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THE BOREOATLANTIC GONATE SQUID *GONATUS FABRICII*: OCCURRENCE OFF WEST GREENLAND IN SUMMER AND AUTUMN 1989 AND 1990

Uwe Piatkowski and Kai Wieland

Institut für Meereskunde
Universität Kiel
Düsternbrooker Weg 20
D-2300 Kiel 1, Germany

ABSTRACT

The Boreoatlantic gonate squid *Gonatus fabricii* is the most abundant squid in the offshore arctic and subarctic waters of the northern Atlantic. Adults are common in midwater layers while juveniles are known from the surface waters close to the continents. Accompanying a research project focussing the interactions of fish stocks off West Greenland we have examined the squid collection that has been sampled with small pelagic nets in summer 1989 and in summer and autumn 1990 off Southwest Greenland. *G. fabricii* was by far the most abundant cephalopod species in the samples. We recorded a total of 698 juvenile specimens. The study provides new data on the distribution and morphometry of the juvenile stages off Southwest Greenland. It is also a contribution to the studies on economically interesting squid stocks of the northern North Atlantic.

INTRODUCTION

The estimated total world catch of marine and freshwater mollusks has been 7.9 million metric tonnes in 1989 (FAO 1991). Teuthoidea, better known as squids, have been the most important order amongst the mollusks. 2.1 million metric tonnes have been yielded in 1989, representing an increase of 14% compared to 1988. While present squid fisheries in the South Atlantic are very intense (approximately 0.8 million metric tonnes in 1989) and oncentrated off the coasts of Southeast America, commercial catches from the North Atlantic are comparatively low with only 50000 metric tonnes in 1989. With the depletion of a number of fish stocks in the North Atlantic increasing attention is now being paid to the so-called unconventional marine resources which include many squid species (Roper *et al.*, 1984).

Possible target species are the myopsid squid *Loligo forbesi* (Gaard 1987; Howard *et al.*, 1987), the ommastrephid squids *Illex illecebrosus* (Black *et al.*, 1987) and *Todarodes sagittatus* (Sundet 1985; Shimko 1989), and the subarctic gonate squid *Gonatus fabricii* (Wiborg *et al.*, 1984). *G. fabricii* is the most abundant squid of the arctic and subarctic waters of the North Atlantic and has been intensely studied by Nesis (1965) and Kristensen (1984). Especially its early life stages are found in large numbers in West Greenland waters, mostly as bycatch in shrimp trawls. *G. fabricii* occurs in the stomachs of marine mammals, birds and fishes like gadoids and the redfish *Sebastes marinus* (Nesis 1965; Roper *et al.*, 1984). Undoubtedly, the squid is an important component in the marine ecosystem off West Green-

land with a considerable fishery potential. At present, however, only at Greenland Inuit use it as bait in the cod fishery and to some degree for human food (Roper *et al.*, 1984). Despite the very comprehensive work by Kristensen (1984) we believe it is essential to emphasize again the economical potential of *G. fabricii* which we will demonstrate with new data on the distribution of juvenile specimens in the waters off West Greenland.

MATERIALS AND METHODS

The cephalopod specimens reported upon here were sampled along oceanographic station-transects off West Greenland during cruises of RV POSEIDON (6.7. - 4.8.1989; 12.7. - 12.8.1990) and FRV WALTHER HERWIG (20.10. - 28.11.1990) (Fig. 1). During the first POSEIDON cruise in summer 1989 zooplankton and micronekton was sampled with a MOCNESS (Multiple Opening/Closing Net and Environmental Sensing System; Wiebe *et al.*, 1976) which has a mouth opening of 1 m^2 and a mesh size of 300 µm. The standard oblique haul was sampling consecutively eight different depth layers between 200 m and the surface. The towing speed was 3 knots. Since squids appeared in low numbers, only their total density was calculated for the whole water coulumn sampled during each MOCNESS haul. In summer and autumn 1990 the early life stages of fish and squid were sampled with an IKMT (Isaacs Kidd midwater trawl; Isaacs and Kidd, 1953). The net opening was 10 m^2 and the mesh size in the cod end 4.5 mm in summer 1990, and 5.0 mm in autumn 1990, respectively. The standard oblique haul reached down to 175 m in summer 1990, and 200 m in autumn 1990, respectively. The towing depth of the IKMT was recorded with an acoustic net sonde; a flowmeter was attached in the center of the net opening. Total micronekton samples were stored in 4% buffered formalin/freshwater solution. In the home laboratory squids were sorted from the samples and dorsal mantle length (DML, in mm) was measured for each specimen. Density of squid was calculated in number per unit volume (n/1000 m^3).

Physical oceanographic data were obtained from CTD recordings with a ME multi-sonde. They were performed correspondingly to the biological sampling to characterize the hydrography at the sampling sites. Data for the WALTHER HERWIG cruise were supplied by Manfred Stein, Institut für Seefischerei Hamburg.

RESULTS

Forty seven of 67 micronekton stations during the three cruises yielded squids. All specimens were juvenile and sub-adult and belonged to the species *Gonatus fabricii* (n = 698), with the exception of one animal that was identified as the cranchiid species *Teuthowenia megalops* (DML = 52 mm). It was captured during the autumn 1990 cruise at one of the most southern stations (59°17'N, 44°52'W) within the top 200 m. Water temperature was ca. 5°C.

During the summer cruise in 1989 (Fig. 1) the total number of juvenile *Gonatus fabricii* was 84. They were distributed all over the sampling area with slight concentrations at the Fyllas Bank off Godthab (Fig. 1). The lengths varied from 6 to 35 mm (Fig. 2).

The summer cruise in 1990 yielded the richest squid samples. Alltogether 542 specimens were caught on three transects off West Greenland (Fig. 1). The length distribution ranged from 10 to 48 mm (Fig. 2). Mean lengths of the two northern transects were very similar with $\bar{x}$ = 18.7 mm (std = 5.4) off Holsteinsborg, and $\bar{x}$ = 18.8 mm (std = 5.1) at Fyllas Bank (Fig. 3). The southern transect off Kap Desolation, however, revealed a distinctly larger

mean mantle length of *Gonatus fabricii* with $\bar{x}$ = 22.9 mm (std = 5.2). Densities varied between 0.05 ind./1000 m^3 and 2.88 ind./1000 m^3 (Fig. 4). The animals were most abundant at the nearshore stations of the Fyllas Bank transect at water temperatures between 0 and 3°C.

During the autumn cruise in 1990 a comparatively low number of *Gonatus fabricii* was caught: n = 72 specimens at 11 of 29 IKMT stations. The lengths ranged from 19 to 64 mm showing that the animals had considerably grown compared with the length distribution from the summer collection (Fig. 2). All animals were caught on the three most northern transects (Fig. 1) with the exception of 4 specimens which were sampled off Kap Desolation (Transect 5) and off Kap Farvel (Transect 6). The length distribution at the various transects (Fig. 5) illustrates that the biggest animals were sampled at the Fyllas Bank transect (Transect 3). Densities were considerably lower than during the summer cruise, with values ranging between 0.04 ind./1000 m^3 and 0.41 ind./1000 m^3. Again, the animals were most abundant at the nearshore stations of the Fyllas Bank (T = 1 to 5°C), whereas at the northern transects the inshore stations with cold water masses (<1°C) were mostly avoided.

Fifty five specimens of *Gonatus fabricii* were selected for additional measurements of the fin width. The morphometric relationship of dorsal mantle length vs. fin width is shown as a scatter diagram (Fig. 7). This ratio is a useful tool for illustrating species typical characters and provides additional information on taxonomic characteristics of *G. fabricii*.

DISCUSSION

The most comprehensive and detailed work on *Gonatus fabricii* off West Greenland has been done by Kristensen (1984), who examined 7000 juvenile and 300 adult specimens. The present data can only be viewed as a supplement to Kristensen's work. Although juvenile *G. fabricii* occurred only as bycatch in the samples on the distribution of larval and 0-group fish of West Greenland (Wieland 1991), the collection of nearly 700 specimens allows some meaningful conclusions. The mean size of *G. fabricii* is not as uniform as Kristensen (1984) reports from his collections from 63° to 68°N which were sampled each July during the years from 1950 to 1966. In summer 1990 the mean length of *G. fabricii* was distinctly larger ($\bar{x}$ = 22.9 mm) off Kap Desolation than at the more northern transects off Holsteinsborg and at Fyllas Bank ($\bar{x}$ = 18.7 and 18.8 mm) which indicates that different populations had been sampled (Fig. 3). A similar pattern can be derived from the autumn collection where specimens from the Fyllas Bank transect were clearly larger ($\bar{x}$ = 36.8 mm) than those from the more northern transects ($\bar{x}$ = 32.0 and 27.6 mm; Fig. 5).

If we assume that populations off Holsteinsborg and at Fyllas Bank are resident a juvenile growth for *Gonatus fabricii* can be simply estimated by the difference of the mean length values from autumn and summer samples. This would lead to growth rates of 4.0 mm per month off Holsteinsborg, and 5.5 mm per month at Fyllas Bank. Both estimations are significantly lower than the 8.0 mm per month which Kristensen (1977) suggests for juvenile growth of *G. fabricii*.

The present data recommend quite evident conclusions on geographical distribution, body size, and even on juvenile growth estimations of *Gonatus fabricii*. However, as squid are extremely capable in avoiding traditional sampling gear, abundances and length frequencies might be even underestimated from our samples. Moreover, larval drift and active migration of juvenile specimens cannot be excluded. They are characteristic phenomenons in other squid

species like *Todarodes sagittatus* where they substantially affect the investigations on biology and distribution in the North Atlantic (Shimko 1989).

Although juvenile *Gonatus fabricii* are frequently caught in shrimp trawls, it has never been possible to estimate the quantitative occurrence of the adults and only few information is available on their biology (Kristensen 1984). They live at the bottom on the slopes, rarely ascending to the surface at night, whereas larvae and juveniles live in the epipelagic zone. Based on large catches of sub-adult specimens by midwater trawls in the Norwegian Sea Wiborg *et al.* (1984) suggest that spawning concentrations of *G. fabricii* may be of commercial interest. However, these concentrations have not yet been found off West Greenland. Therefore, more basic research is needed, probably in conjunction with sampling of the early life stages of the Greenland halibut, *Reinhardtius hippoglossoides*, which shows a similar distribution pattern like *G. fabricii* (Kristensen 1984).

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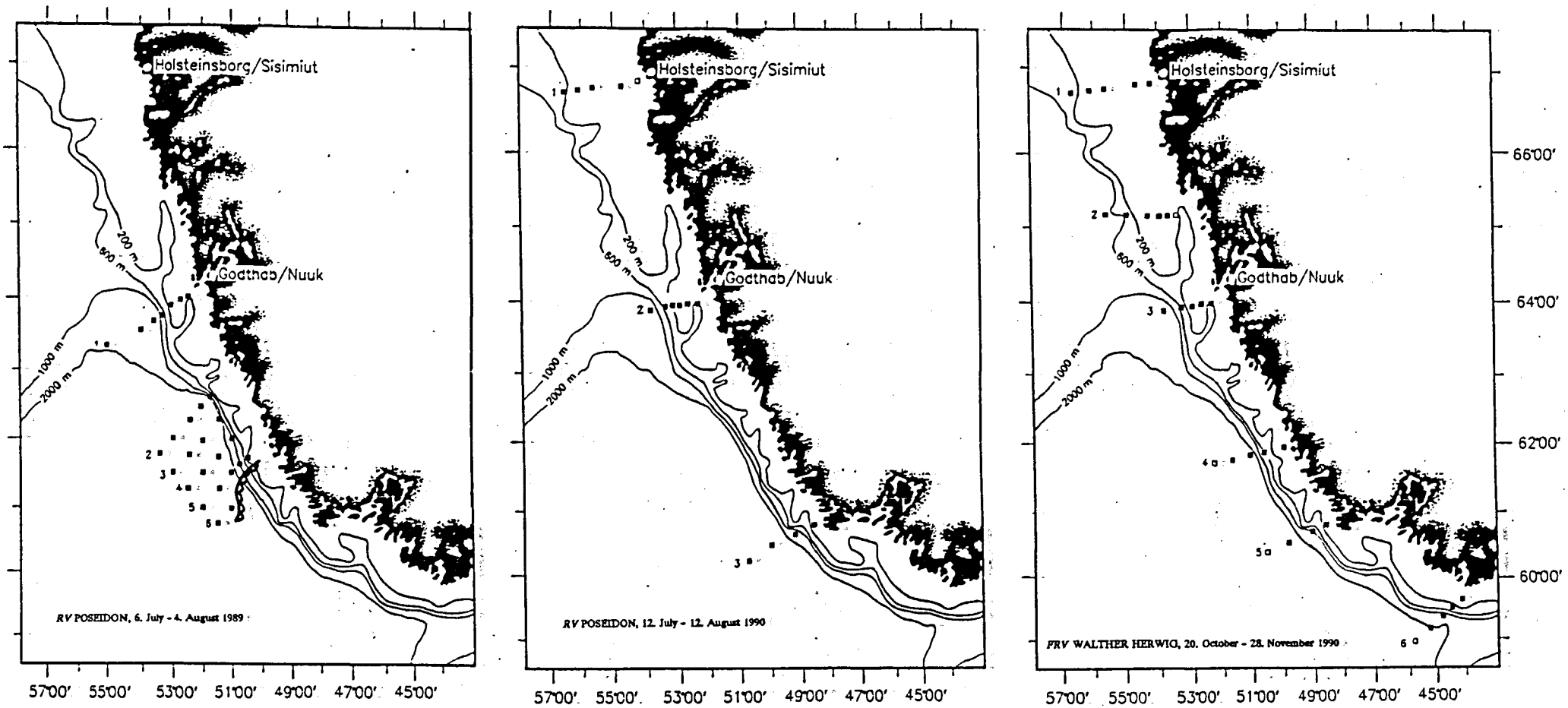


FIGURE 1: Sampling sites. ■ MOCNESS stations (summer 1989) or IKMT stations (summer and autumn 1990). Open squares: only CTD casts

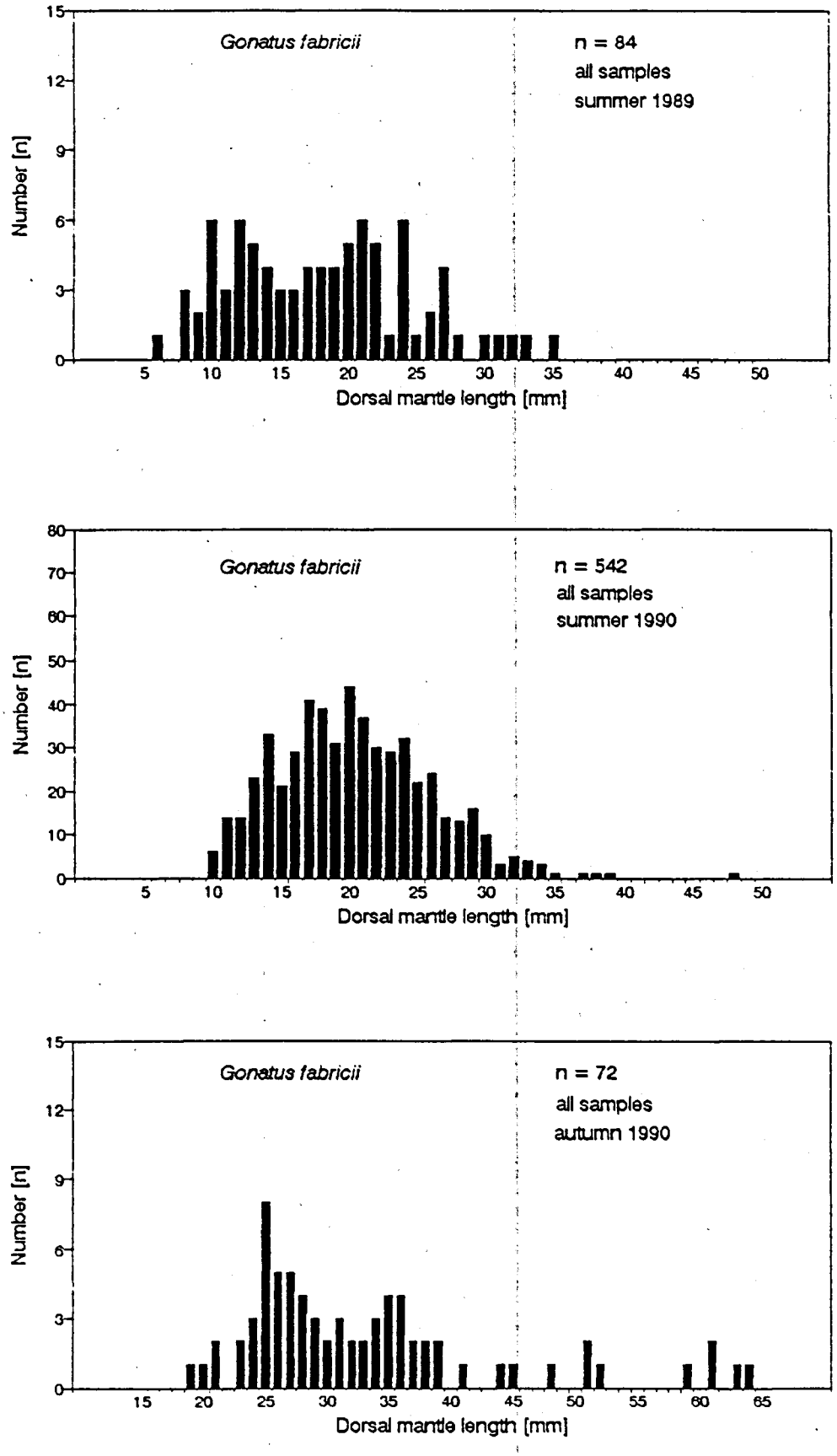


FIGURE 2: *Gonatus fabricii.* Length distribution off West Greenland in in summer 1989, summer 1990 and autumn 1990 (n = total number).

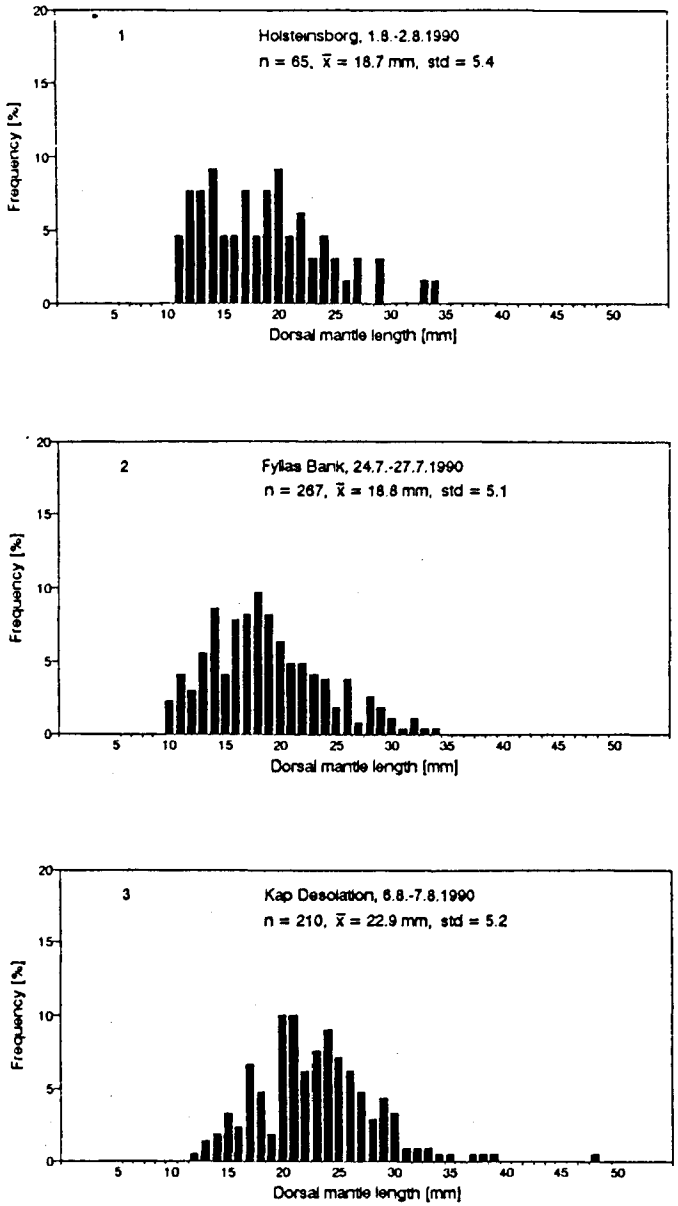


FIGURE 3: *Gonatus fabricii.* Length distribution at various locations off West Greenland in summer 1990 (n = total number, x̄ = mean length, std = standard deviation).

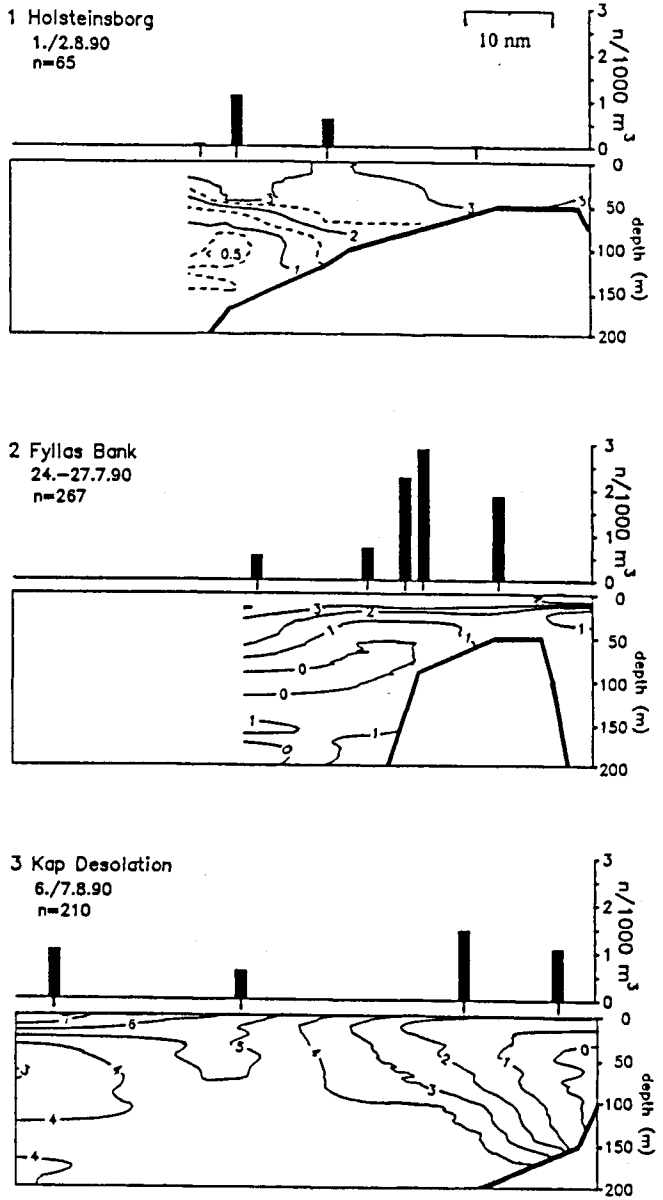
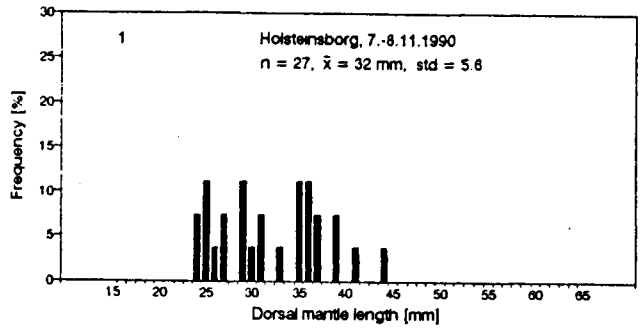
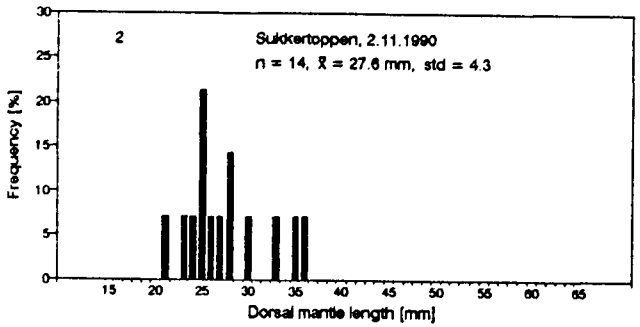


FIGURE 4: *Gonatus fabricii.* Relative abundance and temperature section along transects off West Greenland during summer 1990.





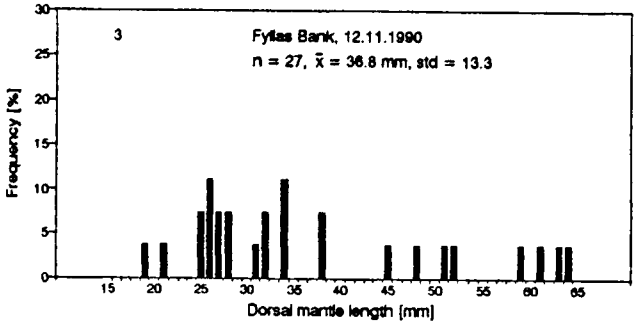


FIGURE 5: *Gonatus fabricii.* Length distribution at various locations off West Greenland in autumn 1990 (n = total number, x̄ = mean length, std = standard deviation).

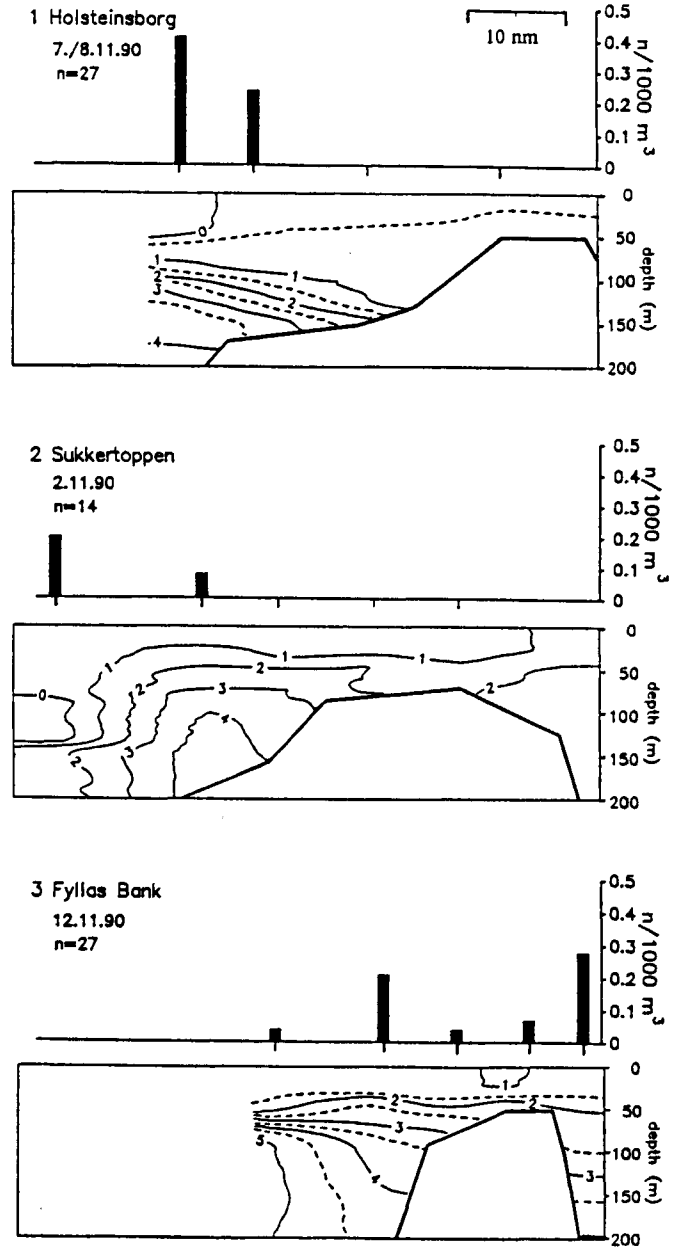


FIGURE 6: *Gonatus fabricii.* Relative abundance and temperature section along transects off West Greenland during autumn 1990.

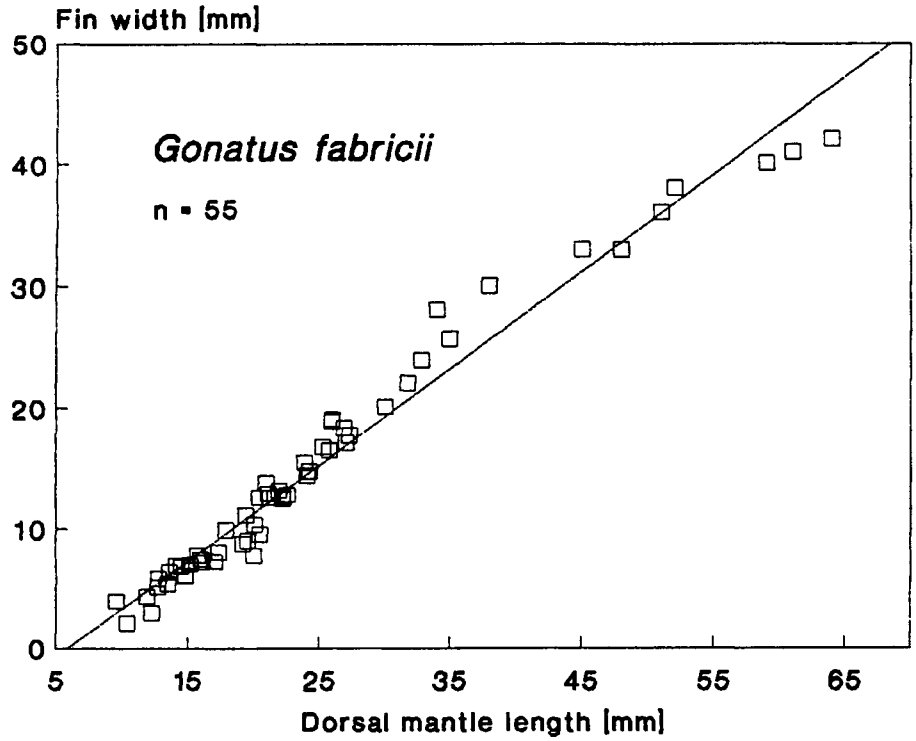


FIGURE 7: *Gonatus fabricii.* Scatter diagram of dorsal mantle length vs. fin width from 55 selected specimens.