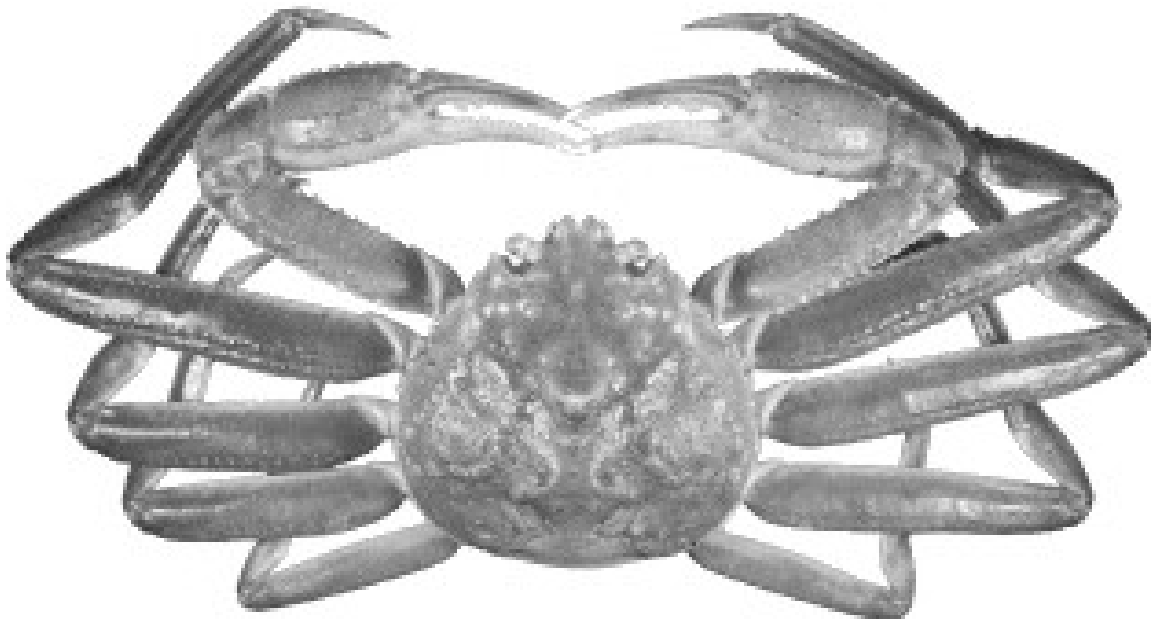


Assessment and advise of snow crab in west Greenland 2010

By

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Assessment and advice of Snow Crab in West Greenland 2010

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Introduction

This report documents the scientific basis for the assessment of snow crab (*Chionoecetes opilio*) stocks in West Greenland. Snow crabs are patchily distributed and commercially exploited along the coast and within the fjords. The fishery is managed by quotas and assessed when data are available within the inshore and offshore of 6 management areas (Upernavik, Uummannaq-Disko Bay, Sisimiut, Maniitsoq-Kangaamiut, Nuuk-Paamiut and Narsaq-Qaqortoq). The report briefly updates and summarizes the historical background of commercial crab fishing, which includes catch, effort, CPUE and spatial distribution of the fishery, as well as the results from scientific surveys undertaken by the Greenland Institute of Natural Resources (GINR).

There are no specific long-term management objectives for the snow crab resource in West Greenland. However, since 2004 the main objective of recommendations from GINR has been to stop the decline in biomass of the crab resource in the different management areas.

Summary

Management area Disko Bay - Uummannaq

- *The recommended catch level for 2010 in Disko Bay inshore is 600 tons. The quota should be divided on 200 tons in the southern part of Disko Bay, 200 tons in the Northern part of the bay and 200 tons in Vaigat.*
- No survey has been conducted in Disko Bay 2009 owing to technical problems with r/v *Adolf Jensen*.

Management area Sisimiut

- *The recommended catch level for 2010 in Sisimiut inshore is 500 tons, divided on 300 tons in the traditionally fishing area and 200 tons in Ndr. Isortoq and Ndr. Stoemfjord.*
- Fishery and survey CPUE index as well as abundance index of recruits based on survey data dropped from 2008 to 2009, but remain high and are still above the series average based on available observations. If this drop and if continues in 2010 the commercial biomass might decrease over the next few years.
- *The recommended catch level for 2009 in Sisimiut offshore is 200 tons. In 2009 there is no sign of progression in the biomass and the previous year sign of recovery has turned into a decline in the biomass and recruitment.*
- Survey and fishery data indicate signs of recovery in 2007 and 2008. The increase in biomass was largely attributable to greatly reduced removals due to the large reductions in commercial catches, from 2004 up to 2007. Nevertheless, all available indexes show a significant drop from 2008 to 2009.

Recruitment indices for the offshore area are poor and indicate low recruitment prospects in the short term. Caution must be exercised as CPUE from the fishery and survey declining and the recruitment is at a very low level. Those results might be effects of increased removals by the fishery after the re-opening and suggesting that the biomass is/was not recovered.

- It should be emphasized that re-opening of the fishery in 2007 was sustained before the re-opening criteria was met.

Management area Nuuk - Paamiut

- *The recommended catch level for 2010 in Nuuk – Paamiut inshore is 200 tons.*
- *The recommended catch level for 2009 in Nuuk - Paamiut offshore is 1,600 tons, and unchanged from 2008.*

Management area Maniitsoq - Kangaamiut

- *Due to the lack of survey and fishery data no recommendation is given for Maniitsoq - Kangaamiut inshore and offshore.*

Management area Narsaq - Qaqortoq

- *Due to the lack of survey and fishery data no recommendation is given for Narsaq - Qaqortoq inshore and offshore.*

General recommendation and advice

- GINR recommends a seasonal fishery from April to July in all management areas to reduce discarding and associated mortality to soft-shelled crabs and to maximize recruitment to the stock. Such a seasonal fishery will also promote the most optimal and sustainable utilization of the crab resource.

Resource status in each management area derived from fishery data

An overview of GINR's recommendations and the imposed quota and fishing status (open or closed) of the management areas in 2010 are given in Table 1.

Table 1. Summary of catch recommendations for the crab fishery in 2010 from the Greenland Institute of Natural Resources and total catch from 2008 (catch statistics for 2009 are incomplete at this time).

	Recommended catch Inshore 2010 in tons	Recommended catch Offshore 2010 in tons	Catch in tons 2008 Inshore	Catch in tons 2008 Offshore
Disko Bugt	600	130	531	96
Sisimiut	500	200	765	214
Maniitsoq	No advice	No advice	19	111
Nuuk-Paamiut	200	1,600	200	418
Recommended catch in all	1,300	1,930	1,515	839

Species biology

Snow crab habitat include sites where bottom is covered by mud/sand and rock. Their diets include brittle stars, shrimp, younger stages of snow crab (cannibalism), clams, polychaete worms and other crustaceans. Predators are various ground-fish, snow crab and human.

Snow crab hatchling their broods in spring and larvae undergo two planktonic larval stages and settle to bottom during fall. Benthic juveniles snow crab males as well as females molt frequently and become sexually mature from > 50 mm carapace width (CW) depending on bottom temperature.

Snow crabs tend to molt during spring and continue until terminal molt at adulthood is reached within a size range of 50 – 130 mm CW for males and 40 – 95 mm CW for females. At the terminal molt males developing enlarges claws improving their mating ability. Only a portions of any given cohort recruit to the fishery at 100 mm CW, where the males is approx. 9 to 10 years. Recruitment is periodic or episodic and varies considerably over a cycle of 8 to 12 years.

After the molt to adulthood legal sized males remain soft/new shelled having low meat yield for the rest of the year. In the following year, meat yield would have increased to a suitable level for the industry. Discard of soft shell and new-shelled, due to their low yield contents is resources wastage.

Historical fishery background

Snow crabs are distributed along the West coast of Greenland and are commercially exploited primarily from Disko Bay in the North (up to 71° 30N) to Paamiut in the South (60° 45N). Commercial fishery for snow crab began primarily in inshore areas (within basis-line) in the mid-1990s and from 1999, also included offshore areas (outside basis-line).

Since 2004, the crab resource in Greenland has been managed in 6 areas (from North to South - Upernavik, Uummannaq-Disko Bay, Sisimiut, Maniitsoq-Kangaamiut, Nuuk-Paamiut and Narsaq-Qaqortoq, see Fig. 1). The fishing fleet is made up of two components; small vessels (less than 75 GRT), which have exclusive rights for fishing inshore within the basis-line as well as offshore. Small vessels are, however, restricted to fishing in only 2 management area during the year. Large vessels (greater than 75 GRT) may only fish in all offshore areas (outside the basis-line), but not within the "Crab Boxes". Quota restrictions have been imposed to each of the 6 management area since 1995 and individual quotas to vessels larger > 75 GRT, but have only limited the catch in 2004. Management decisions allow increasing quota in each of the 6 management area, when the catch achieved the first fixed quota. Un-used quota from larger vessels is re-allocated to the inshore fleet (small vessels < 75 GRT). Basically, there is now quota restriction for the small vessel.

The fishery is regulated by prohibitions to land females and undersized males (<100 mm CW), logbooks for all vessels larger than 10 meters and closure of the fishery north of 64°N for 3 months (1 January to 31 March). There is also a regulation that states movement of the fishing effort when soft-shelled crabs exceed 20% of the catch, however the term "movement" is not specific and this is not monitored. From 2005 to 2007, the offshore crab fishery was closed in the management areas Maniitsoq-Kangaamiut and from 2005 to August 2007 in the offshore area of Sisimiut except for dispensation to 1 vessel that was allowed to fish in 2005. Only in 2006, the fishery was closed for 2½ months (July 1 to September 15) in all areas except Uummannaq-Disko Bay (closed only 1 month from July 1 – August 3) to protect soft-shelled crabs.

The number of vessels with licenses to participate in the snow crab fishery increased by more than a factor of 3 from approx. 120 to 374 boats from 1999-2002. Since then the number of both large and small vessels have decreased substantially as the abundance of the resource has also declined. In 2008 the number license holders amounted 74 in all management areas an 80% reduction compared to 2002. In 2009 number of license increased to 117.

Greenland Institute of Natural Resources (GINR) provide stock assessment and total allowable catch (TAC) advice for the stock both inshore and offshore within each management area when sufficient data is available. The decision to give advice for both inshore and offshore areas was based on the assumption that snow crab migration is limited (tagging studies have indicated approx. 10 km per year) and therefore the resource in different areas is considered to be spatially independent.

Commercial fishery data

Logbooks from the large vessels >75 GRT have been mandatory since 1999 in conjunction with the start of offshore fishing with vessels of this size. Logbooks for the small vessels (<75 GRT) were first mandatory from July 2002, and thus first covered the annual fishery in 2003. Only landing statistics are available from boats less than 10 meters as they are not required to report catches in logbooks.

Catch, Effort and CPUE

The historical development of the crab fishery in Greenland is shown in Figure 2. Landings increased from approx. 1,000 tons in 1995 to a peak of approx. 15,000 tons (Quota 26,800 tons) in 2001 (based on landings from small vessels and catch from logbook data from large vessels >75 GRT). From 2001 to 2007 total catch decreased by approx. 89% to 2,189 tons (Quota 4,380 tons). Landings increase to 2,354 tons

(Quota 4,200 tons) in 2008 and preliminary data indicate an additional increase in landings in 2009 (2,412 tons ultimo September 2009, Quota 4,225 tons). The ratio of total landings to logbooks landing varies between management areas.

As well as in 2008, 2009 quota was increased from 500 tons to 800 tons in the management area Sisimiut and from 700 tons to 1000 tons in Nuuk - Paamiut management area (only in 2009). The increasing quota was based on re-allocation (removing a part of the quota from five vessels > 75 GRT) allowing small vessel < 75 GRT to increase catches inshore as well as offshore.

The distribution of landings and geographic distribution of the fishery in each management area in Fig. 3 and Fig. 4, show that most of the landings in 2008 have predominately come from management Sisimiut (42%), where as Disko Bay-Uummanaq and Nuuk-Paamiut amounted 27% and 26% respectively of the total landings.

The total fishing effort (trap hauls) has declined by 91% since 2001 (from 3,416 to 323 thousand trap hauls during 2001-2008) (Fig. 3). The decline has been mostly due to a declining number of participants in the fishery. Preliminary and incomplete logbook data for 2009 shows total effort is 353 thousand trap hauls. The overall distribution of the fishery along the West coast of Greenland from 2003-2009, derived from available logbook data is shown in Figure 4.

Research Surveys

Since 1997, trap surveys have been conducted annually in inshore areas of Disko Bay and Sisimiut. In 2000, a Sisimiut offshore area (Holsteinsborg Dyb) was included in the Sisimiut trap survey. In 2002, annual offshore trap surveys were initiated in areas between Nuuk and Paamiut and in 2003 were extended north to include the offshore in the Maniitsoq-Kangaamiut management area.

Methods

Snow crabs are sampled with Japanese-style conical traps with large (70 mm) and small (21 mm) mesh sizes. Sampling stations are at predetermined fixed positions for all years and soak times range between 14-24 hrs depending on weather conditions. Bottom temperatures are recorded at each station.

For males, the carapace width (CW) and chela height (CH) are measured (± 0.01 mm) to determine size and molt status (adolescent or adult). Male snow crabs stop growing after their terminal moult. Sexually mature males are referred to as adolescents (recognized by their small claws) prior to the terminal molt and as adults after their terminal molt (large claws). Males reach legal size (≥ 100 mm CW) at about 9 years of age. The range of carapace widths defining the adolescent male groups which are presumably 1, 2 and 3 years from recruitment to legal size are: ADO⁻¹, 82.2-100mm CW; ADO⁻², 67.3-82.2mm CW and ADO⁻³, 53.2-67.3mm CW.

For females, the CW and abdomen width (AW) are measured (± 0.01 mm) to determine size and maturity. Females that have mated once and are carrying their first clutch of eggs are called primiparous, while females that are carrying their second clutch and have mated more than once are called multiparous. They are distinguishable by the number of scars on their legs caused by mating and by shell conditions. Shell condition in both males and females is determined on a scale of 1-5 according to guidelines by Sainte-Marie (1993).

Data from trap survey catches of males are used to determine CPUE (kg/trap), mean CW of legal-size males, shell condition and NPUE (number/trap) of adolescent males to assess recruitment prospects. Male and females size distributions are also described to follow the progression of size modes through the populations and determine pri-

miparous/multiparous ratios within the female population.

Inshore surveys in Disko Bay and Sisimiut

In Disko Bay, 43 stations are sampled annually (Fig. 5a) and in Sisimiut, 40 stations are sampled (Fig. 5b), from May to June. The sampling gear consists of a longline of 10 large-mesh (70mm) and 2 small-mesh (21mm) conical traps fished at depths ranging from 100-600m. Traps are placed approx. 40m apart and baited with squid.

Offshore surveys in Sisimiut, Maniitsoq and Nuuk-Paamiut

Fifteen stations are sampled annually in Sisimiut offshore (Fig. 5b) in June and a total of 30-60 stations are sampled in the Nuuk-Paamiut and Maniitsoq offshore areas in August-September (Fig. 5c). The sampling method in Sisimiut offshore is the same as the method used inshore in Disko Bay and Sisimiut. In 2002, the sampling in the Nuuk-Paamiut offshore survey was also the same as the method inshore. In 2003, however, the offshore sampling method used in Nuuk-Paamiut and Maniitsoq was changed such that each station was then sampled using a long line of 16 traps, eight large-meshed traps alternating with eight small-meshed traps at approx. 40m apart and baited with squid.

Input data from commercial fishery to assessment

No sampling from the commercial fishery has been conducted since the fishery began in 1996.

Available logbook and landing statistics is used in data analysis from the commercial fishery. Logbooks nominal catches has since 2003 covered more than 85% of the total landings in Greenland. Before 2003 less than 20% of the fishing fleet were using logbooks.

In order to calculate a standardised CPUE index, a GLM analysis (multiadditive model) was carried out using haul by haul logbook information

including zero catches. The model includes year, month and vessel effects.

Management area: Uummannaq-Disko Bay

The historical catch, CPUE and effort data for the fishery in Uummannaq-Disko Bay in the inshore and offshore areas are summarized in Table 2. Data for 2009 are preliminary.

One of the most important fishing areas has been Disko Bay where catches are predominately from the inshore. Total catches peaked at 4,202 tons (94% inshore) in 2001 and since then have steadily declined to 627 tons (85% inshore) in 2008, approximately 15% of the 2001 catch.

Inshore - Disko Bay

Fishery

The distribution of the fishery in Disko Bay from 2003 to 2008, according to available logbook data is shown in Figure 6. Fishing grounds include both Vaigat, area "Disko Nord" and "Disko Syd". The geographic distribution of the fishery has been homogeneous in the period from 2003 to 2008, although total catches, CPUE used effort has changed markedly. In contrast to the previous years, 2009 preliminary data indicate a very limit fishery in the area "Disko Nord".

The fishery in Disko Bay starts in April, peaks during the summer months (June-July) and steadily declines towards the end of the year, except in 2003 when the fishery peaked in March and May. Early season catch rates (April-May generally decreased over time (2004-2008), perhaps because early season focused on traditional areas. Late season CPUE increased from 2004-2006, reflecting allocation of effort to new areas as the season progressed. In 2006 the fishery peaked in September, mainly due to a closure during July and August (Fig. 7). In 2008 CPUE were higher that compares to previous years, but declined to 2007 level from October to December.

A standardised CPUE index (Fig. 8), show a significant dropped in CPUE from 2001 to 2003 from approx. 7.7 kg/trap to 3.8 kg/trap ($F = 78.60$, $P < 0.0001$). In the following years CPUE has remained low at a stable level. Data from 2008 and preliminary data for 2009 indicate increasing trends in CPUE (Table 2) and (Fig. 8).

From 2000-2001 catches inshore increased from 2,940-3,950 tons as effort more than doubled (613-1274 thousand trap hauls, Table 2). Catches and effort have steadily decreased since 2001 by approx. 86% to 531 tons and 107 thousand trap hauls, respectively, in 2008 (Table 2 and Fig. 8).

Standardised soak time index (Fig. 9), shows a significantly decrease in soak time from 2001 to 2002. Since 2003 soak time increased steadily until 2007, at a level of average 72 hour per hauls and comparable to 2001 level.

Research Surveys

Important: *Owing to the breakdown of the main engine at the research ship Adolf Jensen, the survey has been cancelled in 2009. In 2008 survey was only conducted in the Northern part of Disko Bay. No new survey data is available for the stock assessment and advice.*

Trap surveys have been conducted in 2 inshore areas of Disko Bay since 1997 (See Fig. 5a for maps), despite in 2008 where only the subarea North, were investigated. CPUE of legal-size males (≥ 100 mm CW) in South and North peaked in 2001 and 2000 respectively and have declined steadily by more than 50% to 2004; from 4.2-1.7 kg/trap in South and 7.5-2.3 kg/trap in North (Fig. 10). The 2004 CPUE was the lowest observed in the time series. In 2005 and 2006 CPUE in South was still considerably below the reference mean of 3.7, but increased to 4 kg/trap, marginally above the reference mean, in 2007. In North, CPUE increased from 2.3 to 6.4 kg/trap and has

reached the reference mean in 2006. In 2007 CPUE decreased to 4.4 kg/trap and only a very small increase to 5.1 kg/trap was observed in 2008. Reference means are based on the average kg/trap from 1999-2002.

The mean carapace width (CW) of legal-size males had continually declined in both survey areas to a minimum in 2004 (Fig. 11). CW subsequently increased in both areas in 2005 and remaining unchanged in South to 2007, while the mean CW has increased over the past 4 years in North to 116 mm CW in 2008 similar to observation from 2007.

The abundance of adolescent males (ADO-1), measured as number per trap (NPUE), peaked at 2.2/trap in South in 2001, and 2.6/trap in North in 2002 (Fig. 12). The NPUE of ADO-1 has since declined sharply in both areas and was at the lowest levels observed for the time series in 2004 in South. In 2006, the NPUE of ADO-1 males in South were 0.8/trap and increased in 2007 to 1.8/trap, above the reference mean. NPUE of ADO-1 in North decreased continuously to 1/trap, the lowest levels observed in the time series, from 2001 to 2007, with exception from a increase in 2005. The NPUE of ADO-1 in North increased to 2.1/trap in 2008 and is now above the reference means and close to the highest observation in the time series.

Annual trends in size distribution of adolescent and adult males are shown in Fig. 13. In South there was no further progression through the size range until 2006. Data from 2007 implies a recent increase in recruitment caused by increasing recruitment of small legal-sized new-shelled since 2005. In North the recruitment pulse in 2005, resulted in increasing CPUE and mean CW as legal-sided adolescent pre-recruits molted and the 'recruitment pulse' progressed through the size range. The decrease in ADO-1 males in 2006 showed up clearly as a reduction of adult males in

the size range from 100mm to 130mm CW. In North there was progression through the size range in 2007 and 2008. Data from 2008 strongly implies a recent increase in recruitment caused by increasing recruitment of small legal-sized new-shelled since 2006. Further more in 2008, the highest proportion of adolescent males from 60 mm to approx. 80 mm CW has been observed in North (i.e. a mix of ADO2 and ADO3, expected to recruit to the fishery with in 2 and 3 years from 2008). In North the recruitment pulse since 2008, didn't results in increasing CPUE in the two following years.

Increasing proportion of legal-size soft and new-shelled males (shell condition 1 and 2) have been observed from 2001-2006 (Fig. 14) and have peaked at around 70% in 2006 in both South and North. The continuously high proportion of soft and new-shelled males suggests a continuous removal of the older shelled males by the fishery, which was becoming increasingly dependent upon recruitment in the years from 2001 to 2006. However, the proportion of soft and new shelled males (shell condition 1 and 2) has decreased to less than 40% in 2008, suggesting that the fishery the past year has been less dependent of the recruitment to the stock in the North.

The ratio of primiparous and multiparous females, used to support trends in recruitment, decreased sharply in South from 2000 to 2003, remained low in 2004 and has increased until 2006 and decreased again from 2006 to 2007 (Fig. 15). The increase in South in 2005 and 2006 could either reflect the loss of a large group of mature females from the population or that a recruitment wave could be forthcoming. In 2007 a minor decrease has been observed but is at the 2005 level. In North the ratio of primiparous and multiparous female has remained constant at a level of 0.45 from 2004 to 2006, decreased to 0.26 in 2007. In 2008 the ratio of primiparous and multiparous

females increased to approx. 0.5, indicating a recruitment of mature females to the stock.

Outlook - Disko Bay Inshore

Available fishery and survey data indicate that the crab resource in Disko Bay has been declining over the period from 2000 to 2004 despite a decrease in total catch and effort by approximately 50% in that period. Catches and effort continue to decline in 2008 to a level of 85% and 91% respectively compared to 2001. The commercial catch rate has remained low and at present around 3.3 - 4.0 kg/trap. There is no new survey data, but survey CPUE in Disko Bay South has increased since 2004, and the CPUE was at the lowest observed level at 1.2 kg/trap in 2004 and increased to 4 kg/trap in 2007. Recruitment has increased since 2004 in Disko Bay South and both CPUE and recruitment were in 2007 at the mean reference point for the time series. Survey CPUE in Disko Bay North decreased from 6.4 kg/trap in 2006 to 4.4 in 2007. A minor increase has been observed in 2008. CPUE is still below reference means for the time series in the Northern part of Disko Bay. Recruitment, (ADO-1) has increased significantly from 2007 to 2008 in the northern part of Disko Bay and is now at the reference mean for the time series. This suggests that there is some improvement in the resource and recruitment prospects in the next coming years is considered to be fair. Commercial CPUE at the present level of recruitment indicate that there has been no increase in commercial crab biomass despite declining fishery removals especially in the area covering the southern shore of Disko Island (survey area Disko Bay North). Recruitment indices for a long-term prognosis are uncertain. The percentages of new shelled adult approx. (40 %) males in Disko Bay North indicate that the fishery in Disko Bay has become more sustained by crabs recruited two years ago.

Recommendations for the 2010 fishery

Disko Bay Inshore

Data obtained by logbooks and landings indicates that the quota has never been fully taken in the period from 2005 to 2008. The catch has never been regulated, but the fishery has been self regulating. Despite a big decrease in removals by the fishery, both commercial and survey CPUE has only increase a little and very gradually. Data from research survey in the Northern part of Disko Bay suggest some progression in the forthcoming recruitment to the resource, and will probably be available to the fishery in 2010. An increase in catch in 2010, above 600 tons, could impose high handling mortality on soft/shelled crabs that would harm the forthcoming recruitment and prospects for an increase in the future are still uncertain.

The recommended catch level for 2010 in Disko Bay inshore is 600 tons. The status quo is recommended for 2010 and should help stabilize the commercial biomass. The quota should be divided on 200 tons in the southern part of Disko Bay, 200 tons in the Northern part of the bay and 200 tons in Vaigat.

Offshore - Disko Bay

Fishery

Catches in offshore Disko Bay have increased from 112 tons in 2000 to 252-349 tons between 2001 to 2003 (Table 2). Meanwhile, effort increased about 500% from 20 to approx. 100 (97-116) thousand trap hauls. Concurrently, CPUE steadily declined from 5.5 to a low of 2.6 kg/trap in 2003. Catches in 2006 and 2007 were 126 tons and 123 tons, respectively and the CPUE decreased from 6.7 – 5.1 kg/trap in the same period. Catches decline to 96 tons, and CPUE remain stable. Preliminary logbook data from 2009 show CPUE is 5.5 kg/trap at a preliminary and incomplete catch of 174 tons.

Outlook - Disko Bay Offshore

Catches have been between 120-350 tons since 2001 and CPUE has varied between 2.6 and 6.7 kg/trap. The fishery in recent years has almost exclusively concentrated effort around the south-western part of Disko Island with some sporadic fishing in the far South. Recruitment is unknown because there are no surveys undertaken in this area.

Recommendations for the 2010 fishery Disko Bay Offshore

CPUE from the fishery indicates increasing biomass since 2004 and there are signs of stock improvement. A catch level of 130 tons is recommended, which is the same recommendation as in 2008.

Management area: Sisimiut

The commercial fishery for snow crab in the Sisimiut area began inshore in 1996 and expanded to include the offshore area, primarily in Holsteinsborg Dyb, in 1997. Historical catch, CPUE and effort data of the fishery in Sisimiut in the inshore and offshore areas are summarized in Table 2. Data for 2009 is only preliminary and incomplete. Owing to a markedly decrease in biomass from 2002 to 2004, the offshore area has been closed for fishery from January 2005 to October 2007, where the area was reopened, despite reopen criteria was not meet. In the closure period 2 boats has been fishing on derogation.

In 2006 the fishery from were closed in all sites from mid July to primo September in order to protect soft shell crabs.

The distribution of the fishery over the last years shows fishing effort has moved outside the fjords in the traditional fishing grounds near Sisimiut. Furthermore two fjords (Ndr. Stoemfjord and Ndr.

Isortoq) north from Sisimiut has been exploited since 2004 (Fig 16).

Interpretation of the fishery data is subject to some uncertainty, caused by incomplete data and a big change in the spatial distribution of effort in 2009, where effort rose near the shelf edge.

Inshore Sisimiut

Fishery

Number of license holders has varied since the beginning of the fishery and implementation of management areas. In 2005 there were 12 license holders and 21 in 2009, from which 15 is active license holders.

In the period from 2000-2004 inshore catches steadily increased from 491 to 1,111 tons (Table 2 and Fig. 18). From 2005 catches decreased by 50% to a level of 559 tons in 2007. Effort decreased from 2000 to 2002, increased again in 2003, and declined by approx. a factor of 4 to a historical low level of 75 thousand trap hauls in 2007. The distribution of the fishery changed from 2004 to cover new fishing areas in fjords in the northern part of the area (Fig. 16), which have comparatively high CPUE. Thus, these new areas are largely responsible for the increase in the overall commercial CPUE since 2005.

Monthly trends in catches, CPUE and effort from 2004-2008 and preliminary data for 2009 are shown in Fig. 17. The temporal pattern of CPUE in 2009 is identical with trends in 2007 were CPUE peaked in May and decreased as the season progressed and total catch for the area increased. A similar pattern was seen in data for 2008, except for a peak in both August and December.

A standardised CPUE index (Fig. 18), show a significant dropped in CPUE from 2002 to 2004 from approx. 5.2 kg/trap to 2.8 kg/trap ($F= 92.12$, $P < 0.0001$). Since 2005 CPUE have been increasing

to 8.5 kg/trap in 2008, however preliminary data from 2009 indicate a minor decrease in CPUE to 8 kg/trap. The two more Northern fjords (Nordre Isortoq and Nordre Stoemfjord) have comparatively high CPUE. Thus, these new areas are largely responsible for the increase in the overall commercial CPUE since 2005.

Standardised soak time index (Fig. 19), shows a steadily significant increase in soak time from approx. 48 hour 2002 to 74 hour in 2008 ($F=17.87$ $P < 0.0001$). Preliminary data for 2009 log-books information show a minor decrease to 67 hour per trap haul.

Research Surveys

Inshore

Normally annual snow crab trap survey is conducted in late May to mid June, but owing to technical problems with *r/v Adolf Jensen*, survey in 2009 was carried out early August.

The survey CPUE inshore increased steadily from 2.9-6.7 kg/trap from 1997 to 2001, and was followed by a decline by a factor of 3 to a record low level of 2 kg/trap in 2005. During 2004-2006 survey CPUE was stable at a comparatively low level and below the reference mean of 5.8 kg/trap (1999-2002) for the time series (Fig.20). Since 2007, a standardize CPUE index, show increasing catch rates to 10.9 kg/trap in 2008, a record high level in the time series. Data for 2009 show a decreasing CPUE to 8.3 kg/trap ($F=5.1$, $P<0.001$) in the historic fishing area (the fjord: Amerloq, Iker-tooq, Kangerluarsuk, Ittilleq and the area outside the fjords but inside the basisline). However, the estimated CPUE in 2009 is still above the reference mean.

Mean CW of legal-size males inshore decreased from 2004 to 2006 (Fig. 21), but has for the past three years been 113 mm CW and identical with the reference mean for the time series.

Abundance of ADO-1 (82.2-100 mm CW) males in Sisimiut inshore was comparably high the first 3 years of the survey (2000-2002) (Fig. 22). Since From 2003, the abundance of ADO-1 males, declined sharply to approx. 1 ADO-1 per trap in 2004. The abundance of ADO-1 remained low but stable from 2004 to 2007. A significant increasing of ADO-1, to a record high level of 6.1 ADO-1/trap, was observed in 2008. The increasing CPUE as well as increasing number of ADO-1, suggested some positive recruitment to the stock. However, estimated abundance of pre-adults in 2009 show a decline to 4.6 ADO-1/trap, but is still high and above the series average based on available observations for adolescents (Fig. 22).

Annual size distributions of adolescent and adult males in Sisimiut inshore (Fig. 23) show evidence of recruitment progressing through to the legal size range (≥ 100 mm CW) from 2007 to 2008.

Legal-size males of shell condition 2 (new shelled males) has for the past two years comprised 50% of survey catches (Fig. 24) and positively showing a tendency of increasing number of intermediate shelled (SC3) adult males. The proportion of soft shell and new shelled males (SC2) has increased to approx. 70 % in 2009, probably because of incoming recruits.

The ratio between primiparous: all mature females declined sharply from 2000-2002 (Fig. 25), and has remained low up to the present with the exception of a slight increase in 2005. An increasing is observed in 2008 and 2009, suggesting new mature female recruiting to the stock. This observation compared to other survey trends suggesting fair recruitment with prospect for increase in the exploitable biomass in the near future.

In Nordre Isortoq CPUE were estimated to 8.1 kg/trap in 2007 and 12.5 kg/trap in 2009.

The 2007 inshore trap survey included (for the first time) an area in the Northern fjord – Ndr. Strømfjord. In that area CPUE was 8.1 kg/trap and is estimated to 12.5 kg/trap in 2009. Average mean CW was 116 mm in 2007 and dropped to 114 mm CW in 2009. The proportion of new shell males comprised 58% in 2007 and 70% in 2009. Intermediate males amounted (SC3) 42% and 30% respectively of the adult males exceeding the minimum legal size of 100 mm CW.

Abundance of ADO-1 was at a low level of 0.1 per trap but has been increased to 2.6 ADO-1/trap in 2009. Number of recruits is lower than compared to the other inshore areas of Sisimiut. In 2008 survey was not conducted in this fjord.

Outlook - Sisimiut Inshore

The survey data showed some improvement in the stock from 2006 to 2008. In the same period fishery removals decreased from 725 tons in 2006 to 559 tons in 2007. Biomass showed sign of recovering, and is again in 2009 observed to be higher than during the previous peak, 2001-2002 (Fig. 20). However, fishery and survey CPUE index as well as abundance index of recruits based on survey data dropped from 2008 to 2009, but remain high and are still above the series average based on available observations. If this trend continues in 2010 the commercial biomass will decrease might decrease over the next few years.

Recommendations for the 2010 fishery - Inshore Sisimiut

Because biomass (catch rates from both fishery and survey) and recruitment remains high, despite a drop from 2008 to 2009, still is above average for the time series, it is recommended that TAC be maintained on 500 tons for the entire inshore area in 2010, which may be sustainable at existing biomass and recruitment levels. The advice TAC level is the same as for the 2009 fishery.

Offshore Sisimiut

Fishery

In 2000 to 2002 Sisimiut offshore area, were the most important fishing area with commercial catches between 2,043-2,275 tons (Table 2 and Fig. 26), which was approximately 52-55% of the total offshore catch during that time. After a significant decline in commercial biomass, catches amounted 321 tons in 2004. In the following 2.5 years this area were closed for fishery in an attempt to promote the recovery of the resource (one vessel fished on derogation that period) until re-opening in fall 2007 were catches amounted 225 tons and at were the same level in 2008. Preliminary and incomplete logbooks data indicate a 30% increase in catch level to 308 tons in 2009.

The standardised CPUE index (Fig. 26), declined significantly from 8.5 kg/trap in 2000 to 3.4 kg/trap in 2002 ($F=170.4$, $P<0.0001$) indicating that high catches were sustained by an increase in effort (from 319 to 643 thousand trap hauls). In the following years catches continued to decrease despite a reduction in effort and by 2004 catches were reduced by 85% to 375 tons in comparison to 2001 and 2002 levels. In 2004 CPUE were at its lowest level at 2.2 kg/trap (Fig. 26) despite an approx. 80% reduction in effort. In the closure period CPUE increased significantly from 5.7 kg/trap in 2005 to 10.2 kg/trap in 2007. The CPUE level was maintained in 2008, but preliminary and incomplete logbooks data for 2009 indicate a 30% reduction in CPUE to 7.3 kg/trap. Monthly trends in CPUE 2009 show highest values in April (14.2 kg/trap) when the fishery was opened and a sharp decreased as the season progressed in September (4.2 kg/trap) and total catch for the area increased (Fig. 27). Seasonal trend in CPUE (Fig. 27) shows a rapid depletion to September in 2009 compared to the previous years. It appears that depletion began in 2008 and that the high overall CPUE for 2008 (Fig. 26) is misleading. CPUE dropped sharply from August to October in 2008

and the annual mean was increased by high CPUE in November- December.

Standardised soak time index (Fig. 28), show an increase in soak time from approx. 54 hour in 2002 to 78 hour in 2005 ($F= 57.31$ $P < 0.0001$). Soak time decreased to approx. 43 hour in 2008. Preliminary data from 2009 logbooks information show an increase to 53 hour per trap haul.

The area stayed closed from January 2005 and re-opened during 15 August to 31 October in 2007. Re-opening criteria were not reached, when a political decision allow fishery.

The following re-opening criteria were established in July 2007 in an agreement with KNAPK the fishermen's organization and Greenland Institute of Natural Resources:

- An average CPUE of 6 (kg/trap) obtained from logbooks and survey data
- An average carapace width of 115 mm for commercial sized males
- An average abundance of pre-recruits (Ado-1; 82 – 100 mm CW) of 2 per trap obtained by survey
- A maximum level of 50% new shelled males in commercial as well as survey catches

Research Surveys

A steady increase in the survey CPUE were observed over the period from 2004 (0.6 kg/trap) to 13 kg/trap in 2008 (Fig. 29). In 2009 CPUE have declined significantly to 6.9 kg/trap ($F=5.1$, $P<0.001$) same level as in 2002, and is now below the reference mean of 10.0 kg/trap (derived from the mean in the years 2000-2003) for the time series. However, survey CPUE level is still a bit higher than the 6 kg/trap as prescribed for the re-opening criteria.

The mean CW of legal-size males (≥ 100 mm CW) offshore decreased considerably from 120 to 112 mm from 2003-2005, but has increased to 117 mm CW in 2008 (Fig.21). Only a minor decrease was observed in 2009 to 116 mm CW.

Annual size distributions of ADO-1 (82.2-100mm CW) showed some evidence of these adolescents progressing through to legal-size from 2001 to 2003 (Fig.23) but overall progression was not particularly obvious, possibly disguised by the large drop in the overall biomass of legal-size males since 2002. There is no apparent trend corresponding to progression of length distributions in the most recent years except for a minor trend in 2007 and 2008 (see Fig. 23).

Comparison to the inshore area also indicates that in 2008 and 2009 modal size of adults and mean size of adolescents were much larger in the offshore than inshore, supporting the idea that (offshore) the most recent recruitment pulse has fully entered the fishery and is being removed while there is no strong recruitment following.

The abundance of ADO-1 in Sisimiut offshore declined markedly from 2000 to a record low level below 0.2 ADO-1/trap in 2004 (Fig. 30). From 2005 the abundance of ADO-1 rose to approx. 1.5 per trap in 2006. In 2007 and 2008 abundance of ADO-1 has declined to the 2005 level of 1.2/trap. In 2009 abundance of ADO-1 is estimated to 0.4 /trap and have declined significantly compared to the past two years. Number of recruits is below reference mean for the time series and almost as the same low level as observed in 2003.

The percentages of new-shelled crabs within the legal size range decreased from almost 90% in 2004 to about 25% in 2008 (Fig. 24). This sharp decrease in percent of new-shelled crabs in the survey is primarily likely due to the closure of fishery in the offshore area in the period from 2005 to 2007 and the very low level in commercial

catches in that period (Table 2). The subsequent increase in percent new-shelled males in 2009, however, may have been due to increasing recruitment into the stock, as ADO-1 had increased in 2005 to 2008. However, it is unclear to what extent the changes in shell condition ratios and CPUE are due to reduced catch versus increased recruitment. In general the increased percentage of old-shelled males and increasing CPUE are both positive signs for the stock indicating an increased abundance of older shelled males that are available to participate in reproduction.

The ratio of primiparous:total mature females declined sharply from 2000-2002, then increased from 2003 to 2005 (Fig. 31). A significant drop in this ratio occurred in 2006 and continued in 2008, with a minor increase in 2009 indicating poor recruitment may be forthcoming in the future.

Outlook - Offshore Sisimiut

Survey and fishery data indicate signs of recovery in 2007 and 2008. The increase in biomass was largely attributable to greatly reduced removals due to the large reductions in commercial catches, from 2004 up to 2007. Nevertheless, all available indexes show a significant drop from 2008 to 2009. Recruitment indices for the offshore area are poor and indicate low recruitment prospects in the short term. Caution must be exercised as CPUE from the fishery and survey declining and the recruitment is at a very low level. Those results might be effects of increased removals by the fishery after the re-opening and suggesting that the biomass is/was not recovered.

Furthermore, it appears that the biomass fished upon after re-opening in 2007 may not be able to support catches as large as those landed in 2007-2008. It is quite possible that the biomass will not recover to the same high levels as existed initially. For unknown reasons, (eg. Ocean climate change) observations from Newfoundland shows

crab productivity may never be as high as it once was (pers. Comm., Earl Dawe, DFO, St. John's, Newfoundland, Canada).

It should be emphasized that re-opening of the fishery in 2007 was sustained before the re-opening criteria was met.

Recommendations for the 2010 fishery - Offshore Sisimiut

In 2009 there is no sign of progression in the biomass and the previous year sign of recovery is turned to a decline in the biomass and recruitment.

It is therefore recommended to reduce the TAC to 200 tons in the entire offshore area in 2010.

Special comments: Harvesting should be monitored using a precautionary approach, relayed on approach for changes in catch levels, careful monitoring of the population response to the fishery and implementation of re-open /re-closure criteria.

Management area: Maniitsoq-Kangaamiut

The historical catch, CPUE and effort data of the fishery in Maniitsoq-Kangaamiut inshore and offshore areas are summarized in Table 2.

Overall catches of snow crab from the fishery in Maniitsoq-Kangaamiut area increased from 944 tons in 2000 to 1,835 and 1,775 tons in 2001 and 2002, respectively, as effort was doubled. Catches then decreased considerably to 486 tons in 2003 and 115 tons in 2004 as the CPUE both inshore and offshore decreased to the lowest levels observed in the fishery (2.4 and 2.1 kg/trap in offshore and inshore areas). Since 2003 the inshore fishery has been less than 100 tons and from 2005 the offshore fishery has been closed, but was reopened in August 2007.

Inshore Maniitsoq-Kangaamiut

Fishery

Catches in Maniitsoq-Kangaamiut inshore peaked in 2001 and 2002 at approx. 1,000 tons both years but in the subsequent years the fishery have been very limit and in 2009 catch level amount 22 tons. CPUE remained low at 3.1 kg/trap despite large decrease in catches and effort (Table 2) and Fig. No standardised index of CPUE and soak time has been prepared, owing to the lack of data and un-regularly recurring fishery in this area.

Outlook - Inshore Maniitsoq-Kangaamiut

It is difficult to determine the biomass of the resource in the area, while data from the fishery are limited. There is no survey in the inshore area and comparative biomass and recruitment prospects are unknown.

Recommendations for the 2009 fishery - Inshore Maniitsoq-Kangaamiut

Due to the lack of survey and fishery data no advice is given for Maniitsoq-Kangaamiut inshore.

Offshore Maniitsoq-Kangaamiut Fishery

Catches in Maniitsoq-Kangaamiut offshore peaked in 2001 with a catch level of 826 tons and a CPUE of 5 kg/trap. A significant declined in catches to 445 tons was observed. Despite in catch and used effort CPUE remained low at 2.1 kg/trap in 2004, indicating the resource was still in a state of decline.

Continued poor state of the resource biomass and confirming data from a biological survey led to the recommended and implemented closure of the offshore area in 2005 and again in 2006 to promote the recovery of the resource.

In 2007 CPUE has increased to approx. 10.2 kg/trap, as well as catches and effort increased to 174 tons in 2007. In 2008 catch level declined to 111 tons and CPUE to 9.0 kg/trap. Preliminary

catch for 2009 indicate an increase in catch level and declining catch rate.

No standardised index of CPUE and soak time has been prepared, owing to the lack of data and un-regularly recurring fishery in this area.

Research Surveys

Owing to the breakdown of the main engine and continued technical problems at the research ship Adolf Jensen, the survey has been cancelled in 2007, 2008 and 2008. No new survey data is available for the stock assessment and advice.

Outlook - Offshore Maniitsoq-Kangaamiut

Fishery data is very sparse and those available suggest an decreasing tendency since 2007.

Recommendations for the 2010 fishery - Offshore Maniitsoq-Kangaamiut

No new data are available for 2009. Due to the lack of survey and fishery data no advice is given for Maniitsoq-Kangaamiut offshore.

Management area: Nuuk-Paamiut

The historical catch, CPUE and effort data of the fishery in Nuuk-Paamiut inshore and offshore areas are summarized in Table 2.

The Nuuk-Paamiut area has been an important fishing area where total catches peaked at more than 5,000 tons in 2001 (Table 2.). However, catches the following year were approximately 50% lower (2,531 tons) despite only a 10% decrease in effort. This led to the fishery CPUE inshore and offshore decreased from 5.3 and 3.8 kg/trap respectively in 2001 to 2.8 kg/trap in 2002 in both areas. Total catches including inshore and offshore were somewhat stable around 2,300 tons during 2002-2005, partly as a result of low overall effort and more recently due to quota restrictions. Total catches decreased by 77% to 521 tons in 2007 (410 tons offshore and 111 tons inshore). Over the past two years catches have been

steadily increasing to a preliminary level of 743 tons in 2009 (Fig.32).

Inshore - Nuuk-Paamiut

Fishery

Catches peaked at 4,157 tons in 2001 and then declined by more than 97% to 111 tons in 2007 (Table 2 and Fig. 33), while fishing effort declined by 98%. The catch level increased to 200 tons in 2008 and preliminary data show 216 tons in 2009.

The distribution the fishery in 2004 and 2008 has been concentrated near the sub-areas Fiskenæs-Danasdyb and Frederikshåb-Ravnsdyb. There is, however some fishery in the northern part of the area – Godthåb (Fig. 32).

From the standardised CPUE index (Fig. 33) it appears that CPUE has gradually increased during this period from a low of 1.8 kg/trap in 2000 to 7.7 kg/trap in 2006 ($F= 30.4$, $P<0.001$) and remained somewhat stable. In 2008 average soak time was approx. 80 hour per hauled traps fleet (Fig. 34).

Outlook - Inshore Nuuk-Paamiut

There is no survey undertaken in Nuuk-Paamiut inshore thus recruitment indices and other biological parameters are not available. The commercial CPUE have been somewhat stable since 2005 as total catch and effort remain at a low level. There is concern regarding sustainability of the resource at higher catch levels, due to the lack of biological data.

Recommendations for the 2010 fishery - Inshore Nuuk-Paamiut

There had been indications of improvement to the resource biomass over the last several years in a scenario of decreasing fishing exploitation. It is however, difficult to determine the extent of the improvement due to the lack of other stock indices. It is therefore recommended that the catch level of 200 tons for 2010 and comparable with the commercial catch level since 2005.

Offshore - Nuuk-Paamiut

Fishery

The distribution in the offshore fishery has changed slightly from a continuous distribution of effort along the inner edges of the offshore banks from the middle of the Nuuk-Paamiut area and northward in 2003 to effort concentrating around sub-areas Fiskenæs-Danasdyb and Frederikshåb-Ravnsdyb in 2004 and 2009 (Fig. 32). In 2005 and 2006 and 2009, effort has been allocated to a fishery along the outer edges of the banks (Fyllas bank) in the northern part of Nuuk-Paamiut.

In 2007 there were no landings of crab from ultimo June to mid October 2007 to the main industry component (Royal Greenland) in Paamiut.

Catches in Nuuk-Paamiut offshore declined from 1,339 in 2000 to 761 tons in 2002 (Table 2 and Fig. 35). Catch level more than doubled to 1,611 tons in 2003 and further increased to 2,033 tons as effort decreased to 302 thousand trap hauls in 2005. Since catches have declined and was in 2008 (418 tons) approx. 80% of the 2005 level and effort decrease by 85%.

A standardised CPUE index shown gradually increase to a level of 8.1 kg/trap in 2005 (Fig. 35), followed by a two years decrease in CPUE. Data from 2008 and preliminary data for 2009 indicated some stability of CPUE at 7.9 kg/trap and 7.4 kg/trap respectively.

The fishery starts in January and has the highest catch rates from February to May. Monthly trends in commercial data generally show substantial declines in CPUE during the year, suggesting the resource is being depleted as the fishing season progresses (Fig. 36).

Soak time has been quite stable and varied from approx. 60 to 77 hour per hauled trap fleet from 2000 to 2008. Average soak time in 2009 is 59 hour per hauled traps fleet (Fig. 36).

Research Surveys

Owing to the breakdown of the main engine at the research ship *Adolf Jensen*, the survey has been cancelled in 2007, 2008 and 2009. No new survey data is available for the stock assessment and advice.

Outlook - Offshore Nuuk-Paamiut

Owing to cancelled surveys, there is no fishery-independent data, to validate the apparent increase in the exploitable biomass in this area. It is uncertain if there is a progression in biomass or the increasing catch rates is a result from a lack of interest for commercial snow crab fishery in the management area in 2007 and 2008.

**Recommendations for the 2010 fishery -
Offshore Nuuk-Paamiut**

No new biological data has been available since 2006. It is recommended that the catch level for 2010 does not exceed 1600 tons, identical with the quota for 2008 and 2009.

Tables

Table 2. Catches, catch rates (CPUE) and effort in management inshore and offshore areas from 2000-2009. *2009 data is preliminary and incomplete.

Management Area	Year	Total catch (tons)	Quota	Inshore catch (tons)	Inshore CPUE (kg/trap)	Inshore effort ('000)	Offshore catch (tons)	Offshore CPUE (kg/trap)	Offshore effort ('000)
Uummannaq-Diskobugt	2000	3,052	--	2,940	4.8	613	112	5.5	20
	2001	4,202	--	3,950	3.1	1,274	252	3.6	70
	2002	3,319	--	2,970	3.3	900	349	3.0	116
	2003	2,739	--	2,482	3.7	679	257	2.6	97
	2004	2,341	--	2,174	3.4	632	167	3.7	45
	2005	1,500	1718	1,404	3.9	363	96	4.0	24
	2006	1,134	1600	1,008	4.6	221	126	6.7	19
	2007	698	1530	574	4.2	138	123	5.1	24
	2008	627	1400	531	5.0	107	96	5.2	19
	2009*	439	700	264	5.5	48	174	5.5	32
Sisimiut	2000	2,534	--	491	2.8	175	2,043	6.4	319
	2001	2,602	--	327	2.9	113	2,275	4.6	495
	2002	2,724	--	473	4.6	103	2,251	3.5	643
	2003	1,633	--	692	3.7	187	941	3.1	304
	2004	1,432	--	1,111	3.9	286	321	4.9	65
	2005	1,125	900	891	6.5	137	234	6.4	37
	2006	736	750	725	8.3	87	11	11.1	1
	2007	784	850	559	7.4	75	225	12.8	18
	2008	979	700+300	765	8.8	87	214	13.1	16
	2009*	867	500+300	560	8.6	65	308	8.3	37
Maniitsoq-Kangaamiut	2000	944	--	563	4.3	131	381	7.6	50
	2001	1,835	--	1009	3.7	273	826	5.0	165
	2002	1,775	--	1032	3.8	272	743	2.7	275
	2003	485	--	40	3.5	12	445	2.8	160
	2004	116	--	78	2.4	33	38	2.1	18
	2005	73	200 (inshore)	62	4.2	15	11	3.6	3
	2006	72	100(inshore)	61	4.3	14	11	4.3	3
	2007	187	300	13	2.9	5	174	10.2	17
	2008	130	300	19	5.9	3	111	9.0	12
	2009*	185	--	22	3.1	7	163	6.0	27
Nuuk-Paamiut	2000	3,769	--	2,430	5.3	458	1,339	5.4	248
	2001	5,077	--	4,157	5.3	784	920	3.8	242
	2002	2,531	--	1,770	2.8	632	761	2.8	272
	2003	2,315	--	704	3.4	207	1,611	4.2	385
	2004	1,795	--	180	4.5	40	1,615	8.0	203
	2005	2,295	--	262	8.0	33	2,033	6.7	302
	2006	1,173	1,800	204	7.3	28	969	3.0	328
	2007	521	1,600	111	7.2	15	410	7.4	56
	2008	617	1600	200	7.2	28	418	9.1	46
	2009*	743	700+300	216	7.7	28	527	8.6	62
Narsaq-Qaqortoq	2000	2	--	0	--	--	2	--	--
	2001	822	--	822	--	--	0	--	--
	2002	643	--	642	--	--	1	--	--
	2003	133	--	123	--	--	10	--	--
	2004	541	--	32	3.9	8	2	1.0	2
	2005	76	--	76	8.3	9	--	--	--
	2006	0	--	--	--	--	--	--	--
	2007	0	--	--	--	--	--	--	--
	2008	--	--	--	--	--	--	--	--
	2009*	125	--	--	--	--	--	--	--

Figures

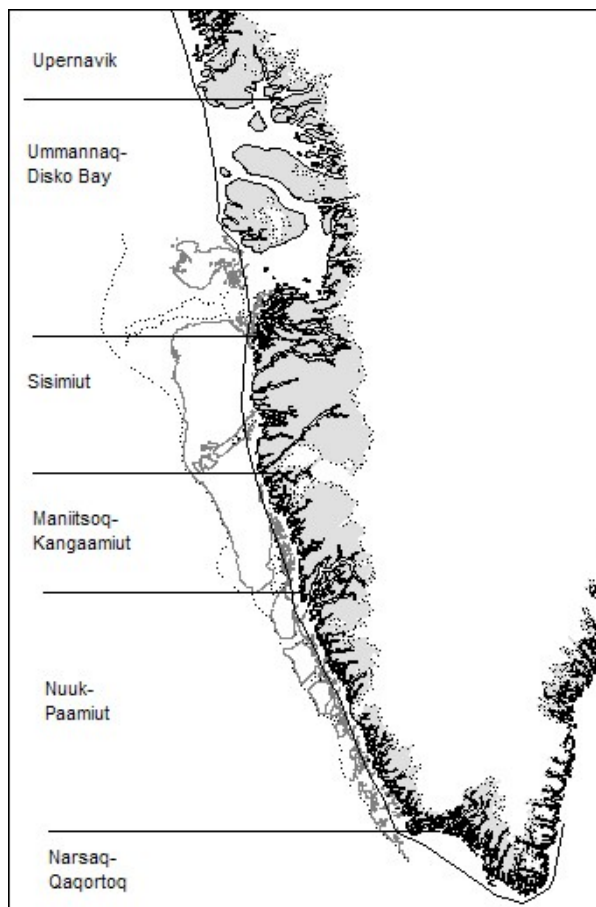


Fig 1. Map of West Greenland outlining the 6 management areas as of 2004 for the snow crab fishery.

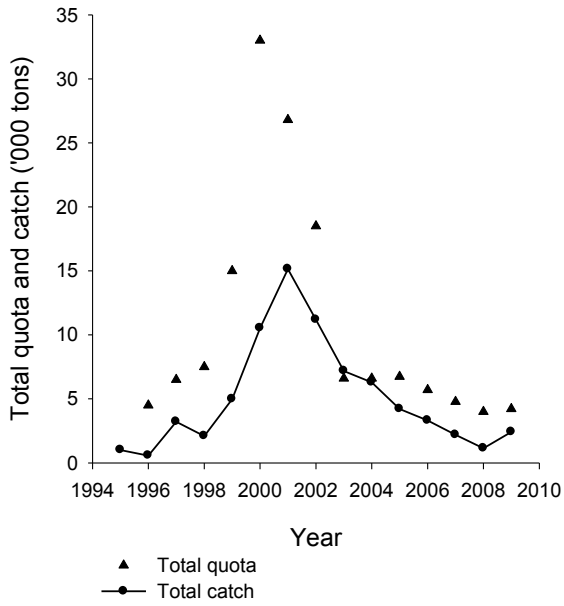


Figure 2. Total catch and quota size from 1995-2009. Data from 2009 is only preliminary.

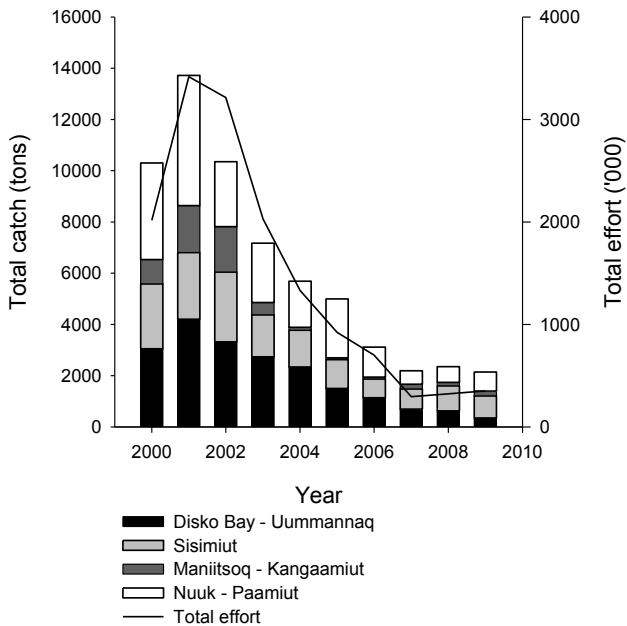


Fig. 3. Snow crab landings in the 4 most important management areas of West Greenland 2000-2009 and used total effort. Data for 2009 are preliminary and incomplete.

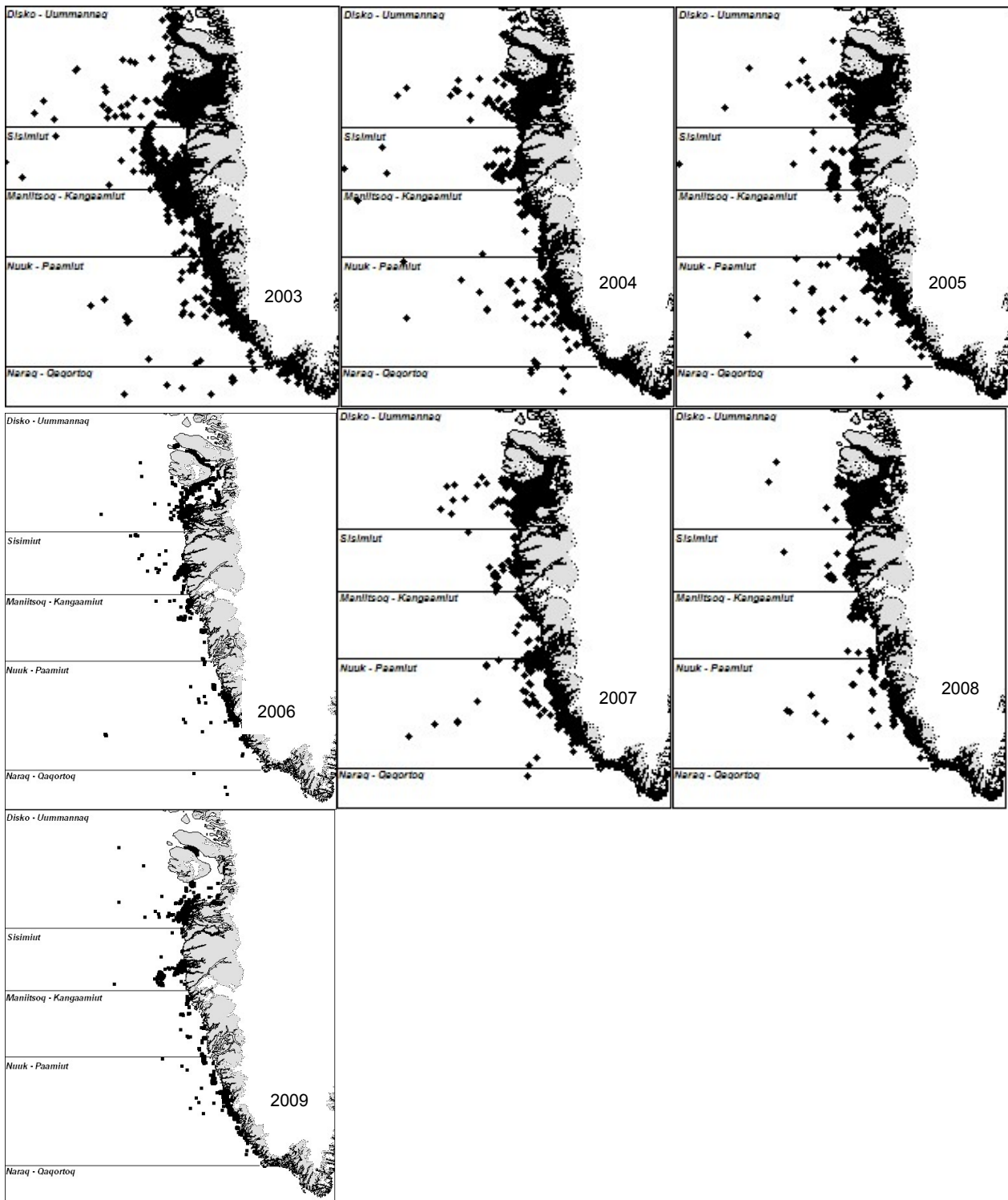


Fig. 4. Distribution of the crab fishery off West Greenland within each management area from 2003 - 2009, derived from logbook data. Lines are used to separate management areas.

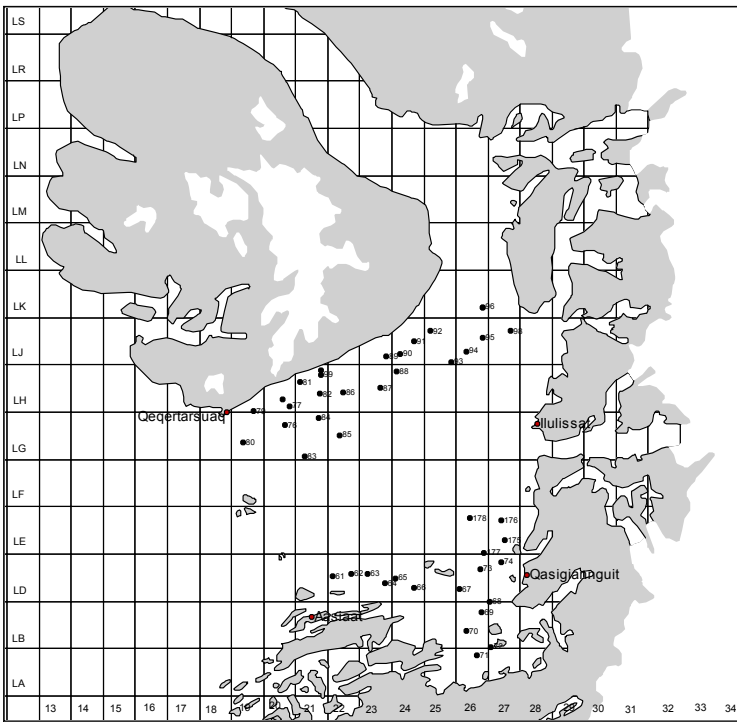


Fig. 5a. Map showing the location of survey stations in Disko Bay, Area 1 (North) and Area 2 (South).

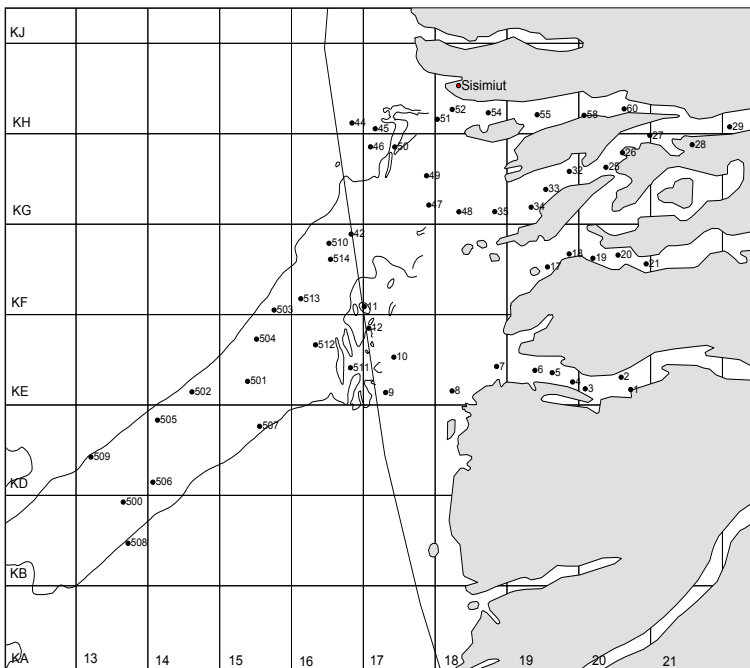


Fig. 5b. Map showing the location of inshore and offshore survey stations in Sisimiut.

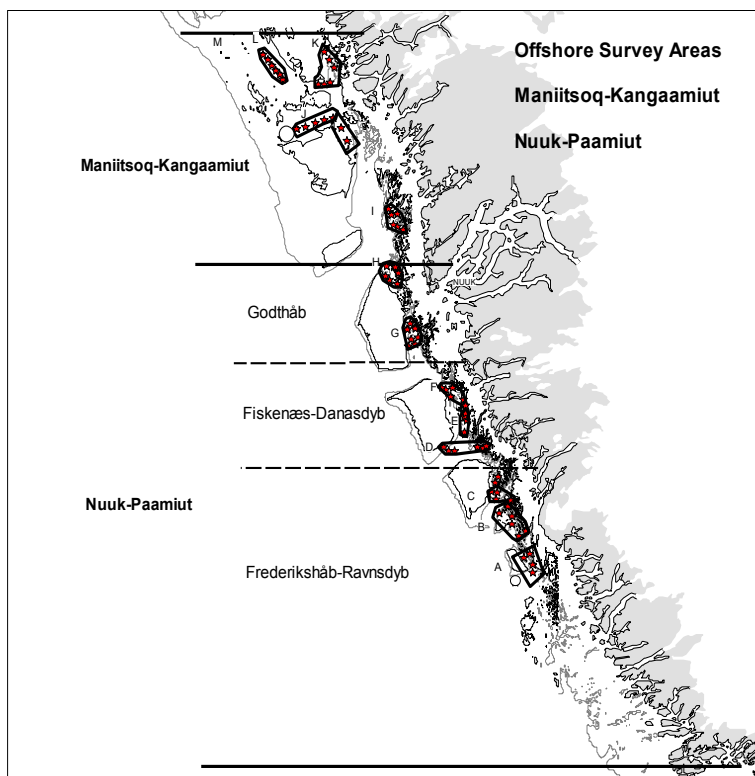


Fig. 5c. Map showing the location of survey stations from Maniitsoq-Kangaamiut and Nuuk-Paamiut (and sub-areas).

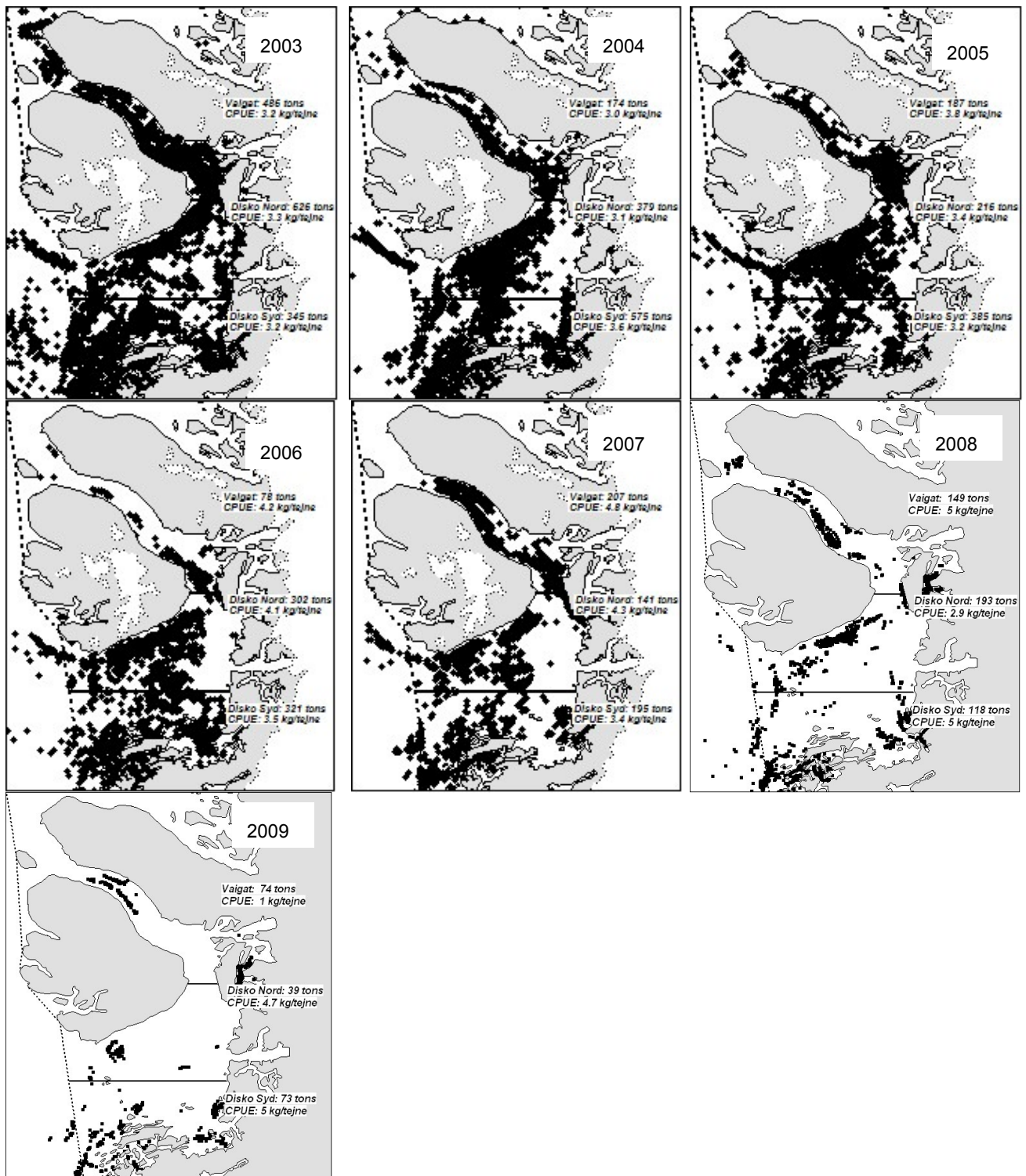


Fig. 6. Annual distribution of fishing effort in Uummannaq-Disko Bay from 2003-2009. Data for 2009 is preliminary and incomplete.

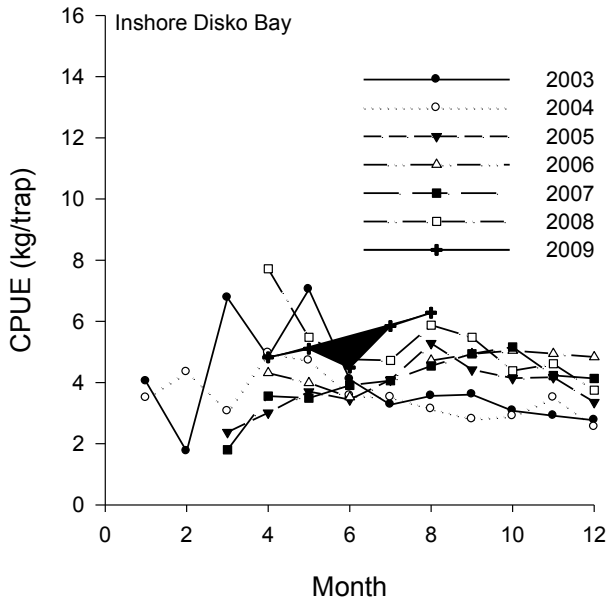


Fig. 7. Monthly trends CPUE (kg/trap) in Uummannaq-Disko Bay Area from 2003-2009. Data for 2009 is preliminary and incomplete.

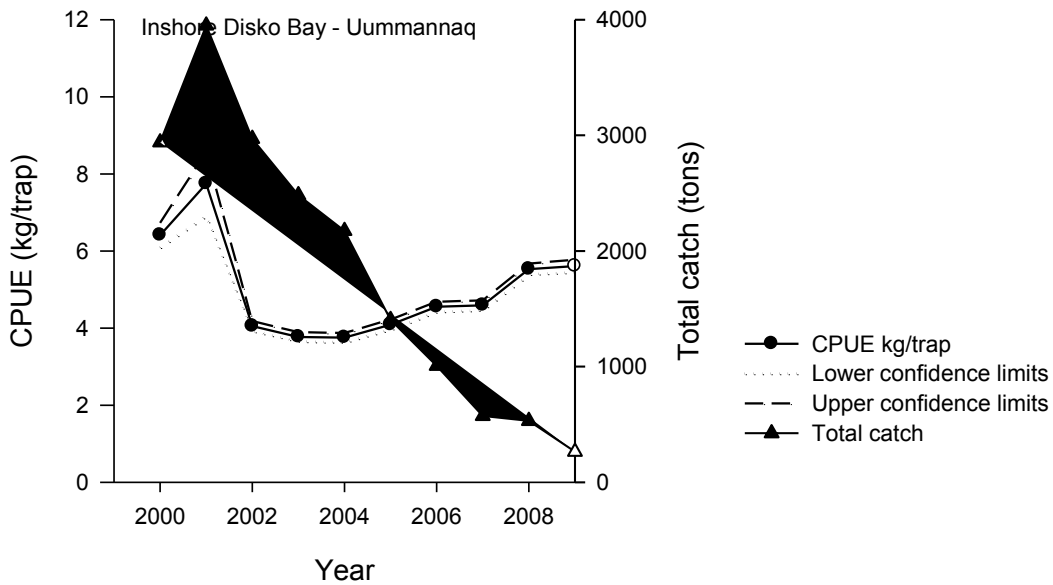


Fig. 8. Standardised CPUE index and total catch based on logbook information inshore Uummannaq-Disko Bay Area from 2000-2009. Data for 2009 is preliminary and incomplete.

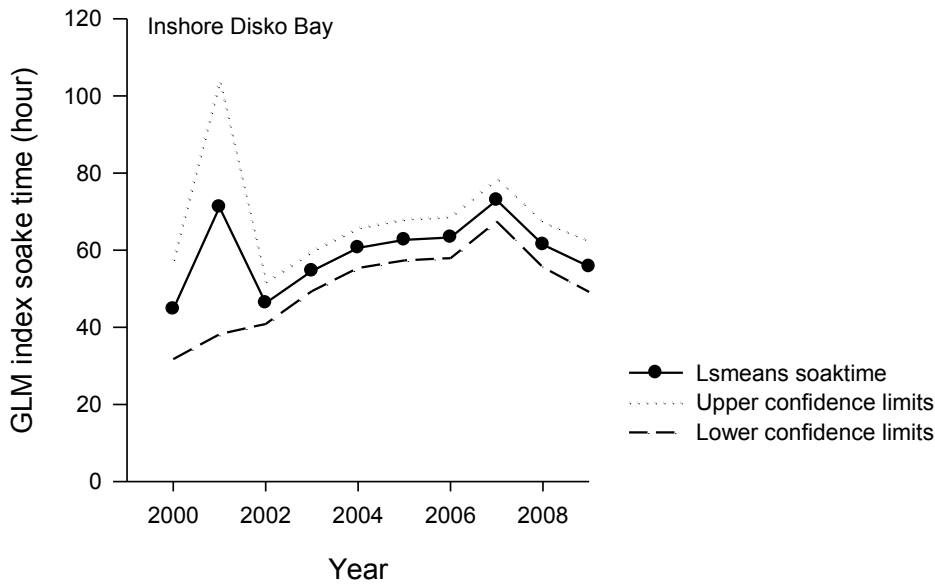


Fig.9. Standardised soaktime index on logbook information in inshore Uummannaq-Disko Bay Area from 2000-2009. Data for 2009 is incomplete.

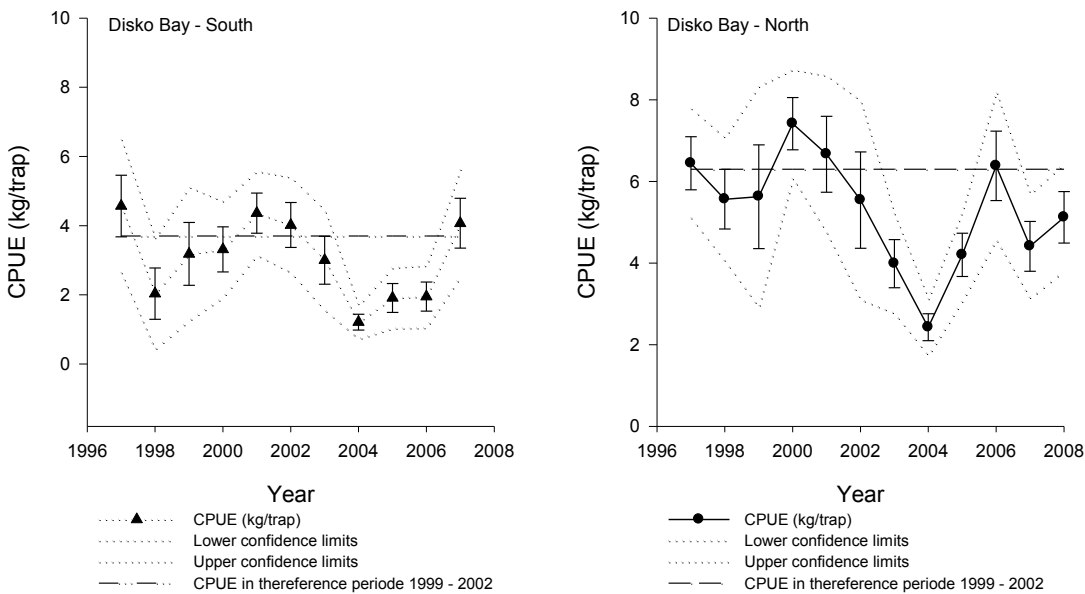


Fig. 10. Annual trends in CPUE (kg/trap) of legal-size males (≥ 100 mm CW) from trap surveys in Disko Bay Survey Area “Disko Bay South” and Area “Disko Bay Nord” (1997-2008). The mean CPUE for the reference period (1999-2002) is indicated with a line.

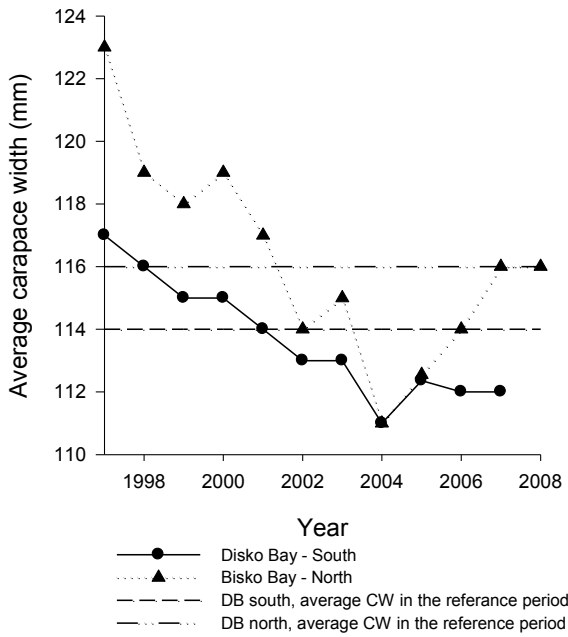


Fig. 11. Annual trends in the mean carapace width (CW) of legal-size males (≥ 100 mm CW) from trap surveys in area “Disko Bay South” and area “Disko Bay North” of Disko Bay 1997 to 2008. The dashed lines represent the mean CW for the time series in Disko Bay South and Disko Bay North during the reference period 1999 to 2002.

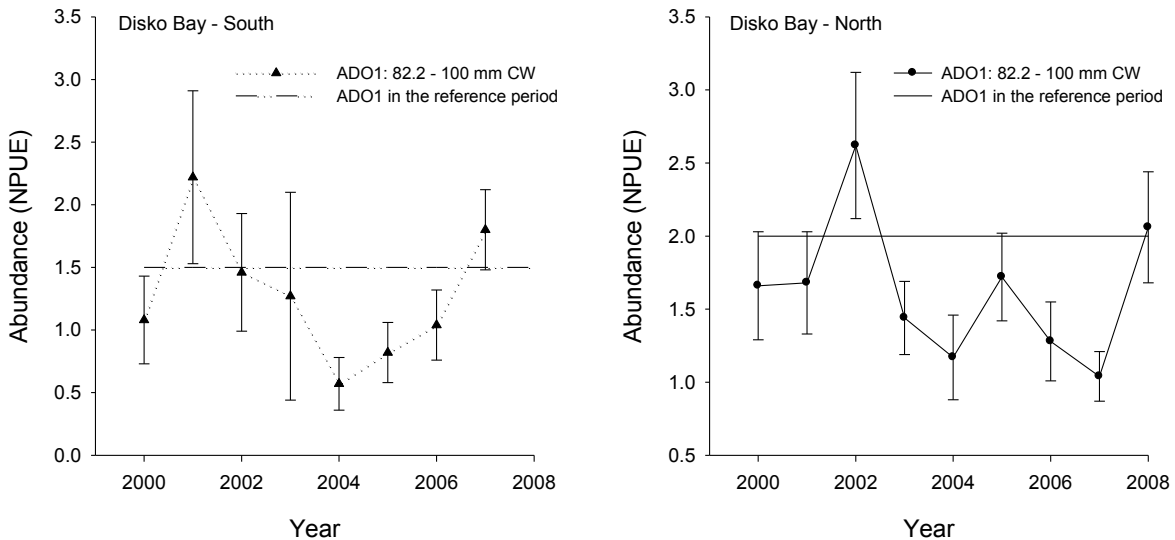
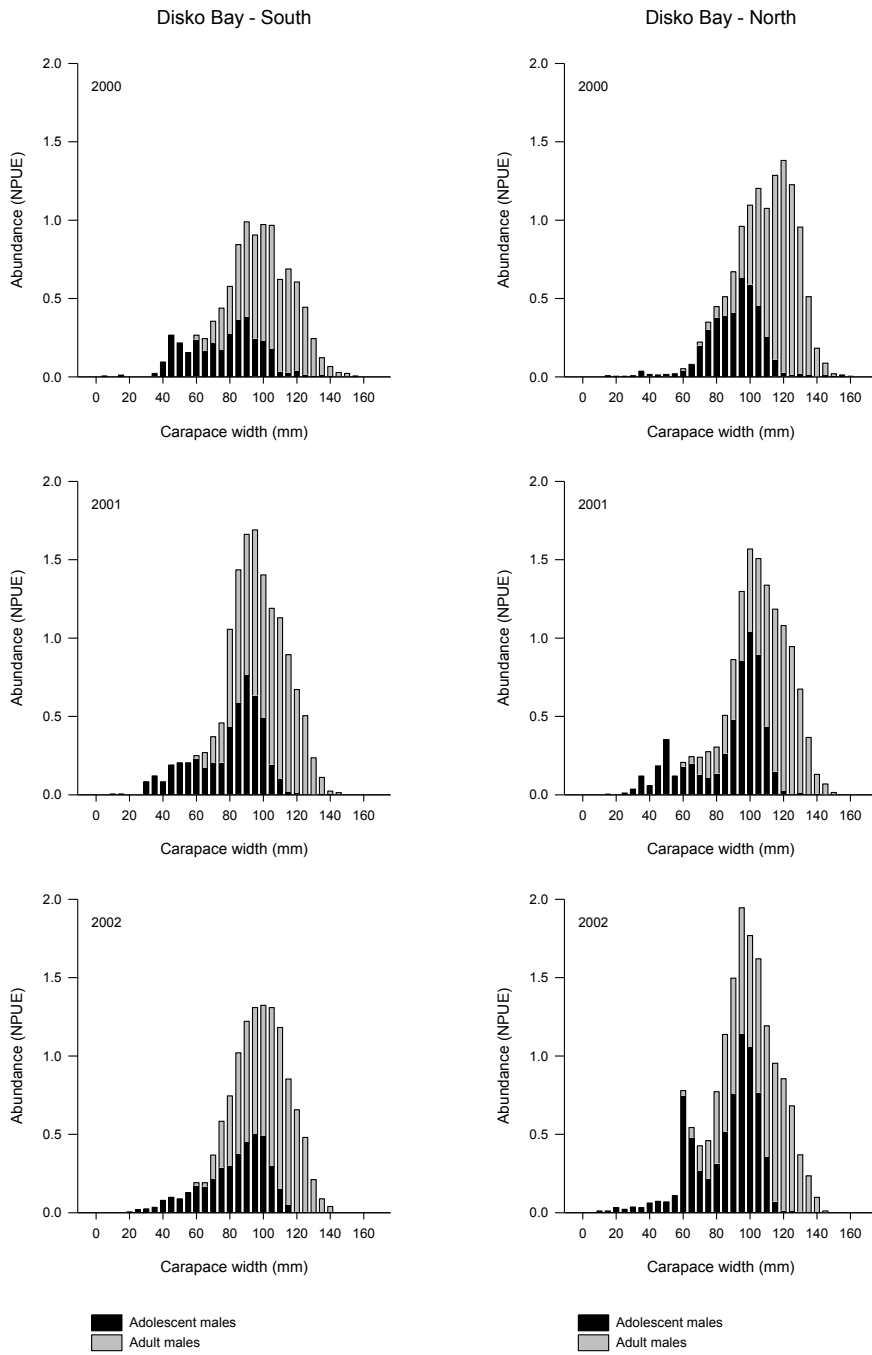
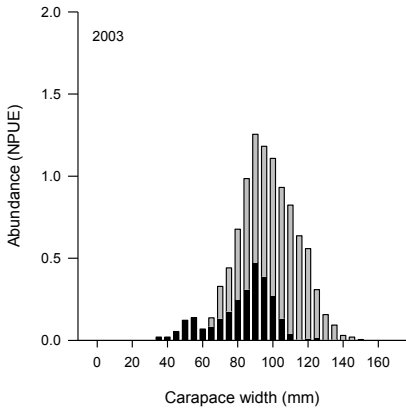


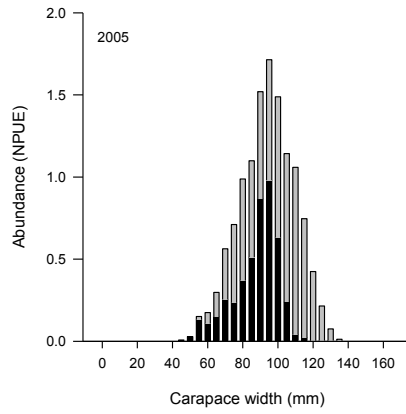
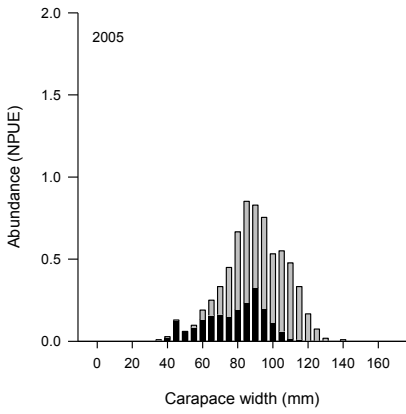
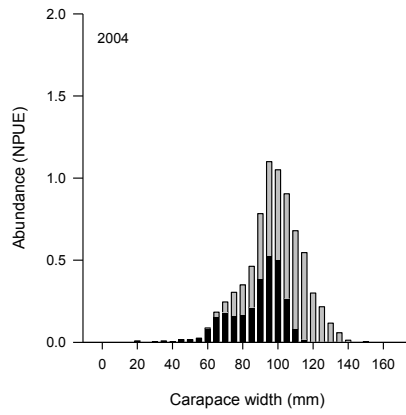
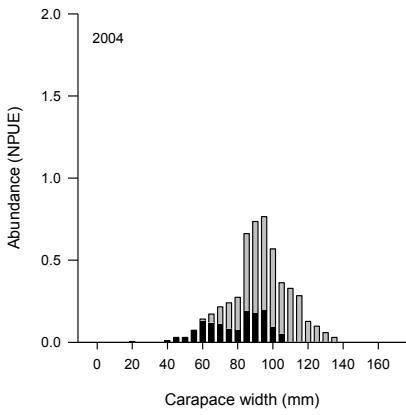
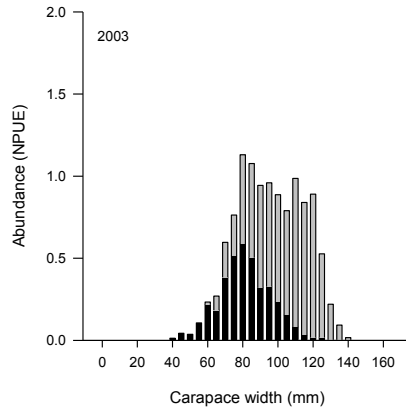
Fig. 12. Annual trends in NPUE (No. of crabs per trap) \pm S.D. of adolescent males (ADO-1: 82.2-100mm CW) in Disko Bay South and Disko Bay North, expected to recruit to the fishery the following year. The dashed line is the mean NPUE of ADO-1 in Disko Bay South and Disko Bay North during the reference period 1999 to 2002.



Disko Bay - South



Disko Bay - North



Adolescent males
 Adult males

Adolescent males
 Adult males

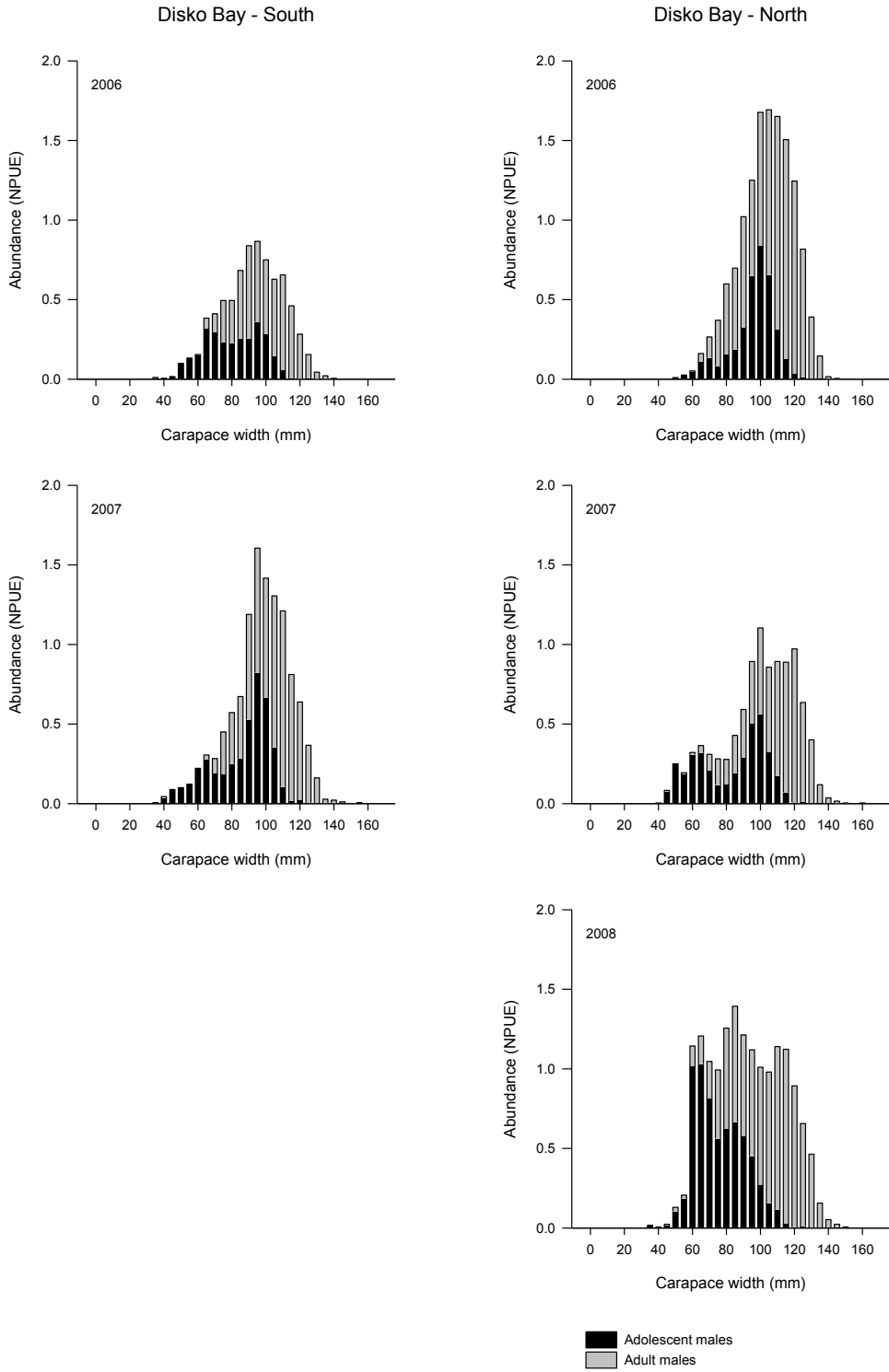


Fig. 13. Size distribution of adolescent and adult males from survey Disko Bay South and Disko Bay North in Disko Bay from 2000-2008.

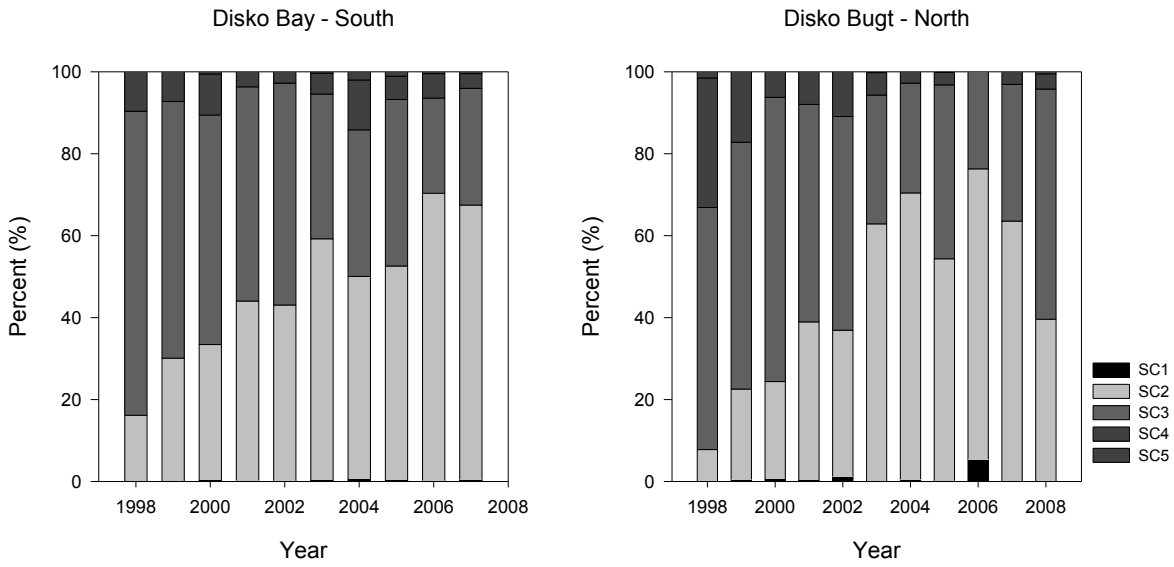


Fig. 14. The percentage of shell conditions (1-5) of adult legal-sized male crabs ($\geq 100\text{mm CW}$) sampled in Disko Bay South and Disko Bay North, Disko Bay 1998 to 2008.

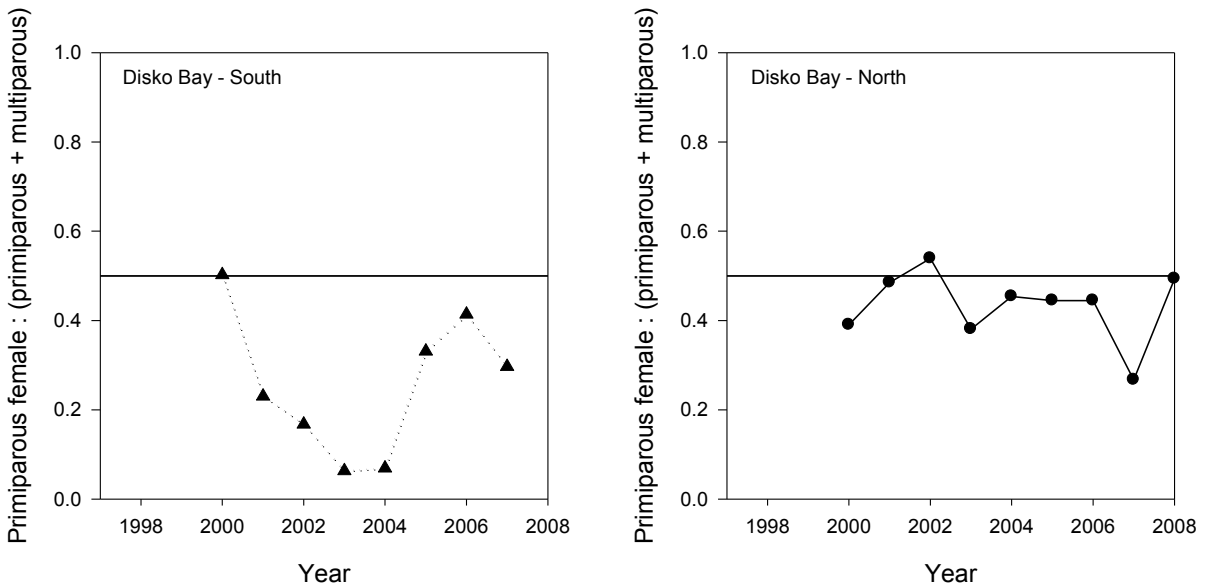


Fig. 15. Annual trends in the ratio between primiparous and multiparous in Disko Bay South and Disko Bay North, Disko Bay 2000-2008.

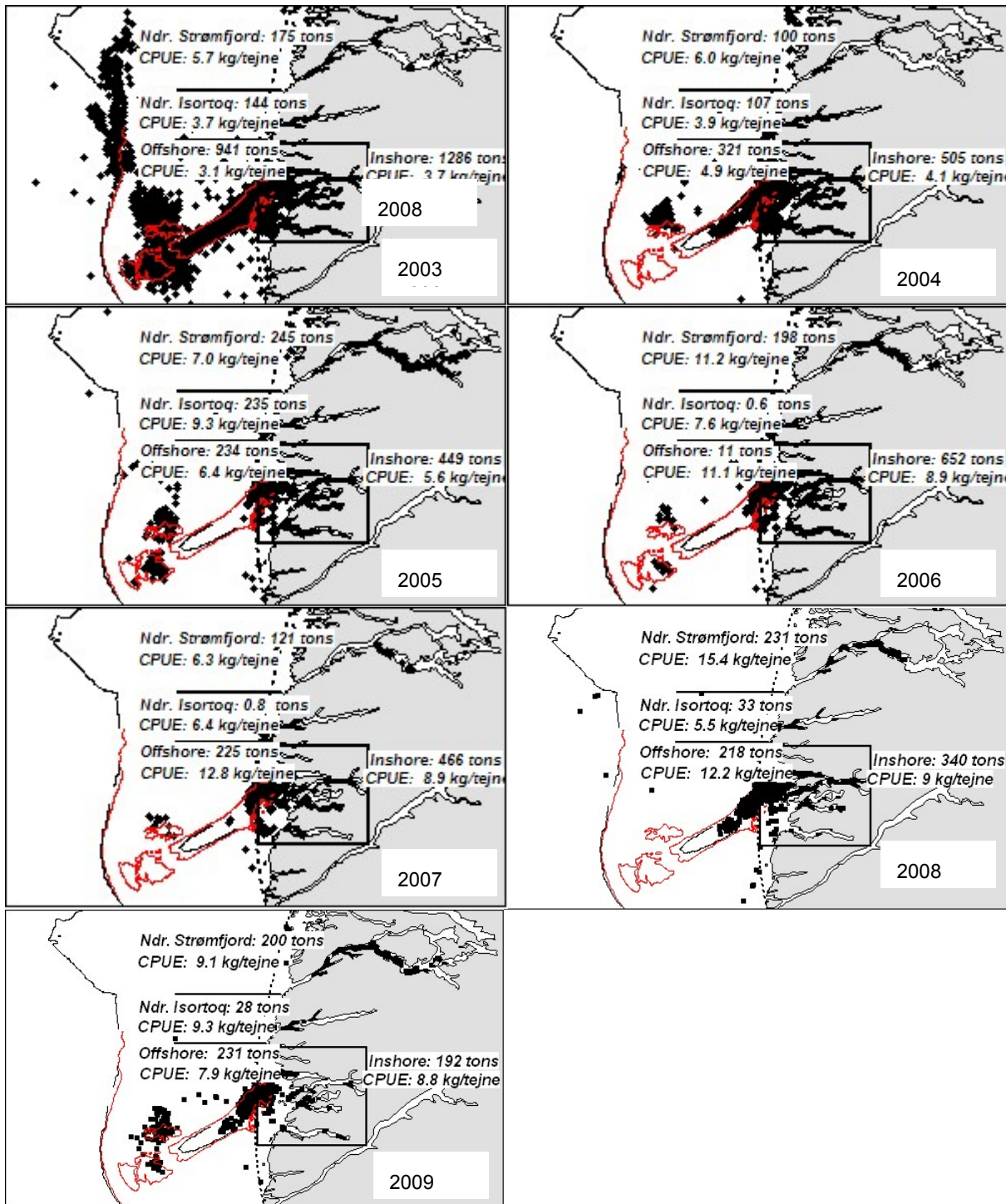


Fig. 16. The distribution and crab fishery in Sisimiut inshore and offshore in 2003 - 2009. The coastal line indicates the basis- line separating the offshore from the inshore. Data from 2009 is preliminary and incomplete.

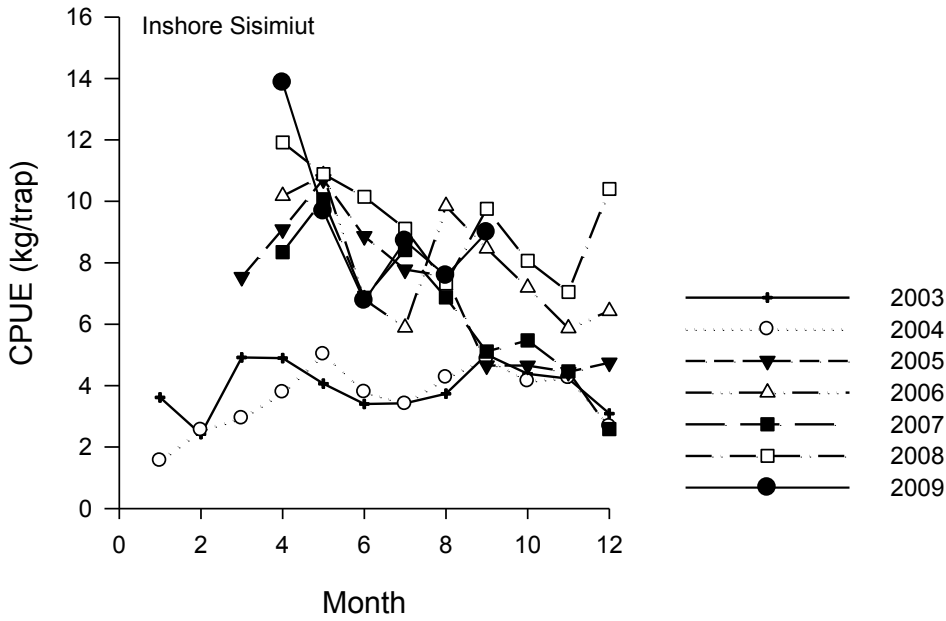


Fig. 17. Monthly trends in CPUE (kg per trap) from the fishery in Sisimiut inshore from 2003 to 2009. Data for 2009 is incomplete.

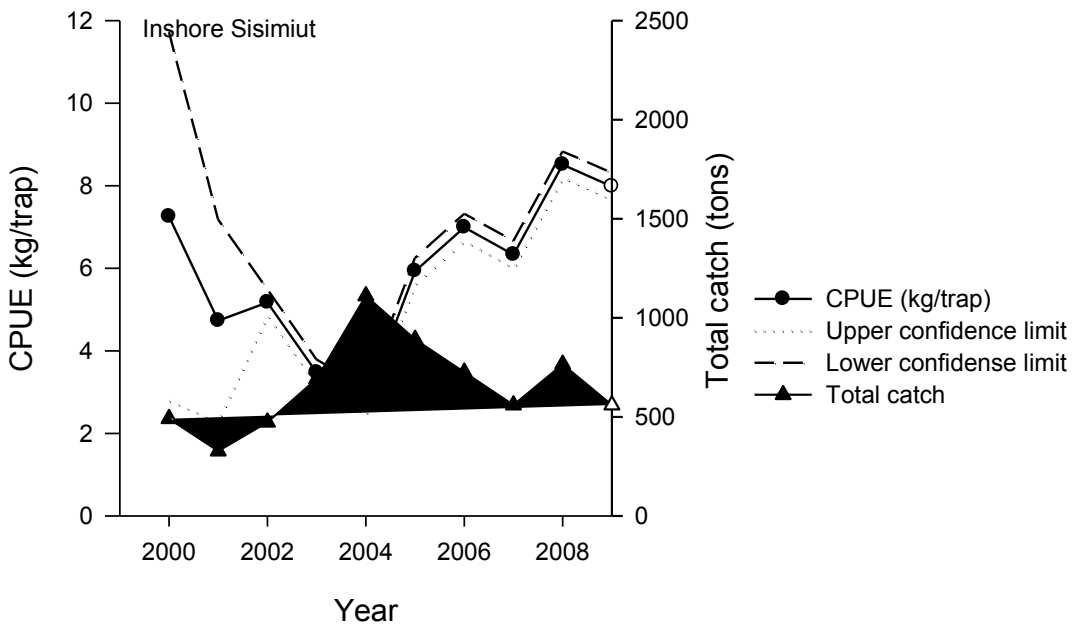


Fig. 18. Standardised CPUE index and total catch based on logbook information inshore Sisimiut from 2000-2009. Data for 2009 is incomplete.

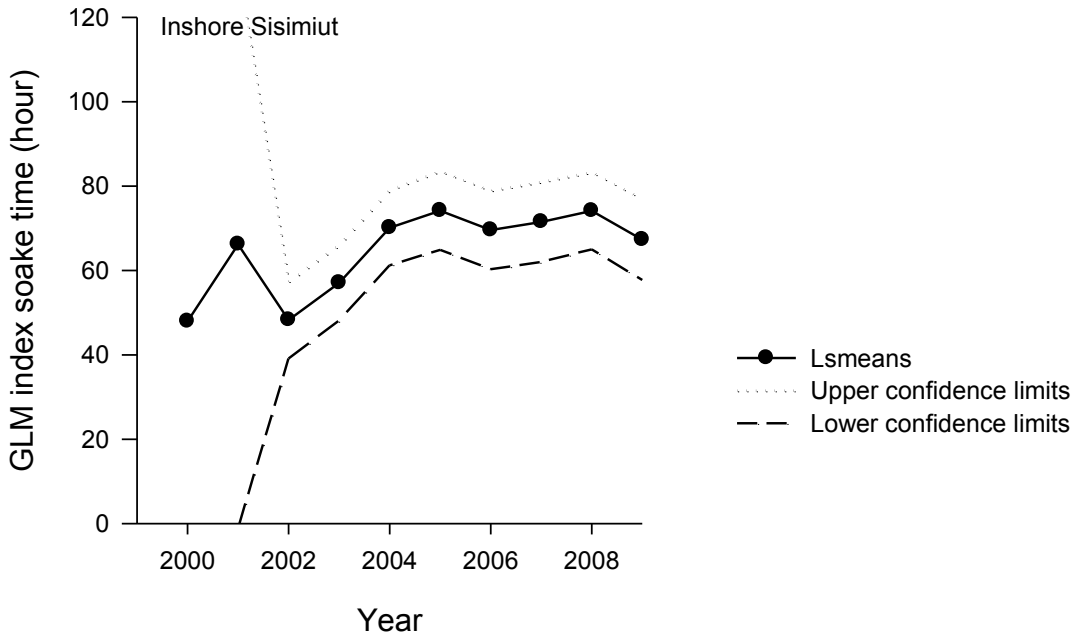


Fig. 19. Standardised soak time index based on logbook information inshore Sisimiut from 2000-2009. Data for 2009 is incomplete.

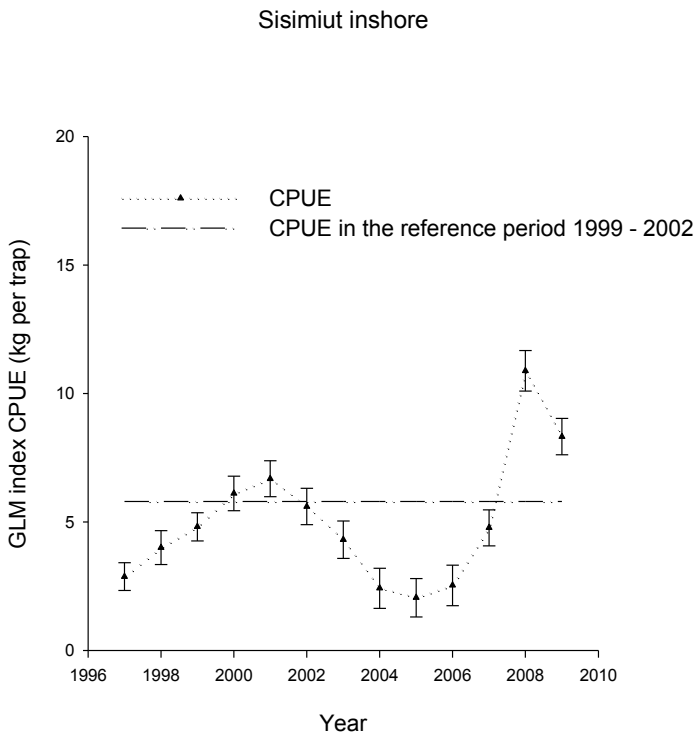


Fig. 20. Annual trends in CPUE (kg/trap \pm S.E.) of legal-size males (≥ 100 mm CW) from trap surveys in Sisimiut inshore from 1997 to 2009. The mean CPUE for the reference period (1999-2002) in Sisimiut inshore is indicated with a line.

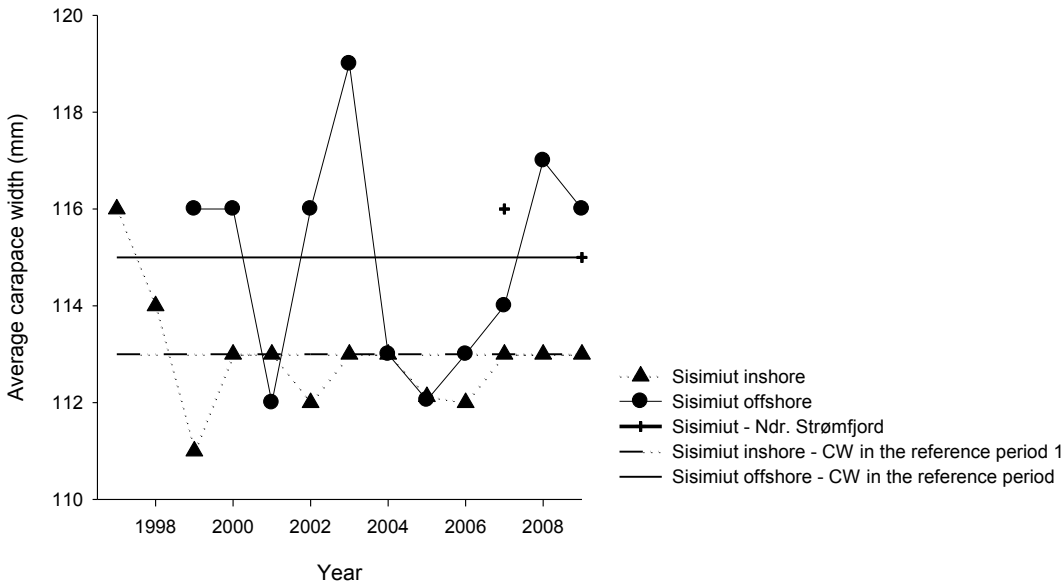


Fig. 21. Annual trends in the mean carapace width (CW) for legal-size males (≥ 100 mm CW) from trap surveys in Sisimiut inshore (1997-2009) and Sisimiut offshore (1999-2009). The mean CW for the reference period (1999-2002) in Sisimiut inshore and (2000-2003) in Sisimiut offshore is indicated with a line.

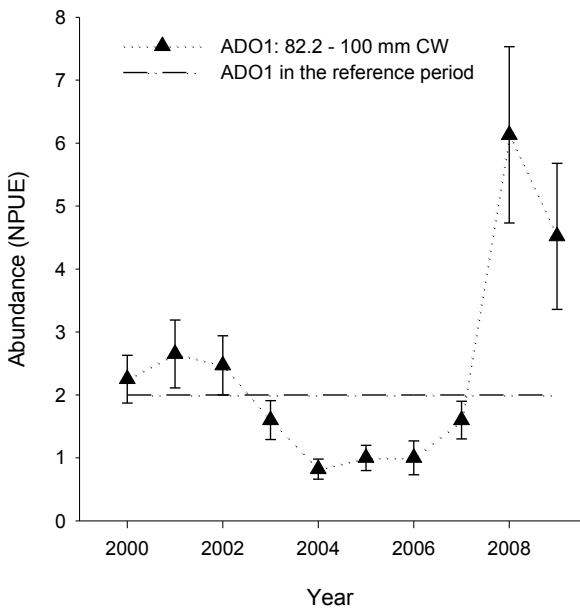
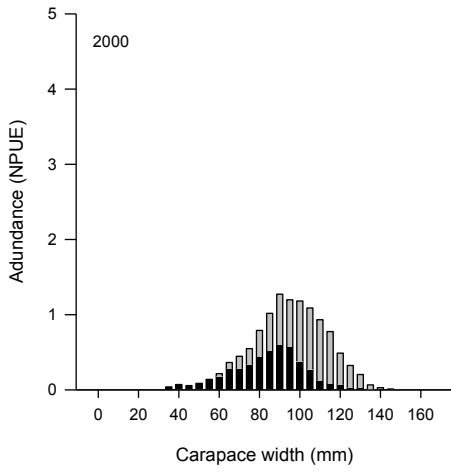
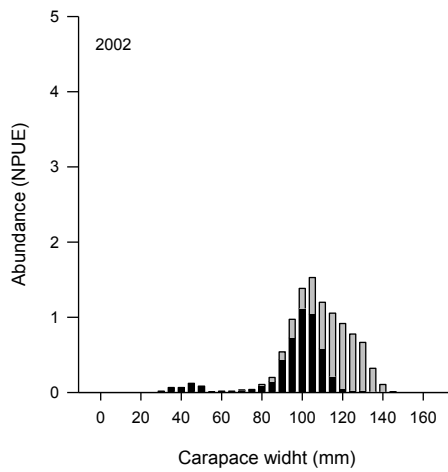
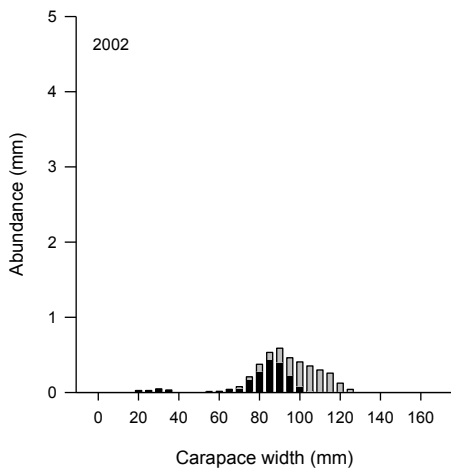
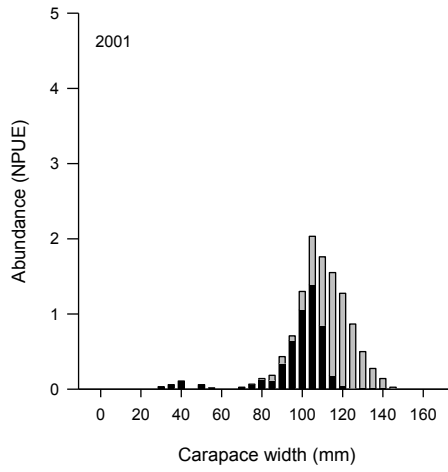
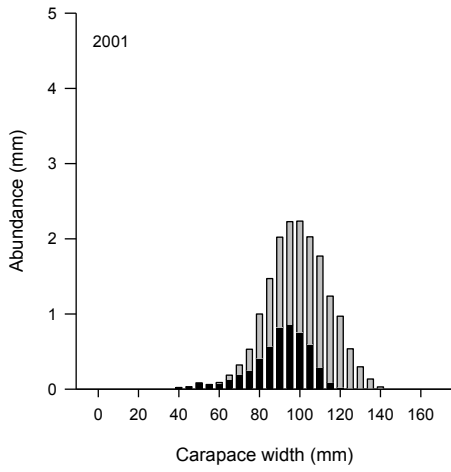
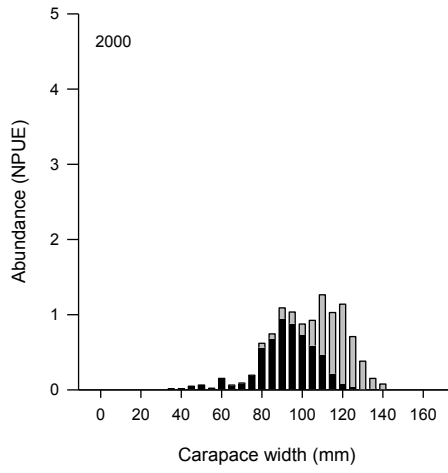


Fig. 22. Annual trends in the abundance NPUE (No. crabs per trap \pm S.E) of adolescent males (ADO-1: 82.2-100mm CW) expected to recruit to the fishery the following year in Sisimiut inshore areas from 2000 to 2009. The mean NPUE for the reference period (1999-2003) in Sisimiut inshore is indicated with a line.

Sisimiut inshore



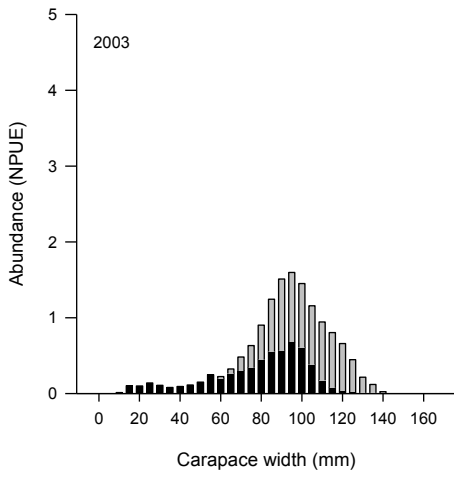
Sisimiut offshore



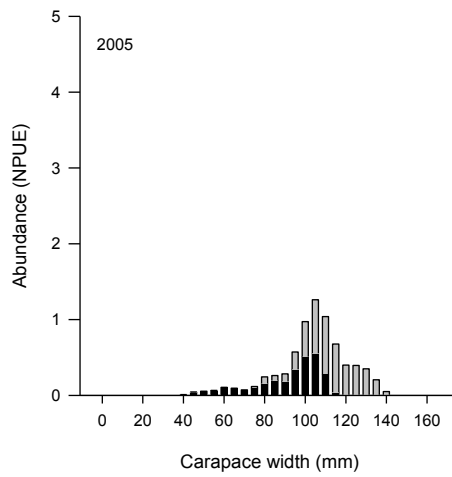
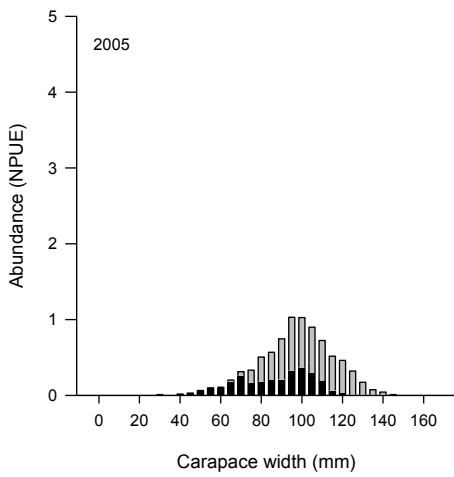
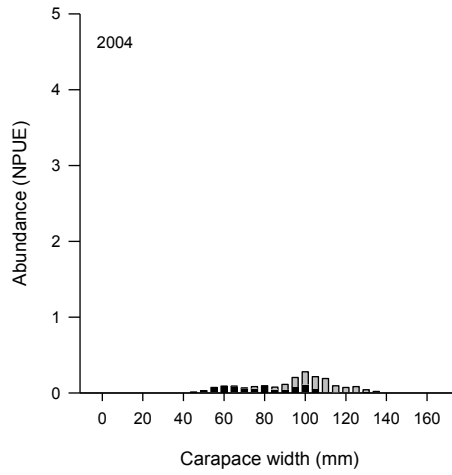
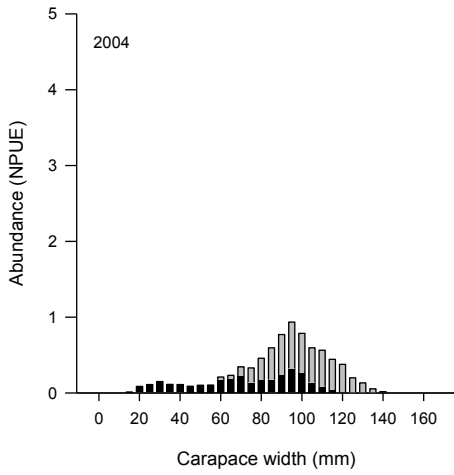
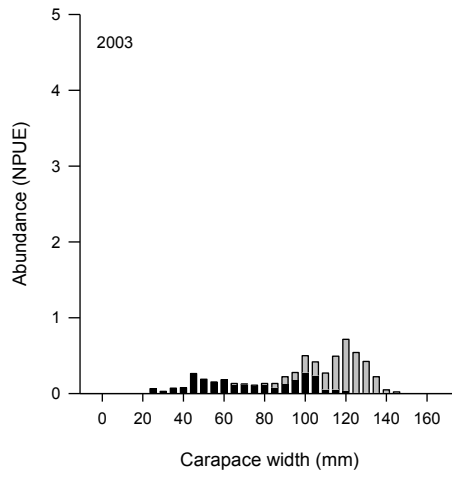
Adolescent males
 Adult males

Adolescent males
 Adult males

Sisimiut inshore



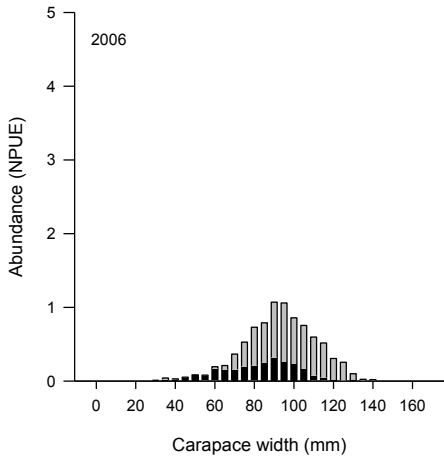
Sisimiut offshore



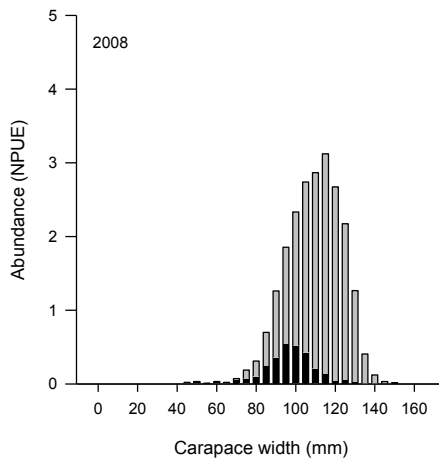
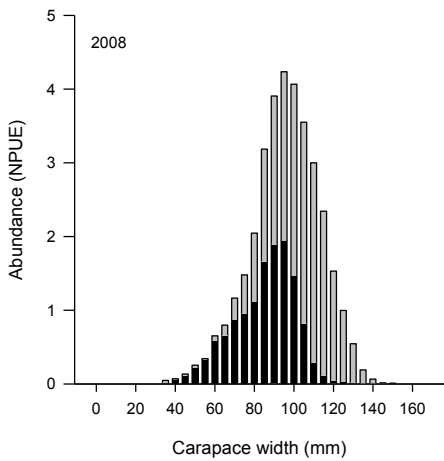
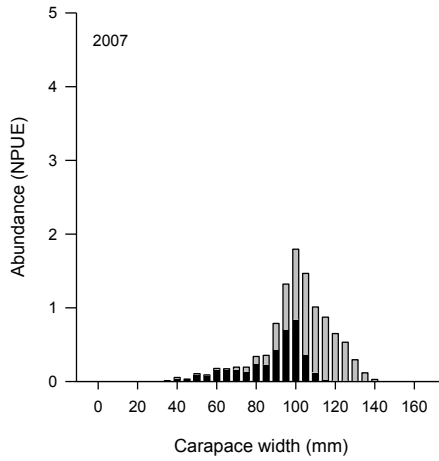
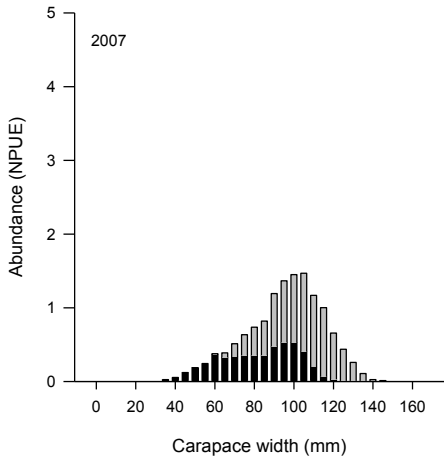
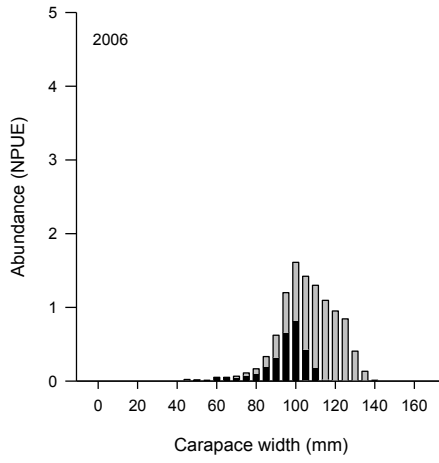
Adolescent males
 Adult males

Adolescent males
 Adult males

Sisimiut inshore



Sisimiut offshore



Adolescent males
 Adult males

Adolescent males
 Adult males

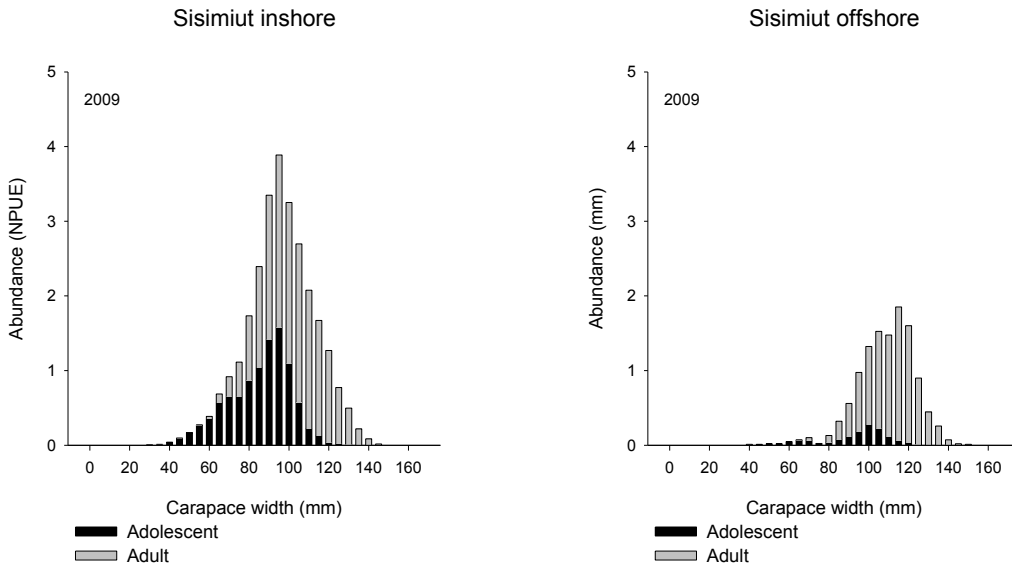


Fig. 23. Size distribution of adolescent and adult males from surveys in Sisimiut inshore and offshore from 2000 to 2009.

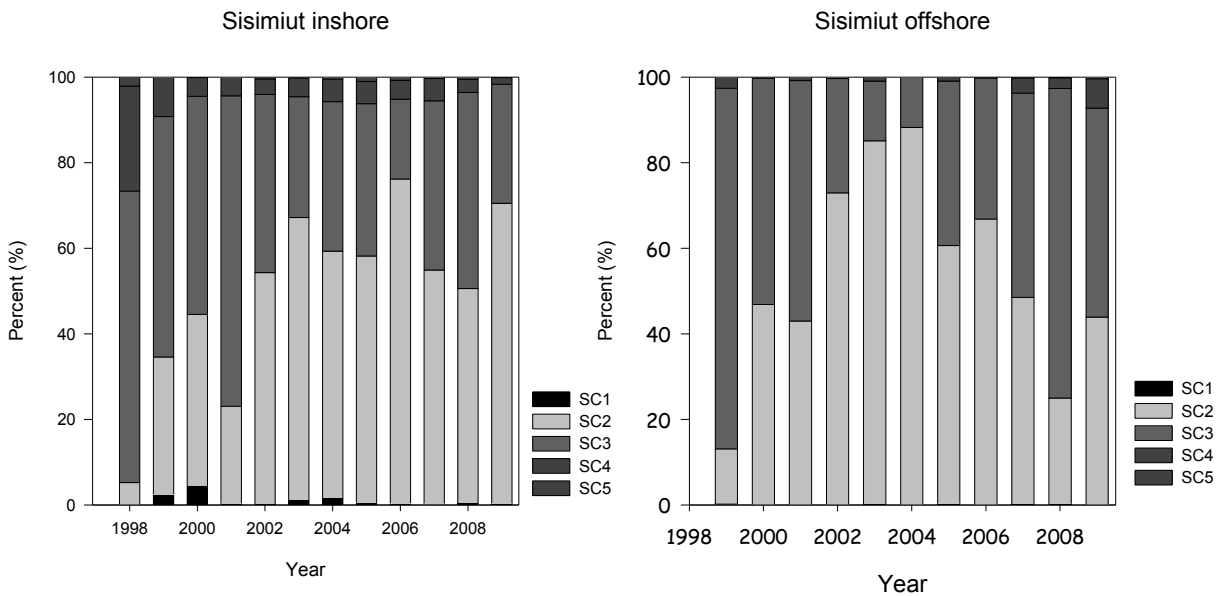


Fig. 24. The percentage of shell conditions (1-5) of legal-size adult males (≥ 100 mm CW) sampled in trap surveys in Sisimiut inshore and offshore from 2000 to 2009.

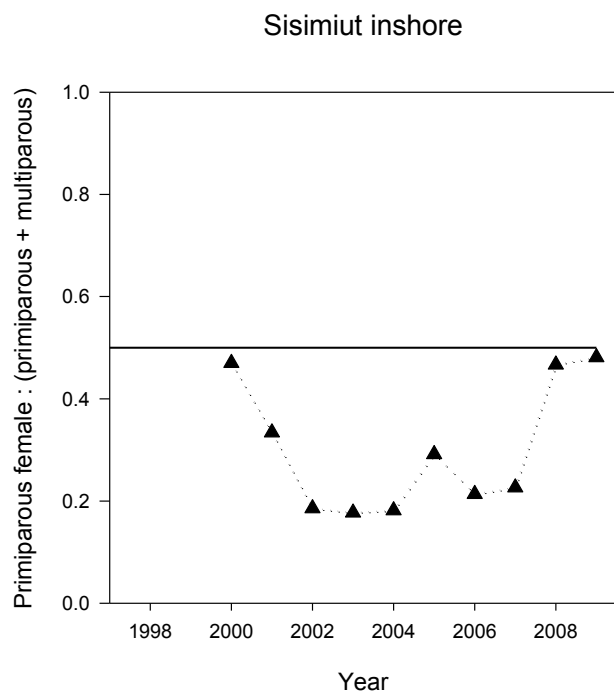


Fig. 25. Annual trends in the ratio between primiparous and multiparous females in Sisimiut inshore from 2000 to 2009.

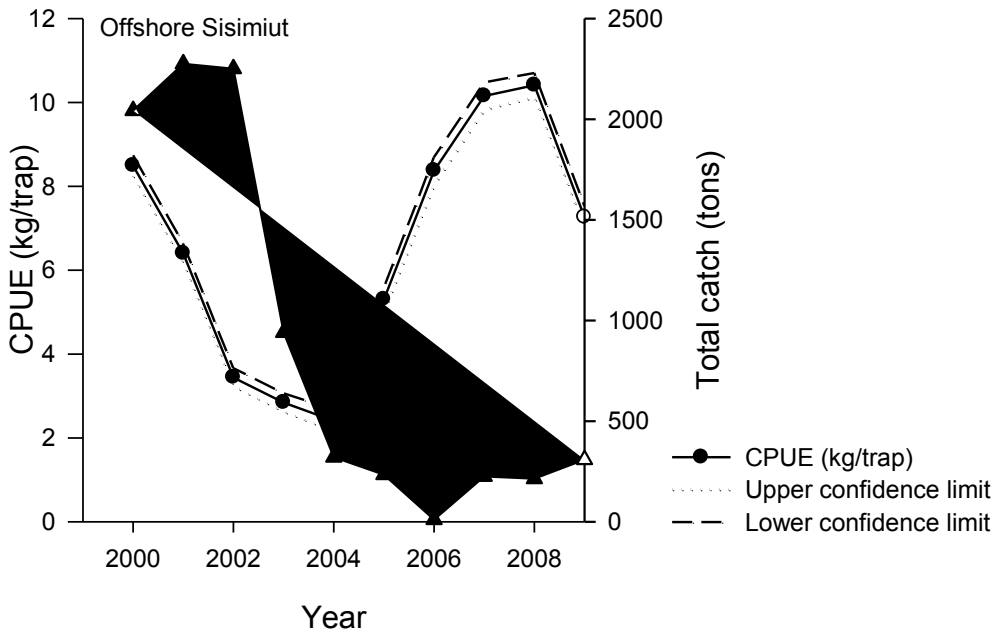


Fig. 26. Standardised CPUE index and total catch based on logbook information offshore Sisimiut from 2000-2009. Data for 2009 is incomplete.

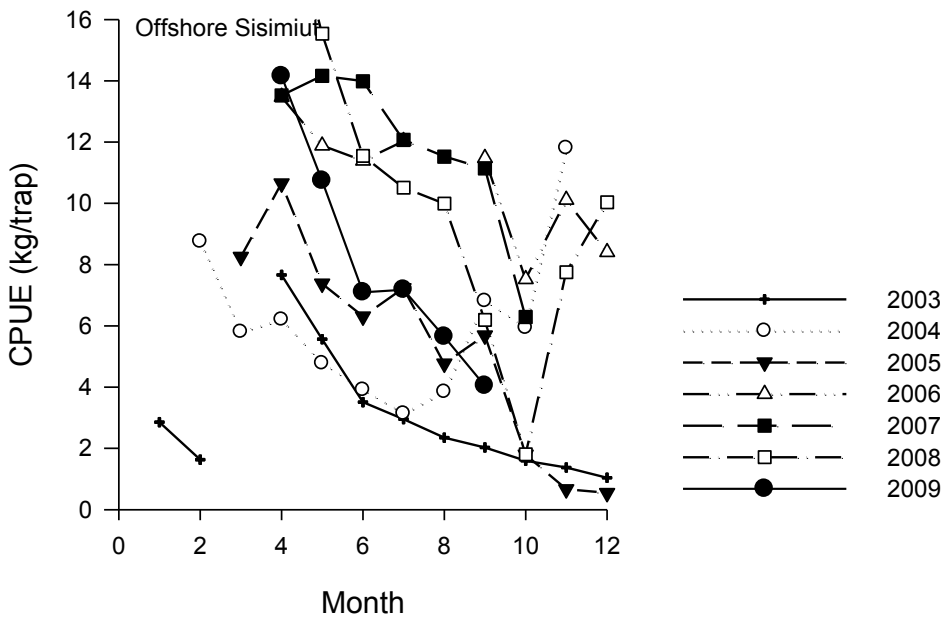


Fig. 27. Monthly trends in CPUE (kg per trap) from the fishery in Sisimiut offshore from 2003 to 2009. Data for 2009 is incomplete.

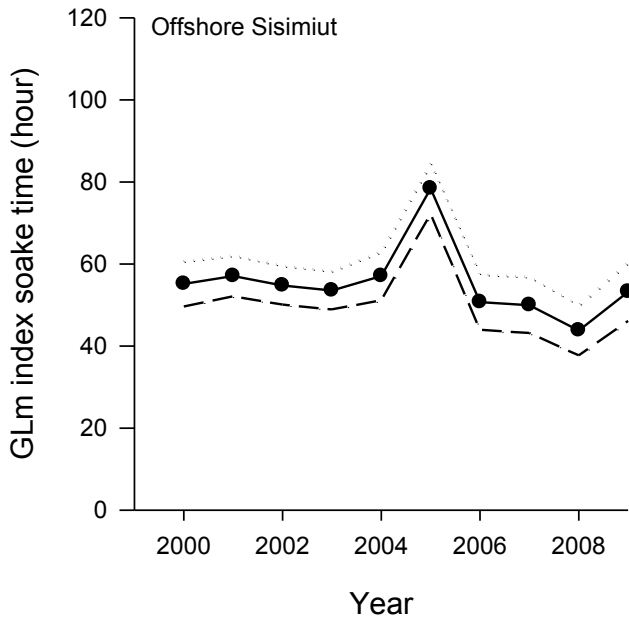


Fig. 28. Standardised soak time index based on logbook information offshore Sisimiut from 2000-2009. Data for 2009 is incomplete.

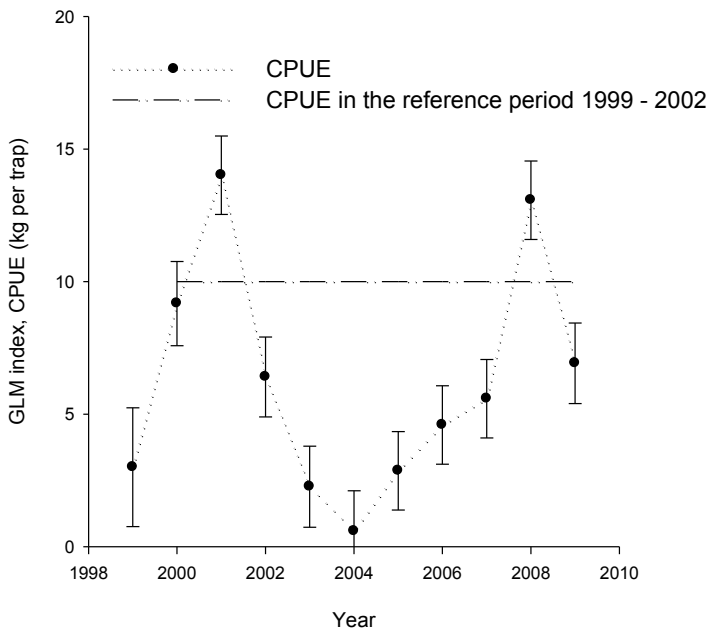


Fig. 29. Annual trends in CPUE (kg/trap \pm S.E.) of legal-size males (≥ 100 mm CW) from trap surveys in Sisimiut offshore from 2000 to 2009 and. The mean CPUE for the reference period (2000-2003) in Sisimiut offshore is indicated with a line.

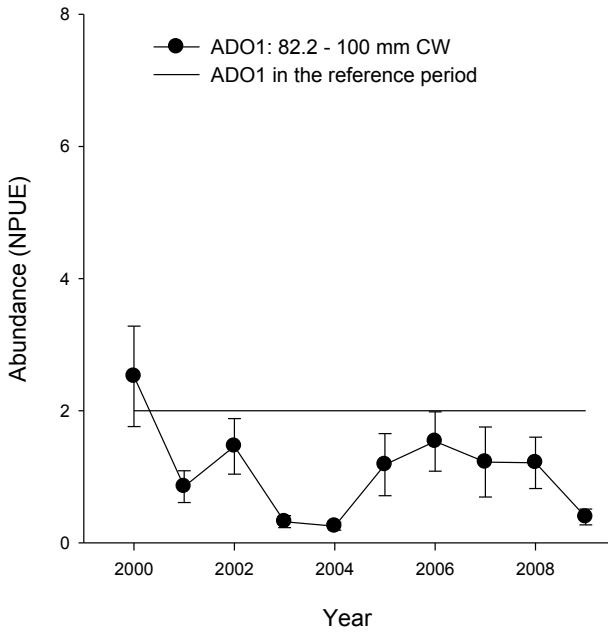


Fig. 30. Annual trends in the abundance NPUE (No. crabs per trap \pm S.E) of adolescent males (ADO-1: 82.2-100mm CW) expected to recruit to the fishery the following year in Sisimiut offshore areas from 2000 to 2009. The mean NPUE for the reference period (2000-2003) in Sisimiut offshore is indicated with a line.

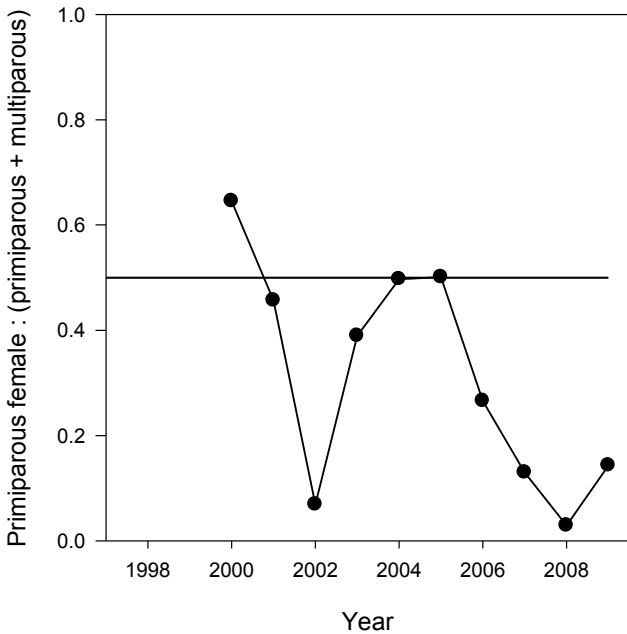


Fig. 31. Annual trends in the ratio between primiparous and multiparous females in Sisimiut offshore from 2000 to 2009.

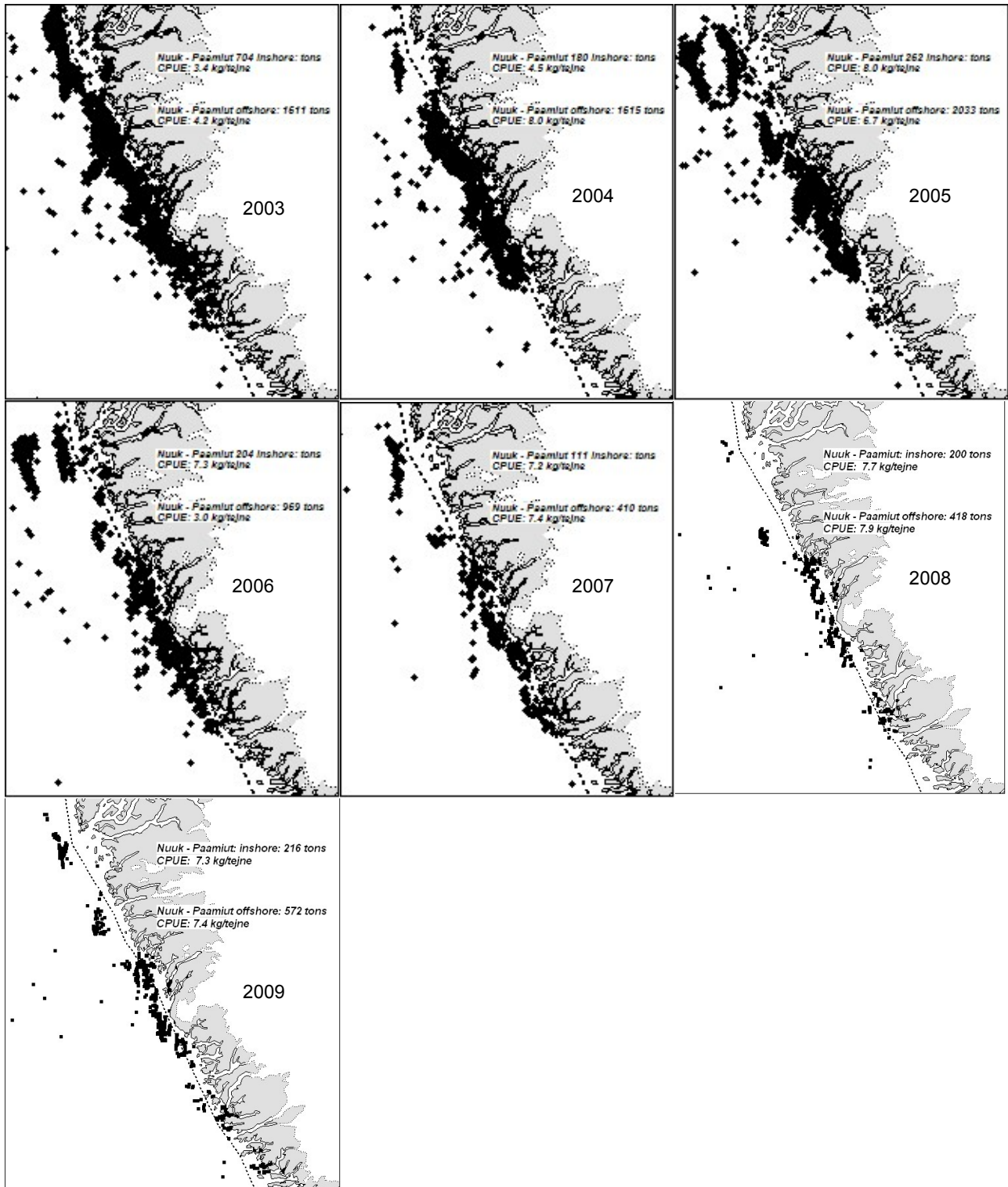


Fig. 32. The distribution and crab fishery in Nuuk - Paamiut inshore and offshore in 2003 - 2009. The coastal line indicates the basis-line separating the offshore from the inshore. Data from 2009 is preliminary and incomplete.

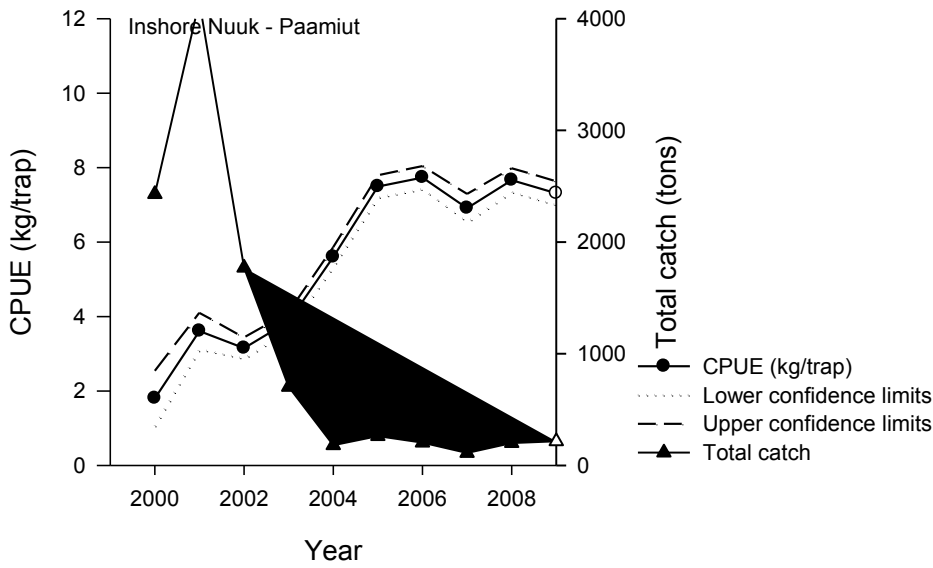


Fig. 33. Standardised CPUE index and total catch based on logbook information inshore Nuuk - Paamiut from 1999-2009. Data for 2009 is incomplete.

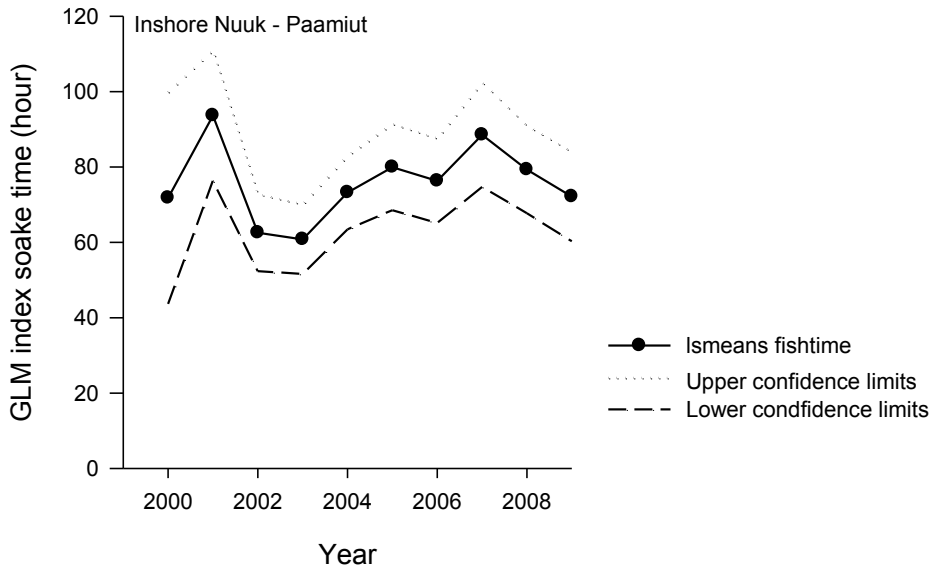


Fig. 34. Standardised soak time index based on logbook information inshore Nuuk - Paamiut from 1999-2009. Data for 2009 is incomplete.

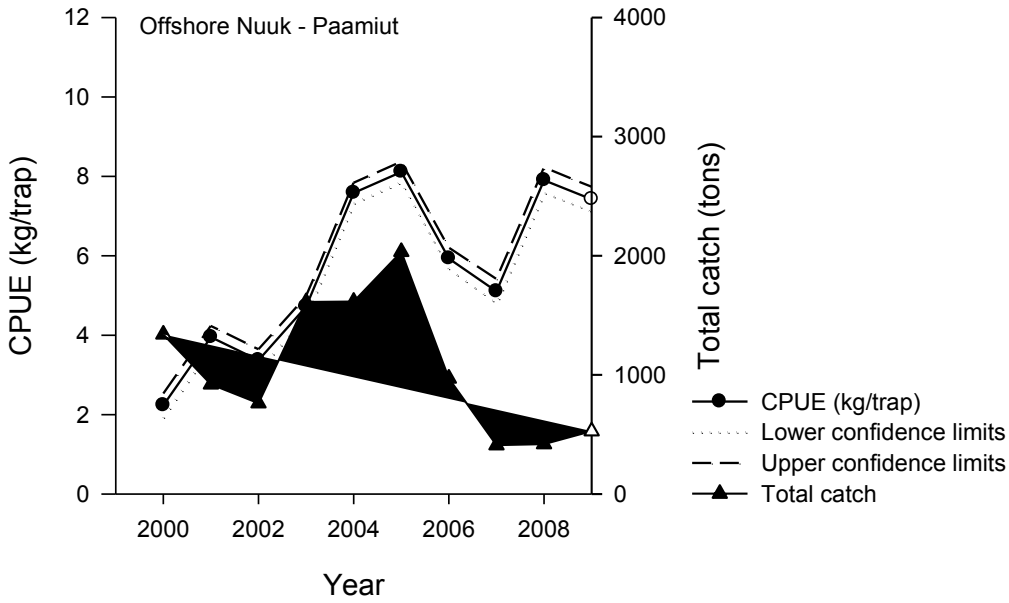


Fig. 35. Standardised CPUE index and total catch based on logbook information offshore Nuuk - Paamiut from 1999-2009. Data for 2009 is incomplete.

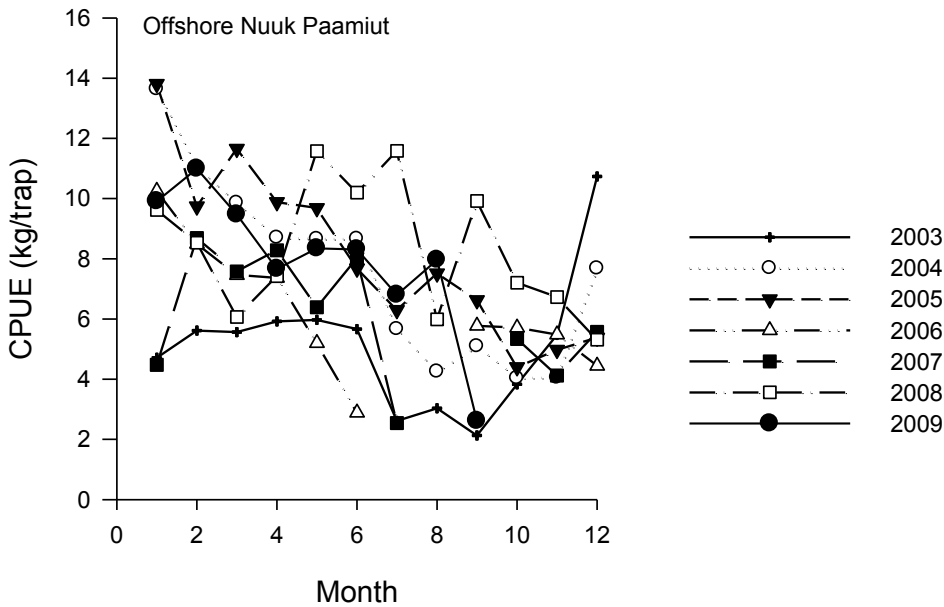


Fig. 36. Monthly trends in CPUE (kg per trap) from the fishery in Nuuk-Paamiut offshore from 2003 to 2009. Data for 2009 is incomplete.

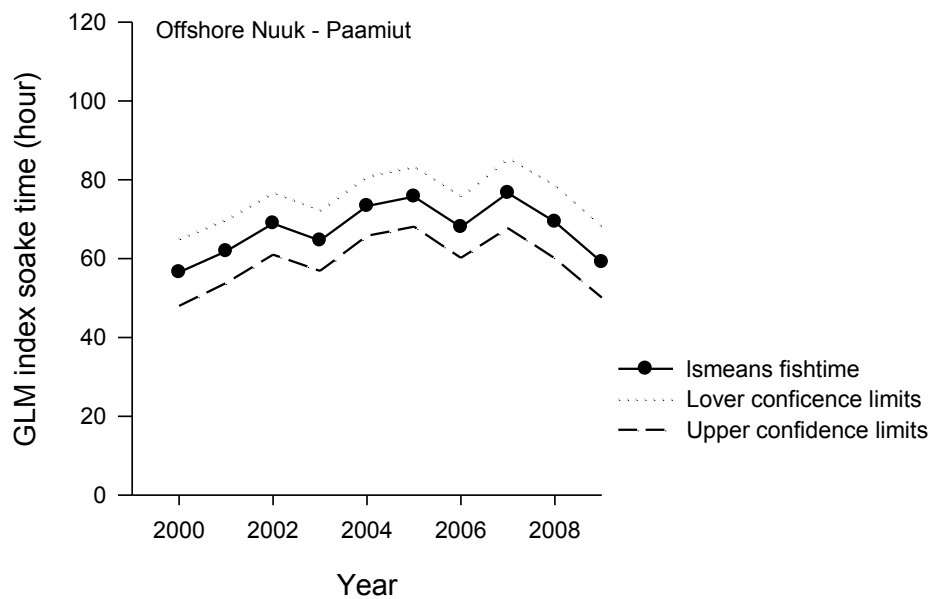


Fig. 37. Standardised soak time index based on logbook information offshore Nuuk - Paamiut from 1999-2009. Data for 2009 is incomplete.