CEPHALOPODS IN GREENLAND WATERS

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Cephalopods in Greenland Waters

by

Rikke Petri Frandsen and Kai Wieland

Technical report no. 57, 2004
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Eqikkaaneq

Kalaallit Nunaata imartaani amikut assigiinngitsut 15 nassaassaapput. Ilimagineqarpoq amikut ilaat *Gonatus fabricii* naammattuugassaanerusoq. Nassaassanera aammalu lipid-inik akoqarluarnera peqqutaaqataalluni siusinnerusukkut oqaatigineqarnikuuvoq amikoq taanna tunisassiassatut soqutiginaateqarsinnaasoq. Kalaallit Nunaat avataaniit amikunik 800 tonsit missaannik eqqussuisarpoq, taakkulu qaleralinniarnermi (*Rheinhardtius hippoglossoides)* saattuarniarnermilu *(Chionoecetes opilio)* neqitassatut atorneqartarlutik. Kalaallit Nunaani tunisassiassanik amikorniarnernik nalunaarsuisoqarnikuunngilaq, kisiannili naluneqanngilaq raajarniarnermi amikut pisarisoorneqartartut neqitassiassatut toqqorneqartartut (Olsvig aamma Mosbech 2003).

Imartani assigiinngitsuni qalunik naqqarsiutinik atorluni misissuisarnerni paasineqarnikuuvoq amikut amerlanerpaat Qeqertarsuup eqqaani 400 aamma 600 meterit akornanni itissutsini nassaassaanerusut. *G. fabricii* immap ikerani nassaassaaneruvoq, inerissimasortai itissutsini 400 aamma 1100 meter-it akornanni naammattuugassaallutik. Misissuinerit tamarmik qalut naqqarsiutit atorlugit misissuinerupput, taamaattumillu amikut *G. fabricii*-t immap ikeraniinerusoq uumasuusut pisaqarfiunnginnerunissaat ilimagineqarsinnaalluni.

600 meteriniit itinerusuni misissuinerit ikittuinnaasimapput, taamaattumillu amikut *G. fabricii*-t misissuinernit paasisaniit immap ikerinnaasiorneruniss aat aammalu siammarsimanerunissaat ilimagineqarpoq.

Amikut pingaartumillu *Gonatus* sp.-t immami uumassuseqarnermut pingaaruteqartorujussuupput, tassami aalisakkanit allanit, imaani timmissanit kiisalu imaani miluumasunit nerineqarluartarmata. Amikut iluaqutiginiarneqassappata imaani uumassuseqarneq piujuartitsinissarlu ataqqillugit pilersaarusiortoqartariaqarpoq.

Sammenfatning

Mindst 15 forskellige blæksprutter lever i Grønlandsk farvand. Det antages at *Gonatus fabricii* er den hyppigst forekomne art og på baggrund af dens forekomst og høje indhold af lipider, har det tidligere været fremsat, at arten kunne være af kommerciel interesse. Grønland importerer ca. 800 tons blæksprutter, der bruges som agn til fiskeri efter hellefisk (*Rheinhardtius hippoglossoides*) og krabber (*Chionoecetes opilio*). Der er ikke registreret kommercielt fiskeri efter blæksprutter i Grønland, men lokalt bliver bifangst af blæksprutte i rejefiskeriet gemt og anvendt som agn (Olsvig og Mosbech 2003).
Togter med bundtrawl har vist, at de største koncentrationer af blæksprutter findes i Diskobugten på dybder mellem 400 og 600 m. *G. fabricii* har en oceanisk udbredelse, og de voksne individer befinder sig midt i vandsøjlen på dybder mellem 400 og 1100 meter. Alle undersøgelser er udført med bundtrawl og må derfor forventes at have en begrænset fangst af pelagiske (fritsvømmende) arter som *G. fabricii*. Da der desuden kun har været få undersøgelser af områder dybere end 600 m, antages det at den egentlige udbredelse af fx *G. fabricii* er mere vidtstrakt, end det fremgår af undersøgelserne.
Blæksprutter generelt og i særdeleshed *Gonatus* sp. har en meget vigtig rolle i økosystemet da de udgør en essentiel andel af føden for fisk, havfugle og marine pattedyr. En udnyttelse af ressourcen skal derfor tilrettelægges med respekt for bæredygtigheden af hele økosystemet.

Summary

Greenland waters are inhabited by at least 15 species of cephalopods of which one, *Gonatus fabricii*, is most commonly caught. Due to its abundance and lipid content, it has previously been stated that this species could be of commercial interest. In Greenland approximately 800 tons of squid are imported and used as bait in the long line and trap fishery for Greenland halibut (*Rheinhardtius hippoglossoides*) and snow crab (*Chionoecetes opilio*), respectively. There is no record of any commercial fishery on cephalopods in Greenland waters, but locally, the by-catch of squid in the shrimp fishery is kept and used as bait (Olsvig and Mosbech 2003).
The highest concentrations of cephalopods as registered from bottom trawl survey, have been found in Disko Bay at depths of 400-600 m. *G. fabricii* is oceanic and adults live in mid-water at depths ranging from 400 to 1100 m. The surveys are conducted with bottom trawls and only few investigations have been carried out at depth below 600 m. The true distribution of pelagic species as *Gonatus* sp. is thus expected to exceed findings in the surveys.
The ecological importance of cephalopods in general and *Gonatus* sp. in particular is profound, since they constitute a significant element of the diet of fish, sea birds and marine mammals. An exploitation of the resource should respect the carrying capacity of the entire ecosystem.

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Introduction

Investigations on cephalopods in Greenland waters

Distribution of the early life stages of *Gonatus fabricii* in Greenland waters was investigated sporadically in the 1980's and early 1990's. Since then, no investigations had cephalopods as target.

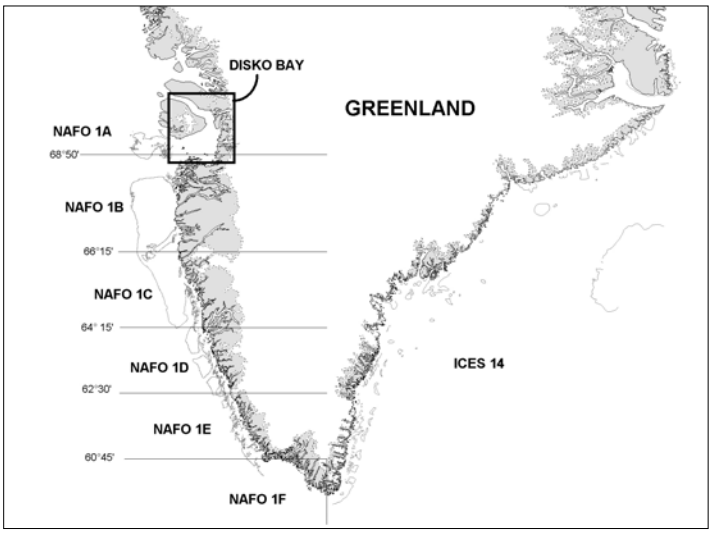

Fig. 1: Map showing NAFO and ICES divisions in Greenland waters (The 200 m isobath is indicated by the dotted line).

This report presents recent information on cephalopods in Greenland waters based on the literature and on by-catch data from research surveys conducted in East and West Greenland waters in recent years (Fig. 1). Results from trawl catches from annual shrimp and two different types of ground fish surveys were considered in the analysis:

The Greenland Institute of Natural Resources (GINR) bottom trawl survey for northern shrimp (*Pandalus borealis*) at West Greenland: The gear used is a shrimp trawl with a high vertical opening (10–12 m), which is towed at 2-3 knots. The survey is conducted from July to October and covers the offshore area of West Greenland between 59°00'N and 72°30'N and depths between 150 and 600 m. In addition, the Disko Bay is covered and in 1992 to 1996 an area off East Greenland was investigated as well. From 1992 and onwards, catch in weight and in number have been registered for all cephalopod species pooled (i.e. without detailed taxonomic identification).

The Institute for Sea Fisheries Hamburg (ISH) ground fish survey for cod (*Gadus morhua*) at East and West Greenland: The survey covered, in recent years, NAFO subdivisions 1C-1F and ICES division 14 at depths down to 400m. The survey gear is a ground fish trawl with a vertical opening of 3–4 m, which is towed at 4.5 knots. In addition, a pelagic trawl was used on one station off Southeast Greenland in 1999 and in 2002 (sampling depth 680-705 m) . Data on cephalopods from 1999 and 2002 were available from Zumholz and Piatkowski (unpubl.).

The Greenland Institute of Natural Resources ground fish surveys for Greenland halibut (*Rheinhardtius hippoglossoides*) at East and West Greenland: The gear used is a bottom trawl, towed with 3 knots. Catches both in weight and in number are registered for the total combined cephalopod catch. Off West Greenland, this survey covers areas with depths of 200 to1400 m.

Noteworthy is, that none of the surveys are ideal for cephalopod sampling, thus catchabilities of the treated species are unknown. Hence the results are likely to be highly biased by gear type, towing speed and depth range of the surveys. Distribution of cephalopods based on these surveys should therefore be interpreted with caution.

Distribution of cephalopods in Greenland waters

Density of cephalopods has been calculated from the shrimp and the ground fish surveys conducted by the GINR in 1992-2002 and 1997-2002 respectively. The results indicate that the highest cephalopod densities (kg km^{-2}) off West Greenland are found in Disko Bay and in the deep trenches between Disko Bank, Store Hellefiske Bank and Lille Hellefiske Bank. Furthermore, high densities occurred in offshore areas north of 62°30'N (Fig. 2).

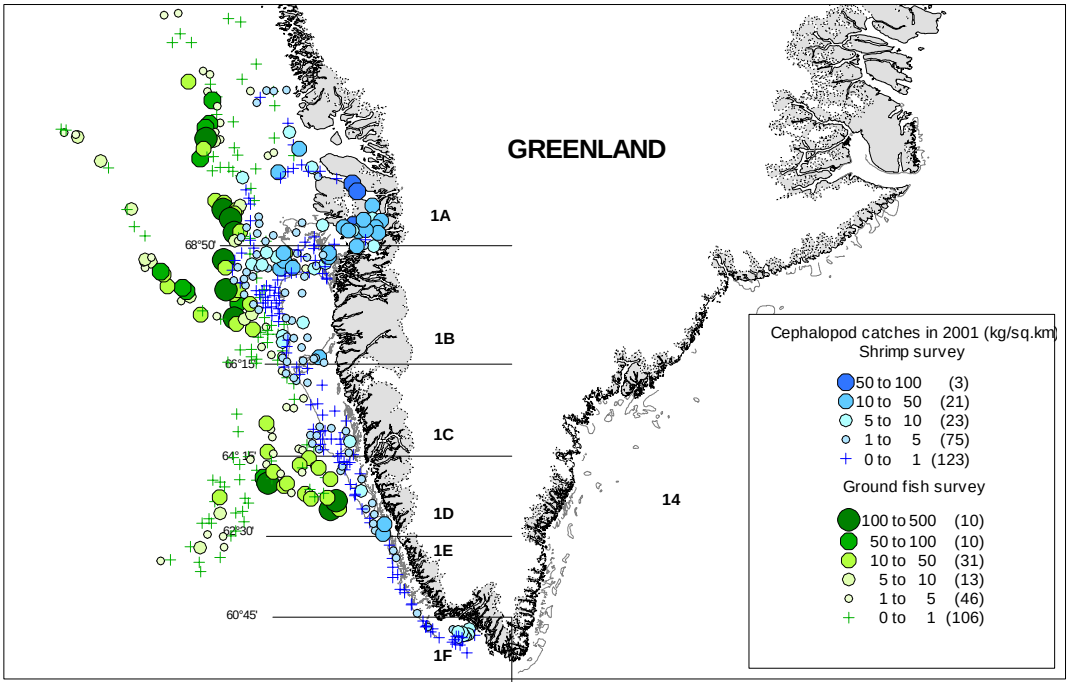

Fig. 2: Distribution of cephalopods in Greenland waters (Data from the GINR shrimp and ground fish surveys conducted in 2001).

Variation between years is small and the distribution in 2001 is presented as representative for the investigated period (Fig. 2). In all GINR surveys off East Greenland, cephalopod catches have been extremely low. In 2001, no survey was conducted in East Greenland.

Cephalopods were caught throughout the investigated area and densities are increasing with depth. Based on personal observations, we believe that off West Greenland, by weight, the majority of the cephalopod catches in the shrimp survey is *Gonatus fabricii* whereas Cirrate

octopods are dominating in the GINR ground fish survey. Whether this difference is due to depth, gear or geography is unknown.

Kristensen (1984) reported that the most common squid in Greenland waters is *Gonatus fabricii*. The adult population of this species is pelagic and usually found at depths of 1000 m and deeper (Bjørke and Gjøsæter 1998). As the catchability of pelagic species must be very low in bottom trawl surveys, the true offshore distribution of cephalopods is expected to be more widespread.

Results from shrimp surveys, indicate that mean individual weight of cephalopods, peaks at bottom depths between 400 and 600 m in Disko Bay (68.33 ± 3.34 g) (Table 1). For *G. fabricii*, mean individual weights of approximately 10 g and 200 g would correspond to pen[1] lengths of 6 and 20 cm and ages of 7 months and 2 years, respectively (Kristensen 1984). Equally, and assuming that the entire cephalopod catch in Disko Bay is *G. fabricii,* mean pen length at depths between 400-600 m would be 13 cm and average age, 1 year. However, during the shrimp survey in 2003 only few individuals with a length above 15 cm has been caught.

Table 1: Weight (Mean ± SE)(g) of cephalopods caught in GINR shrimp surveys. Stations where cephalopods were caught have been divided into strata based on depth and area. Note that ICES area 14 (East Greenland) was only investigated in 1992-1996. Figures in brackets indicate number of stations in the stratum.

	150-200 m	200-400 m	400-600 m
NAFO 1A (excl Disko Bay)	22.28 ± 1.80 (51)	22.16 ± 1.35 (267)	32.67 ± 2.70 (70)
NAFO 1B (excl Disko Bay)	17.25 ± 2.49 (126)	25.31 ± 6.00 (452)	25.50 ± 1.89 (132)
NAFO 1C	13.45 ± 1.41 (103)	13.68 ± 1.04 (103)	26.97 ± 8.00 (54)
NAFO 1D	12.35 ± 1.70 (68)	15.03 ± 1.37 (73)	16.27 ± 3.31 (16)
NAFO 1E	28.11 ± 15.97 (46)	19.28 ± 9.30 (52)	6.92 ± 1.84 (8)
NAFO 1F	11.02 ± 1.22 (58)	17.13 ± 3.13 (46)	9.97 ± 1.21 (35)
ICES 14	28.97 ± 8.92 (13)	22.27 ± 2.67 (83)	19.47 ± 3.35 (33)
DISKO BAY	28.04 ± 4.25 (13)	54.01 ± 4.11 (148)	68.33 ± 3.34 (126)

[1] The pen (=gladius) is a feather or rod shaped chitinous supporting structure in the dorsal midline of some families of squid.

Cephalopod species in Greenland waters

18 species of cepholopods have been registered from Greenland waters. Three of these, *Histioteuthis bonnellii*, *Illex illecebrosus* and *Architeuthis* sp. have only been recorded very few times. Catches of these species are assumed to be exceptional and the species will not be treated further on this account (Kristensen 1980, Muus 1962, Posselt 1898). Details on species characteristics and distribution can be found in: Frandsen and Zumholz 2004, Cephalopods in Greenland Waters – a field guide. Technical report no. 58, Pinngortitaleriffik, Greenland Institute of Natural Resources.

Cirrate octopods (Cirrata)

Three species of cirrate octopods have been recorded in Greenland waters: *Opisthoteuthis* sp., *Cirroteuthis mülleri* and *Stauroteuthis syrtensis* (Collins 2002). They all live in the deep sea from 400 to 5000 m and grow to a total length of up to 50 cm. The cirrate octopods are a frequent by-catch in bottom trawl at the appropriate depths (Maddison et al. 2004, Nesis 1987), but due to their gelatinous texture, the species have no commercial value (Roper et al. 1984).

Incirrate octopods (Incirrata)

Bathypolypus sp.

Female *Bathypolypus* sp. caught in a bottom trawl off West Greenland in July 2003. Total length: 11 cm.

Three species of *Bathypolypus* live in Greenland waters: *B. articus*, *B. bairdii* and *B. pugniger*. They are all benthic and found on the continental shelf and slope at depths from 15-1600 m (Muus 1959, Muus 1962, Muus 2002, Nesis 2001). Total length of *Bathypolypus* is up to 20 cm and the species are frequently taken as a by-catch in otter trawls. *B. arcticus* has the most arctic distribution of the three, and data from the ground fish survey conducted by the ISH, show that it occurs in all areas investigated (Fig. 3). The potential of *Bathypolypus* for a directed fishery has not been assessed, but is believed to be significant (Roper et al. 1984).

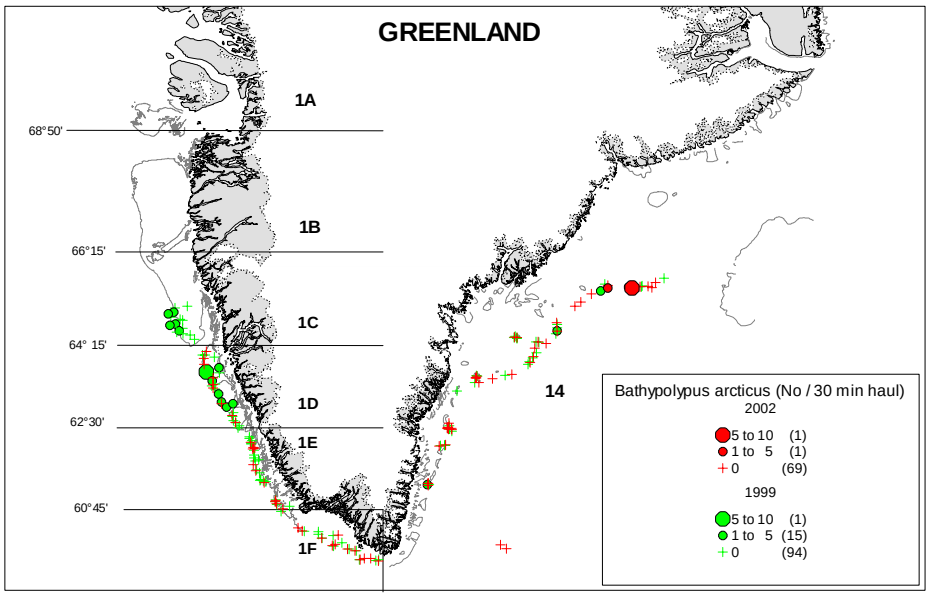

Fig. 3: Distribution of *Bathypolypus arcticus* in Greenland Waters (Data from the ISH ground fish surveys conducted in 1999 and 2002 ; Zumholz and Piatkowski, unpubl.).

Squids (Teuthida)

Brachioteutis riisei

This oceanic squid is present in the North Atlantic off Kap Farvel. It occurs from the surface down to depths of 3000 m (Nesis 1987). The mantle is muscular but generally rather thin and maximum size is 8 cm (mantle length) (Maddison et al. 2004). The potential commercial value of this species is not known (Roper et al. 1984).

Teuthowenia megalops

Juvenile *Teuthowenia megalops* caught in a bottom trawl off West Greenland in July 2003. Mantle length 15 cm.

This squid is known from Southwestern Greenland and Denmark Strait (Nesis 1987). Larval stages occupy the upper 200 m whereas adults are found at depths of 1000-2700 m depth (Maddison et al. 2004). The mantle is thin and the species grows to a size of up to 40 cm (mantle length) (Muus 1962). The species is not considered to be of interest to fisheries at present time (Roper et al. 1984).

Gonatus sp.

Juvenile *Gonatus* sp. caught in a bottom trawl off West Greenland in July 2003. Mantle length 5.6 cm.

Two species of *Gonatus* are found in Greenland waters: *G. fabricii* and *G. steenstrupii*. Both are oceanic and found down to 2000 and 1000 m depth respectively. *G. steenstrupii* is distributed off East and South Greenland outside arctic waters (Kristensen 1981) whereas *G. fabricii* is

found East and West of Greenland as far North as 73°N. *Gonatus* is caught frequently throughout the investigated area (Fig. 4) and since *G. fabricii* is the most abundant squid in arctic and sub-arctic waters of the North Atlantic (Kristensen 1984), a dominant proportion of the catches of *Gonatus* is expected to belong to this species. Currently, there are no fisheries directed at either species, but they are believed to have some fishery potential (Roper et al. 1984).

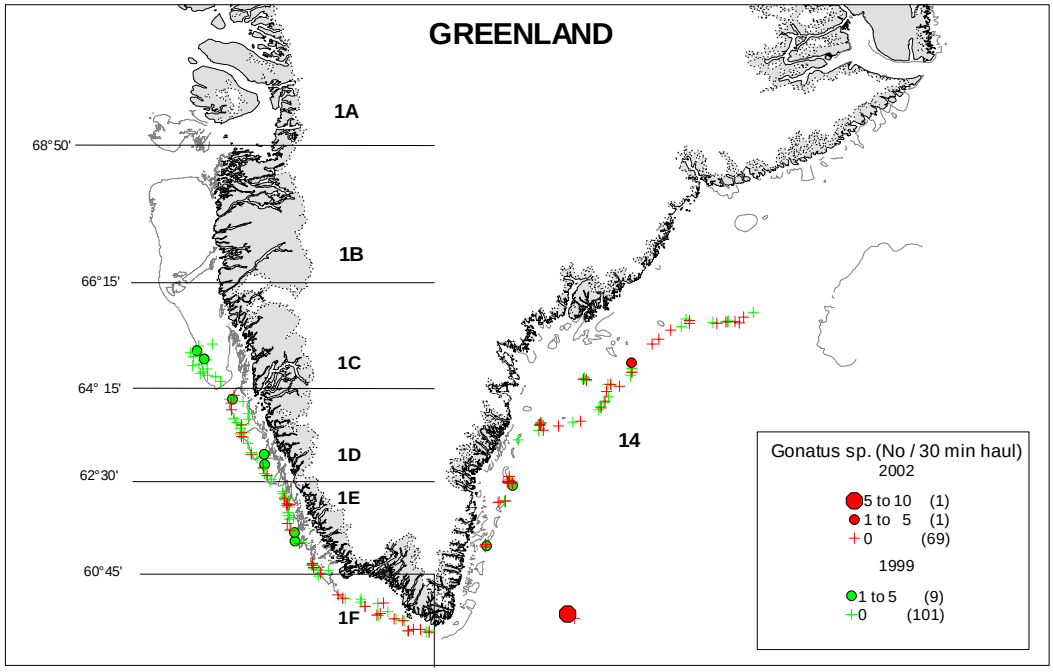

Fig. 4: Distribution of *Gonatus* sp. in Greenland waters (Data from the ISH ground fish surveys conducted in 1999 and 2002 ; Zumholz and Piatkowski, unpubl.).

Todarodes sagittatus

T. sagittatus is an oceanic squid occurring from the surface down to 1000 m depth. It is common in the Eastern Atlantic and is found off East Greenland as well. It grows to a size of 75 cm (mantle length) and a fishery targeting the species takes place off Norway (Roper et al. 1984).

Bobtail squids (Sepiolida)

Rossia sp.

Male *Rossia* sp. caught in a bottom trawl off West Greenland in July 2003. Mantle length 4.8 cm.

Four species of the genus *Rossia* are distributed in Greenland waters: *R. macrosoma, R. megaptera, R. moelleri* and *R. palpebrosa*. They are all benthic species found in the deep littoral usually from 50-600 m depth (Muus 1959, Muus 1962, Nesis 1987, Nesis 2001, Okutani 2001). The results from the ISH ground fish surveys, which do not distinguish the four species, indicate a wide distribution of *Rossia* sp. in Greenland waters (Fig. 5)

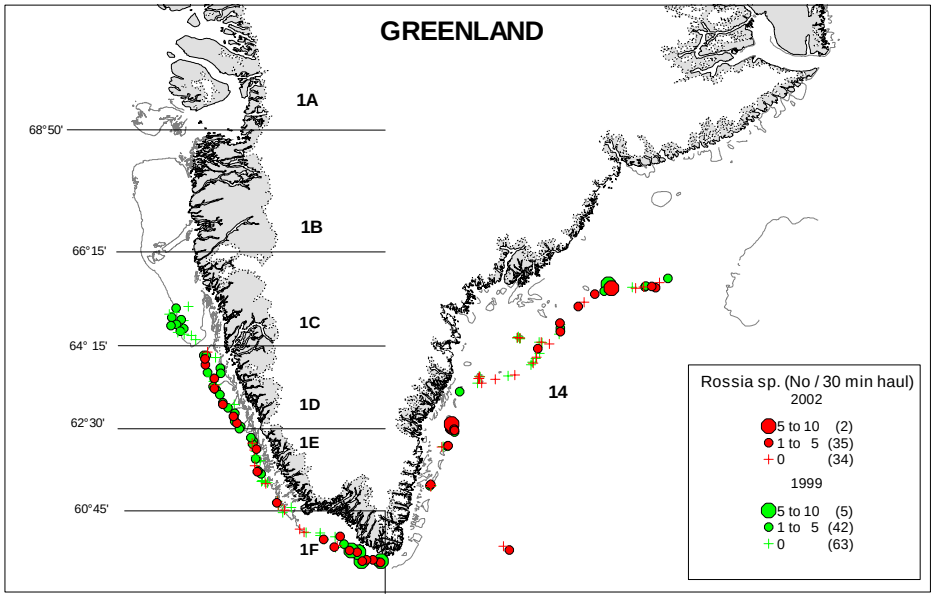

Fig. 5: Distribution of *Rossia* sp in Greenland waters (Data from the ISH ground fish survey conducted in 1999 and 2002 ; Zumholz and Piatkowski, unpubl.).

Review of literature on *Gonatus* sp.

Distribution

Gonatus fabricii is the most abundant squid in arctic and sub-arctic waters in North Atlantic (Bjørke 2001). Adults are common in oceanic mid-water while juveniles occur in surface waters closer to the continents (Piatkowski and Wieland 1993). At lengths between 50-70 mm, the species disappears from the surface layers and is subsequently found from 400 m downwards to at least 1100 (Bjørke 2001, Bjørke and Gjøsæter 1998). South of the polar circle, juvenile *G. fabricii* perform diurnal vertical migration with apparent dispersal of shoaling at night (Kristensen 1984). Also adult *G. fabricii* have been observed near the surface at night, indicating that diurnal migration may not be limited to juvenile stages (Kristensen 1984). *G. fabricii* does not seem to be shoaling when it becomes larger though, but high concentrations of immobile mature females have been reported to attract foraging whales and dolphins in Norwegian waters (Bjørke 2001).

During summer, juveniles occur in high numbers all over Davis Strait. Hatching begins off Kap Farvel in the end of April, and juveniles are transported up the west coast of Greenland by prevailing currents. In Disko Bay, *G. fabricii* is believed to hatch in autumn and early winter (Kristensen 1977, Kristensen 1984). In East Greenland, hatching of *G. fabricii* occurs from the end of February to the beginning of July (Kristensen 1977).

Information on distribution of adult *G. fabricii* mainly originates from stomach content analysis of marine mammals. In the beginning of November, narwhals (*Monodon monoceros*) are thus reported to forage on *G. fabricii* in the Uummannaq area just north of Disko Bay (Laidre and Heide-Jørgensen submitted). The narwhals remain in the region for 2-3 weeks and the brief visit is belived to be due to the formation of large spawning schools of *G. fabricii*. Kristensens (1977, 1984) reports on hatching *Gonatus* in autumn and early winter in Disko Bay corresponds well with this information.

Biology

Growth rates in squid are generally high. Kristensen (1977) reported a monthly growth for juvenile *G. fabricii* off West Greenland of about 8 mm and Piatkowski and Wieland (1993) found the growth rate to be between 4-5.5 mm month^{-1}. Off Norway, Bjørke and Gjøsæter (1998) recorded a growth rate of 14 mm month^{-1}.
In Greenland waters, males mature at an age of about 2 years (20-25 cm pen length) whereas females are assumed to mature at an age between 2.5-3 years (Kristensen 1984). When females mature, their muscle tissue gelatinize and they loose the ability to swim. After mating, the embryos are carried for one year, and the females presumably die after the eggs are hatched (Arkhipkin and Bjørke 1999). Males might be able to copulate twice (Kristensen 1984).

Biomass

It has not yet been possible to estimate the densities of adult squids in Greenland waters (Piatkowski and Wieland 1993). Based on an energy flow analysis of the West Greenland marine ecosystem however, Pedersen and Zeller (2001) estimated the total biomass of squids to be about 90 000 t. This estimate, which corresponds to about 10% of the biomass of northern shrimp (*Pandalus borealis*), should however, be interpreted with much caution as the model is based on a series of assumptions.
In the Norwegian Sea, Bjørke and Gjøsæter (1998) estimate, that during their lifetime, a larval biomass of 1.5 mill t will produce a biomass that amounts to more than 20 million t. Most of this biomass (85%) is produced during the juveniles second year. However it is not known whether the estimate for this single cohort represents the general condition.

Ecological importance

Studies have shown, that *G. fabricii* has a very high lipid content with an energy density (kJ g^{-1}) in the same order of magnitude as that of capelin (Kristensen 1984, Lawson et al. 1998). Hence, if their abundance in Greenland waters reach similar levels as in the Norwegian Sea (Bjørke 2001), the role of *G. fabricii* in the marine ecosystem may be profound.
This assumption is supported by the fact that remains of particularly *Gonatus* sp. occur frequently in stomachs of numerous species of birds, fish and marine mammals in arctic and sub-arctic waters. Thus in the Norwegian Sea, larger specimens is one of the main items in the diet of sperm whales, bottlenose whales, and narwhals. *Gonatus* is also consumed by pilot whales, belugas, Sowersby's whales and other cetaceans, harp seals, hooded seals, seabirds, cod, saithe, sea perch, the Greenland shark, grenadiers, blue ling and Greenland halibut (Bjørke 2001). In Canadian Atlantic waters, *Gonatus* sp. have similarly been found to be important in the trophic web of the shelf-slope ecosystem both as prey and as predator (Dawe et al. 1998). Juvenile stages of *G. fabricii* occur in high numbers in the zooplankton in certain periods of the year and Kristensen (1984) proposes that baleen whales may predate on this species as well.

Marine mammals as predators on *Gonatus* sp.

Due to its importance as food for sperm whales and northern bottlenose whales, Bjørke (2001) suggests that the distribution of *G. fabricii* can, to a great extent, explain the presence of these species in the Norwegian sea (Bjørke 2001). Analysis of narwhal stomach contents, reveal remains of *Gonatus* sp. at all investigated localities in Baffin Bay and Davis Strait and at in all seasons (Laidre and Heide-Jørgensen submitted).

Contents of one Narwhal stomach from Melville Bay in August 2002. The majority of the undigested items consist of beaks from *Gonatus* sp. Foto: M.P. Heide-Jørgensen.

Bottlenose whales also forage on adult gonatid squids as shown by a study on fatty acid and stable isotopes of bottlenose whales off the east coast of Canada (Hooker et al. 2001). The results of this study suggests selective feeding on adult rather than on juvenile gonatids. Furthermore the fatty acid composition of bottlenose whales is reported to be more similar to that of adult female *G. fabricii* than to that of the adult male *G. fabricii* (Hooker et al. 2001). These observations are in agreement with analyses of stomachs from stranded sperm whales in Denmark. Ninety nine percent of the cephalopod beaks found in these stomachs came from *G. fabricii*. Beaks from mature squid dominated. This finding suggests, that sperm whales forage heavily on female squid during the last stage of their life cycle (T.K. Kristensen, pers. com.). In the Disko Bay, a wide range of size classes of *G. fabricii* are found in narwhal stomachs (collected in December to April), suggesting narwhal feeding on both juvenile stages and spawning adults (Laidre and Heide-Jørgensen submitted).

Results from stomachs and intestines of seals in the Greenland Sea, off East Greenland, indicate that *G. fabricii* is the dominant food item for hooded seal (*Cystophora cristata*) but not for harp seal (*Phoca groenlandica*) in this area (Potelov et al. 2000). Off West Greenland, harp seal did contain remains of squid though (Kapel and Angantyr 1989, Potelov et al. 2000). A study on stomachs of ringed seal (*Phoca hispida*) from West Greenland shows that *G. fabricii* is included in the diet in all samples except those from the northern most municipalities. Thus from Upernavik in the north to Nanortalik in the south, ringed seal feed on *G. fabricii*. The estimated fraction by weight peaks in Uummannaq and Kangaatsiaq with 52.5% and 45.8% respectively (Siegstad et al. 1998).

Fisheries

There is no history of fishery directed towards cephalopods in Greenland waters, but based on the high occurrences of early life stages of *G. fabricii* off West Greenland, Piatkowski and Wieland (1993) suggested that the species might be of commercial interest.
As previously mentioned, Bjørke and Gjøsæter (1998) estimated the lifetime biomass production of *G. fabricii* in the Norwegian Sea, to be 20 mill t. Of this biomass, the authors calculated that sperm whales consume 384 750 t/year and northern bottlenose whales consume 480 000 t/year. Furthermore it is reasonable to believe that at least 100 000 t of *G. fabricii* is consumed by hooded seal in this area (Bjørke 2001). Based on these calculations Bjørke and Gjøsæter (1998) suggest that there is a surplus production of *G. fabricii* taking place in the Norwegian Sea, which could be exploited by the fisheries. In short lived species, abundance may fluctuate widely from year to year, so that predators and fisheries must be able to turn to alternative resources in years of low abundance (Piatkowski et al. 2001).
In 2003, an experimental bottom trawl fishery for cephalopods was conducted off West Greenland during a period of two months. In this experimental fishery, the total catch of Oegopsids (probably *Gonatus* sp.) was 4.7 kg. In 1998, a pelagic trawl was used in an experimental fishery targeting adult *G. fabricii* in the Norwegian Sea. Catches were small (max. 10 kg haul-1) probably due to the slow speed of the trawl (1.5 knots) (H. Bjørke pers. comm.). There are no other reports on catches of large specimens of *Gonatus*, thus its commercial value is yet to be investigated.

Assessment

In short-lived and fast growing species such as squid, the standing stock (biomass) per se is not necessarily a good indicator of the level of predation or exploitation that the population may sustain, since the rate at which biomass is generated must also be considered. Thus, catch statistics per month rather than per year, is necessary for cephalopod stock assessment (ICES 2003). The influence of environmental factors on cephalopod stocks in Greenland is unknown but likely to be of high importance. From the fishery for squids (*Loligo* sp.) in the North Sea it is known that catch per unit effort in the winter is strongly positively related to both sea surface and sea bottom temperature and also but to a lesser extent, salinity. Thus forecast accuracy in squid production can be improved by taking into account environmental variables (ICES 2003).

Conclusion

Since *G. fabricii* may be the most common cephalopod in Greenland waters, it may be presumed that this species would dominate the catch in an experimental squid fishery. The species has a nutritional value, that makes it suitable for consumption and a very high lipid content, which makes it suitable for industrial use (Kristensen 1984). Though less abundant, *Rossia moelleri,* may also be of commercial interest e.g. in association with the shrimp fishery (Thomas K. Kristensen, pers. com.).
Considering the suspected high ecological importance of this resource, any exploitation should be preceded by and subsequently closely accompanied with thorough investigations on stock sizes, distributions and biology in order to assess the fishery potential for a sustainable exploitation of this resource.

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