

## Occurrence of the fascigera forms of shrimp *Hippolyte varians* (Leach.) in Gullmarsfjorden, Sweden, with comparisons from the Faroe Islands.

Matz Berggren

Kristinebergs Marinbiologiska Station  
S-450 34 Fiskebäckskil Sweden.

**Abstract :** The fascigera forms of *Hippolyte varians* (Leach) are found in different proportions on the Swedish west coast with its variable temperature and salinity throughout the year and the Faroe Islands with a very stable temperature and salinity.

In Sweden 11 % of the males are found to exhibit the greatest fascigera form (F++) but in the Faroe Islands only the simplest form (F0), is found in low numbers among males. This indicates that the fascigera form is associated with a harsh and changeable environment.

**Résumé :** Les variétés fascigera d'*Hippolyte varians* (Leach) se rencontrent en proportions différentes entre la côte occidentale de la Suède, où température et salinité sont variables tout au long de l'année, et les parages des îles Féroé, où température et salinité sont stables.

En Suède, 11 pour cent des mâles présentent le plus grand nombre de la forme fascigera (F++), tandis qu'aux îles Féroé c'est uniquement la forme fascigera la plus simple (F0) qui est rencontrée en petit nombre parmi les mâles. Cela semble indiquer que la forme fascigera est associée à un environnement aux conditions extrêmes et variables.

### INTRODUCTION

The shrimp *Hippolyte varians* (Leach) occurs in two different morphs. In one morph a variable number of seta tufts are found on the dorsal and lateral sides - the fascigera form. In the other morph these tufts are absent. Those individuals with seta tufts were separated from *H. varians* to a new species called *H. fascigera* by Gosse (1853). That form was investigated by Lagerberg (1908) and Sars (1912), and it was later determined that the two forms should be considered one species (Holthuis, 1950). Investigations of the fascigera form have been conducted very thoroughly by Chassard-Bouchaud (1966) in the Roscoff area, France.

### MATERIALS AND METHODS

This study was carried out on the north-west side of the island Blåbergsholmen (Fig. 1D) on the Swedish west coast. Sampling was performed irregularly from December 1982 to August 1986 on mainly hard substrata (eg. in the algae zone). Comparative samples were taken from an Atlantic locality at 9 different sites in August 1987 on the two main islands of the Faroe Islands (Streymoy & Eysteroy) (Fig. 1B). The shrimps were collected by SCUBA diving. The diver followed a lead weighted line on the bottom in the algae zone

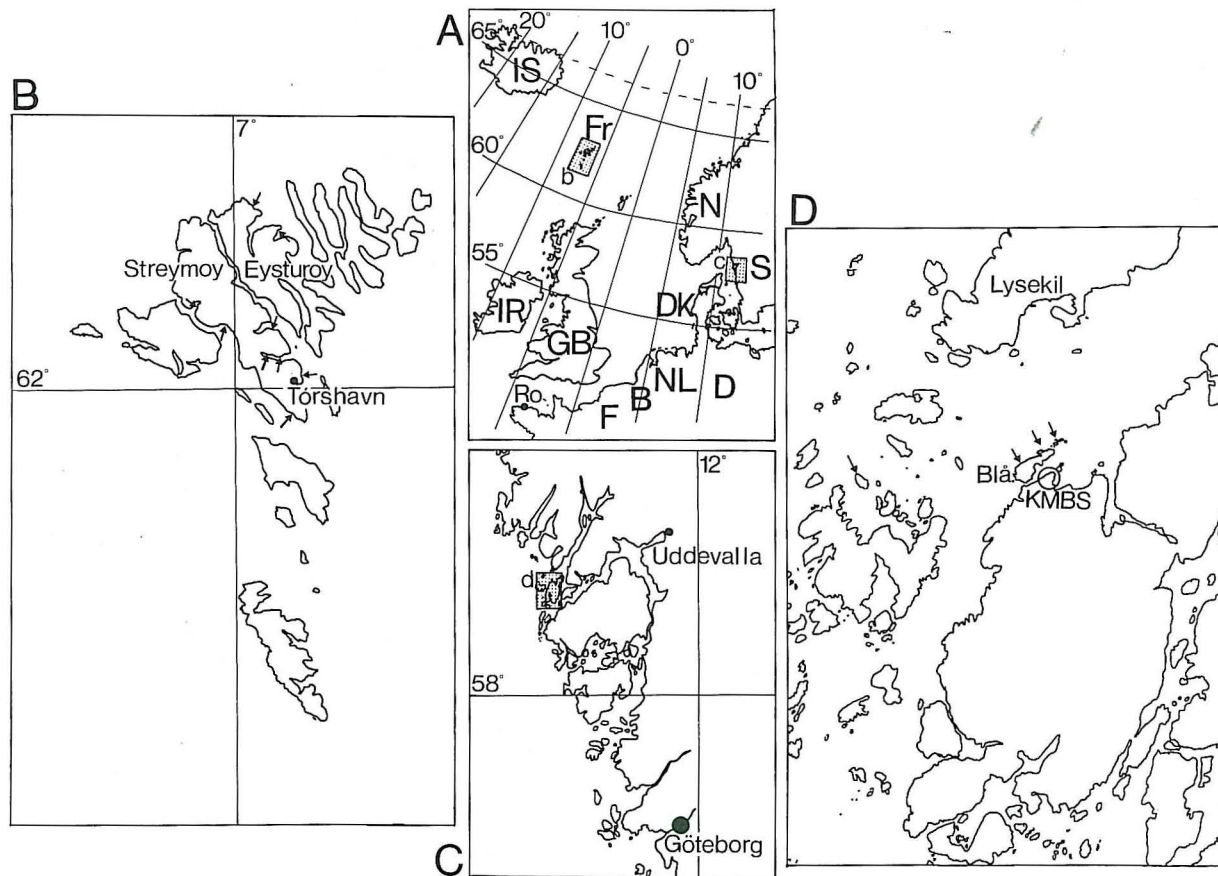


Fig. 1 : A. Small map shows Faroe Island (Fr) in the Atlantic Ocean and west of Sweden. Gray squares with a letter indicating an enlargement with same letter (Ro = Roscoff).  
 B. Faroe Islands with the sampling sites (arrows) at two main islands.  
 C. The Swedish west coast with the marked area in the mouth of Gullmars fjorden (beginning from the upper right corner of the square).  
 D. Sampling site outside the island Blåbergsholmen (Blå.) in the mouth of Gullmarsfjorden (KMBS = Kristineberg Marine Biological Station).

from 20 m depth up to the shore line. Samples were taken at different depths by the use of a dip net (aperture measurements: 300 x 250 mm, with a mesh size of 0.5 mm) with an exchangeable terminal collecting cup, which was changed after each sample. Sampling was carried out by fast movements of the dip net back and forth in a selected bush of algae. The algal sites were chosen subjectively along the line and 8-10 samples were taken during one dive collection. Sampling parameters (depth and type of algae) were written down on a white PVC-sheet after each sample. The sampling method was mainly qualitative and quantitative aspects could only be used in the sense of rare, common or abundant.

Animals caught were picked out in the laboratory and fixed in a mixture of 4 % formaldehyde and 5 % glycerol in sea-water for at least 24 h, before transferral to a mixture of 70 % alcohol and 5 % glycerol. Sex was determined by using the characteristics of the first pleopod or by looking for appendix masculina on the second pleopod. Length was measured with a stereo microscope equipped with a drawing mirror and a digitizer tablet connected to a computer. The mirror image from the stereo microscope on the digitizing tablet was measured with high precision, rounded to the nearest tenth of a millimetre. Measurements were taken from the base of the eye orbit to the lateral end of the carapace (Fig. 2). The type names of different seta patterns follow Chassard-Bouchaud (1966) (Table I), with a small change in the nomenclature however. In this article *F0* is used instead of  $F_{\epsilon}$  (used by Chassard-Bouchaud, 1966) as the code of the form which has seta only on the 3rd segment on the abdomen. In almost all near-shore areas of the Swedish west coast, salinity and temperature change significantly both during the year and with depth. This applies to Gullmarsfjorden and therefore the occurrence of the fascigera form was tested for correlation with depth of capture. This because the west coast of Sweden is highly influenced by the Baltic Sea through a surface current along the coast. The current dominates the upper 10-20 m and cause the water column to be highly stratified. At the Faroe Islands the salinity is relatively constant from the surface down to 20 m depth (Dr A. Nörrevang, Kaldbak marine laboratory, pers. comm.) and therefore the differences in the fascigera form were correlated to degree of exposure (0=sheltered - 3=fully exposed) instead of depth as in Sweden.

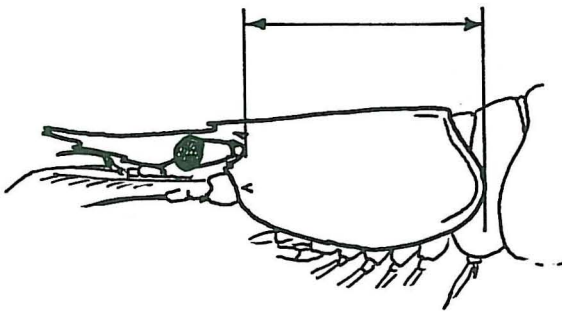


Fig. 2 : Measuring distance at the carapace of the shrimp.

TABLE I

Seta pattern on Hippolyte varians to distinguish the different fascigera form.

r = seta present, a = anterior seta, m = medial seta, p = posterior seta (Modified from Chassard-Bouchaud, 1966).

Fascigera			Carapace		Abdomen (segments)						Telson
type					1	2	3	4	5	6	
F++	Maximum dorsal of seta	lateral margin	a, p x x	x	x x x	x x x	a, m, p x x	x x x	x	x	x
	Minimum dorsal of seta	lateral margin	a, p	x	x x x		m, p	x			
F+	Maximum dorsal of seta	lateral margin		a, p			x	m, p	x		
	Minimum dorsal of seta	lateral margin				x			x		
F0	Maximum dorsal of seta	lateral margin									
	Minimum dorsal of seta	lateral margin	p			x	m, p				
L	Maximum dorsal of seta	lateral margin					m, p				
	Minimum dorsal of seta	lateral margin					p				

## RESULTS

The catches from Gullmarsfjorden were divided into two depth ranges, 0-10 m and 10-24 m. Of all *Hippolyte varians* 79.6 % were collected above 10 m and 20.5 % below. The fascigera form was found more abundantly in the upper layer than in the lower (Table II). Overall, of the specimens caught in Gullmarsfjorden 48 % was of the fascigera form and of those 41 % were collected above 10 m and 7 % below. Approximately half of the catches between 0-10 m were of the fascigera form and about a third below 10 m. All four fascigera forms were found in Gullmarsfjorden. They were collected from both depth ranges for



TABLE II

The percentage of individuals for each sex of the two different forms (L-type=without setae and F-type with seta) at two depth ranges in Gullmarsfjorden (upper part of table). Percentage of each type and sex compared with all sexes and depths (lower part of table).

% males			% females				
Depth	L-type	F-type	no.males	L-type	F-type	no.fem.	Tot.no.
0-10 m	37.3	62.7	51	55.9	44.1	93	144
10-24 m	72.2	27.8	18	61	39	18	36
Sum			69			111	180
	L-type	F-type	=%males	L-type	F-type	=%fem.	% tot
0-10 m	11	18	28.3	29	23	51.7	79.6
10-24 m	7.2	2.8	10.0	6.1	3.9	10.0	20.5
% sum	18	21	38.3	35	27	61.7	100.1

females, but in fewer numbers below 10 m (Fig 3a). The same is true for the males except that below 10 m the F++ was not found (Fig 3b).

The Faroe Island catches were divided into two groups ; 0-1 = low exposure and 2-3 = high exposure (Table III). Of all *Hippolyte varians* 77.8 % were collected in low exposure and 22.2 % in high. The fascigera form was more abundant in low exposure areas (males and ovigerous females) except for non-ovigerous females which demonstrated the opposite trend (42.5 % were of fascigera form in high exposure areas but only 29.3 % in low). Of the total numbers of *Hippolyte varians* collected in the Faroe Islands 28 % were of the fascigera form and of those 22 % were caught in low exposure areas and 6 % in high exposure areas. In both cases a little less than a third were of the fascigera form (22 % in 77.8 % and 6 % in 22 %).

In the Faroe Islands, higher numbers of the fascigera forms were found only in low exposure areas. This was true for non-ovigerous and ovigerous females as well as for males. In both males and females a lower percentage of fascigera forms were caught in high exposure areas compared to the total catch in both areas. The fascigera forms were only completely represented among females in low exposure areas and even then F+ and F++ were only found in very low numbers. The only fascigera form found among the males was F0.

The observed percentage of fascigera forms in Gullmarsfjorden, Sweden and the Faroe Islands is shown in relation to carapace length in Figs. 4-8. The fascigera form does not develop in very small individuals, but was found only among individuals with a carapace length exceeding 1 mm.

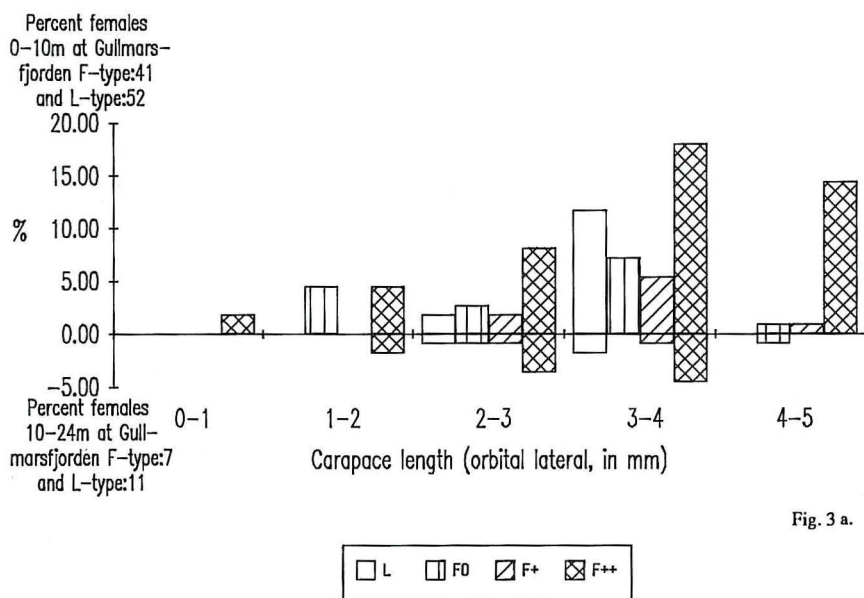


Fig. 3 a.

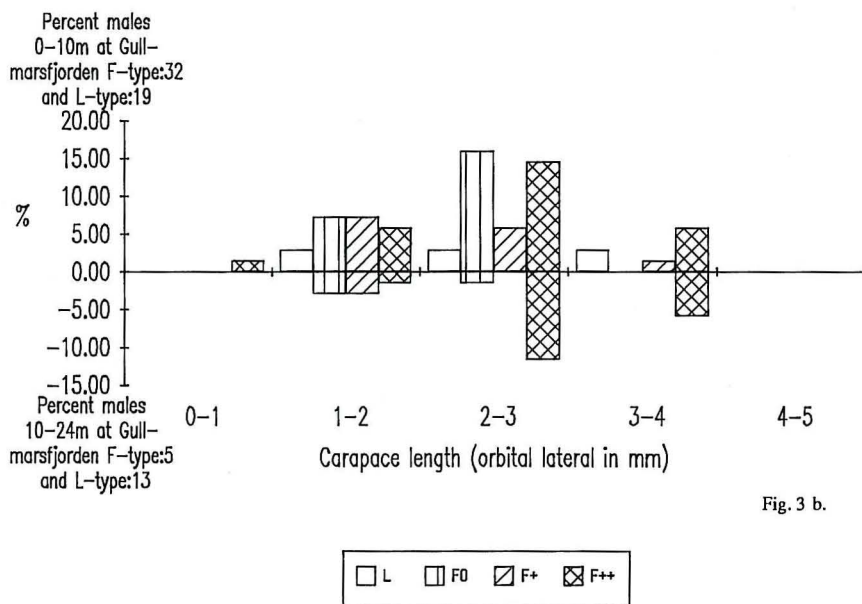


Fig. 3 b.

Fig. 3. : a. Percentage of females according to carapace length, above (upper part) 10 m and below (lower part) in Gullmarsfjorden, Sweden.  
b. Percentage of males according to carapace length, above (upper part) 10 m and below (lower part) in Gullmarsfjorden, Sweden.

Percent females 0-24m  
at Gullmarsfjorden  
F-type:48 and L-type:63

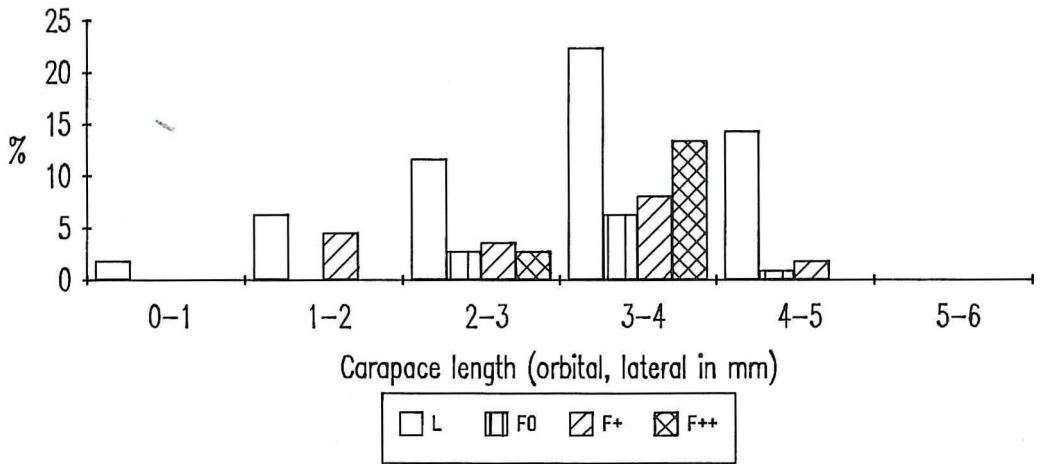


Fig. 4 : Percentage of females according to carapace length, in Gullmarsfjorden, Sweden (0-24 m).

Percent males 0-24m  
at Gullmarsfjorden  
F-type:37 and L-type:32

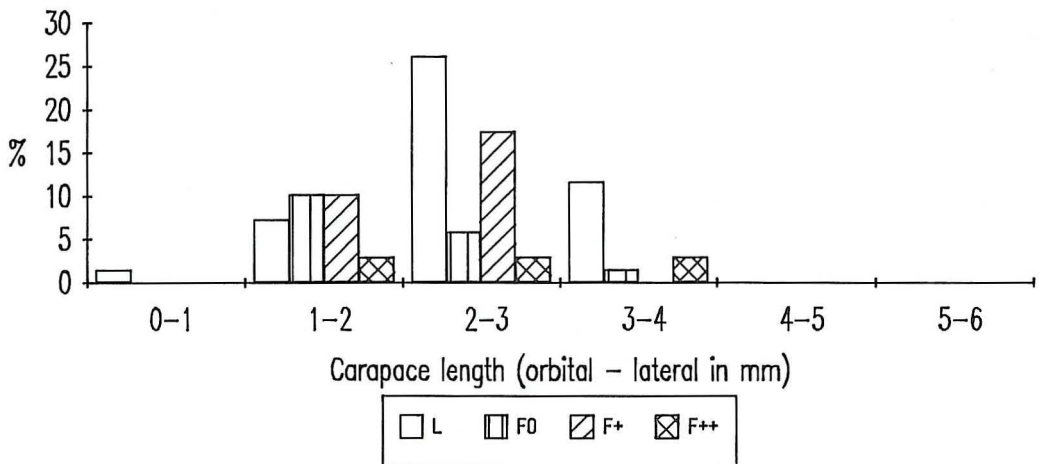


Fig. 5 : Percentage of males according to carapace length, in Gullmarsfjorden, Sweden (0-24 m).

Percent females 0-16m  
at the Faroe Islands.  
F-type:66 and L-type:141

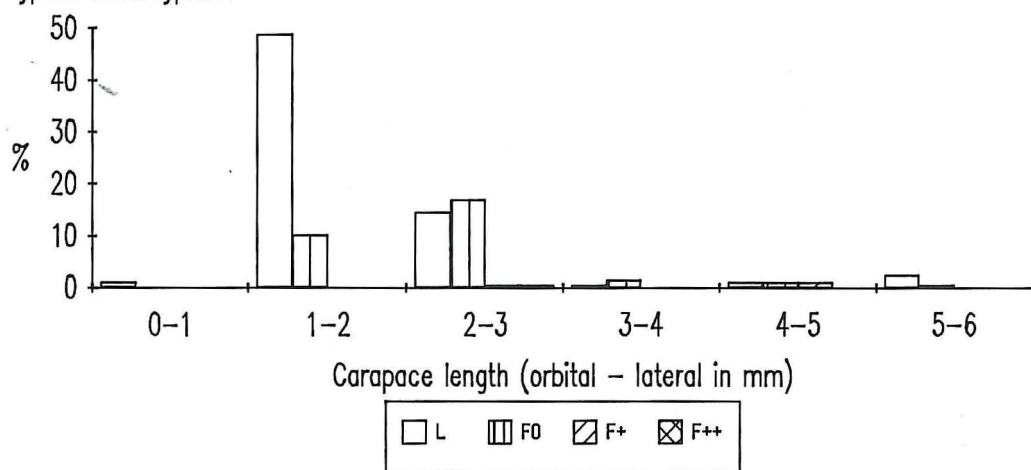


Fig. 6 : Percentage of females according to carapace length, at Faroe Islands (0-16 m).

Percent ovigerous females  
at the Faroe Islands  
F-type:4 and L-type:7

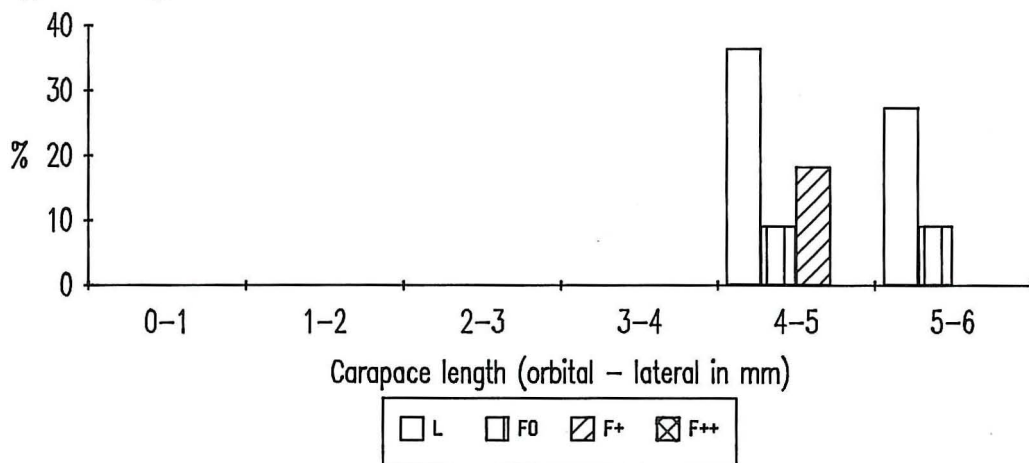


Fig. 7 : Percentage of ovigerous females according to carapace length, at Faroe Islands (0-16 m).



Percent males 0–16m  
at the Faroe Islands.  
F-type:31 and L-type:110

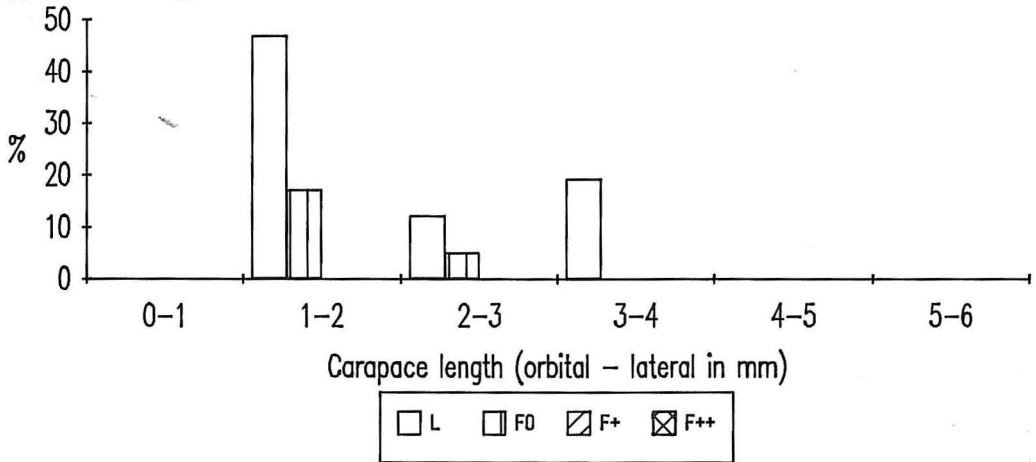


Fig. 8 : Percentage of males according to carapace length, at Faroe Islands (0–16 m).

Temp. (°C)/ Sal. (ppt)

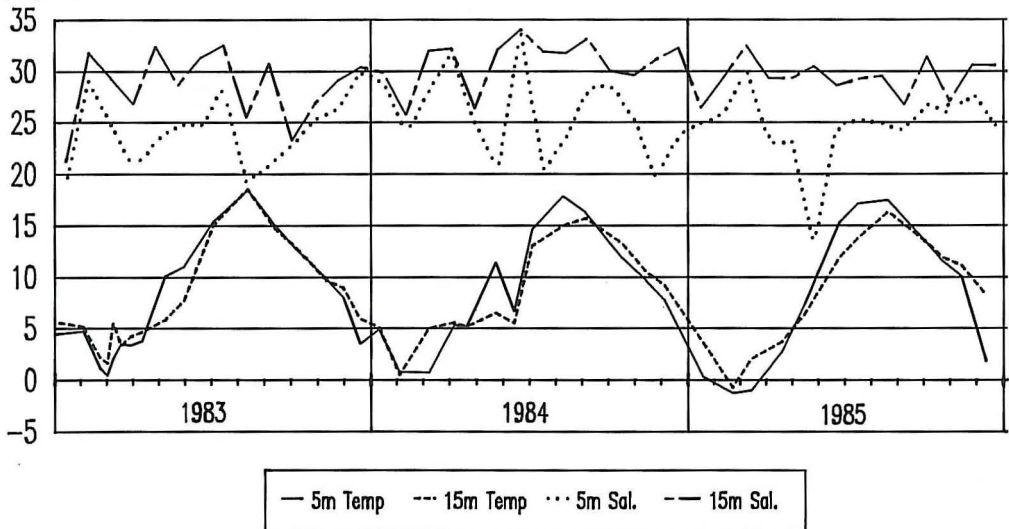


Fig. 9 : Temperature and salinity in two depths (5 and 15 m) in Gullmarsfjorden, Sweden.

TABLE III

The percentage of individuals in three groups (according to sex and reproductive stage) of the two different forms (L-type=without seta and F-type=with setae) at two types of exposure ; 0-1=protected shore and 2-3=exposed shore at the Faroe Islands (upper part of the table).

Part of the total percentages are also shown for both F- and L-type as well as exposure (lower part).

% males			% ovig. females			% females				
Exposure	L-type	F-type	no. males	L-type	F-type	no. ovig.	L-type	F-type	no. fem.	Tot. no.
0-1	73.1	26.9	108	50	50	4	70.7	29.3	167	279
2-3	93.9	6.1	33	71.4	28.6	7	57.5	42.5	40	80
Sun			141			11			207	359
	L-type	F-type	=%males	L-type	F-type	=%ovig.	L-type	F-type	=%fem.	% tot
0-1	22	8.1	30.1	0.6	0.6	1.2	32.9	13.6	46.5	77.8
2-3	8.6	0.6	9.2	1.4	0.6	2	6.4	4.7	11.1	22.3
% sun	32.6	8.7	39.3	2	1.2	3.2	39.3	18.3	57.6	100.1

## DISCUSSION

In Gullmarsfjorden higher proportions of the fascigera forms were found above 10 m depth than below. The pattern was the same in both sexes. This indicates that a high variation of temperature and salinity in the environment are associated with the release of the fascigera form. Chassard-Bouchaud (1966) indicated that low temperature was a possible reason for the fascigera form to develop. When comparing the Swedish west coast (Gullmarsfjorden) with the Faroe Islands (Streymoy and Eysturoy) the differences in variation of temperature and salinity were greatest in the uppermost 20 m. In Gullmarsfjorden the temperature varied between -1°C and 18°C and the salinity between 15 ‰ and 32 ‰ (Fig. 9) whilst in the Faroe Islands the temperature normally varied between 6°C and 10°C and the salinity was about 35 ‰ during the whole year (Dr. A. Nørrevang, pers. comm.). At the Faroe Islands the fascigera forms in general were very few and the highly developed forms even fewer. The males (135 males of 359 total of both sexes from all exposure sites) were only found to develop the simplest fascigera form (F0). On the Swedish west coast 11 % of males (51 males of 144 total of both sexes in 0-10 m) in the upper zone (0-10 m) were found to exhibit the highest fascigera form (F++). In a material of more than 1300 individuals of both sexes at Roscoff (1954-1958) France, where the temperature normally varies between 6°C and 15°C, no male of type F++ was found (Chassard-Bouchaud, 1966). But males are frequently found to exhibit both F0 and F+ and females all fascigera forms (Chassard-Bouchaud, 1966). It is possible therefore that shrimps on the Swedish west coast

develop a higher degree of fascigera forms because they are exposed to a harsher and more changeable environment.

The benefit for the shrimp of the fascigera form may be anti-predatory by camouflage. Sars (1912) mentions that the extreme fascigera form only occurs on ovigerous females and the fascigera form in males and "young specimens" (probably preadults) were very sparsely developed. By this Sars (1912) suggests the fascigera form to be most needed by ovigerous females as camouflage because of their reduced escape abilities.

### CONCLUSION

The development of the fascigera form is probably triggered by a slowness in movements either due to carrying eggs under the abdomen or to unfavourable conditions of the external medium. The support for this explanation would be that there are more fascigera forms above 10 m than below and that there are much fewer fascigera forms as a whole at the Faroe Islands compared to Sweden.

### ACKNOWLEDGEMENTS

This work, contribution n° 1 from the Biofar project, Kaldback, Faroe Islands, were made possible by a grant from the Nordic Collegium for Marine Biology for collecting shrimps at the Faroe Islands. Dr A. Nørrevang for all help and arrangements at the Faroe Islands, and Ms Anne-Marie Norby for diving assistance at the Faroe Islands. Prof. J-O Strömberg and the staff at Kristinebergs marine biological station has provided excellent working facilities. Dr B. Tunberg and Dr J. Havenhand for critical reading and English corrections.

### REFERENCES

- CHASSARD-BOUCHAUD, C. 1966. *Hippolyte Varians* Leach et sa "Variete" fascigera (Crustace Decapode). *Cah. Biol. Mar.* 7 : 445-462.
- GOSSE, P. H. 1853. Notes on some new or little-known Marine Animals. *Ann. and Mag. of Nat. Hist.* 2, 12, 69 : 153-159.
- HOLTHUIS, L. B. 1950. Decapoda (K IX) A. Natantia, Macura Reptantia, Anomura. *Fauna van Nederland*, Leiden, 15 : 1-166.
- LAGERBERG, T. 1908. Sveriges Decapoder. Göteborgs Kungl. Vetenskaps-och Vitterh. Handl. ser.4 (XI:2) : 1-117.
- SARS, G. O. 1912. Notes on Caridea (Sexual Differences -Mimicry). *Archiv for Matematik og Naturv.* 9 : 1-12.