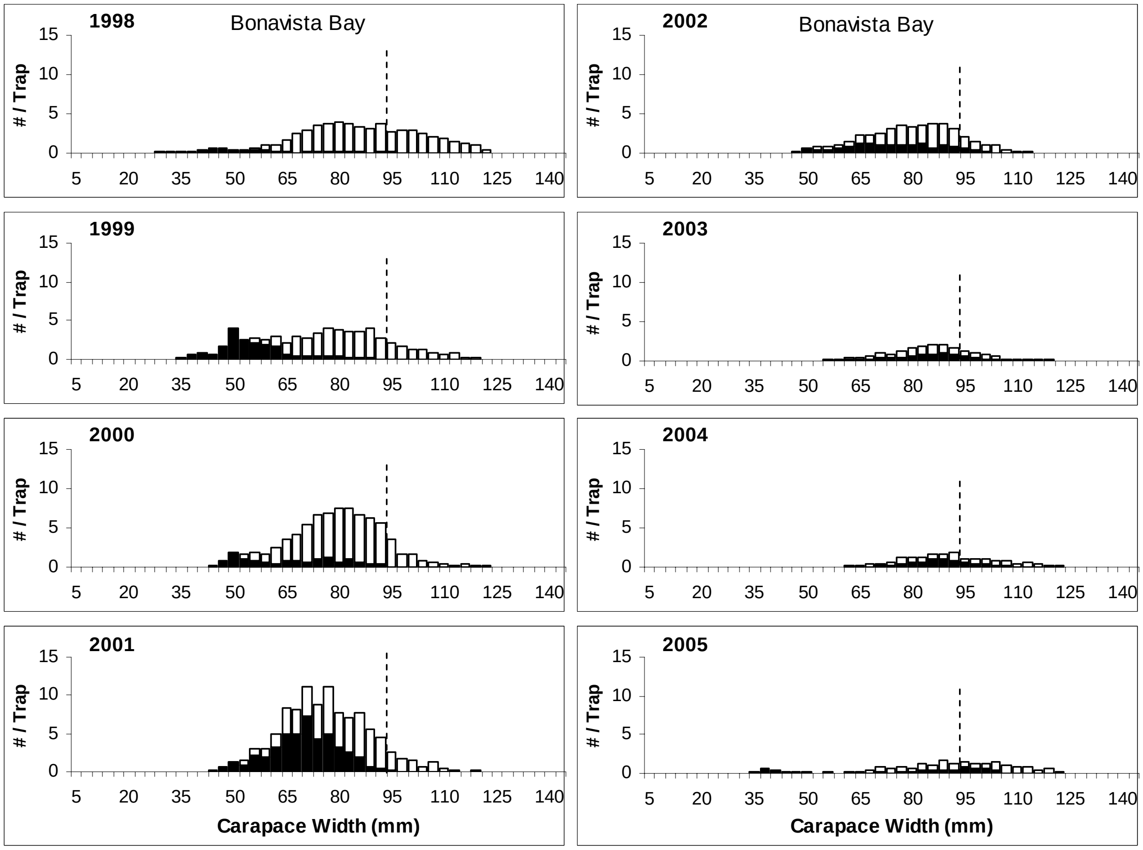

Figure 87. Male size composition from small-meshed traps by Year from inshore summer trap surveys in Bonavista Bay; adolescents (small-clawed) in black vs. adults (large-clawed) in white.

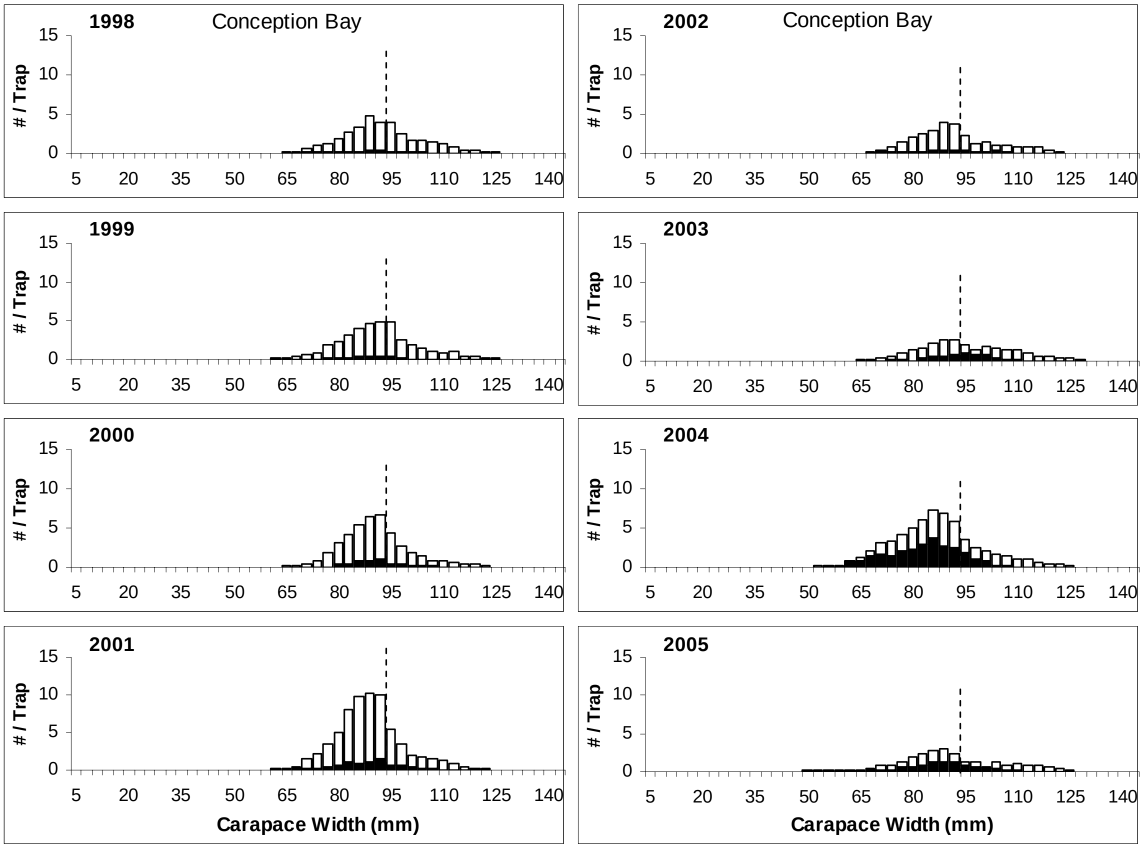

Figure 88. Male size composition from small-meshed traps by Year from inshore fall trap surveys in Conception Bay; adolescents (small-clawed) in black vs. adults (large-clawed) in white.

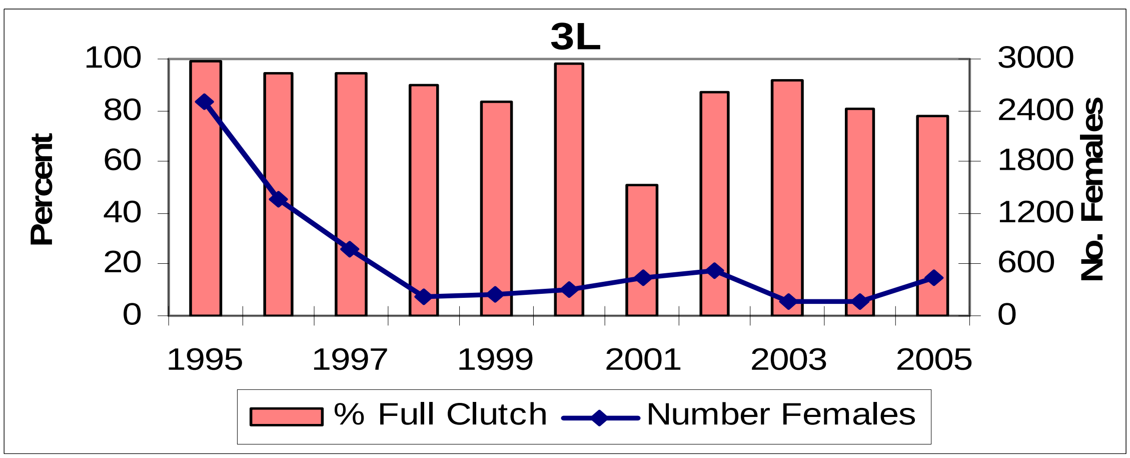

Figure 89. Trend in percent of mature females bearing full clutches of viable eggs and sample sizes in Division 3L from fall multispecies surveys.

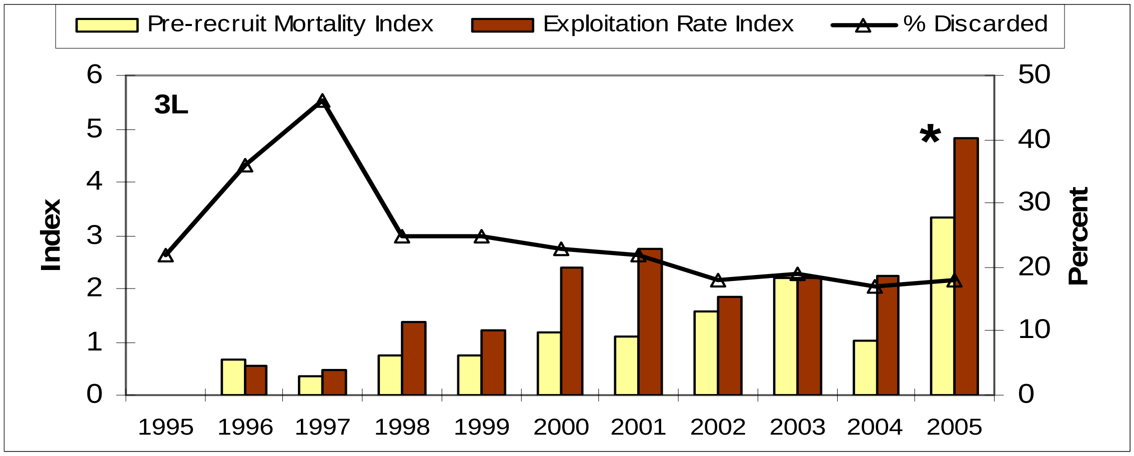

Figure 90. Trends in Division 3L mortality indices (the exploitation rate index and the pre-recruit fishing mortality index) and in the percentage of the catch discarded in the fishery.

* incomplete survey in 2004

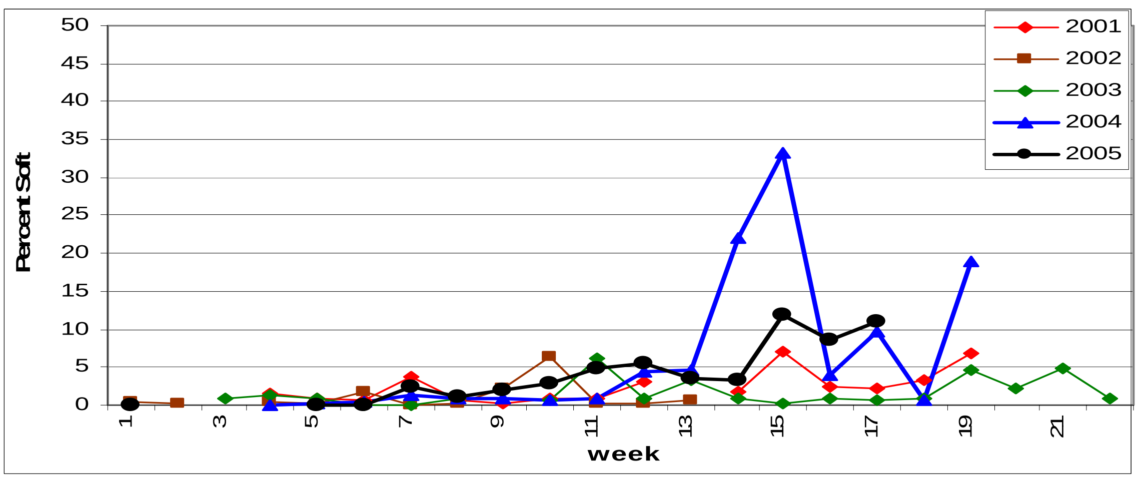

Figure 91. Seasonal trends (from April 01) in the percentage of legal-sized crabs that are soft-shelled by Year (2001-05), from at-sea sampling by observers in Division 3L.

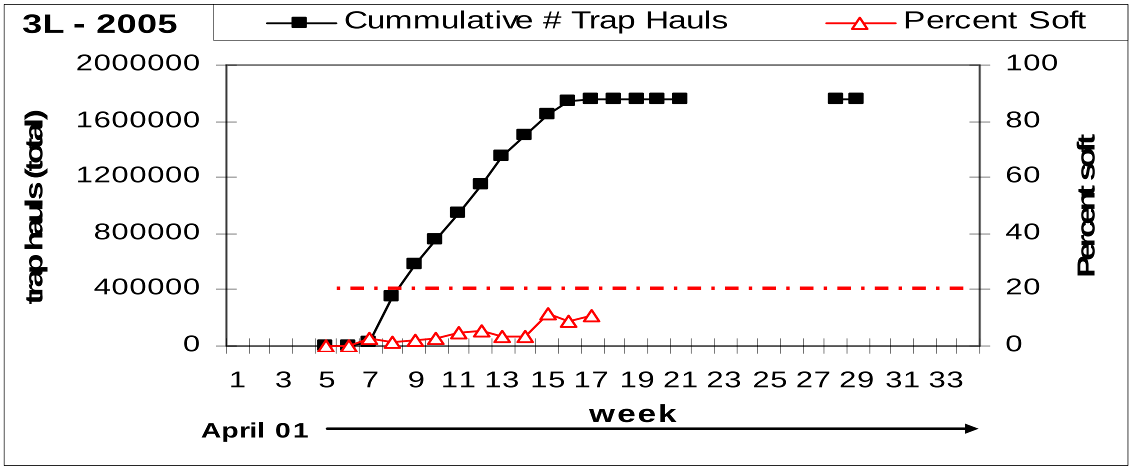

Figure 92. Cumulative distribution of weekly fishing effort in Division 3L during 2005 from logbooks in relation to weekly percentage of soft-shelled crabs from at-sea sampling by observers.

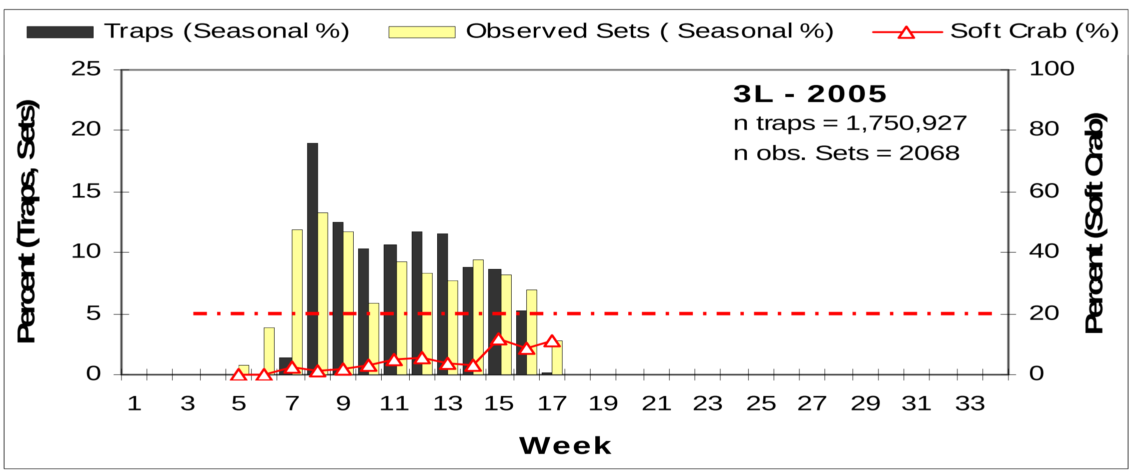

Figure 93. Distribution of Division 3L total fishing effort throughout the 2005 fishery and of effort from observed sets in relation to weekly percentage of soft-shelled crabs from at-sea sampling.

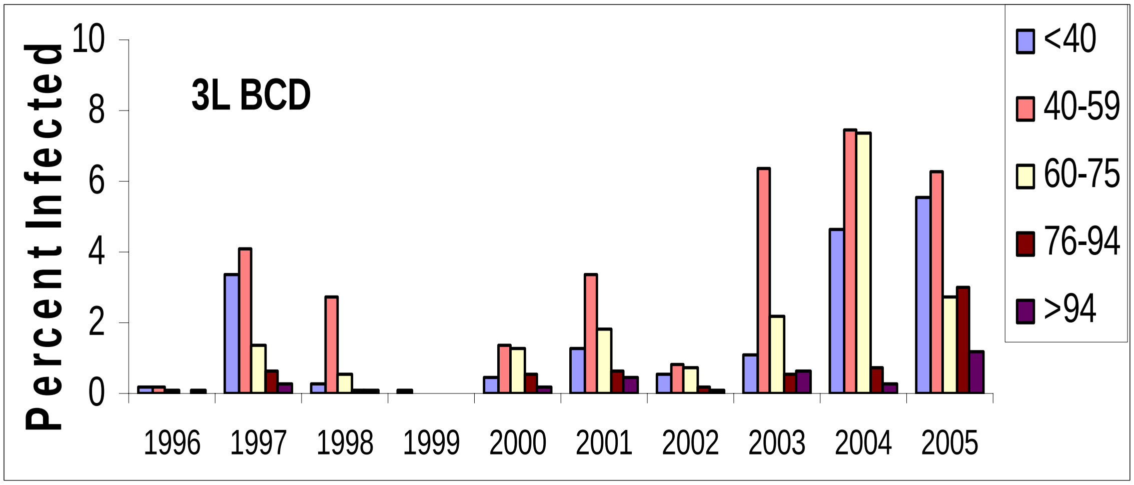

Figure 94. Trends in prevalence of BCD in Division 3L new-shelled males by size group from multispecies surveys.

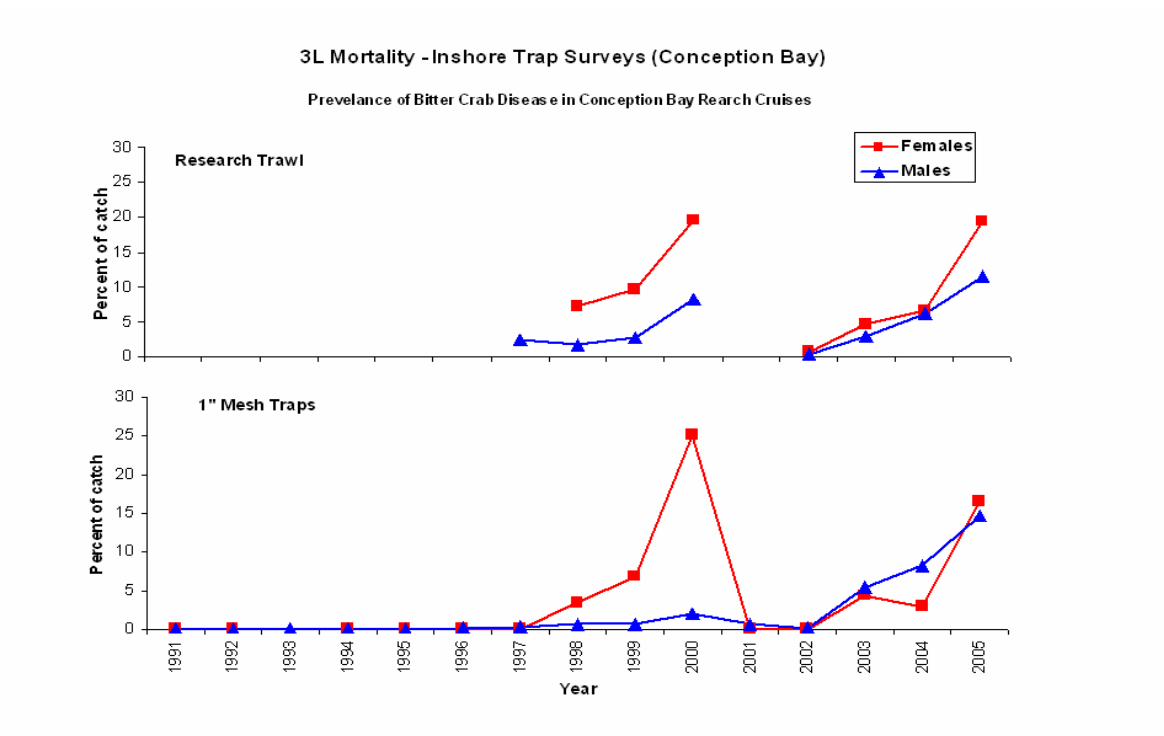

Figure 95. Trends in prevalence of BCD by sex from fall surveys in Conception Bay.

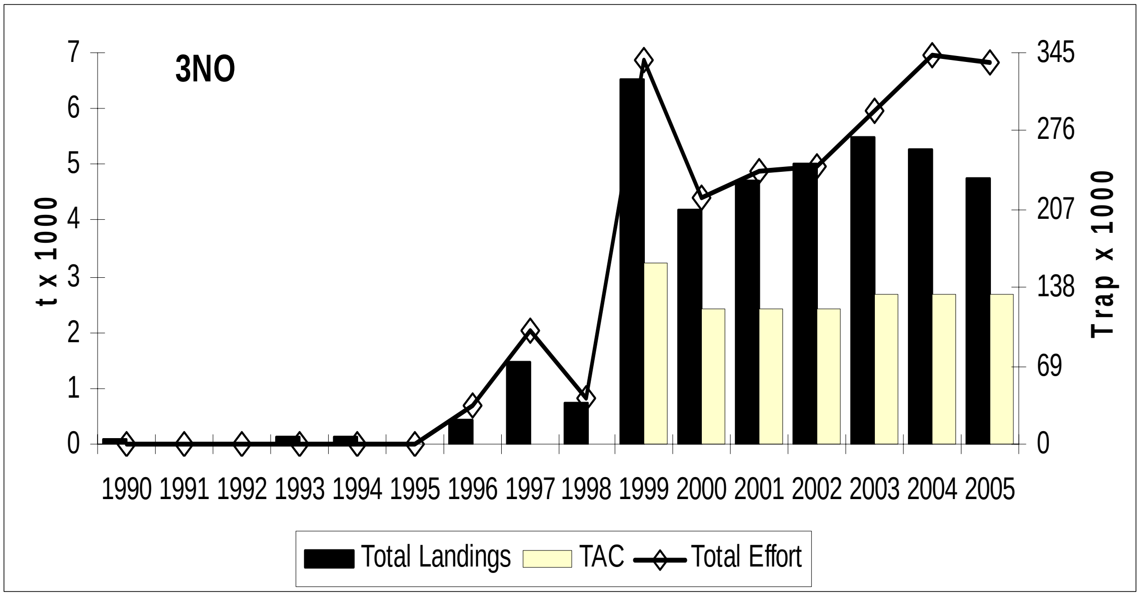

Figure 96. Trends in Division 3NO landings, TAC, and fishing effort.

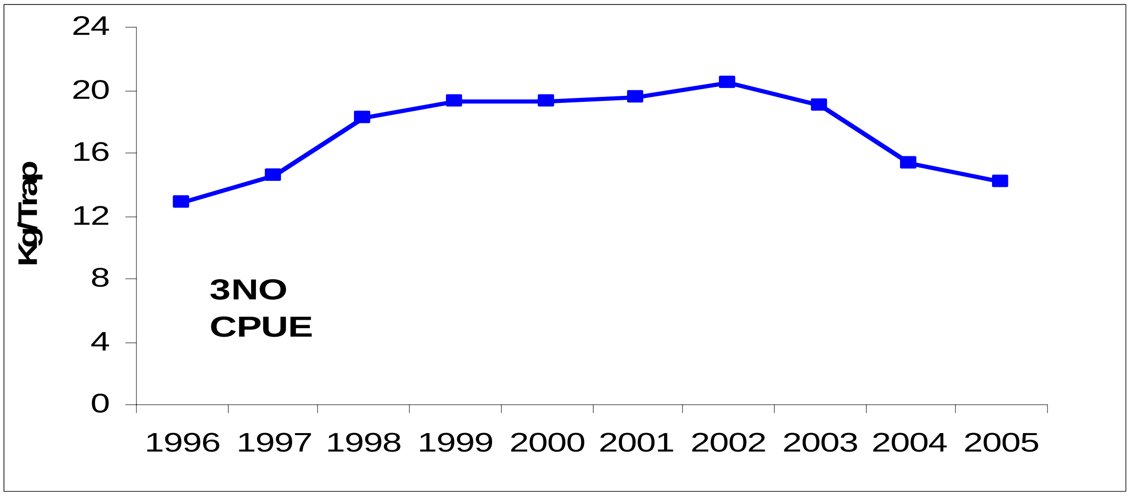

Figure 97. Trends in Division 3NO commercial CPUE.

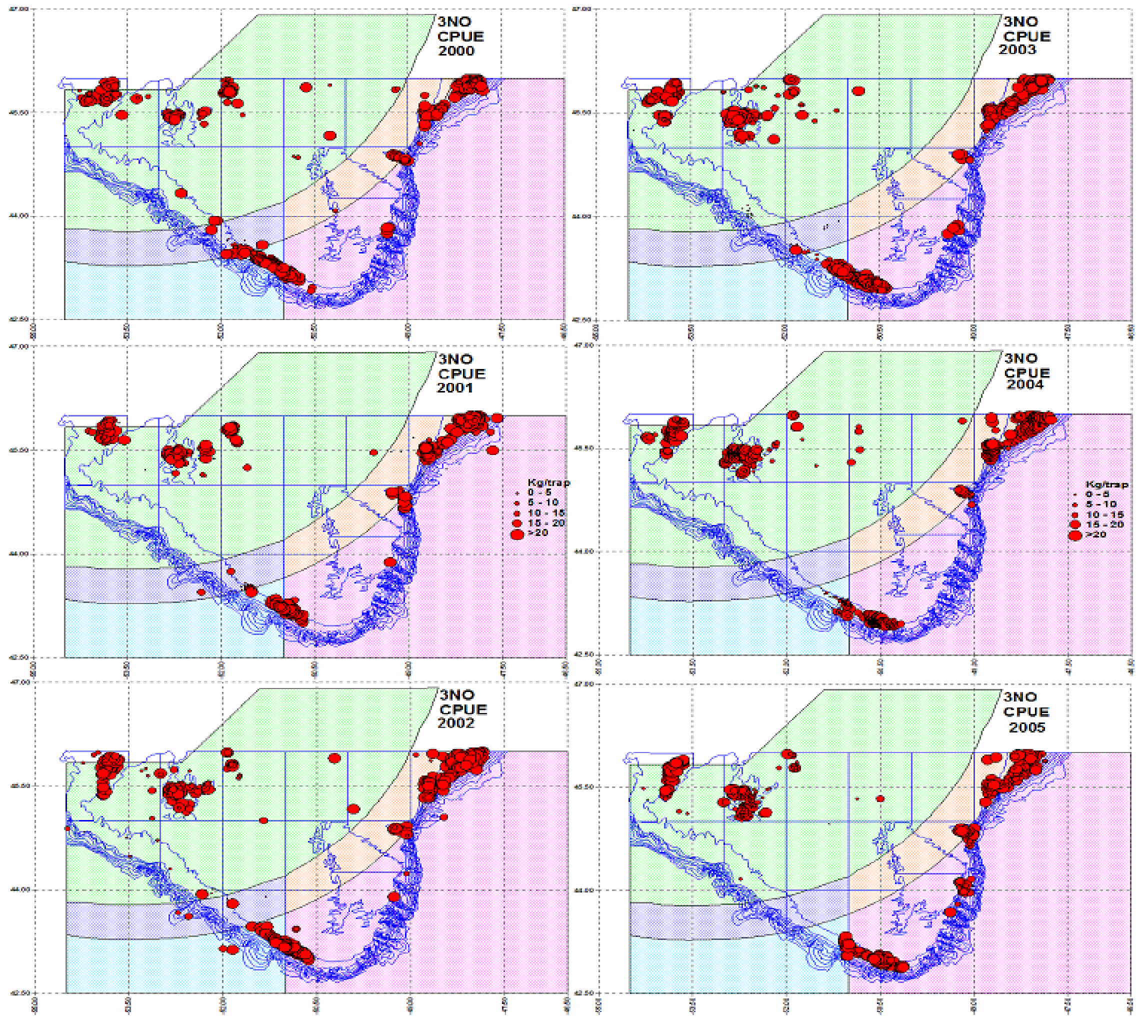

Figure 98. Spatial distribution of Division 3NO commercial CPUE by Year.

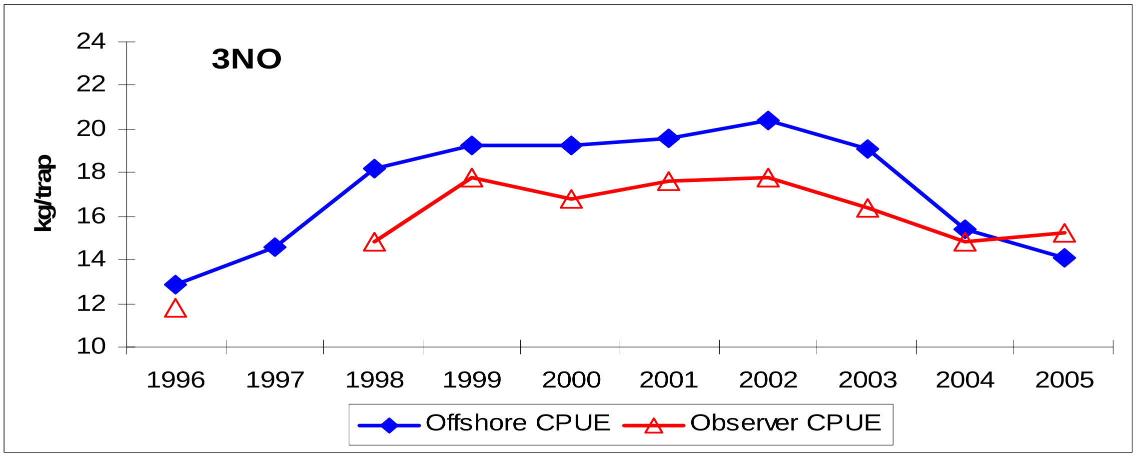

Figure 99. Trends in logbook-based CPUE vs. observer-based CPUE in the Division 3NO fishery.

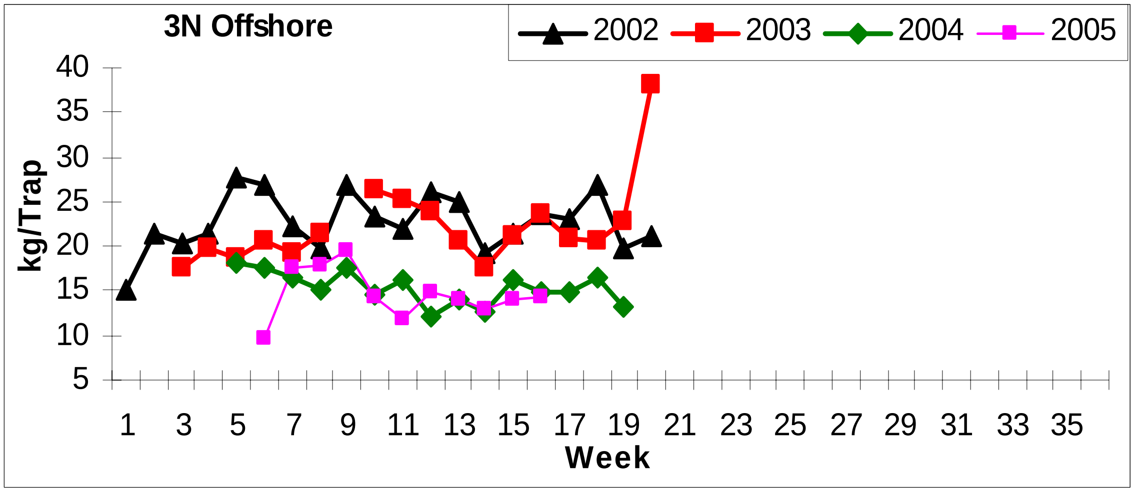

Figure 100. Seasonal trends in CPUE, by week, for Division 3N during 2002-05.

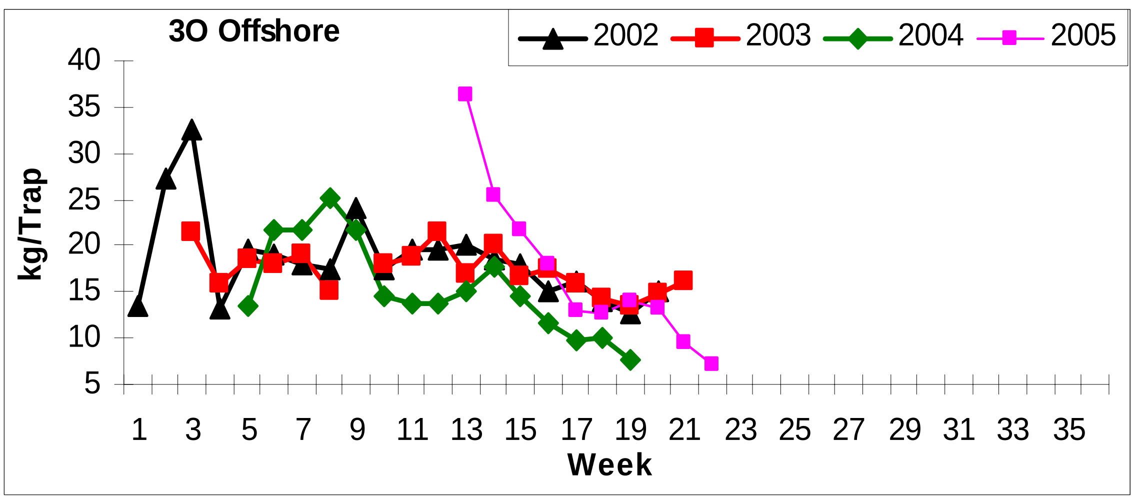

Figure 101. Seasonal trends in CPUE, by week, for Division 3O during 2002-05.

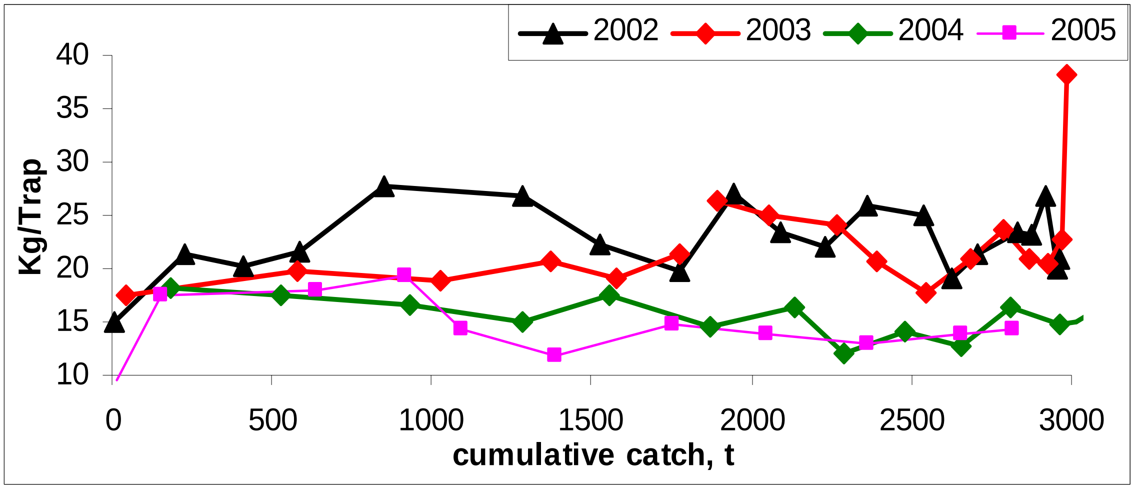

Figure 102. Seasonal trends in CPUE, in relation to cumulative catch, for Division 3N during 2002-05.

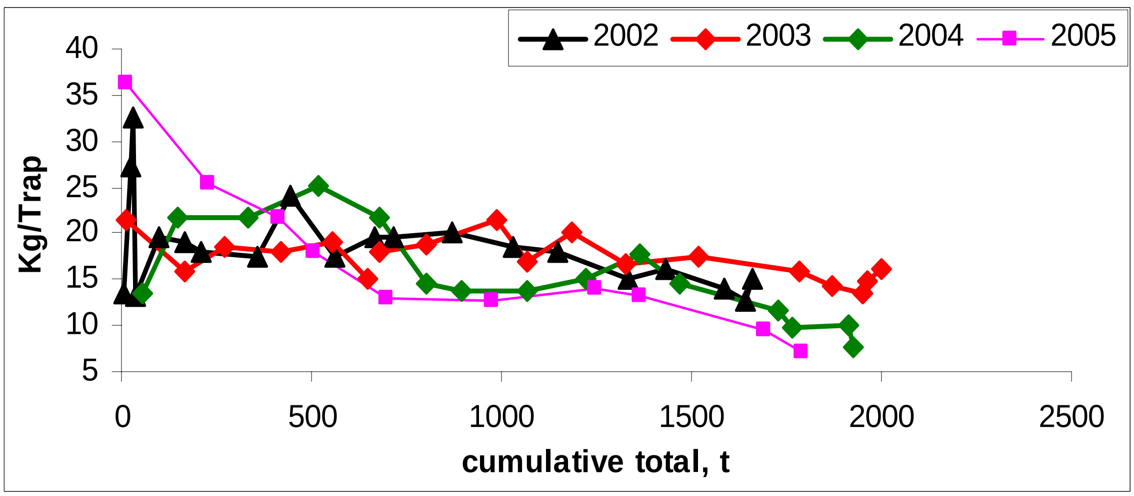

Figure 103. Seasonal trends in CPUE, in relation to cumulative catch, for Division 3O during 2002-05.

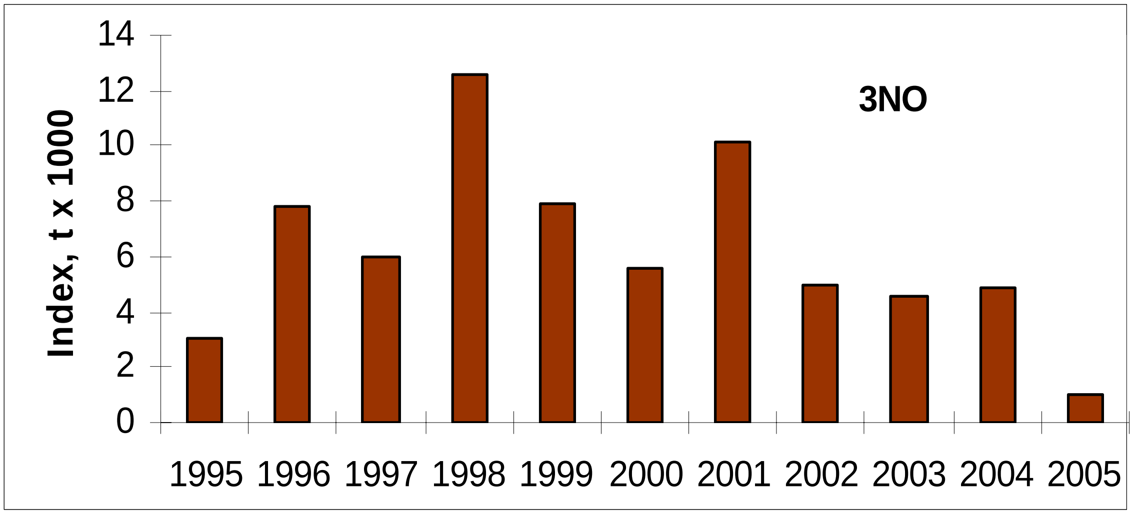

Figure 104. Trends in the Division 3NO fall multispecies survey exploitable Biomass index.

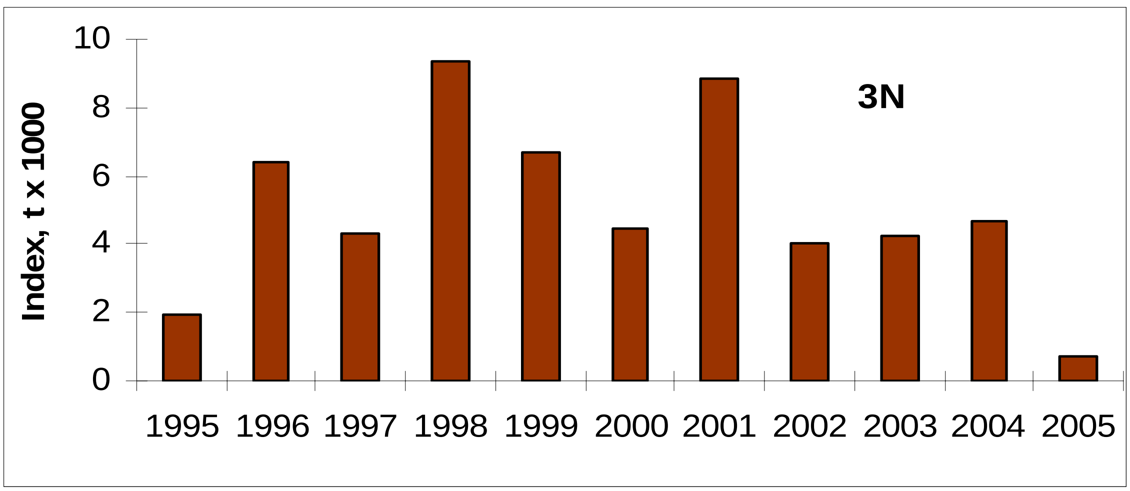

Figure 105. Trends in the Division 3N fall multispecies survey exploitable Biomass index.

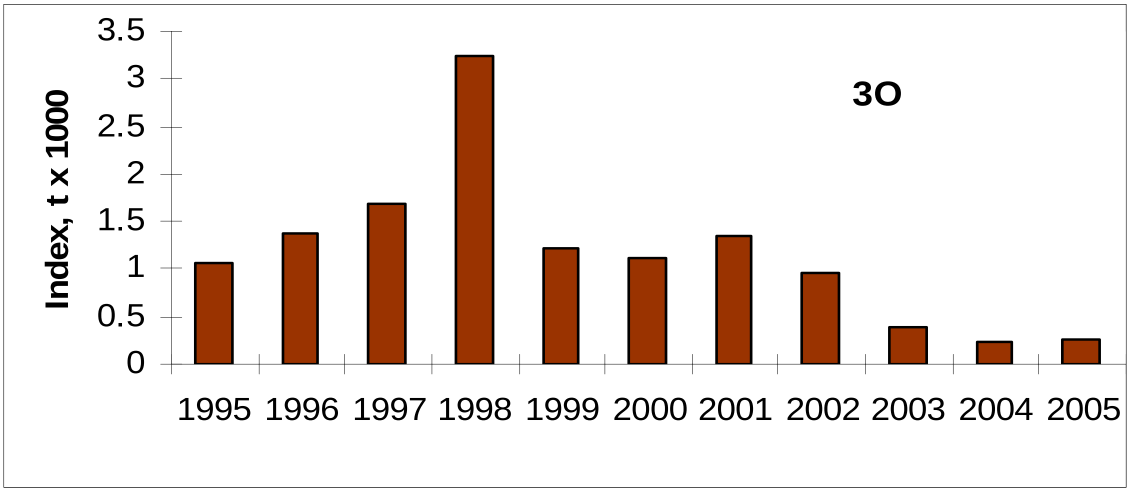

Figure 106. Trends in the Division 3O fall multispecies survey exploitable Biomass index.

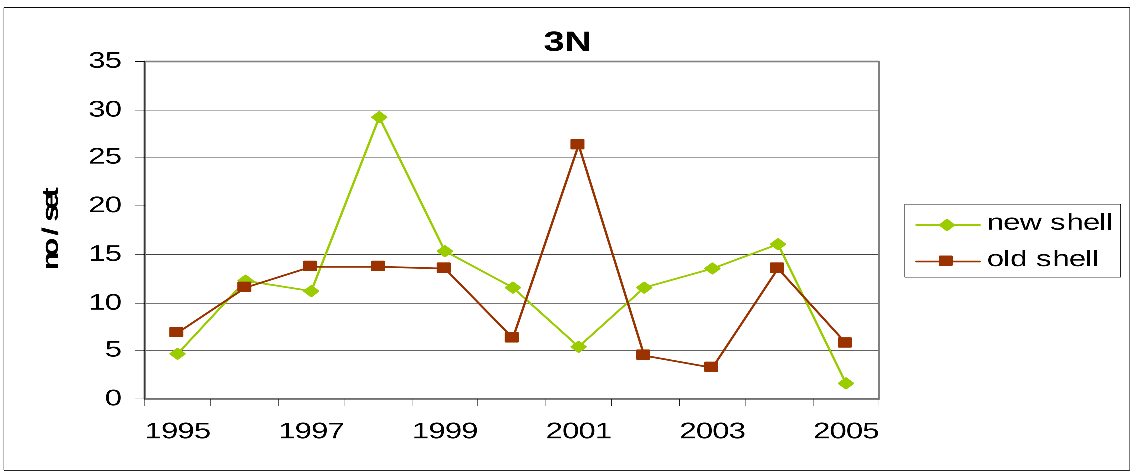

Figure 107. Trends, by shell condition, in abundance indices of legal-sized males for Division 3N from fall multispecies surveys.

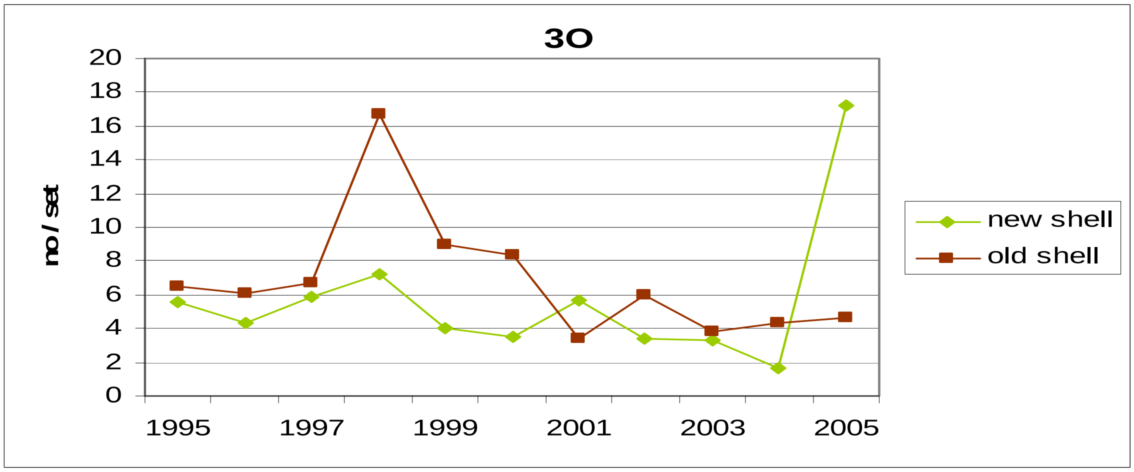

Figure 108. Trends, by shell condition, in abundance indices of legal-sized males for Division 3O from fall multispecies surveys.

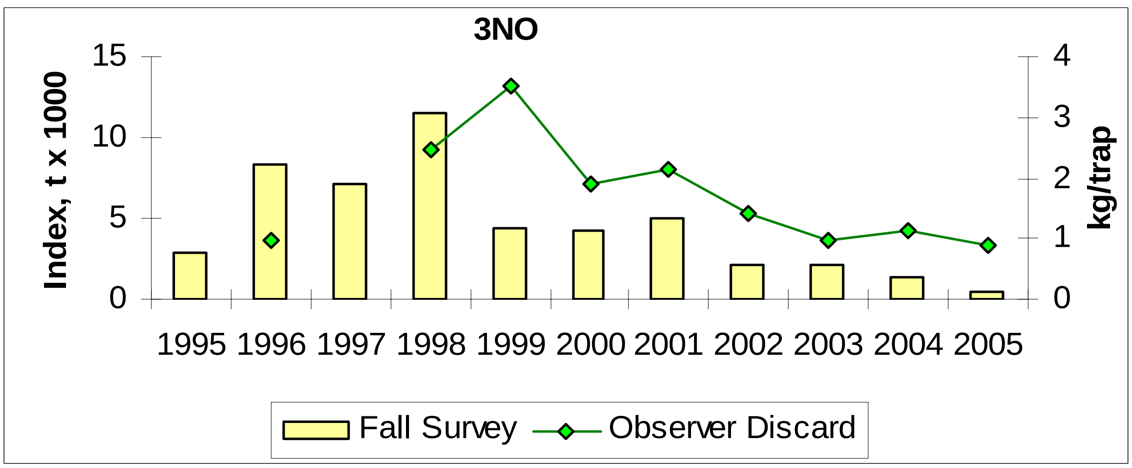

Figure 109. Trends in the Division 3NO fall multispecies survey pre-recruit Biomass index and the observer discard catch rate index.

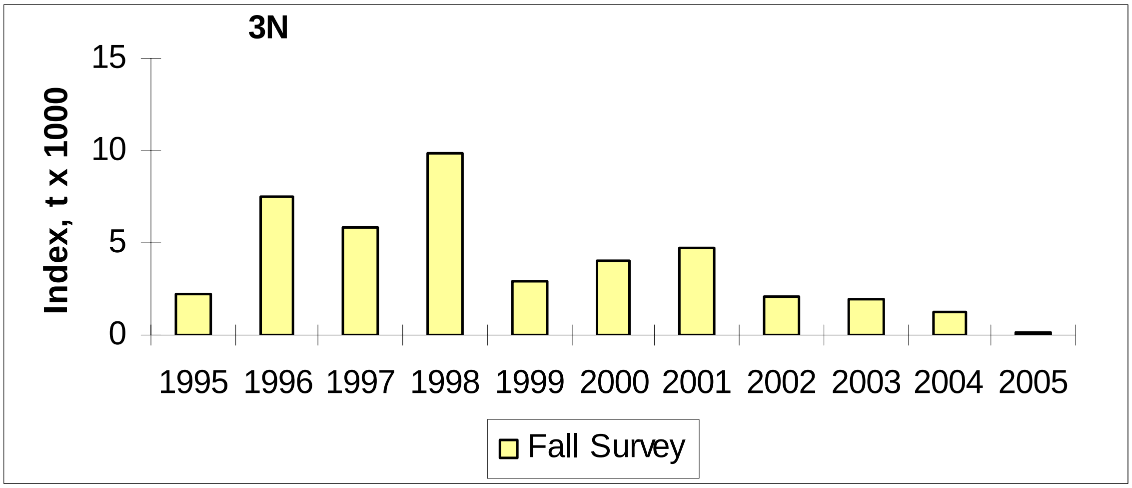

Figure 110. Trends in the Division 3N fall multispecies survey pre-recruit Biomass index.

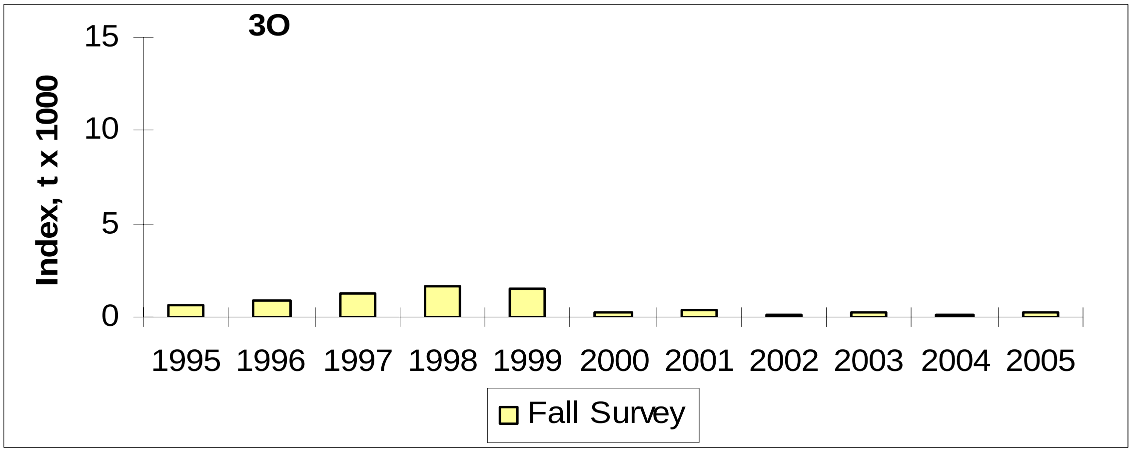

Figure 111. Annual trends in the Division 3O fall multispecies survey pre-recruit Biomass index.

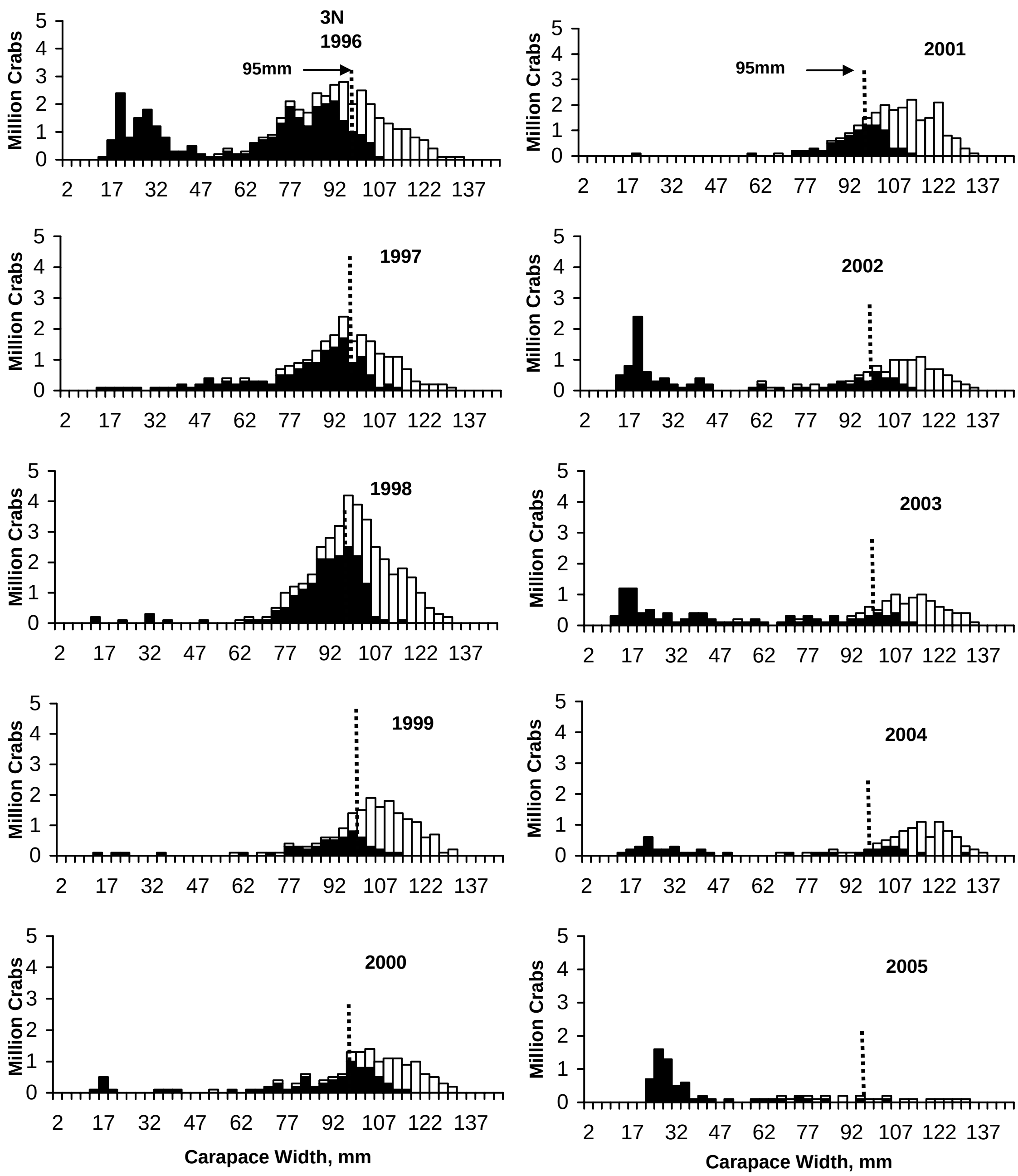

Figure 112. Truncated distribution of abundance (index) by carapace width for Division 3N juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

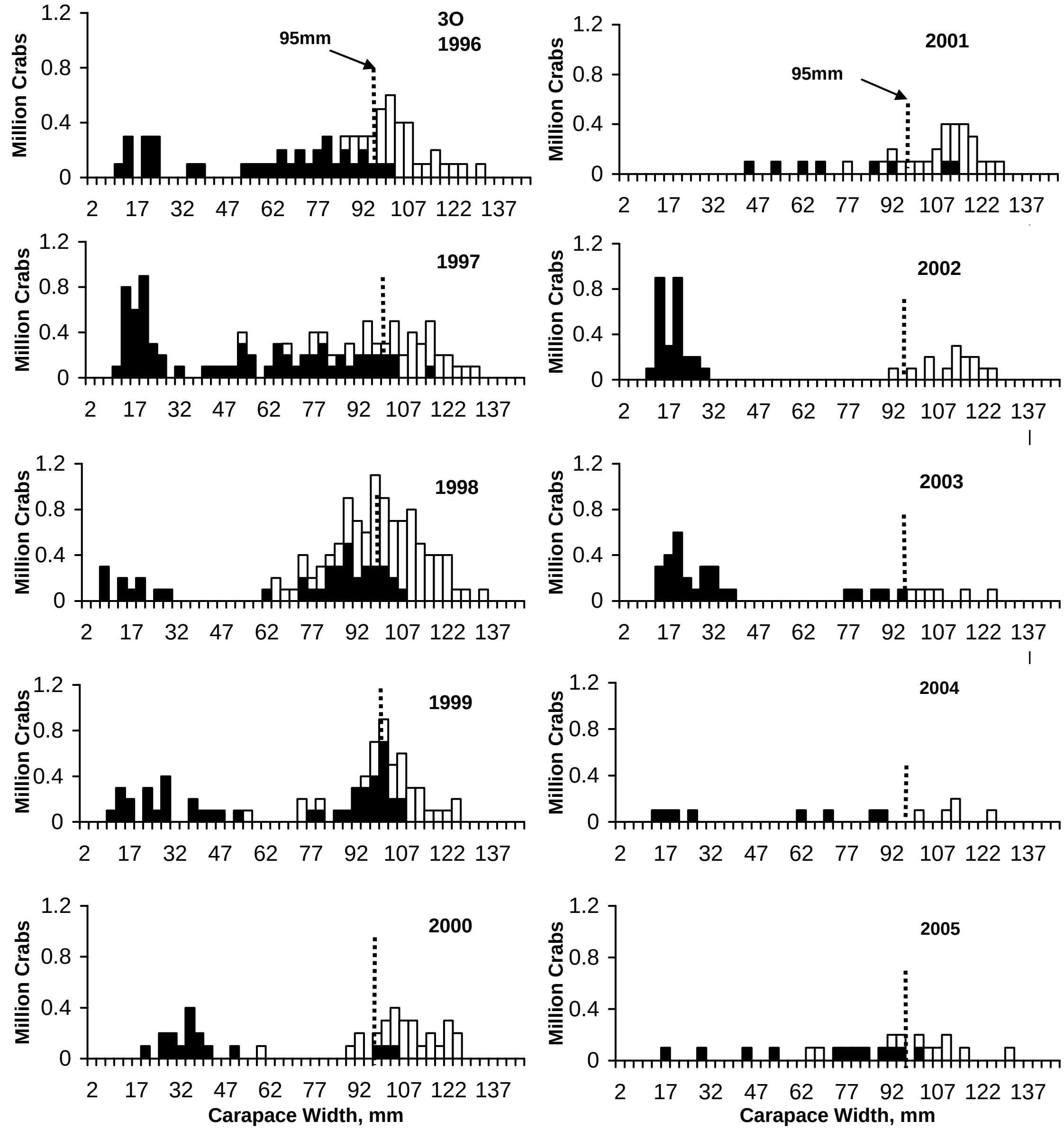

Figure 113. Truncated distribution of abundance (index) by carapace width for Division 3O juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

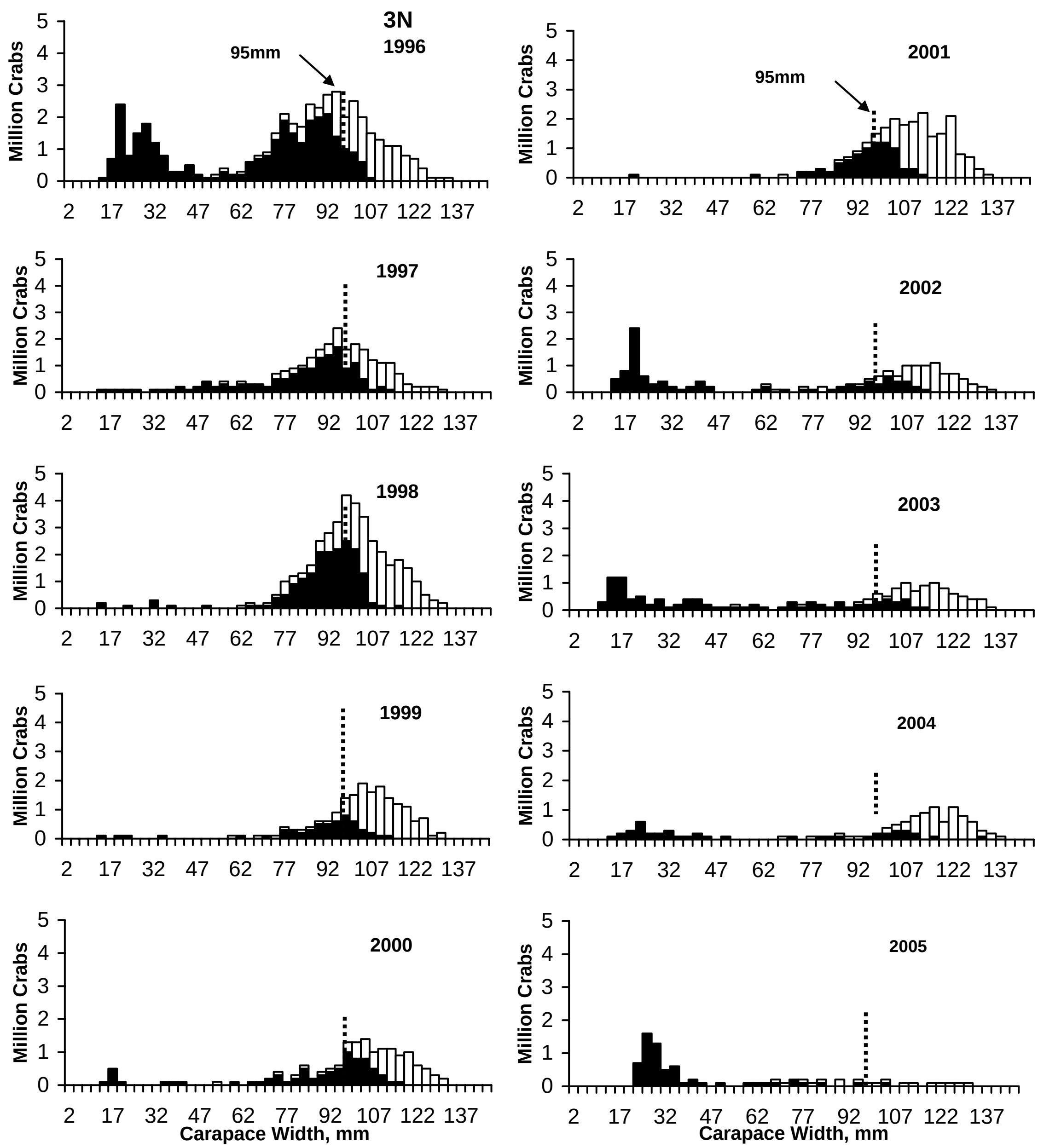

Figure 114. Distribution of abundance (index) by carapace width for Division 3N juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

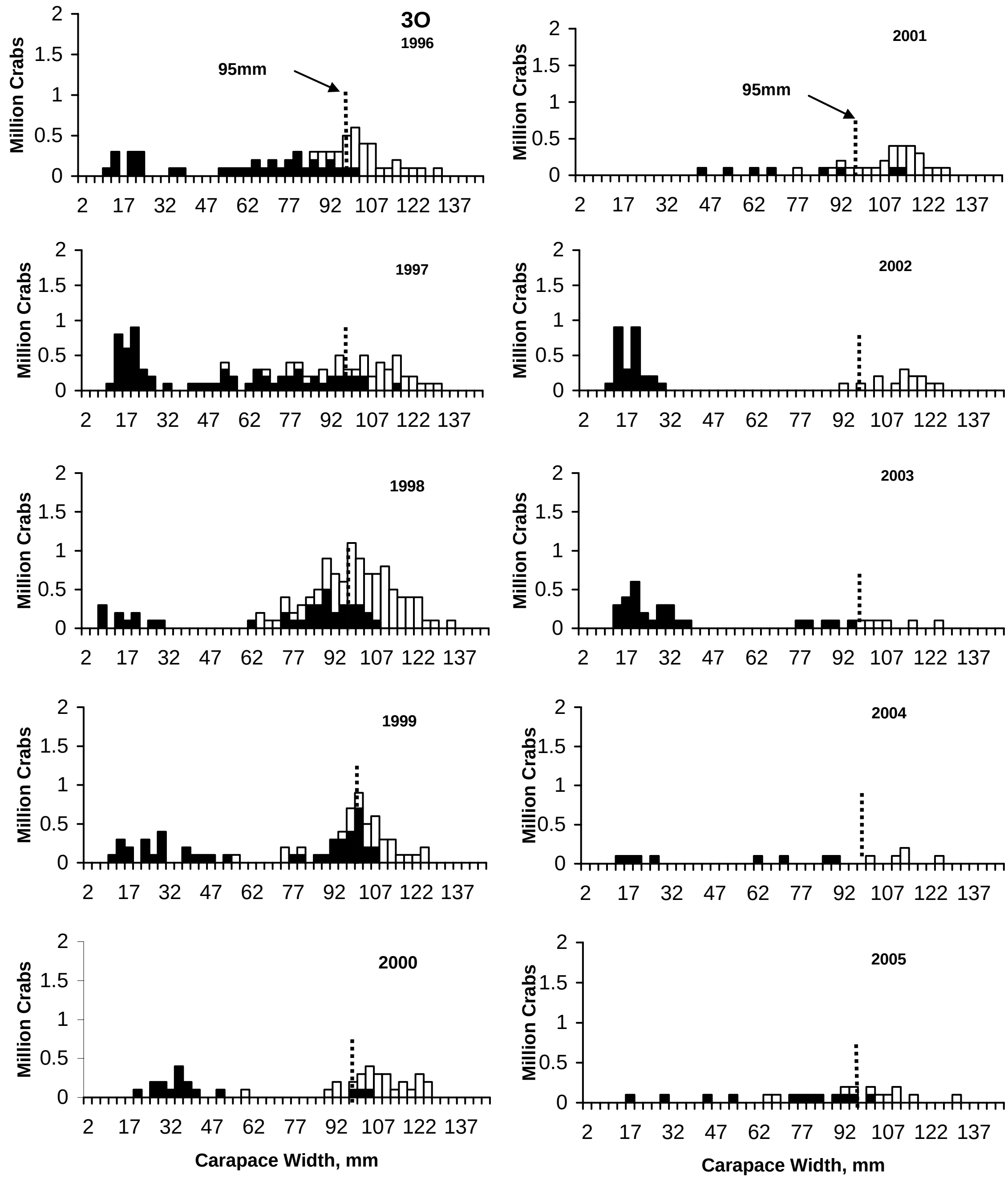

Figure 115. Distribution of abundance (index) by carapace width for Division 3O juveniles plus adolescents (dark bars) versus adults (open bars) from fall multispecies surveys.

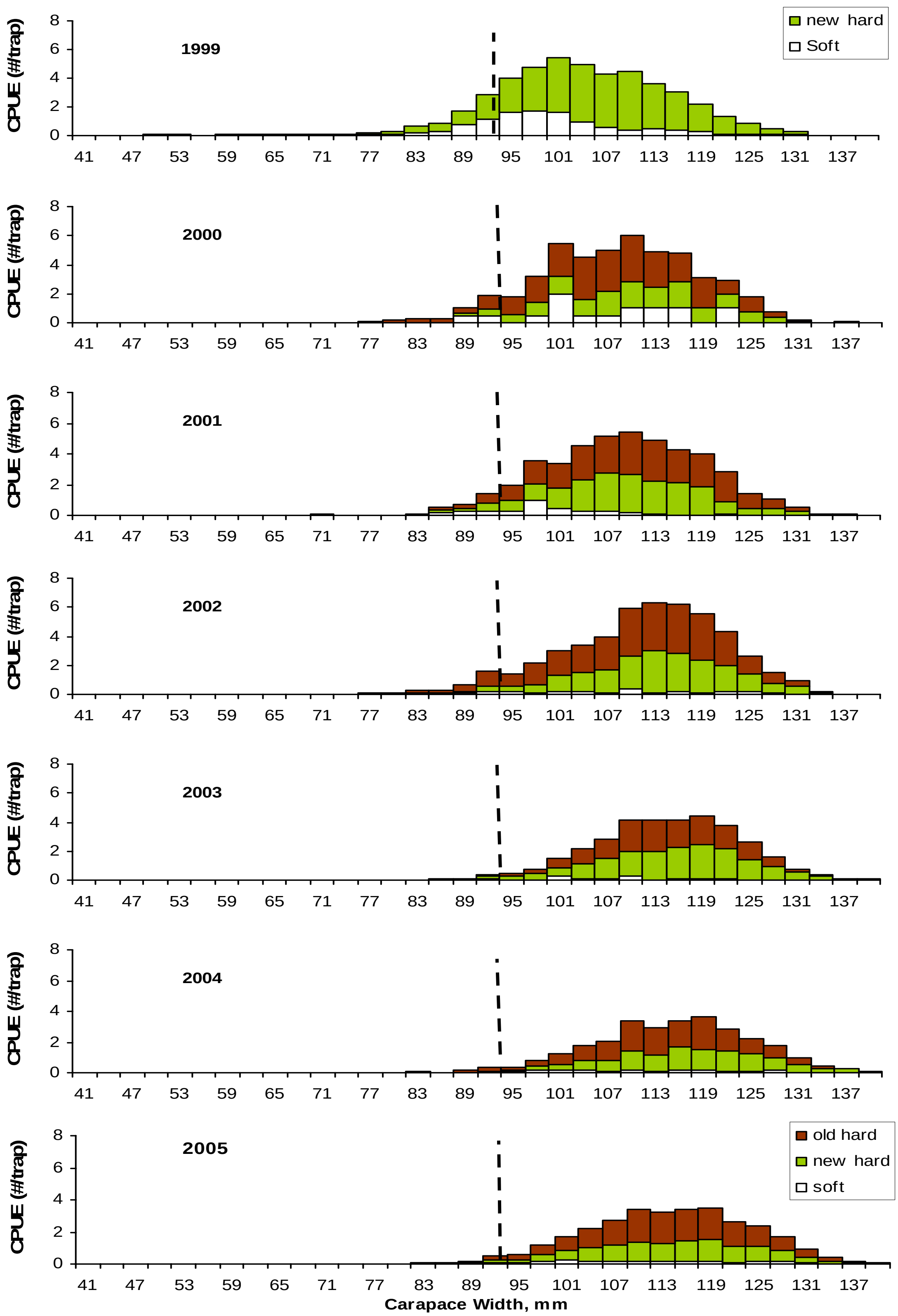

Figure 116. Trends in male carapace width distributions from observer at-sea sampling for Division 3N.

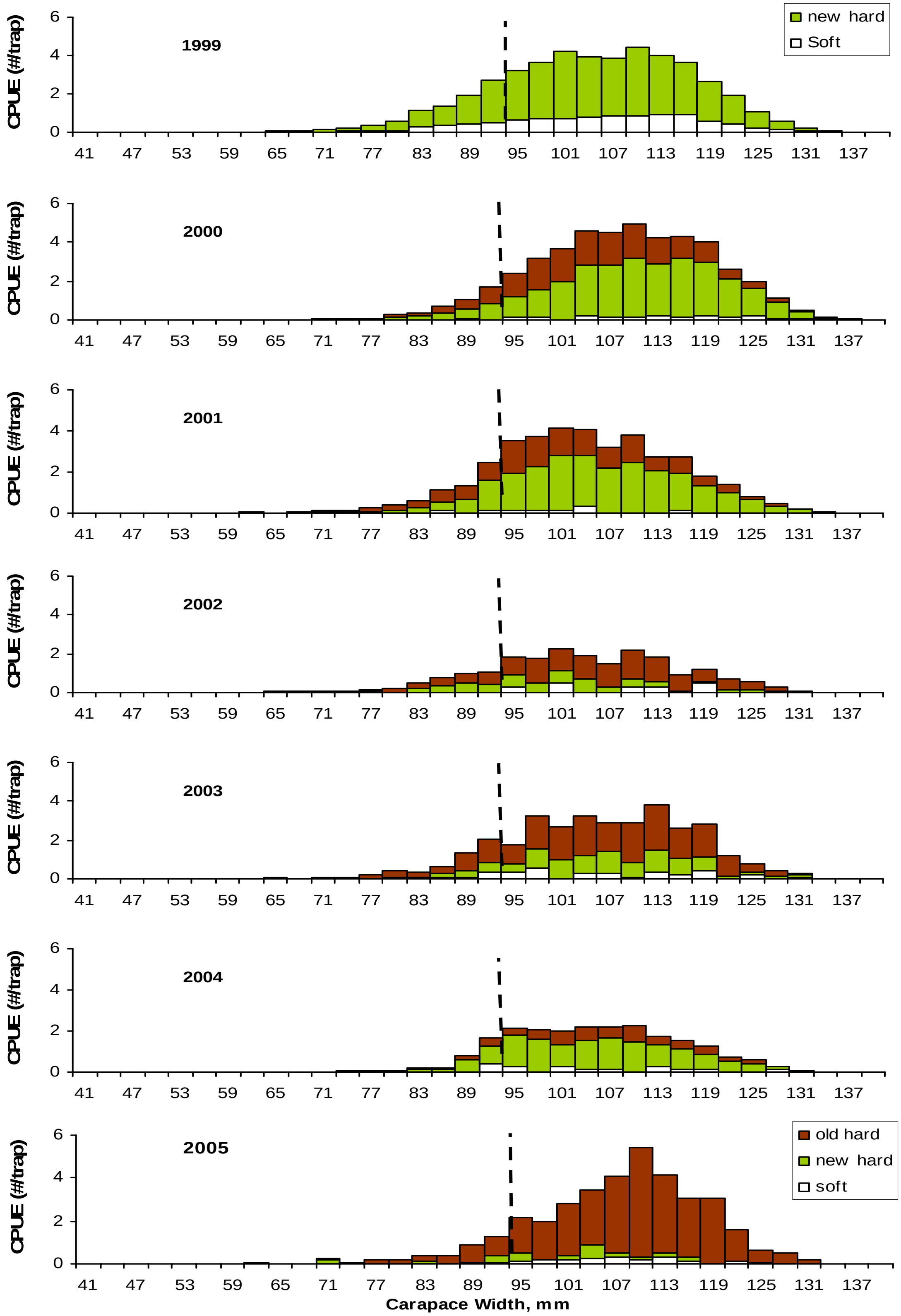

Figure 117. Trends in male carapace width distributions from observer at-sea sampling for Division 3O.

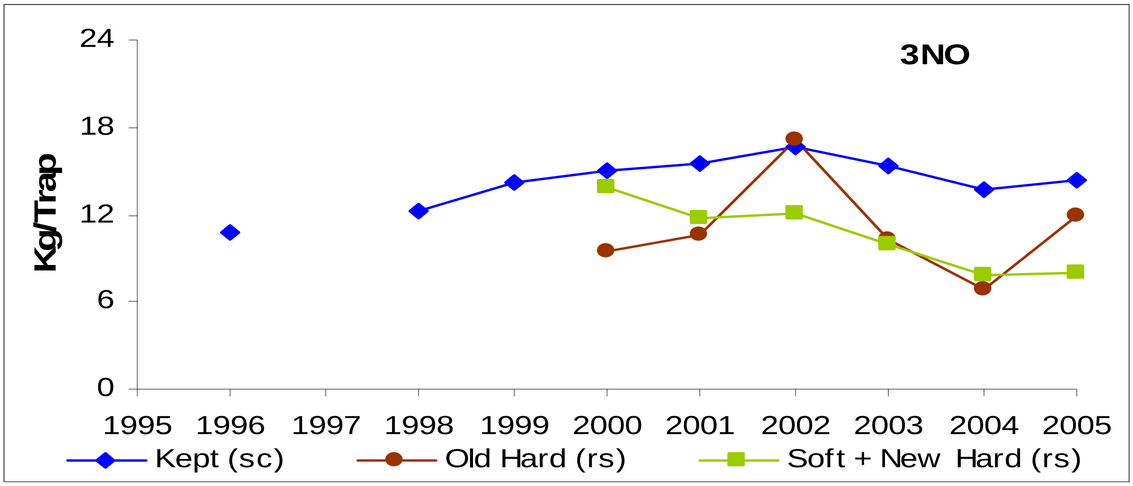

Figure 118. Trends in Division 3NO observer catch rates of exploitable crabs since 1996 from set and catch records and of legal-sized crabs by shell category since 2000 from at-sea sampling

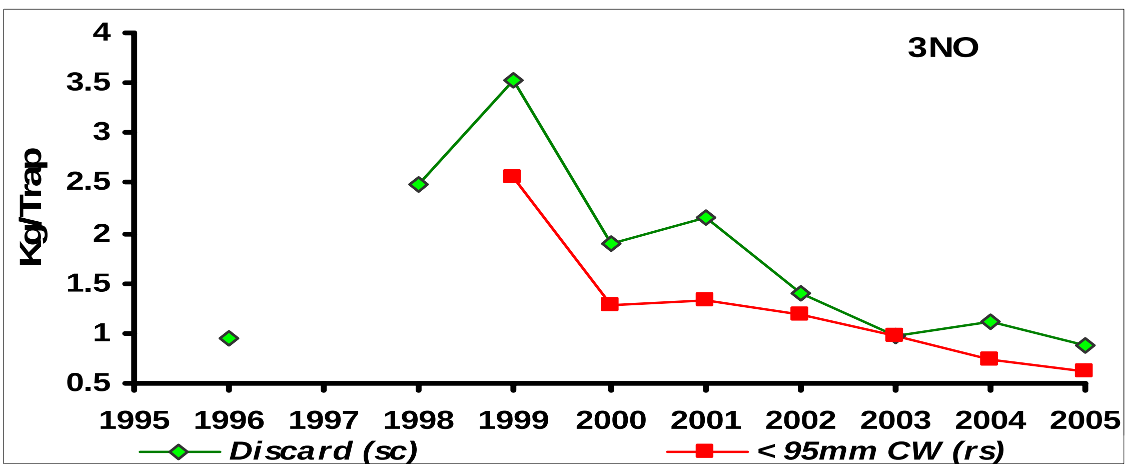

Figure 119. Trends in Division 3NO observer catch rates of total discards since 1996 from set and catch records and of sub-legal sized crabs since 1999 from at-sea sampling.

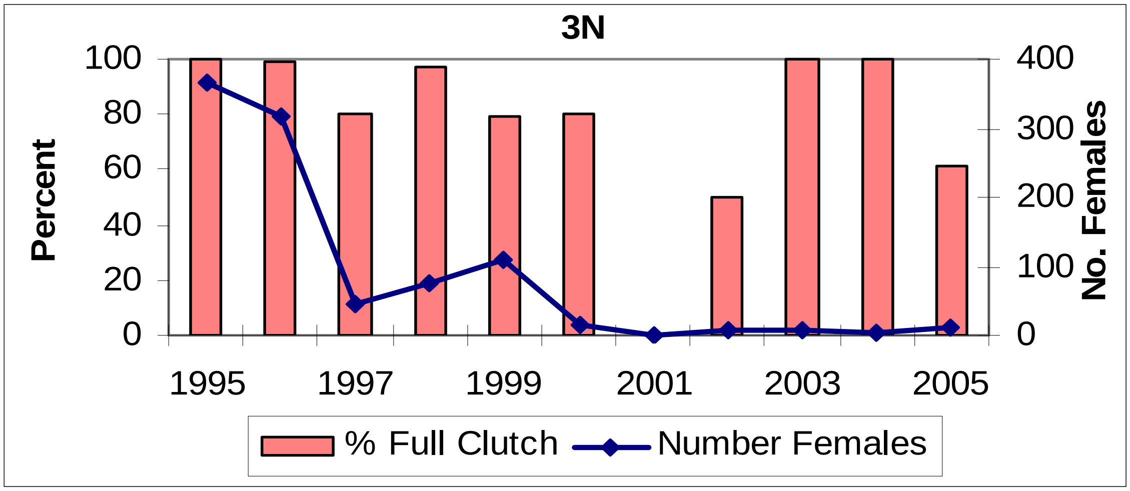

Figure 120. Trends in percent of mature females bearing full clutches of viable eggs and sample sizes in Division 3N from fall multispecies surveys.

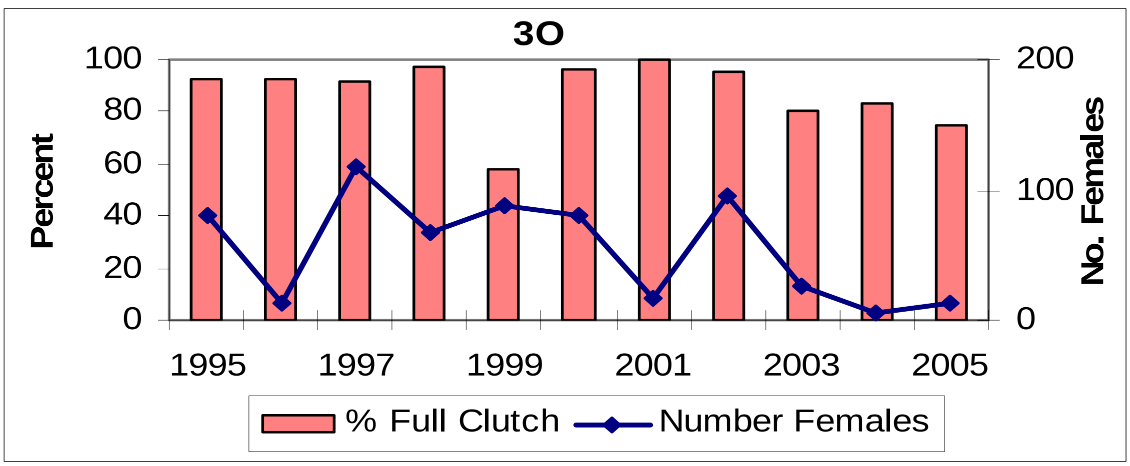

Figure 121. Trends in percent of mature females bearing full clutches of viable eggs and sample sizes in Division 3O from fall multispecies surveys.

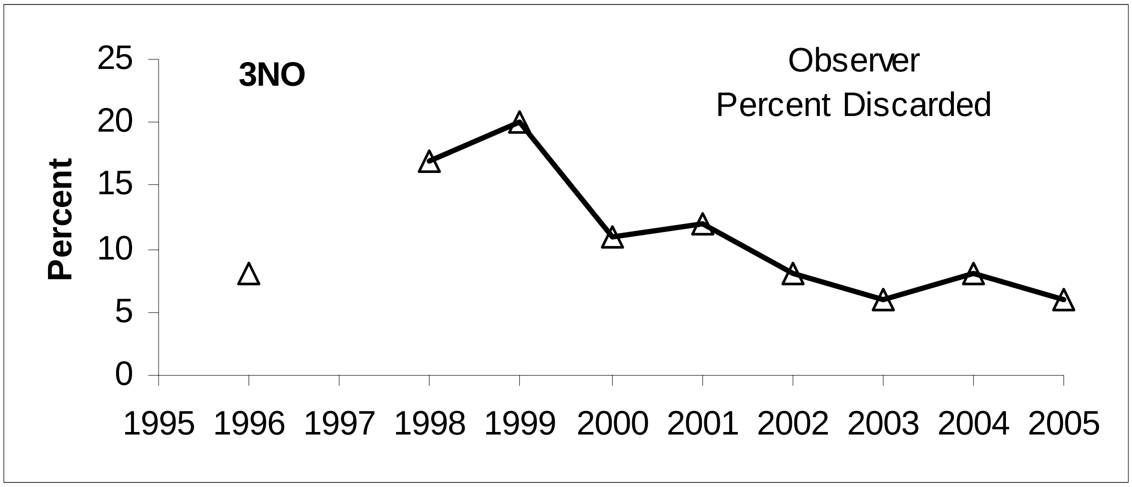

Figure 122. Trends in percentage of the catch discarded in the Division 3NO fishery.

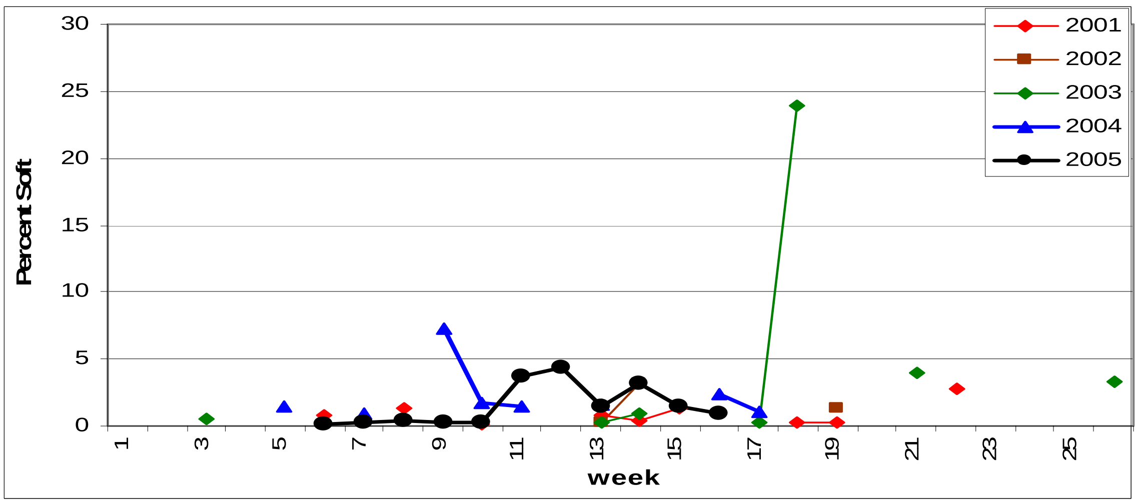

Figure 123. Seasonal trends (from April 01) in the percentage of legal-sized crabs that are soft-shelled by Year (2001-05), from at-sea sampling by observers in Division 3N.

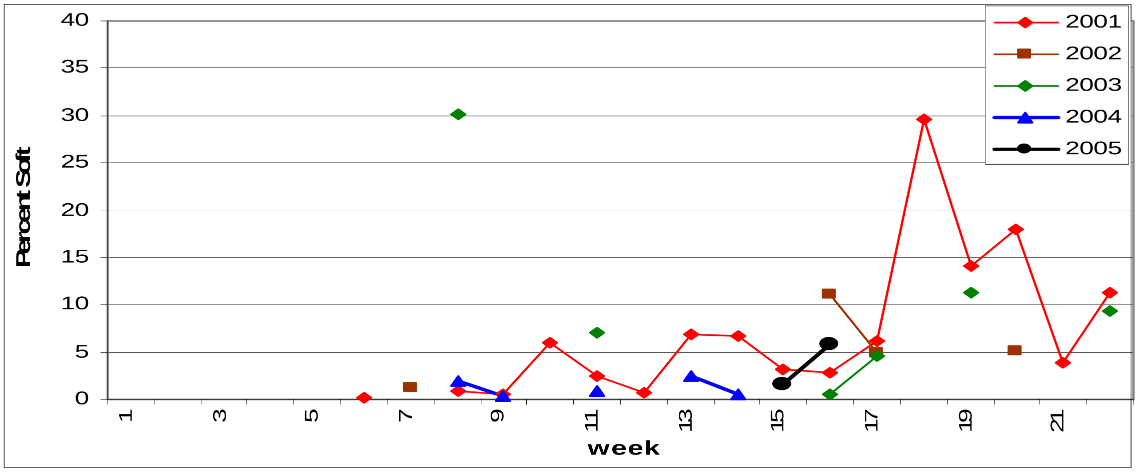

Figure 124. Seasonal trends (from April 01) in the percentage of legal-sized crabs that are soft-shelled by Year (2001-05), from at-sea sampling by observers in Division 3O.

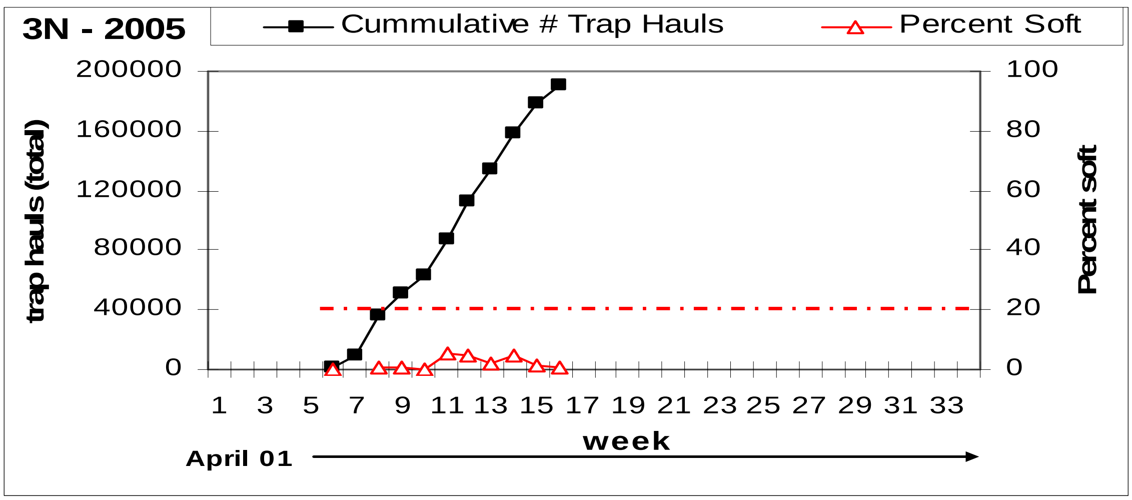

Figure 125. Cumulative distribution of weekly fishing effort in Division 3N during 2005 from logbooks in relation to weekly percentage of soft-shelled crabs from at-sea sampling by observers.

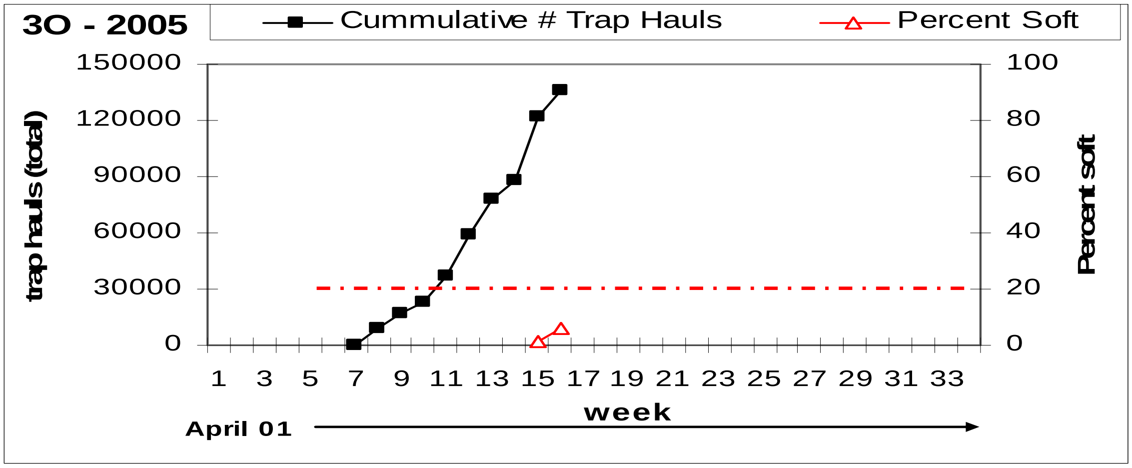

Figure 126. Cumulative distribution of weekly fishing effort in Division 3O during 2005 from logbooks in relation to weekly percentage of soft-shelled crabs from at-sea sampling by observers.

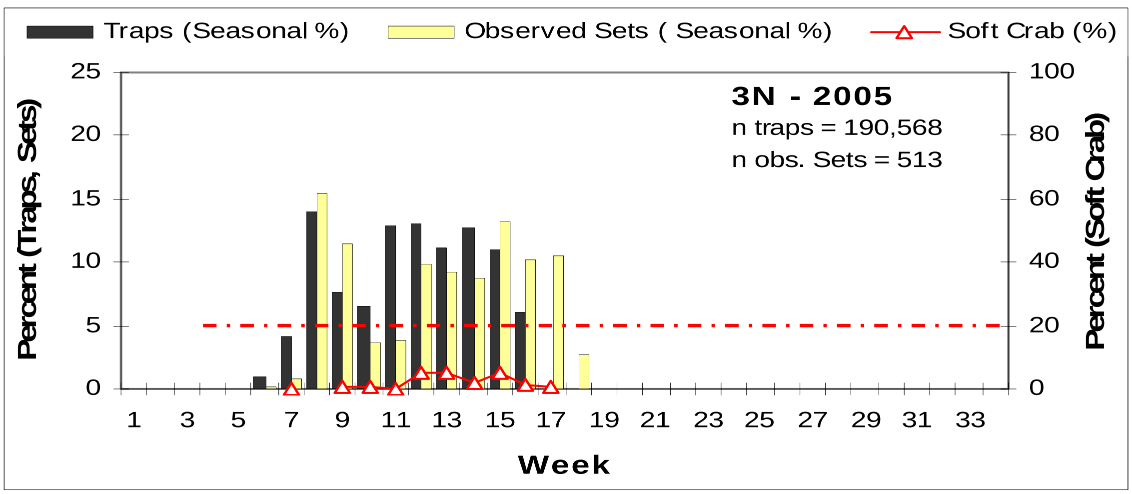

Figure 127. Distribution of Division 3N total fishing effort throughout the 2005 fishery and of effort from observed sets in relation to weekly percentage of soft-shelled crabs from at-sea sampling.

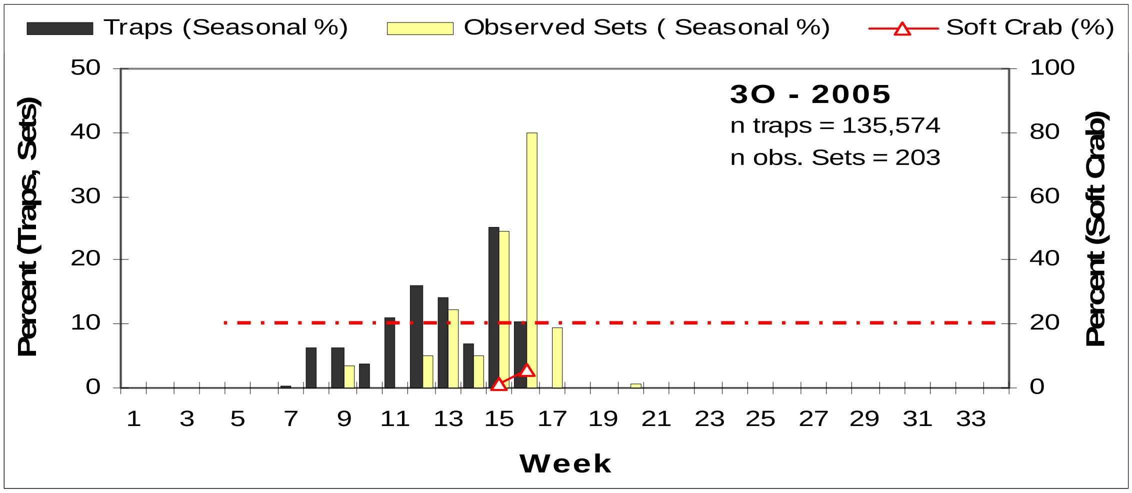

Figure 128. Distribution of Division 3O total fishing effort throughout the 2005 fishery and of effort from observed sets in relation to weekly percentage of soft-shelled crabs from at-sea sampling.

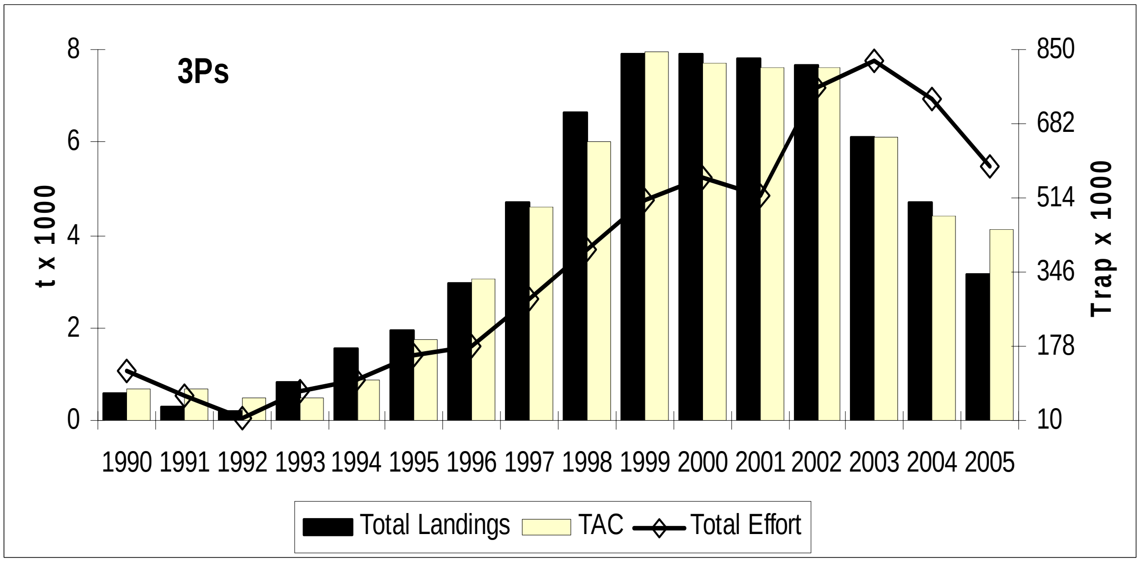

Figure 129. Trends in SubDivision 3Ps landings, TAC, and fishing effort.

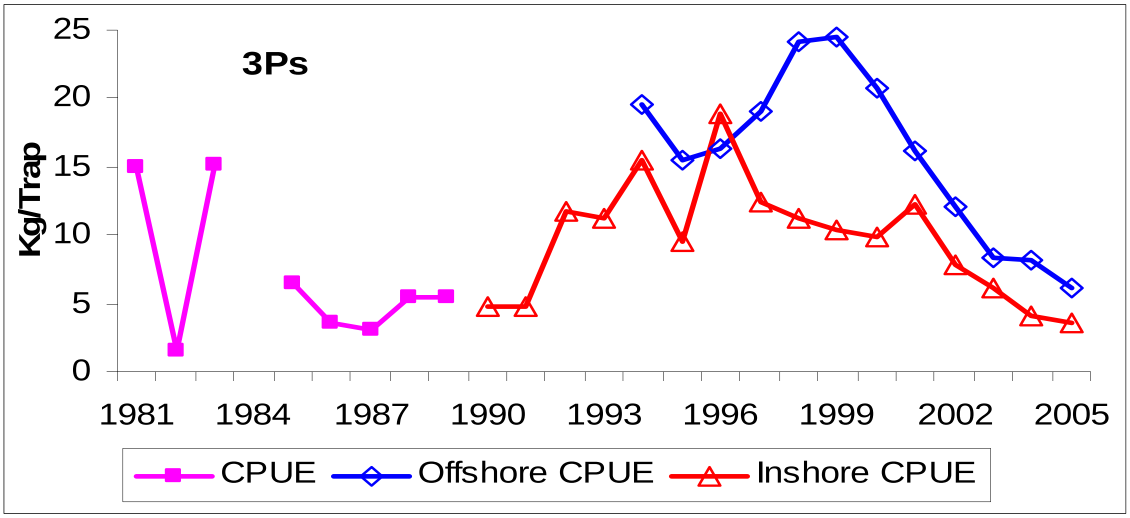

Figure 130. Trends in Division 3NO commercial CPUE.

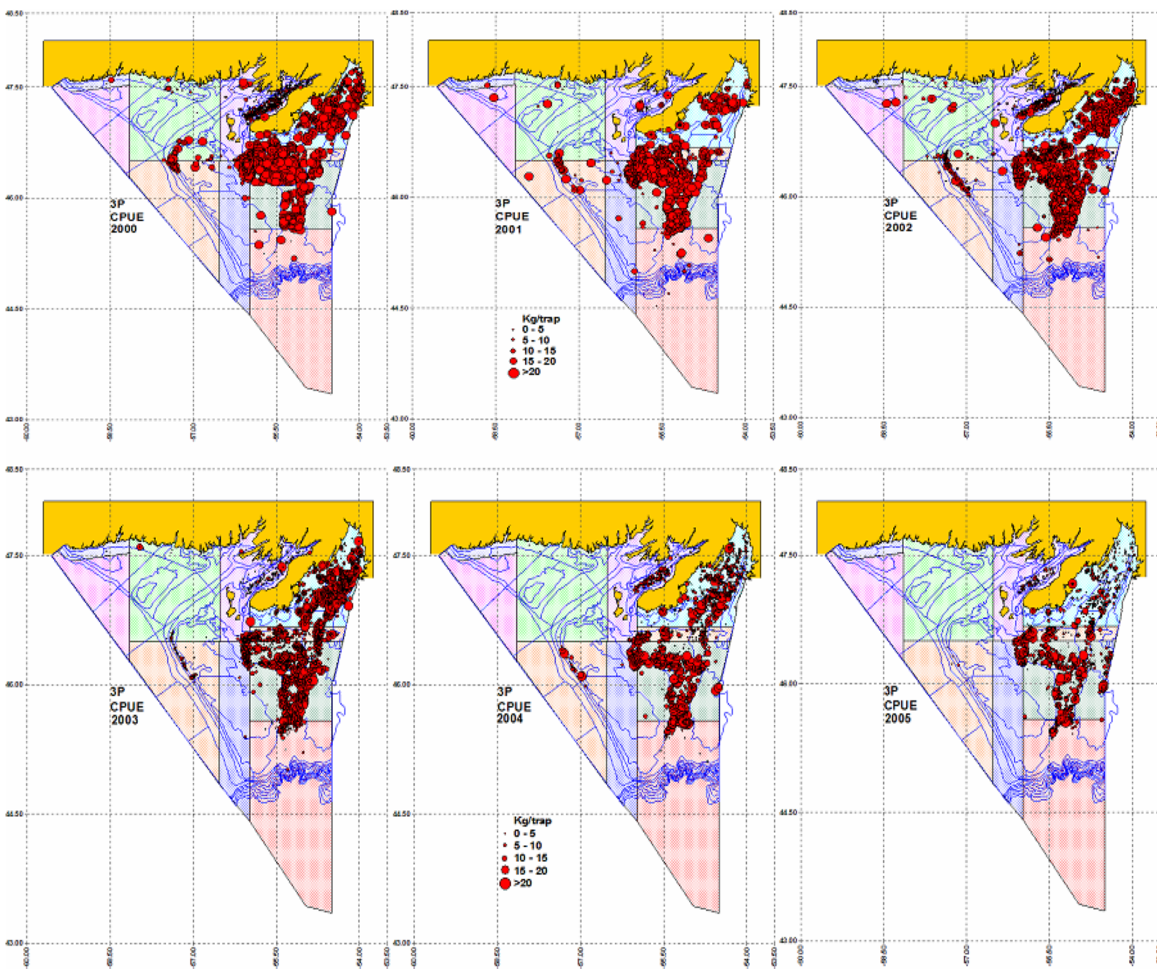

Figure 131. Spatial distribution of SubDivision 3Ps commercial CPUE by Year.

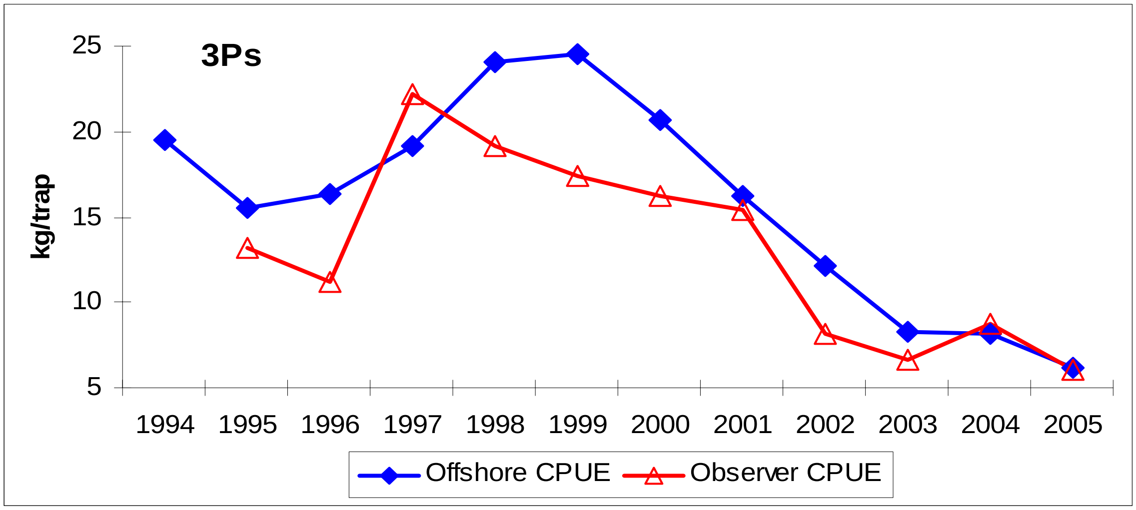

Figure 132. Trends in logbook-based CPUE vs. observer-based CPUE in the SubDivision 3Ps fishery.

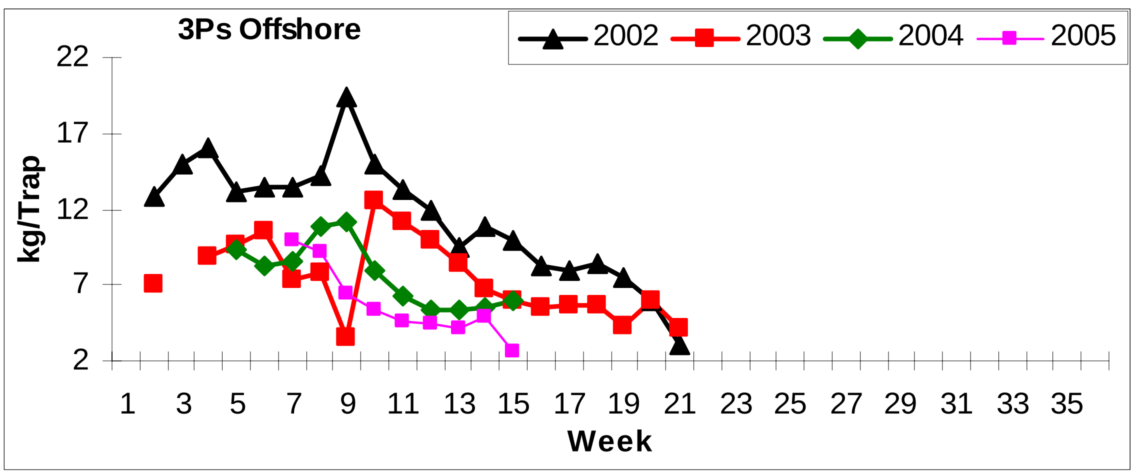

Figure 133. Seasonal trends in CPUE, by week, for SubDivision 3Ps during 2002-05.

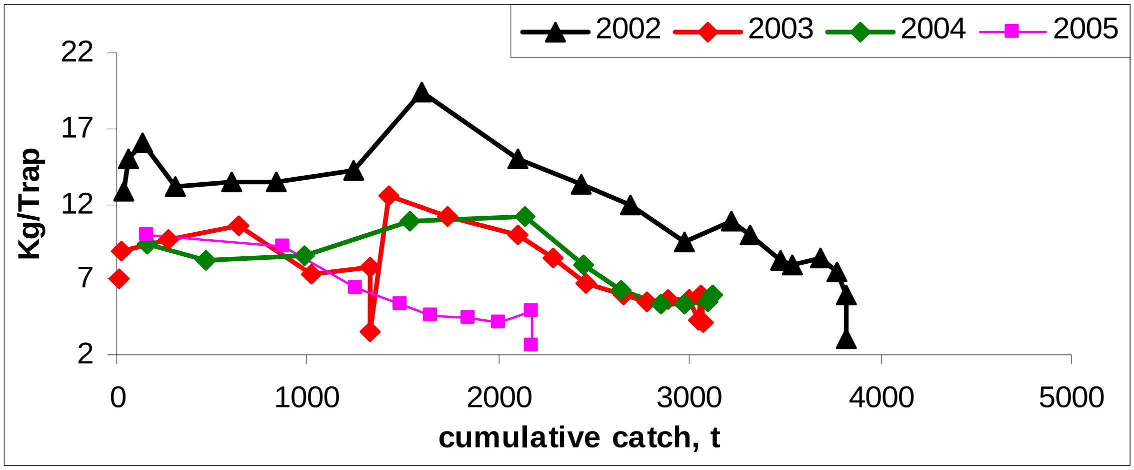

Figure 134. Seasonal trends in CPUE, in relation to cumulative catch, for SubDivision 3Ps during 2002-05.

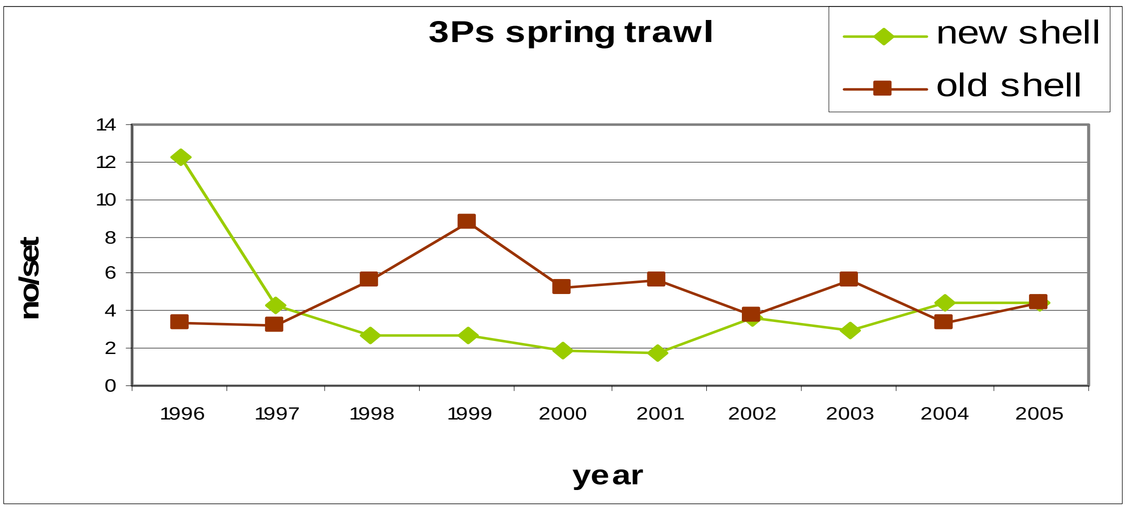

Figure 135. Trends, by shell condition, in abundance indices of legal-sized males for SubDivision 3Ps from spring multispecies surveys.

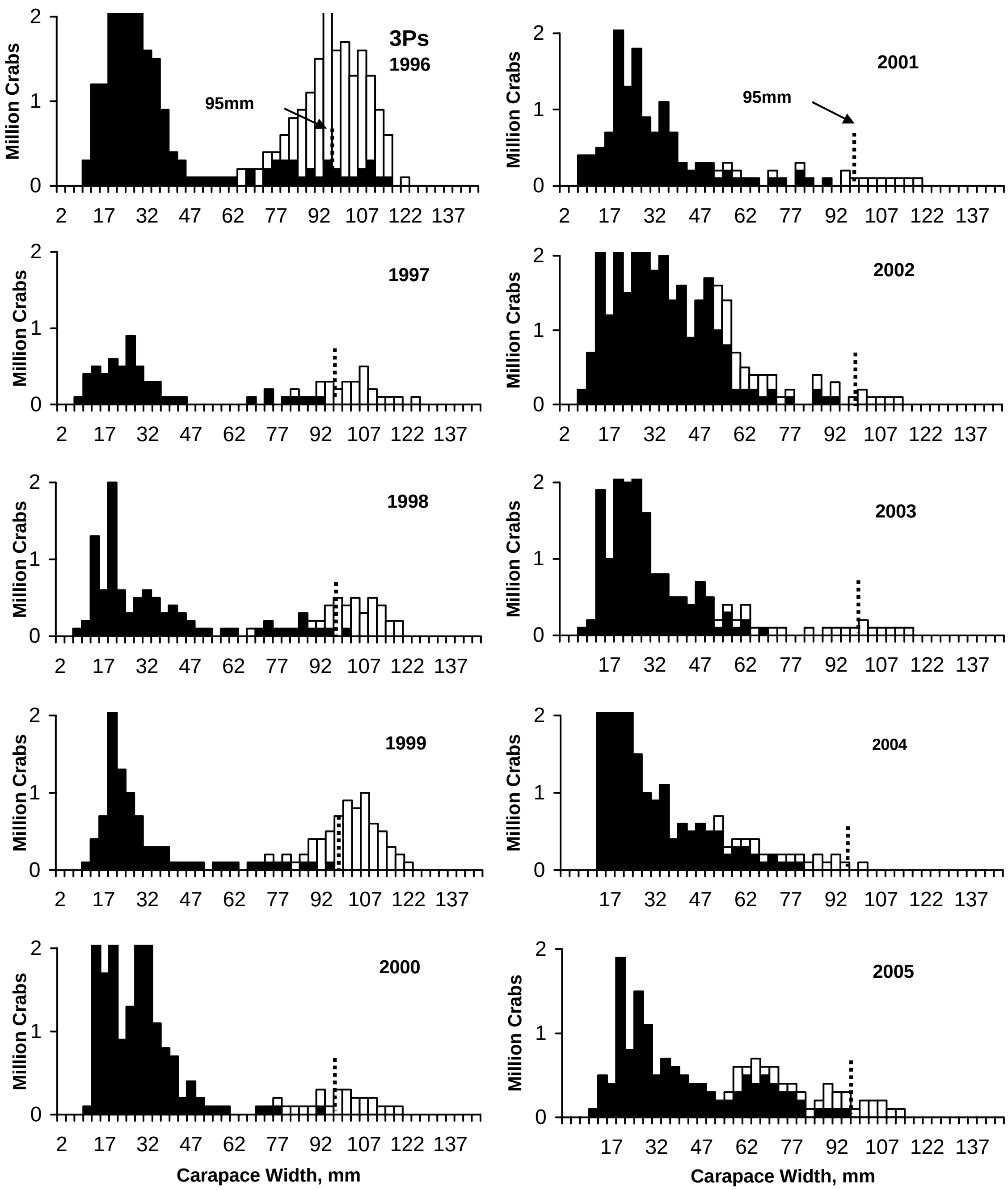

Figure 136. Truncated distribution of abundance (index) by carapace width for SubDivision 3Ps juveniles plus adolescents (dark bars) versus adults (open bars) from spring multispecies surveys.

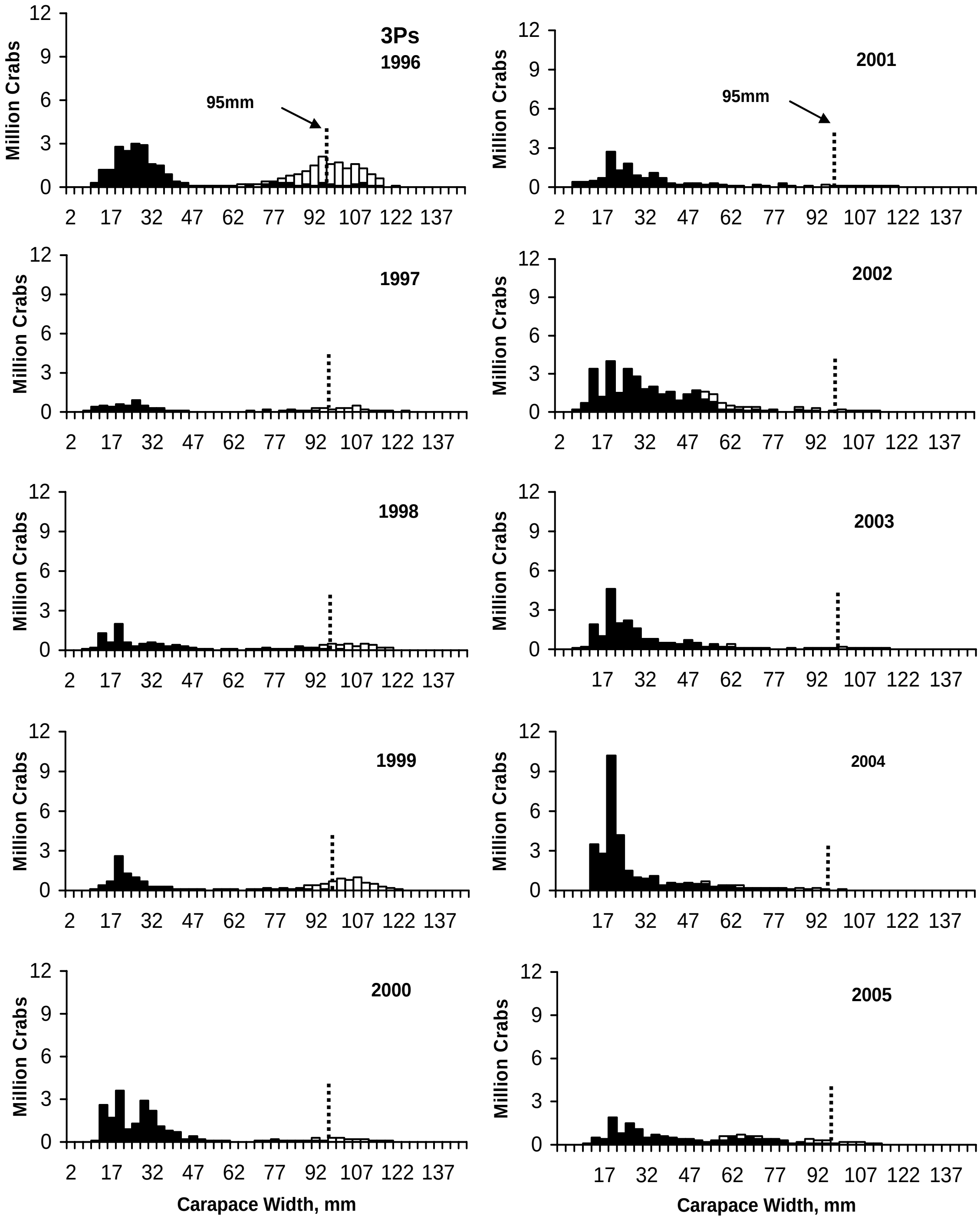

Figure 137. Distribution of abundance (index) by carapace width for SubDivision 3Ps juveniles plus adolescents (dark bars) versus adults (open bars) from spring multispecies surveys.

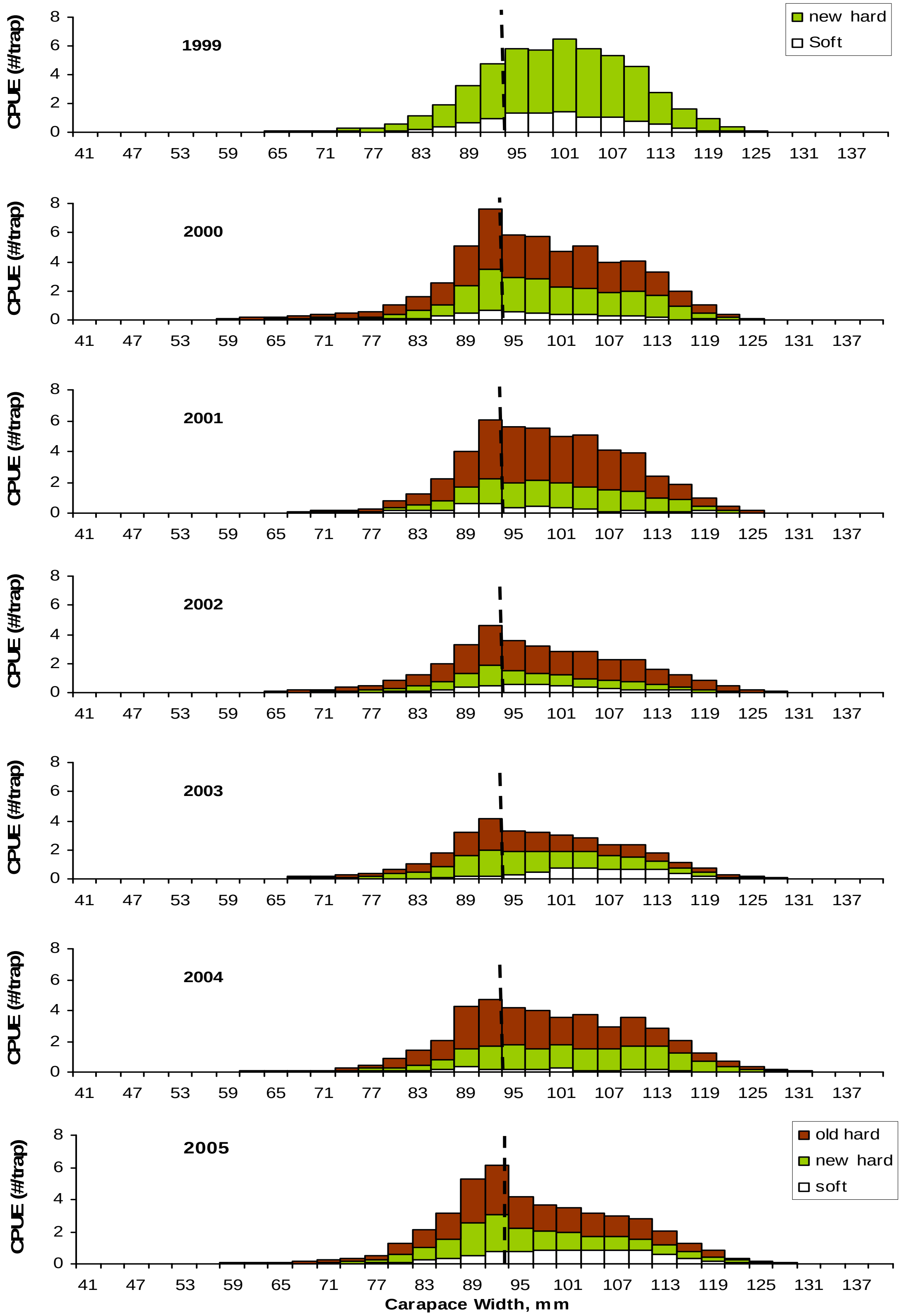

Figure 138. Trends in male carapace width distributions from observer at-sea sampling for SubDivision 3Ps.

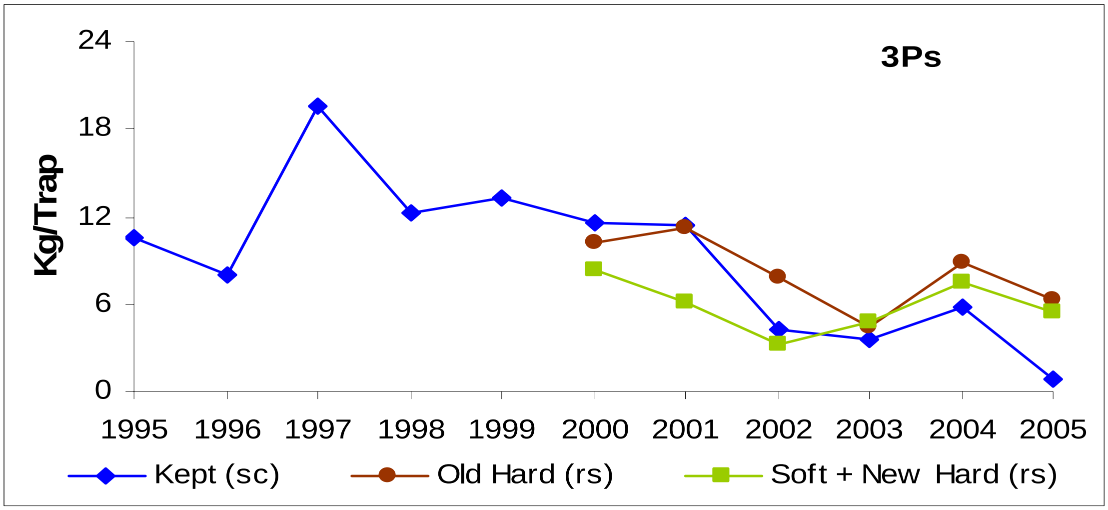

Figure 139. Trends in SubDivision 3Ps observer catch rates of exploitable crabs since 1995 from set and catch records and of legal-sized crabs by shell category since 2000 from at-sea sampling.

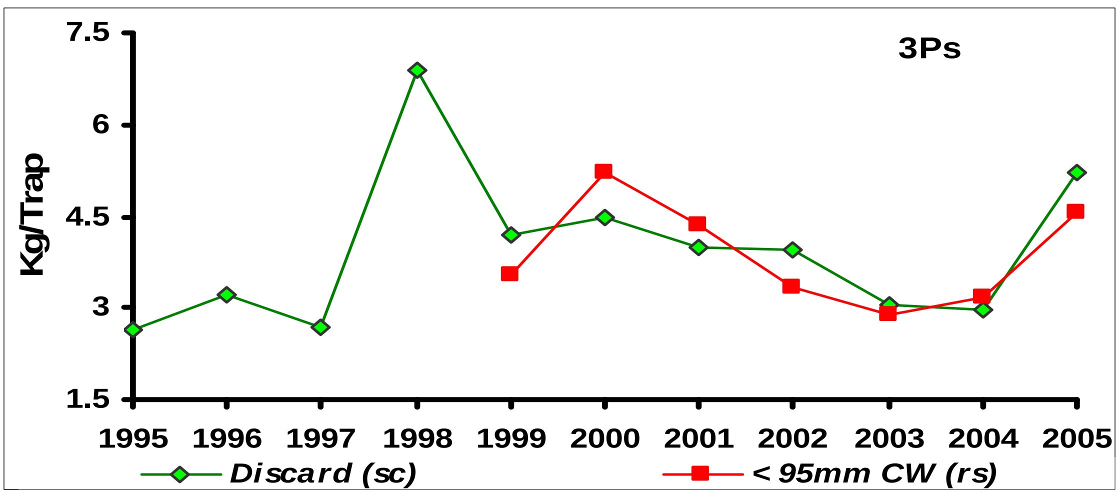

Figure 140. . Trends in SubDivision 3Ps observer catch rates of total discards since 1995 from set and catch records and of sub-legal sized crabs since 1999 from at-sea sampling.

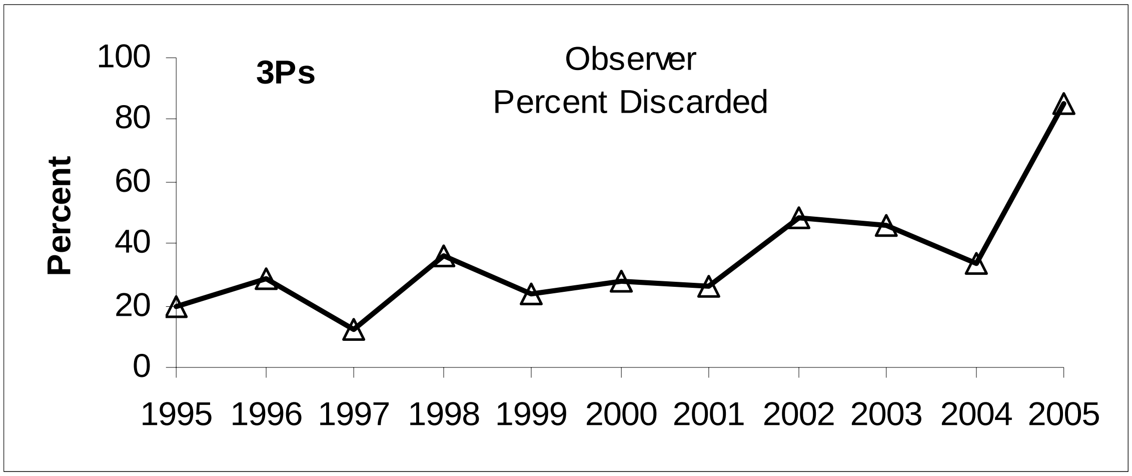

Figure 141. Trends in the percentage of the catch discarded in the SubDivision 3Ps fishery.

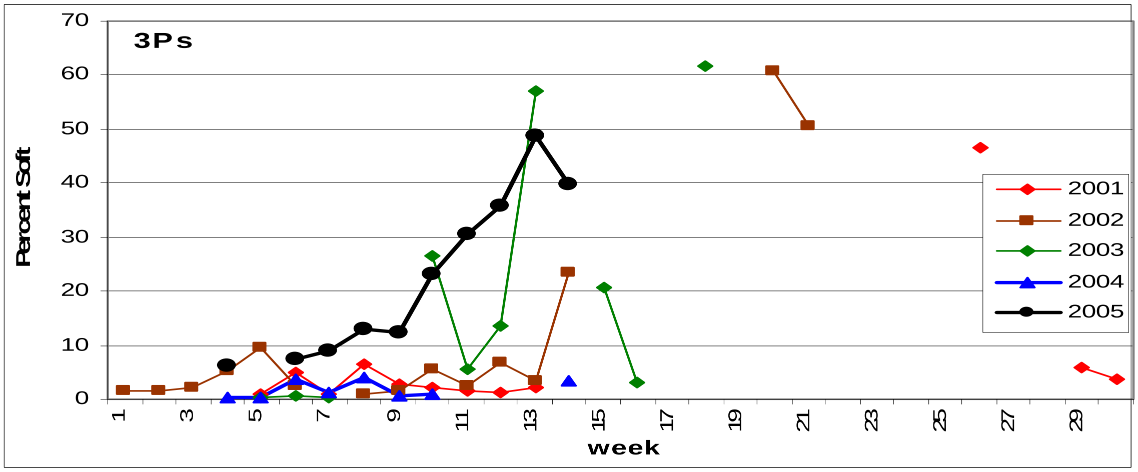

Figure 142. Seasonal trends (from April 01) in the percentage of legal-sized crabs that are soft-shelled by Year (2001-05), from at-sea sampling by observers in SubDivision 3Ps.

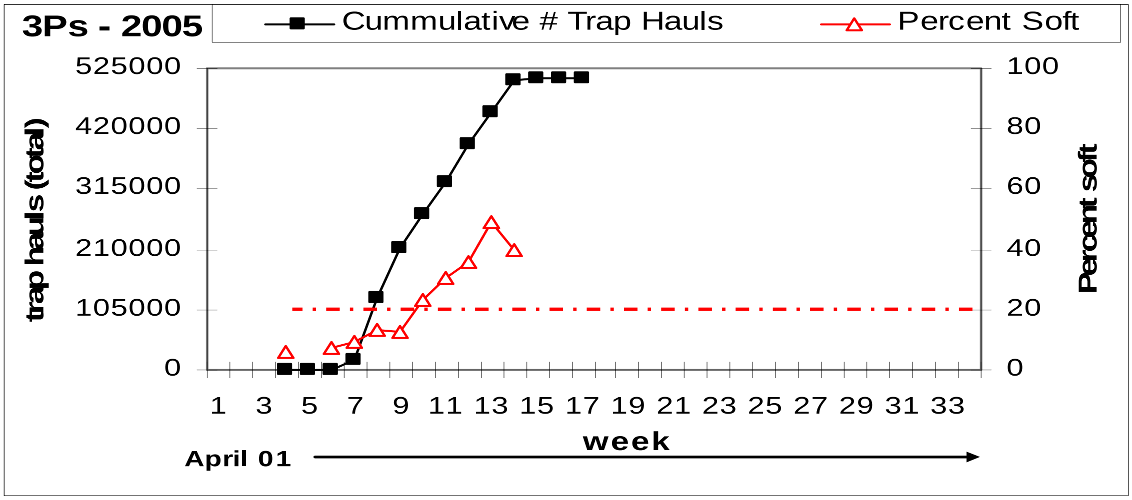

Figure 143. Cumulative distribution of weekly fishing effort in SubDivision 3Ps during 2005 from logbooks in relation to weekly percentage of soft-shelled crabs from at-sea sampling by observers.

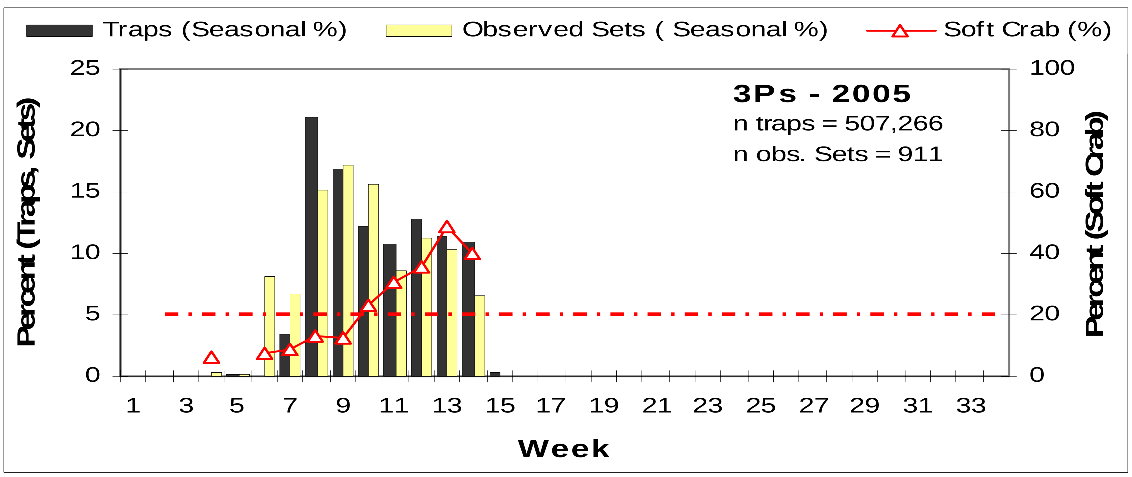

Figure 144. Distribution of SubDivision 3Ps total fishing effort throughout the 2005 fishery and of effort from observed sets in relation to weekly percentage of soft-shelled crabs from at-sea sampling.

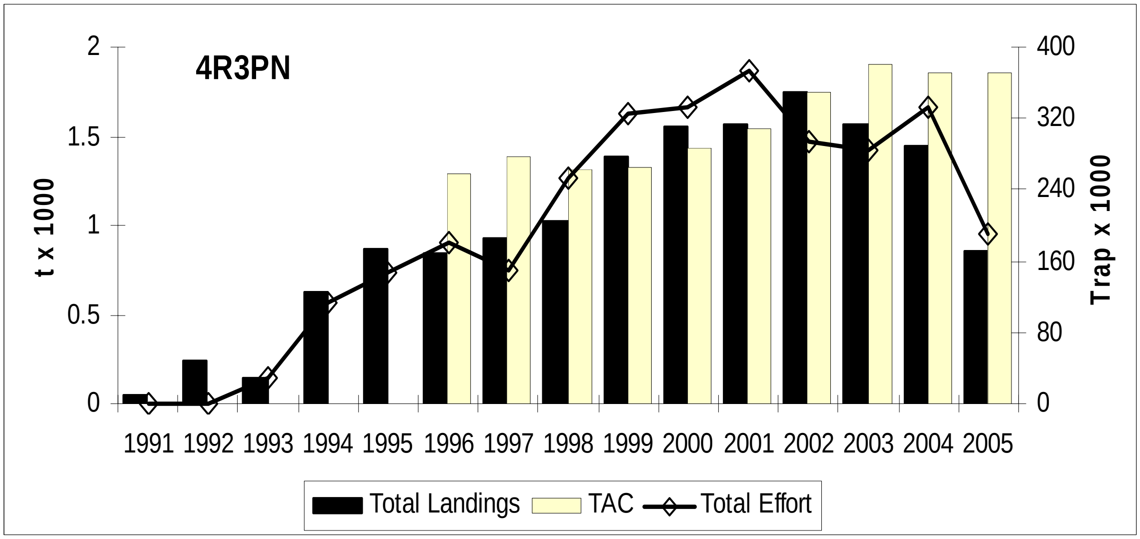

Figure 145. Trends in Division 4R and SubDivision 3Pn Landings, TAC and fishing effort.

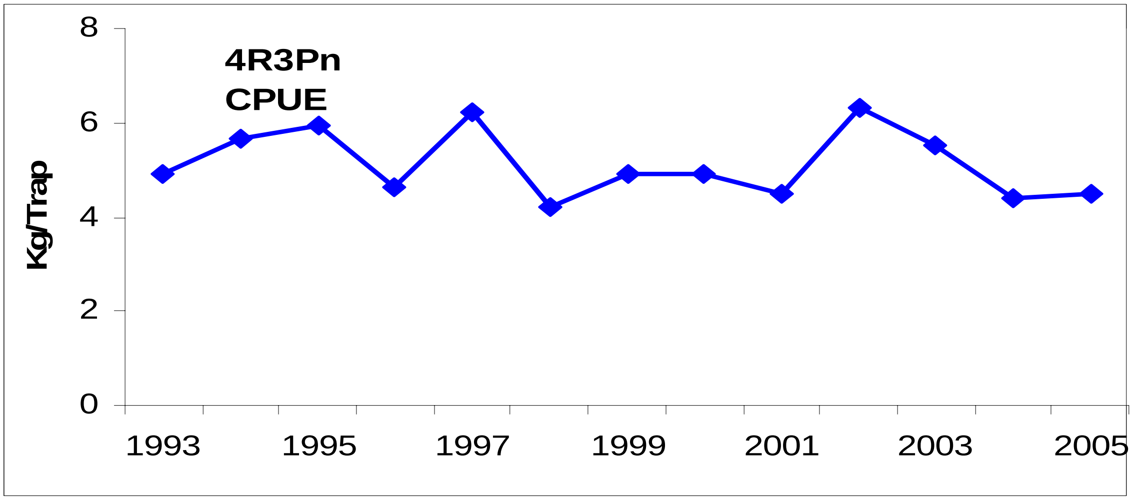

Figure 146. Trends in Division 4R and SubDivision 3Pn commercial CPUE.

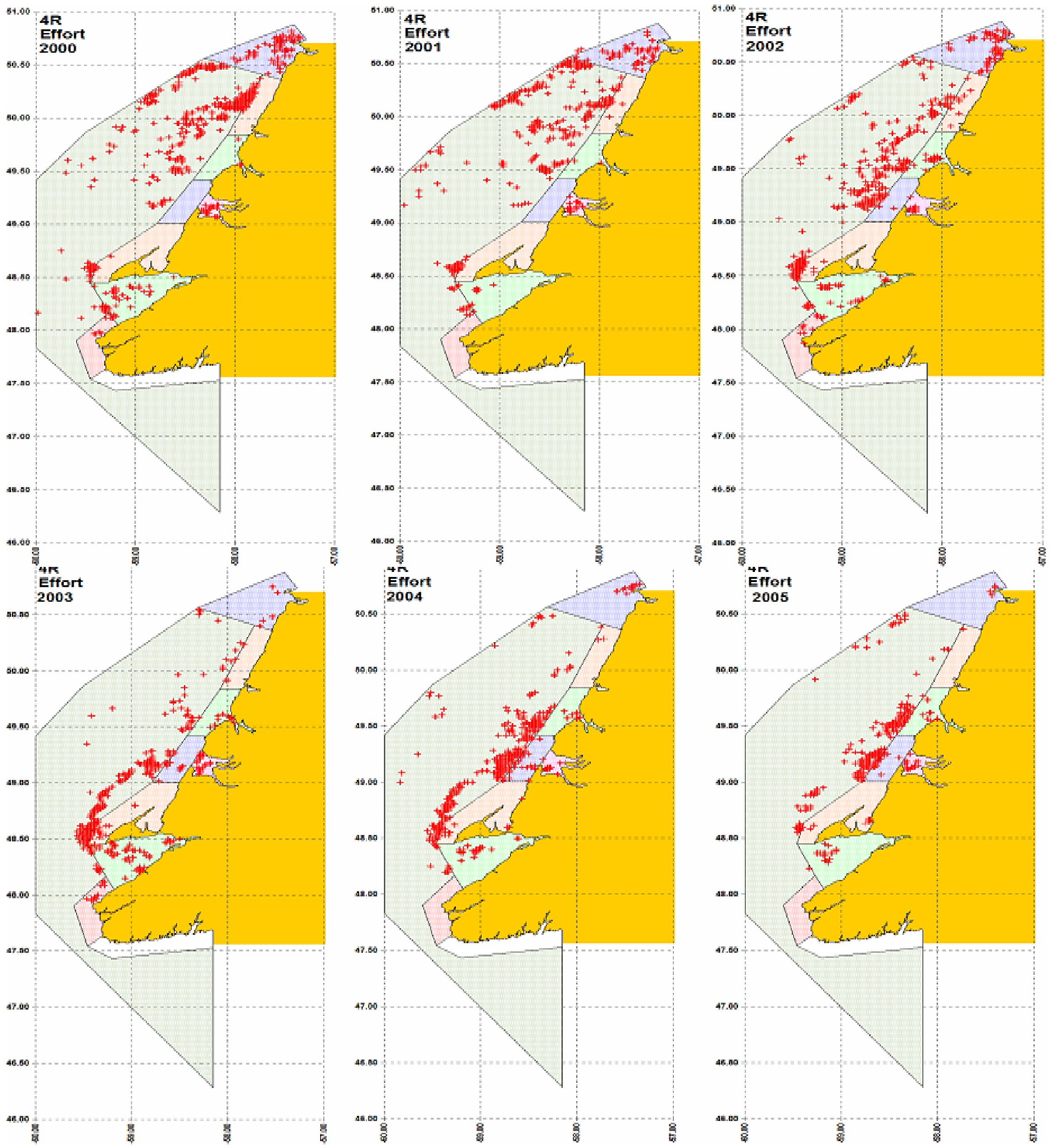

Figure 147. Spatial distribution of Division 4R and SubDivision 3Pn fishing effort for 1999-2004.

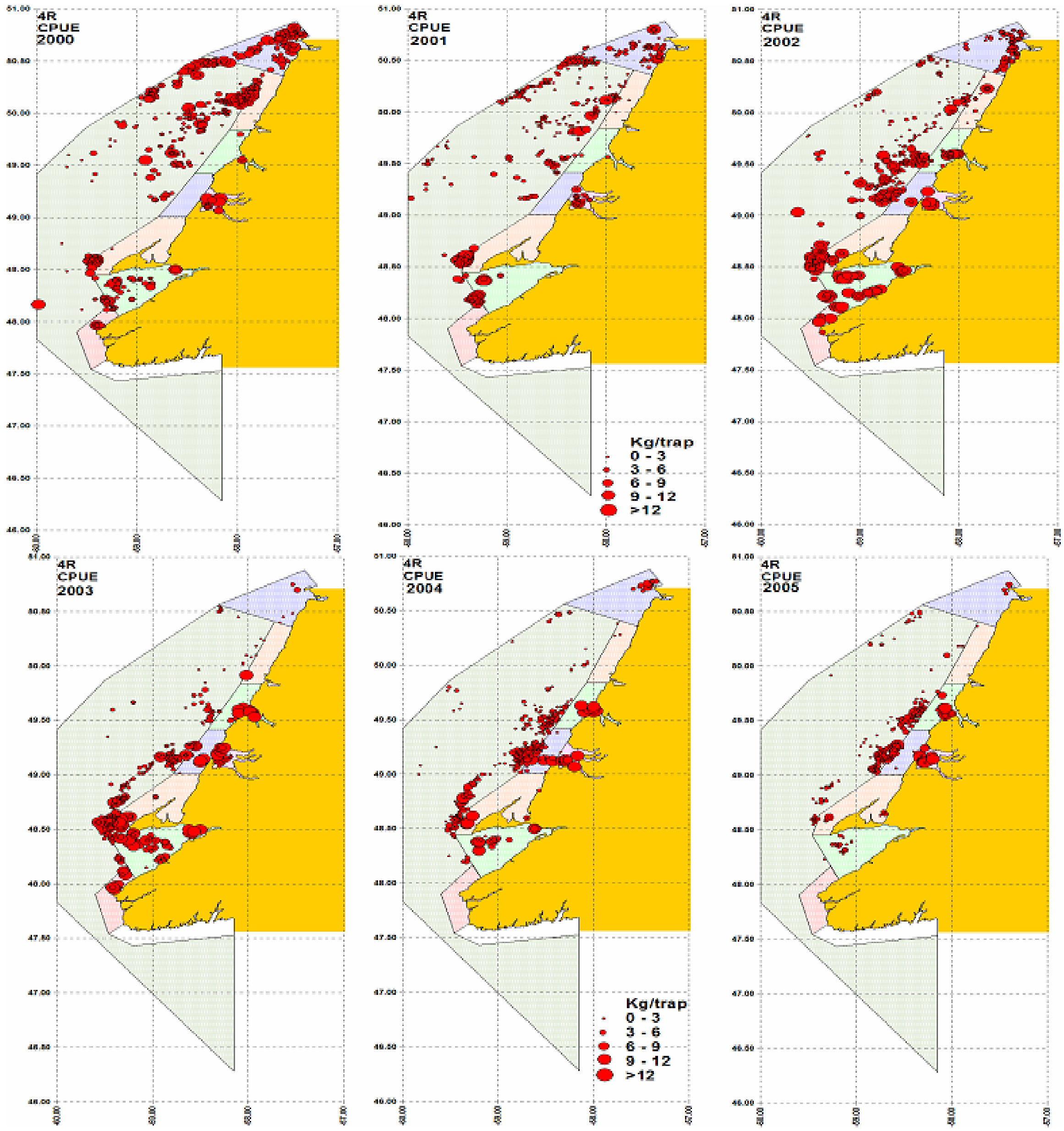

Figure 148. Spatial distribution of Division 4R and SubDivision 3Pn commercial CPUE by Year.

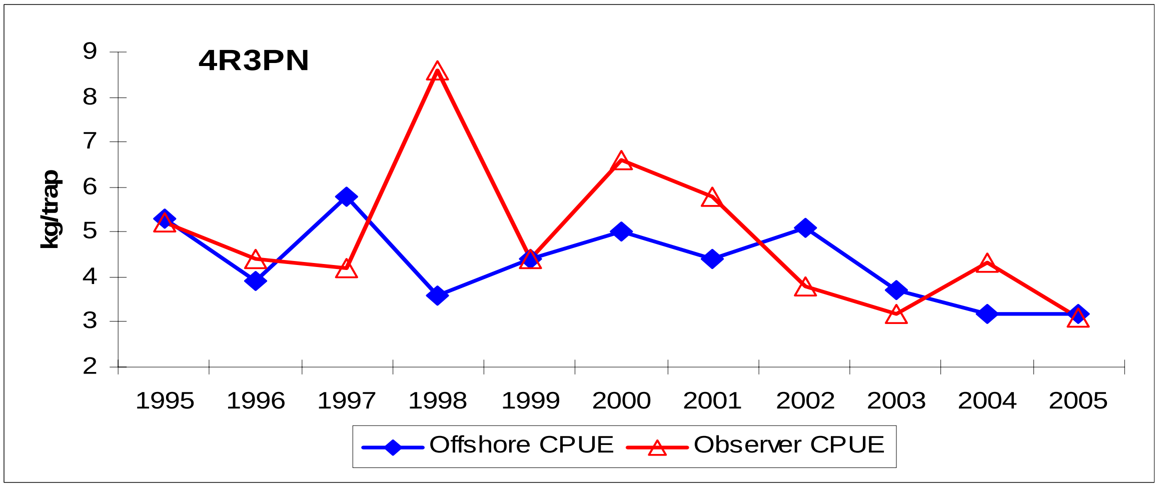

Figure 149. Trends in logbook- based offshore CPUE vs. observer-based CPUE in the Division 4R and SubDivision 3Pn fishery.

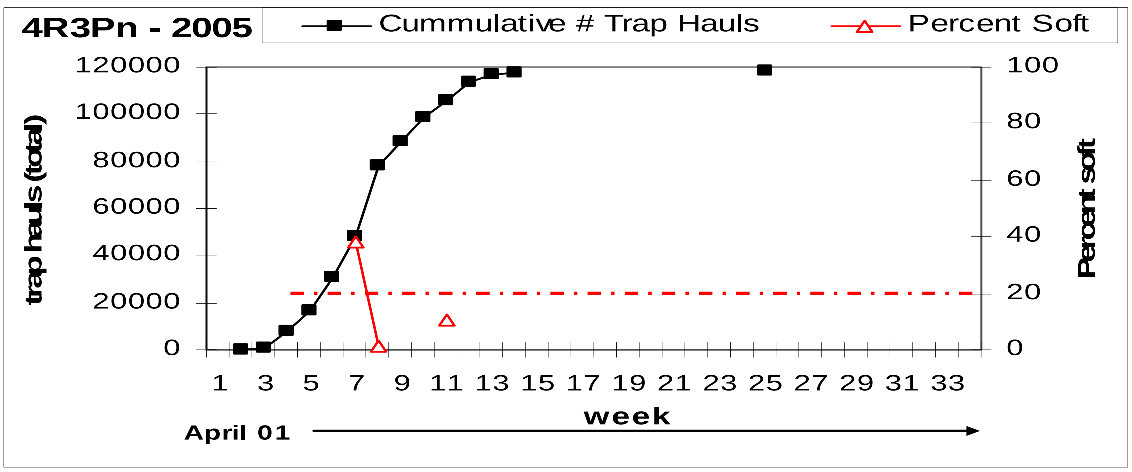

Figure 150. Cumulative distribution of weekly fishing effort in Division 4R during 2005 from logbooks in relation to weekly percentage of soft-shelled crabs from at-sea sampling by observers.

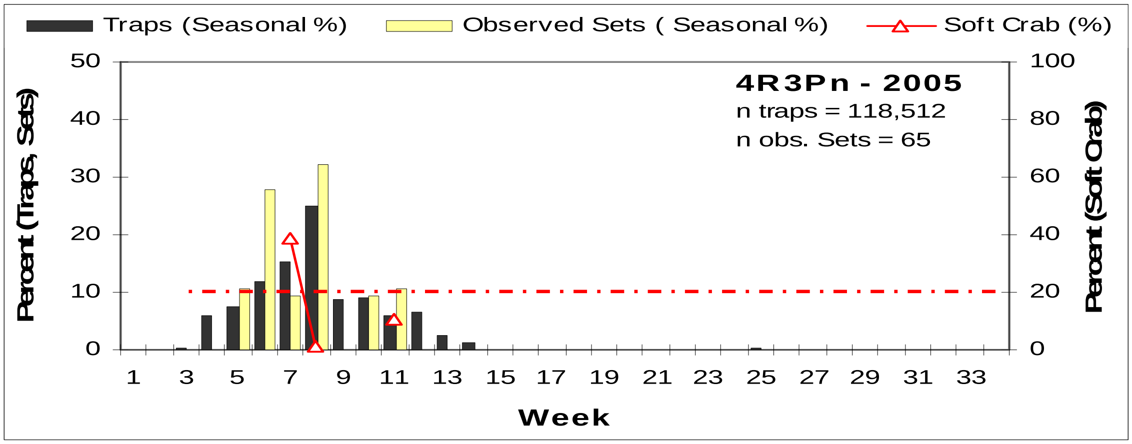

Figure 151. Distribution of Division 4R total fishing effort throughout the 2005 fishery and of effort from observed sets in relation to weekly percentage of soft-shelled crabs from at-sea sampling.