

Notes on Ophiuroidea (Echinodermata) from the northeastern Atlantic Ocean. I. Ophiacanthidae

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Abstract

Collections made off Portugal, Morocco and Spanish Sahara, at depths from 50 to 2000 m, held 14 species of Ophiacanthidae, viz. *Ophiomyces grandis* Lyman, *Ophiacantha abyssicola* G. O. Sars, *O. angolensis* Koehler, *O. aristata* Koehler, *O. brevispina* Koehler, *O. cuspidata* Lyman, *O. densa* Farran, *O. lineata* Koehler, *O. setosa* (Retzius), *O. simulans* Koehler, *O. smitti* Ljungman, *Ophiothamnus affinis* Ljungman, *Ophiambix meteoris* Bartsch, and *Ophiocamax dominans* Koehler. Taxonomic details and the known range of distribution of each species is given.

Introduction

In the years 1967 to 1975 RV "Meteor" ran several transects off Portugal and along the African coast (Morocco, Spanish Sahara) in order to study the fauna on the seamounts Gettysburg Bank, Josephine Bank, Great Meteor Bank and the upwelling region off Northwest Africa. Samples were taken on shallow seamounts, in shelf areas and along the continental slope, with trawls, dredges, sleds and grabs, at depths from 50 to ca 2000 m (THIEL 1970, 1981). Ca 50 species of Ophiuroidea were present in the samples. The Ophiacanthidae were represented by 14 species, viz. *Ophiomyces grandis* Lyman, *Ophiacantha abyssicola* G. O. Sars, *O. angolensis* Koehler, *O. aristata* Koehler, *O. brevispina* Koehler, *O. cuspidata* Lyman, *O. densa* Farran, *O. lineata* Koehler, *O. setosa* (Retzius), *O. simulans* Koehler, *O. smitti* Ljungman, *Ophiothamnus affinis* Ljungman, *Ophiambix meteoris* Bartsch, and *Ophiocamax dominans* Koehler.

The ophiuroid material is deposited in Zoologische Staatssammlung, München.

Table 1: Station list

Meteor Cruise	Station and gear No	Date	Position		Depth in m
			N	W	
M 8	8/AT 6	20. 1. 67	37°39.0'	09°32.0'	1370–1430
M 8	13/KT 8	23. 1. 67	33°19.0'	09°00.0'	120–180
M 8	19/AT 19	26. 1. 67	33°34.2'	09°19.8'	1300
M 8	59/KD 12	7. 2. 67	37°42.1'	09°27.5'	500
M 8	62/KD 13	8. 2. 67	38°21.9'	08°56.4'	85–90
M 9c	82a/AT 19	19. 6. 67	31°35.0'	10°10.5'	150–160
M 9c	90/AT 22	22. 6. 67	37°14.7'	09°01.5'	114–117
M 9c	90b/KT 24	22. 6. 67	37°20.4'	09°01.5'	140–145
M 9c	90d/AT 26	22. 6. 67	37°21.5'	09°12.5'	320–385
M 9c	94/AT 29	24. 6. 67	36°29.9'	11°33.0'	150–430

Meteor Cruise	Station and gear No	Date	Position		Depth in m
			N	W	
M 9c	103a/KD 35	27. 6. 67	36°46.2'	14°14.5'	570
M 9c	120/KD 40	1. 7. 67	36°40.7'	14°15.5'	211–218
M 9c	120/KD 40–41	1. 7. 67	36°40.7'	14°15.5'	198–211
M 9c	132/AT 50	4. 7. 67	36°40.2'	14°17.5'	235–240
M 9c	169a/DD 66	21. 7. 67	30°07.0'	28°36.6'	318–321
M 9c	170/DD 68	21. 7. 67	30°05.5'	28°35.0'	306–313
M 9c	172/DD 72	22. 7. 67	29°49.1'	28°23.5'	296–297
M 9c	180b/KD 78	24. 7. 67	29°59.5'	28°22.5'	314–323
M 19	129/DD 94	17. 2. 70	29°59.0'	28°33.0'	293–296
M 19	210/AT 128	11. 3. 70	36°41.0'	14°16.0'	223–237
M 23	174/AT	28. 5. 71	35°30.6'	08°07.3'	1750
M 26	FS 3	17. 3. 72	24°14.9'	16°35.6'	250–367
M 36	97/KT 146	23. 2. 75	25°25.0'	16°00.9'	350
M 36	97/ES 147	23. 2. 75	25°30.2'	16°00.7'	409–417
M 36	98/ES 148	23. 2. 75	25°40.8'	16°02.0'	883–992
M 36	98/AT 149	24. 2. 75	25°31.5'	16°02.2'	658–888
M 36	104/ES 156	28. 2. 75	21°23.0'	17°32.4'	415–417
M 36	105/ES 157	28. 2. 75	21°19.5'	17°29.2'	206
M 36	105/KT 158	28. 2. 75	21°20.8'	17°29.5'	186–247
M 36	127/ES 181	12. 3. 75	33°40.0'	08°55.0'	988

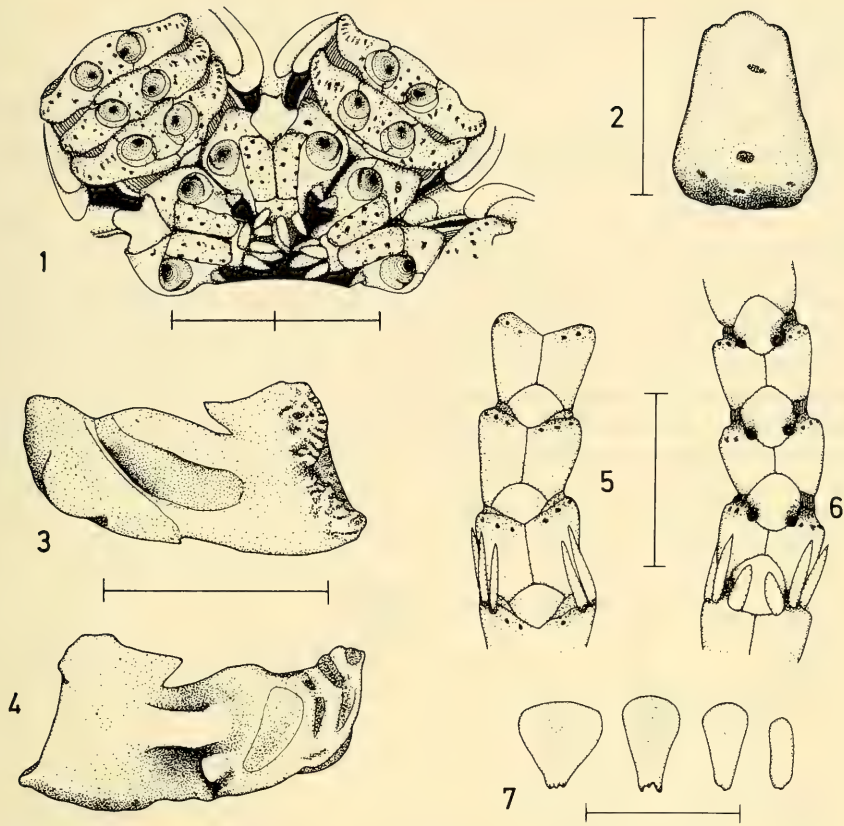
Taxonomy

Ophiomyces grandis Lyman, 1879 (Figs 1–7)

Collecting data: St. M8 59/KD 12, off Portugal, 500 m; St. M9c 94/AT 29, Gettysburg Bank, 150–430 m; St. M9c 103a/KD 35, Josephine Bank, 570 m; St. M9c 120/KD 40, Josephine Bank, 211–218 m; St. M9c 120/KD 40–41, Josephine Bank, 198–211 m; St. M9c 132/AT 50, Josephine Bank, 235–240 m; St. M9c 169a/DD 66, Great Meteor Bank, 318–321 m; St. M9c 170/DD 68, Great Meteor Bank, 306–313 m; St. M9c 172/DD 72, Great Meteor Bank, 296–297 m; St. M9c 180b/KD 78, Great Meteor Bank, 314–323 m; St. M19 129/DD 94, Great Meteor Bank, 293–296 m; St. M19 210/AT 128, Josephine Bank, 223–237 m.

Description: 35 specimens, with disk diameters (dd) of 3.0–8.0 mm, and length of dorsal disk up to 7.0 mm. The disk is scaled, some of the scales bear spines. The spines on the centre of the dorsal disk are slender, pointed, 0.5–0.7 mm in length. Towards the periphery, the spines are short and blunt. Numerous, often wide scales and spines on the ventral plates and arms conceal the disk plates. The dental plate is wide (Fig. 2), slightly arched. In most specimens 4–5 teeth are present, though specimens with 2 as well as with 7 teeth have been found. The dorsal tooth is spine-like, the following teeth are flattened. On the ventral edge of the dental plate stand 3, sometimes 4, stumpy infradental papillae. The oral plates are rectangular in ventral view (Fig. 1). Two rows with 4–5 papillae stand on the ventral flank; the inner papillae are spiniform, the outer wide, flattened and fan-shaped (Fig. 7). In abradial and adradial view, the oral plates are more than twice as long as high (Figs 3, 4). The abradial muscular area is a long-ovate, slightly oblique scar, the adradial muscular area is very wide, hardly excavated, ovate or round in outline. Only few knobs, ridges and grooves are developed on the articulation areas. The adoral plates are wing-like, triangular, with 1 or 2 wide and fan-shaped papillae. The oral shields usually are spade-like.

Length of arms ca 4 times the dd. The first ventral arm plate is a small triangular scale, separated from the second ventral arm plate by long wedges from the lateral arm plates. The following ventral arm plates are very wide in their distal ends (Fig. 1); 2 or 3 of the ventral arm plates are contiguous,



Figs 1–7: *Ophiomyces grandis* Lyman

1. 4.5 mm dd, ventral disk; 2. 4.0 mm dd, dental plate; 3. 4.0 mm dd, oral plate, abradial; 4. 4.0 mm dd, oral plate, adradial; 5. distal arm, dorsal; 6. distal arm, ventral; 7. oral papillae.

(1, 3–7 each scale division = 1 mm; 2 scale division = 0.5 mm)

then a wedge from both lateral arm plates advances and the lateral arm plates meet on the ventral line. In the peripheral end of the arms, the ventral plates are rounded, well separated from each other by the lateral arm plates (Fig. 6). The dorsal plates at the arm base are short but wide; the plates become fan-shaped toward the end of the arms (Fig. 5). In specimens of 3.0–4.0 mm dd, 8–10 spines are present at segments IV–VII. In larger specimens, up to 13 arm spines have been found. Three to 4, sometimes even 6, of the dorsal spines are pointed, short, less than one arm segment in length; the next spines are larger and slightly curved; the 2 or 3 ventralmost spines are short and blunt. The tentacle pores are very wide, surrounded by numerous flat tentacle scales. At the basal arm segments, there are usually 1–2 scales on the lateral arm plate and 2–3 on the ventral arm plate; from segment IV or V onward, there are a small spines on the lateral arm plate and 1 large flattened scale on the ventral arm plate. Towards the distal end of the arms the scales become more spine-like and decrease in number down to 1 spine on both lateral and ventral arm plate; finally, only 1 spine-like scale insert on the lateral arm plate.

In the stomach wall single, scythe-shaped ossicles of 30 μ m length are present.

Distribution: *Ophiomyces grandis* was first described from the southeast Atlantic Ocean, from Tristan da Cunha (LYMAN 1879). The following records came from the northeast Atlantic Ocean: off

Britain (GAGE et al. 1983), Bay of Biscay (KOEHLER 1906, CHERBONNIER 1969, 1970), off Portugal and Spain (REYS 1961; present collection), and off North Africa (present collection).

Ophiomyces grandis is known from a depth range from 150 m (present collection) to 1800 m (LYMAN 1879).

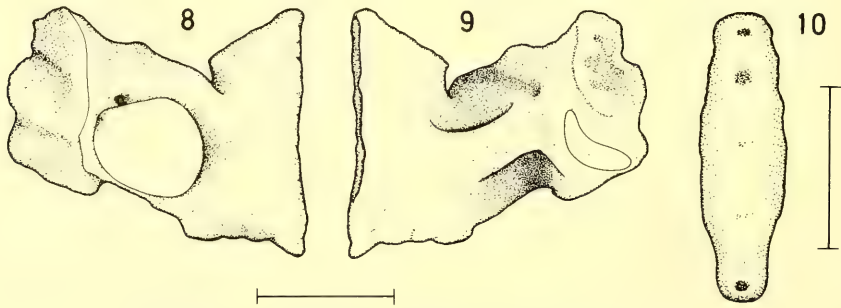
Remarks : From the Josephine Bank another species of *Ophiomyces*, *O. fructectosus* (Lyman, 1869) is recorded, a species otherwise known from the Caribbean area. From the description *O. fructectosus* resembles *O. grandis* closely.

Ophiacantha abyssicola G. O. Sars, 1871 (Figs 8–10)

Collecting data: St. M8 59/KD 12, off Portugal, 500 m; St. M9c 90d/AT 26, off Portugal, 320–385 m; St. M36 98/ES 148, off Spanish Sahara, 883–992 m; M36 98/AT 149, off Spanish Sahara, 658–888 m.

Description: Ca 100 specimens, with disk diameters of 1.0 to 6.0 mm.

This species is easily recognized by the oral shields with the almost cross-shaped outline and the deep grooves, and the cup-shaped dorsal arm plates. In the material studied, all specimens have 5 arms, but specimens with 4 or 6 arms are known to occur (MORTENSEN 1933).



Figs 8–10: *Ophiacantha abyssicola* G. O. Sars, 5 mm dd
8. oral plate, abradial; 9. oral plate, adradial; 10. dental plate.
(scale division = 0.5 mm)

The dental plate is elongate, more than 3 times longer than wide. The depressions for the uppermost and lowermost tooth are deeply excavated, whereas the other 3 depressions are more or less inconspicuous (Fig. 10). The lowermost tooth is stout, conical, the next teeth are flattened, with wide cutting edges, the uppermost tooth is often spiniform. The oral plates are elongate, with their adoral sides clearly higher than the aboral flank, the muscular area is rounded and slightly excavate, it occupies half the length of the abradial flank (Fig. 8). The muscular scar on the adradial flank is a small, bean-shaped, excavated area (Fig. 9). Only minute grooves and ridges are present on the abradial articular area, whereas the adradial articular area has coarse ridges and grooves. Small fenestrated sclerites are embedded in the stomach wall, and spiny sclerites in the bursal wall. The smallest specimen with gonads is 1.4 mm in dd.

Some of the 60 specimens opened had exoskeletons of planktonic Crustacea or large Foraminifera in their stomachs; but in most of the specimens only few minute forams and a little detritus were found or the stomachs were completely empty.

Distribution: *Ophiacantha abyssicola* is a common species in the North Atlantic Ocean. In the north it is known from Northern Norway (Lofoten) and from between Norway and Bear Island (GRIEG 1902), off southern Greenland (MORTENSEN 1913) and off Cape Cod (VERRILL 1880). The southern-most record is from off Spanish Sahara (ca 25°N).

O. abyssicola lives in the abyssal as well as in the sublittoral, the depth distribution ranges from 35 m (KOEHLER 1909) to 3500 m (VERRILL 1885).

Ophiacantha angolensis Koehler, 1923

Collecting data: St. M9c 82/AT 19, off Morocco, 150–160 m; St. M9c 90/AT 22, off Portugal, 114–117 m; St. M9c 90b/KT 24, off Portugal, 140–145 m; St. M36 104/ES 156, off Cape Blanc, 415–417 m.

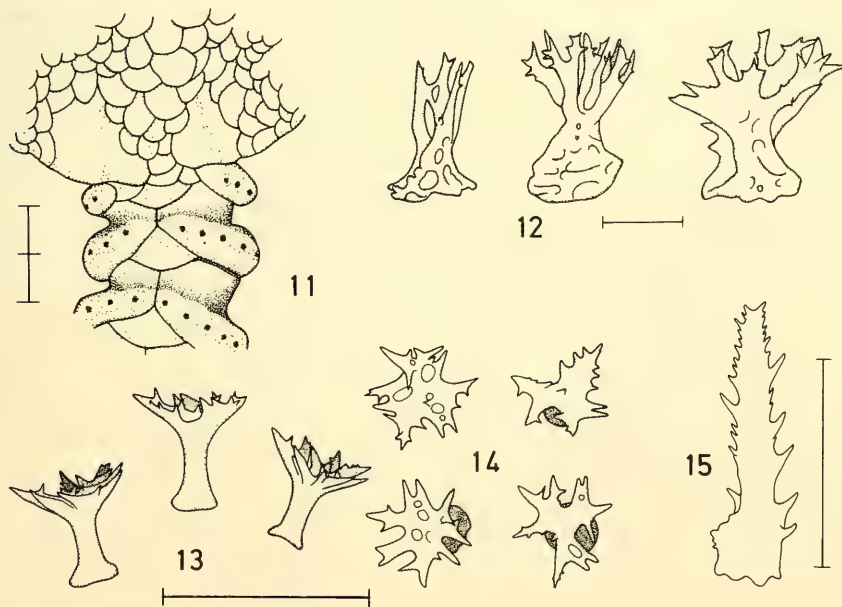
Description: Ten specimens, with disk diameters of 3.0–5.5 mm. The disk is covered with short stumps which end in 3 slender spinules. Many of the features in these specimens agree perfectly with those of *O. angolensis* presented by KOEHLER (1923). However, the dorsal arm plates at the arm base are wider than long, instead of being longer than wide as mentioned in KOEHLER (l. c.); the following arm plates are cup-shaped, resembling those in *O. abyssicola*; 7 pairs of arm spines are present on the first free arm segment, the second arm segment has 5 pairs of arm spines in larger, 4 in smaller specimens; the third arm segment bears 4 pairs of spines. Denticulation is denser on the ventral than on the dorsal arm spines.

Specimens collected in February (M36 104/ES 156) hold large oocytes, up to 0.2 mm in length.

Distribution: The type specimen was found off Angola, at 73 m depth (KOEHLER 1923). Further records are both from south and north of the equator (MORTENSEN 1936, CHERBONNIER 1962, TOMMASI 1967, MADSEN 1970), from between Angola and the Ivory Coast, from 55 to 200 m depth. The present finding is the most northerly record of *O. angolensis*.

Ophiacantha aristata Koehler, 1896 (Figs 11–15)

Collecting data: St. M36 98/ES 148, off Spanish Sahara, 883–992 m; St. M36 98/AT 149, off Spanish Sahara, 658–888 m.



Figs 11–15: *Ophiacantha aristata* Koehler

11. 5.8 mm dd, dorsal disk; 12. sclerites in stomach wall; 13. 4.5 mm dd, dorsal disk spines, lateral; 14. same, dorsal; 15. 4.5 mm dd, third ventral arm spine on second arm segment.

(11, 13–15 each scale division = 0.5 mm; 12 scale division = 0.1 mm)

Description: Twenty-six specimens, 3.6–10.0 mm in dd. The description in KOEHLER (1896) gives a good characterization of this species. Conspicuous are the stumps on the dorsal disk (Figs 13, 14; KOEHLER 1909: Fig. 6) with a straight, smooth stem and a wide almost horizontal crown. In elder specimens, the spicules are arranged spherically.

The radial shields are seen as small triangular plates (Fig. 11), beset with the characteristic stumps. The oral papillae are very stout, 3 to 4 on each side of the jaws, all similar in shape, none is widened. The stomach wall is lined with fenestrated platelets and multiple branched spiny stumps (Fig. 12), projecting into the stomach lumen.

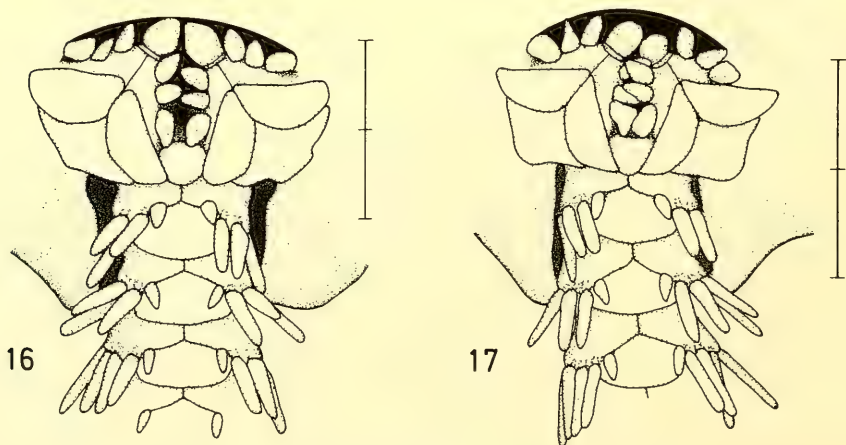
The arms are wide at their base. Most of the arms are broken, but apparently the arm length is 5–6 times the dd. The dorsal arm plates are small, triangular (Fig. 11) throughout the arm, always separated by the lateral arm plates. The basal 2 – according to KOEHLER (1896), the basal 3 – ventral arm plates are contiguous. The following plates are well separate, quadrangular in outline. The arm spines, 7–8 in number, are extremely serrate, increasing in length, the ventral obtuse spine equalling length of an arm segment, the slender dorsal spines equalling that of 3 segments. The ventral and the lateral spines are stout, often slightly flattened, while the dorsal spines are slender. The single tentacle scale on each arm pore is flattened, serrate, and slightly pointed at the end.

Distribution: *Ophicantha aristata* is known from the eastern North Atlantic Ocean, from off the west coast of Ireland (GRIEG 1921) to south of the Canary Islands (KOEHLER 1906). Most records are from more than 1000 m depth (KOEHLER 1906, 1909; GRIEG 1921).

Ophicantha brevispina Koehler, 1898 (Figs 16, 17)

Collecting data: St. M36 97/KT 146, off Spanish Sahara, 350 m; St. M36 97/ES 147, off Spanish Sahara, 409–417 m; St. M36 105/ES 157, off Cape Blanc, 206 m; St. M36 105/KT 158, off Cape Blanc, 186–247 m.

Description: Thirteen specimens, 3.0–6.0 in dd. The dorsal disk is uniformly covered with short, thorny stumps. In some specimens some scattered stumpy and blunt spines, only slightly longer than the stumps, are present. The oral shields are diamond-shaped, with the peripheral edge slightly protruding and the inner edge pointed (Fig. 17). The centre of the shield is slightly depressed. The ad-oral plates are 2.5–3.0 times wider than long. Three pairs of oral papillae are present, the 2 inner papillae are conical, the outer papilla is wide and leaf-like.



Figs 16, 17: *Ophicantha brevispina* Koehler
16. holotype, 7 mm dd, ventral disk; 17. 5 mm dd, ventral disk.
(each scale division = 1 mm)

The arms are at least 3–4 times the length of the dd (all arms are broken). In the largest specimen (6 mm dd), the 7 pairs of arm spines present on the first free arm segment form a continuous row of dorsal arm spines across the segment; 5 pairs of arm spines stand on the following segments. The dorsal-most spines are longer than 2 arm segments; then the arm spines rapidly decrease in length. The 2 ventralmost pairs of spines are stout, usually less than an arm segment in length. All dorsal plates are separate. The first dorsal plate is diamond-shaped, twice as wide as long. The following plates are triangular, wider than long and with a convex distal margin; the peripheral arm plates are as wide as long. All ventral arm plates are separate. The first plate is conspicuous, as wide as long, the following plates are distinctly wider than long, and, at a distance of a disk diameter, as wide as long. The arm papillae are slender scales.

Remarks: The characteristics of these specimens agree well with those known for *O. brevispina*, dredged in the Bay of Biscay. In the holotype and the present material, the ventral arm spines are short and stout; the dorsal and ventral disk is covered with rather small, stumpy spines. But, in the present material, the oral shields and adoral plates are 1.5 and 2.5–3.0 wider than long, respectively, whereas in the holotype (7 mm dd), the oral shields and the adoral plates are twice as wide as long (Fig. 16).

Distribution: *Ophiacantha brevispina* is recorded from the Bay of Biscay (KOEHLER 1898) and off Dakar and the Azores (CADENAT 1938). It is found in depths between 90 and 417 m.

***Ophiacantha cuspidata* Lyman, 1878**

Collecting data: St. M23 174/AT, off Morocco, 1750 m.

Description: Four specimens, of 4.8 to 8.0 mm dd. The oral shields are wider than in the specimens figured by MORTENSEN (1933), with a straight distal margin and a depression in the middle of the plate. Usually there are 3, rarely 4, oral papillae present on both sides of the jaws. The teeth are stout. The peripheral portion of the radial shield is naked.

All dorsal arm plates are separate; slightly triangular in outline with well rounded distal margins. The first and second ventral arm plates are contiguous, the following ones usually separate. Seven arm spines are present at the arm base of the large specimen (8.0 mm dd), 5 to 6 spines in specimens of 6 mm dd. The arm spines are blunt, with very fine denticulation. The tentacle scales are coarsely denticulate. Up to 3 tentacle scales have been found at the basal arm pore, but usually, here as on the following segments only 1 pair of tentacle scales are present.

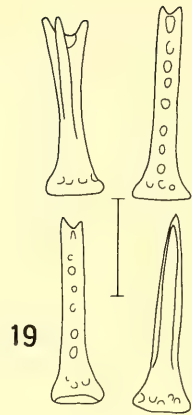
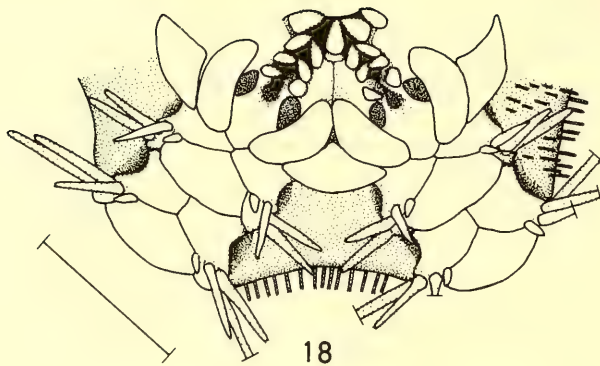
Distribution: The first records of *Ophiacantha cuspidata* are from off the Ascension Islands from 785 m depth (LYMAN 1878). All other records are from the North Atlantic Ocean, from 42°N (KOEHLER 1909) to 60°N (MORTENSEN 1933) from 1495 to 2460 m depth.

***Ophiacantha densa* Farran, 1913 (Figs 18, 19)**

Collecting data: St. M26 FS 3, off Spanish Sahara, 250–367 m.

Description: Disk diameters of the 3 specimens present are 2.1, 3.5 and 3.6 mm, respectively. The dorsal disk is covered with a dense coat of long and spiny stumps which end in 2 or 3 minute points (Fig. 19). The radial shields are long and slender, sometimes raised, and completely hidden beneath the stumps. The oral shields are rhomboid, with their narrow lateral edges touching the lateral arm plates (Fig. 18). The adoral plates are curved and wide. Three subequal oral papillae are present on each side of the jaw. The denticulation on the oral papillae is coarser than on the arm spines. The teeth are stouter than the oral papillae.

The arms are not conspicuously knotted. All dorsal arm plates are separate. The dorsal arm plates are triangular; the distal margin being slightly convex at the arm base. The plates are slightly longer than wide in the small specimen, and in the distal portion of the 2 larger specimens; but they are slightly wider than long on the basal segments of the large specimens. The ventral arm plates are sepa-



Figs 18, 19: *Ophiacantha densa* Farran, 3.5 mm dd
 18. ventral disk; 19. spines on dorsal disk.
 (18 each scale division = 1 mm; 17 scale division = 0.1 mm)

rate, pentagonal, with convex posterior margin; they are twice as wide as long at the arm base in the larger specimens, only slightly wider than long in the small specimen and in the mid-arm portion of the larger specimens, and as wide as long on the distal arm segments. The tentacle scales are small, triangular and pointed. The arm spines are blunt, slightly denticulate. The ventral arm spines are as long as one arm segment, the dorsal spines are twice the length of an arm segment. Three to four spines are present in the small specimen, 3–5 in the larger specimens.

Remarks: In the specimens studied, the ventral arm plates are not as semicircular as figured by MORTENSEN (1927: Fig. 108). Comparison with type material (United States National Museum, USA) proved the present material to be conspecific with *Ophiacantha densa*.

Distribution: *Ophiacantha densa*, hitherto, was known only from off Ireland (51°–53°N, 11°–15°W) at depths of 1 150–1 330 m (FARRAN 1913). The present records extends the known range.

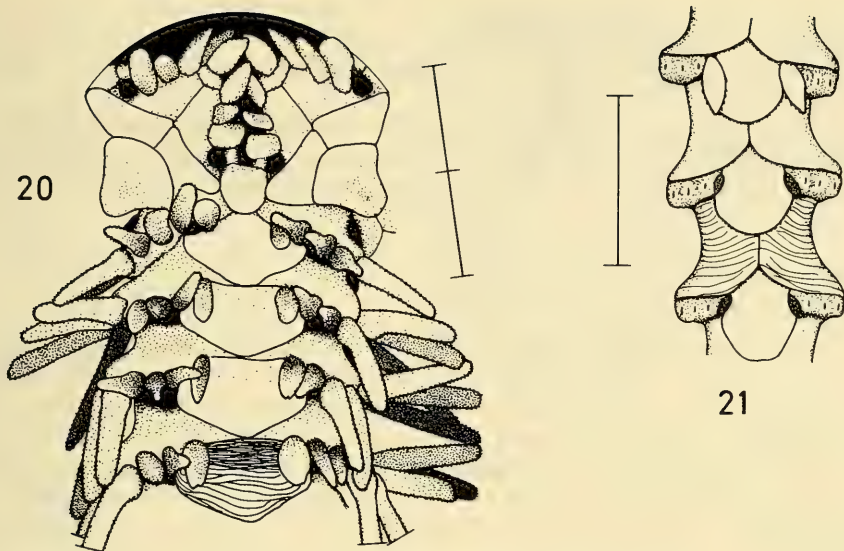
***Ophiacantha lineata* Koehler, 1896 (Figs 20, 21)**

Collecting data: St. M36 98/ES 148, off Spanish Sahara, 883–992 m; St. M36 98/AT 149, off Spanish Sahara, 658–888 m.

Description: 16 specimens, 4.1–8.5 mm dd. The alcohol-preserved specimens are pale, but in several specimens all ventral arm spines, tentacle scales, oral papillae and teeth are brown in their middle, with the pigmentation slowly fainting towards their tips. The dorsal arm spines are pale. In the specimens of the present collection the peripheral lobes of the oral shields are slightly depressed. Beside fenestrated platelets multibranching stumps are present in the stomach wall.

The ventral arm plates at the arm base are much wider than long in large specimens (Fig. 20), almost as wide as long in the middle of the arm and slightly longer than wide at the arm tip (Fig. 21). The dorsal arm plates are small and triangular throughout the arms. Number, length and arrangement of the arm spines agree with those in the description by KOEHLER (1909).

Distribution: *Ophiacantha lineata* is known from the North Atlantic Ocean. Its geographical range from 55°N (CHERBONNIER & SIBUET 1972) to 30°N (KOEHLER 1914) is now emended southward to 25°N. Its depth distribution ranges from 500 m (KOEHLER 1914) to almost 3 200 m (CHERBONNIER & SIBUET 1972). Most records are from water depths beyond 1 000 m.



Figs 20, 21: *Ophiacantha lineata* Koehler, 8.5 mm dd
 20. ventral disk; 21. distal arm ventral
 (each scale division = 1 mm)

Remarks: *Ophiacantha metallacta* H. L. Clark, 1915, lives off the south east coast of the United States and the West Indies. With distinctly striated ventral arm plates and a dorsal disk covered with stumps ending in numerous small spinelets, *O. metallacta* is very similar to *O. lineata*. According to KOEHLER (1914) and H. L. CLARK (1915), *O. metallacta* has 7–8 arm spines (5 mm dd) and small and pointed tentacle scales; whereas *O. lineata* has 8–9 arm spines (6 mm dd) and tentacle scales that are wide and flattened at the arm base.

Ophiacantha setosa (Retzius, 1805)

Collecting data: St. M8 13/KT 8, off Morocco, 120–180 m; St. M8 62/KD 13, off Portugal, 85–90 m; St. M9c 82a/AT 19, off Morocco, 150–160 m; St. M9c 90/AT 22, off Portugal, 114–117 m; St. M9c 90b/KT 24, off Portugal, 140–145 m.

Description: Forty-two specimens, with dd of 3.0 to 7.0 mm. The largest specimen ever recorded had a dd of 12 mm (MÜLLER & TROSCHER 1842). The radial shields are narrow, prominent ribs. The dorsal disk is covered with fine fenestrated scales. In most specimens, thorny stumps are found on the radial shields only, though in a few specimens numerous stumps are present in the disk centre and some scattered stumps at the periphery. Stumps are rarely present on the ventral side of the disk. The outline of oral plates equals that figured by MADSEN (1970: Fig. 2a). The teeth are strong. Three pairs of oral papillae are present. The arm length is ca 9 times the disk diameter. Six to eight arm spines are present close to the arm base. The 4 to 5 ventral spines are stout and heavily denticulate. The dorsal spines are slender, more than 2.5 segments in length, with very fine denticulation. Only 3 pairs of spines are present in the distal portion of the arms; these 6 spines are slender, their denticulation is fine. The first ventral arm plate is squarish, the second triangular with round edges; the following plates are squarish and widely separate. The distal margin of the arm plate is slightly concave in larger specimens. The first dorsal arm plate is wider than long; the plates are cup-shaped in the middle of the arm, elongate in the distal arm portion.

Distribution: *Ophiacantha setosa* is known from the Eastern North Atlantic Ocean from 45°N (KOEHLER 1906) to 5°N (MADSEN 1970) and from the eastern Mediterranean Sea, as far east as the Jonian Sea (KASPARIS & TORTONESE 1982). *O. setosa* is found within depths ranging from 14 m (MONTEIRO-MARQUES 1981) to 1480 m (KOEHLER 1906).

Remarks: Eight of 9 and 13 of 17 of the ophiuroids at St. M9c 82a/AT 19 and St. M9c 90/AT 22, respectively, were infested with myzostomids. The myzostomids usually were found in the esophagus, on the upper teeth, partly hidden beneath the contracted esophageal sphincter.

***Ophiacantha simulans* Koehler, 1896**

Collecting data: St. M23 174/AT, off Morocco, 1750 m.

Description: One specimen of 6.0 mm dd. The oral shields are very wide, 1.8 to 2.0 times as wide as long, thus wider than in the specimens figured by MORTENSEN (1933: Fig. 11 a), they are pentagonal, with almost straight distal margins. Six to seven arm spines are present at the arm base, 5 on the following segment, and 4 to 5 on the next segments. The arm spines are finely denticulate. Near the arm base, the second (third) spine from below has strong dents, the other arm spines usually show only a fine denticulation. The first ventral arm spine is bent from the sixth arm segment onward, with a coarser denticulation on its ventral than on its dorsal flank. The stumps on the disk have an almost smooth stem and a crown of 8 or more thorns.

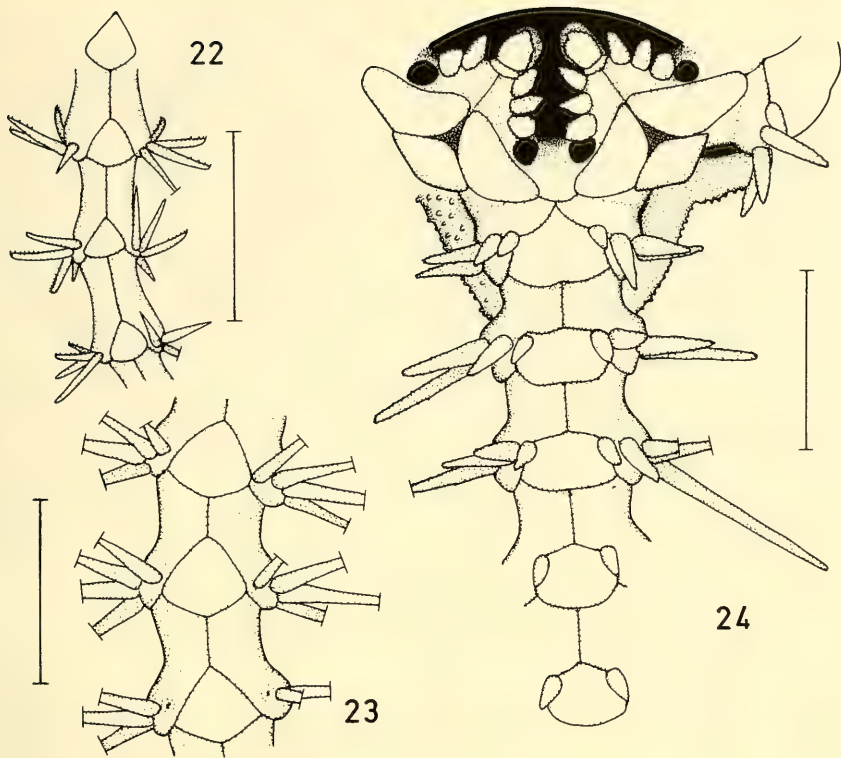
Distribution: *Ophiacantha simulans* is common in deeper water – 1480 to 3020 (KOEHLER 1906, 1909) – of the North Atlantic Ocean. It is found in the eastern (KOEHLER 1896, 1906, 1909; MORTENSEN 1933; GAGE et al. 1983) and in the northwestern Atlantic Ocean (ROWE 1971; ROWE & MENZIES 1969). Off the Carolinas, this species is centered along the 1900 m depth line (MENZIES et al. 1973).

***Ophiacantha smitti* Ljungman, 1871 (Figs 22–24)**

Collecting data: St. M8 8/AT 6, off Portugal, 1370–1430 m; St. M8 19/AT 9, off Morocco, 1300 m; St. M36 98/ES 148, off Spanish Sahara, 883–992 m; St. M36 98/AT 149, off Spanish Sahara, 658–888 m.

Description: The 18 specimens present are small, of 2.6–5.0 mm in dd. The characters of these specimens agree with those of the type specimen (in Swedish Museum of Natural History). The dorsal disk is covered with small stumps, with a wide basal platform and bifid or trifid tip. In most specimens, moreover, some slender serrate spinelets are present in the centre of the disk. The radial shields are long and slender, they form 2 raised slender ribs, concealed beneath minute scales and stumps, with only naked peripheral ends. The oral and adoral plates and shields are set off the disk. The plates are slightly rugose. In most specimens, the madreporite is almost as long as wide, with protruding lateral edges and rounded periphery. The other oral shields are twice as wide as long (Fig. 24). In some radii, the oral shields meet the lateral arm plates. The adoral plates are large, with curved radial and adradial margins. The oral papillae, 3 – rarely 2 or 4 – in number, are stout and blunt. The peripheral papillae are often slightly stouter, but not longer than the others. The teeth are flattened, wider than the oral papillae, 4–5 arranged in a vertical row.

The arms are stout at their base, but very slender in their distal portions, coiled, and at least 5 to 6 times the length of the dd. All dorsal arm plates are well separated, triangular, with rounded distal and almost straight lateral margins (Fig. 23). The first dorsal arm plate is proximally obtuse, the following arm plates are pointed. The dorsal arm plates are slightly wider than long close to the arm base, but as long as or longer than wide at the arm tip (Fig. 22). The first ventral arm plate is pentagonal in outline; the second is pentagonal in some arms, triangular in others, with straight, rarely convex or concave, distal margin. The third ventral arm plate is pentagonal, distinctly wider than long, in most specimens twice as wide as long, with its distal margin straight or slightly concave, rarely convex. The following ventral plates are either pentagonal or triangular, only slightly wider than long. In the slender distal



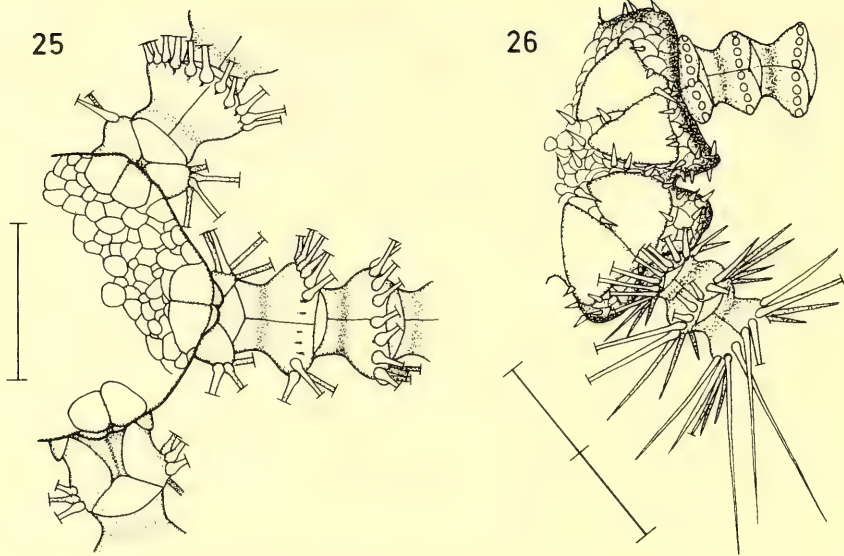
Figs 22–24: *Ophiacantha smitti* Ljungman, 3.0 mm dd
 22. distal arm, dorsal; 23. fifth to seventh arm segment, dorsal; 24. ventral disk
 (each scale division = 1 mm)

portion of the arms, the ventral plates are quadrangular, as wide as long. The first and second arm plates are contiguous at some arms, otherwise, all ventral arm plates are separate. The lateral arm plates meet dorsally and ventrally. The arm spines are arranged in a continuous dorsal row only on the first or second basal segments. Basal arm segments with 6 pairs of arm spines, the following segments with 5 pairs; beyond the basal half of the arms only 4, finally 3 pairs of arm spines present. One to 3 of the ventral spines are stout, finely serrate, equalling an arm segment in length. The 4th to 6th arm spines are slender, 2.5 to 3 times the length of a segment. Beyond the first or second basal arm segments, the dorsal spines are as long or only slightly longer than a segment. At the arm tip, all spines are shorter than one segment; 1 or 2 of the ventralmost spines are strongly denticulate along the ventral margin of the spine (Fig. 22). Only one single tentacle scale present throughout the arm.

Distribution: The type specimens of *Ophiacantha smitti* were taken off Portugal, dredged from 1420 m depth (LJUNGMAN 1871). Recently, *O. smitti* was recorded from the North Atlantic Ocean from 47°N 8°W at 1150–1175 m depth (CHERBONNIER & SIBUET 1972). Another record is from off Sierra Leone from 118 m depth (LONGHURST 1958). Most of the findings are from deep waters.

***Ophiothamnus affinis* Ljungman, 1871 (Figs 25, 26)**

Collecting data: St. M8 8/AT 6, off Portugal, 1370–1430 m; St. M8 19/AT 9, off Morocco, 1300 m; St. M36 98/ES 148, off Spanish Sahara, 883–992 m; St. M36 127/ES 181, off Morocco, 988 m.



Figs 25, 26: *Ophiothamnus affinis* Ljungman
 25. 2 mm dd, dorsal disk; 26. 3 mm dd, dorsal disk
 (each scale division = 1 mm)

Description: All specimens known are small; the 20 specimens on hand have 1.6 to 3.1 mm dd. Large specimens (3 mm dd) have up to 9 pairs of arm spines at the basal arm segments. The dorsal arm spines at the arm base are at least 3 times the length of an arm segment (all arm tips are broken).

Eight of the 20 specimens studied had lost their dorsal disks, 1 had just regenerated the dorsal disk. Fig. 26 shows a portion of an unhurt dorsal disk, Fig. 25 a regenerated disk. The small pointed spines and disk scales are lacking in the regenerated specimen; the radial shields are small, almost as long as wide, contiguous for all its length, whereas they are longer than half the radius in the undamaged specimen. The regenerated dorsal disk overlap the first arm plate in some radii, while there are wide gaps between the radial shields and the first dorsal arm plate in other radii.

Distribution: *Ophiothamnus affinis* is known from the North Atlantic Ocean. It has been found within an area from 24°N to 30°N and at depths from 193 to 415 m along the American coast (KOEHLER 1914), within an area from 25°N (present collection) to 44°N (KOEHLER 1906) and at depth from 883 m (present collection) to 1425 m (KOEHLER 1909) along the European coasts.

Ophiambix meteoris Bartsch, 1983

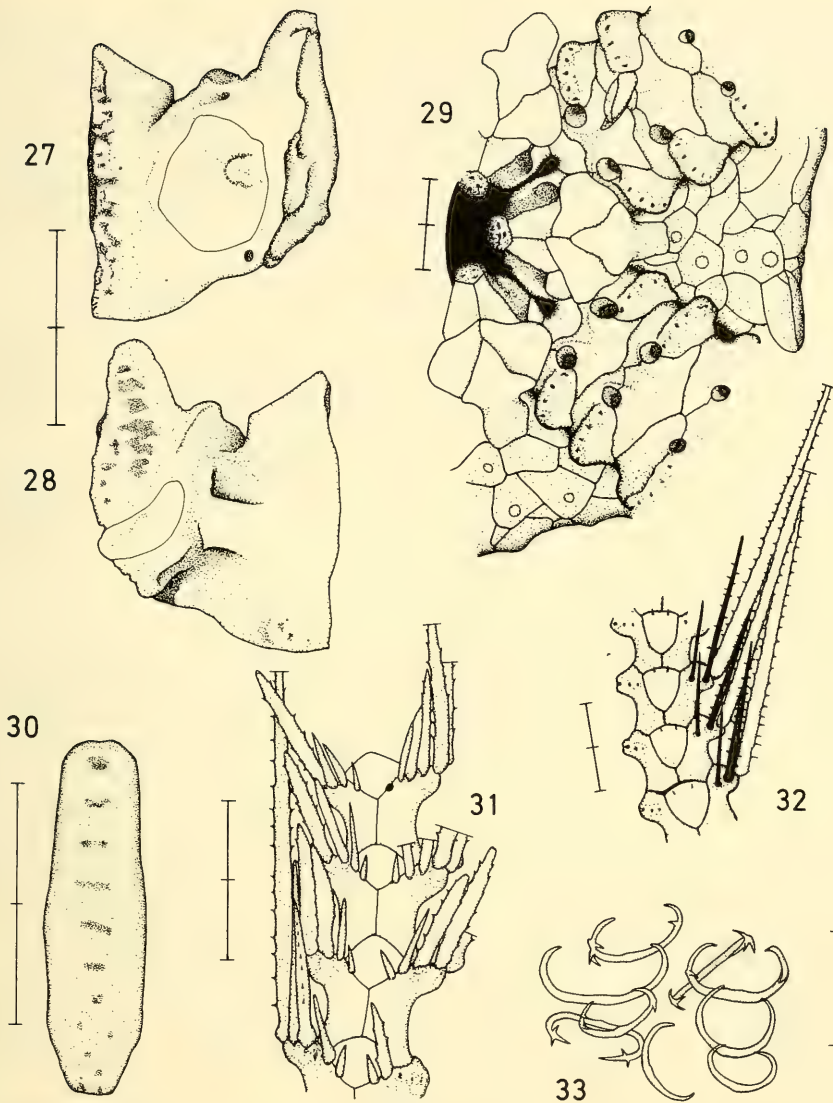
Collecting data: St. M9c 170/DD 68, Great Meteor Bank, 306–313 m.

Description: One specimen of 3.9 mm dd.

Distribution: Records of the genus *Ophiambix* were, hitherto, from deep sea areas only, e. g. *Ophiambix meteoris* was known from the Iberian deep sea basin, from 5315 m depth (BARTSCH 1983). The present record is considerably shallower than the previous finding.

Ophiacamax dominans Koehler, 1906 (Figs 27–33)

Collecting data: St. M36 98/ES 148, off Spanish Sahara, 883–992 m; St. M36 98/AT 149, off Spanish Sahara, 658–888 m.



Figs 27–33: *Ophiocamax dominans* Koehler, 16 mm dd
 27. oral plate, abradial; 28. oral plate, adradial; 29. ventral disk; 30. dental plate; 31. distal arm, ventral; 32. mid-arm, dorsal; 33. crescent spines in stomach wall
 (27–32 each scale division = 1 mm; 33 scale division = 0.1 mm)

Description: Twenty-nine specimens, of 8.0–17.0 mm dd. The radial shields are large; in length at least half the disk radius, in width the same or more than the interradial space. The radial shields are contiguous throughout their length. The dorsal disk plates are large, irregular in outline; most of them with 1 or more spines. Some of the spines are slender, almost smooth, others are stout, with numerous glassy spinelets. The radial shields are bare of spines, but in larger specimens often a row of spines insert along the mid-line of 2 adjacent shields.

The ventral disk is dominated by numerous spines. The oral shields are arrowhead-shaped (Fig. 29); the madreporite is bulbous in its central portion. The adoral plates broadly contact the first lateral arm plates. Often, 1 or 2 spines are present along the line between oral shield and adoral plate, the spines inserting either on the adoral plate or on the oral shield. Seven to 8 spines stand along the margin of the oral plate, several of them included in the cluster of 6–8 spines around the tentacle pore. At the ventral end of the dental plate insert 6–7 spines, followed by cone-like teeth, and short, flattened teeth beyond the middle of the plate. The dental plate is slightly bent; it is 3.5 times longer than wide in a specimen of 16 mm dd. The plate may be divided by a transverse fissure. Small round depressions for the spines are present in the ventral portion, oval depressions for the row of flattened teeth in the middle and dorsal portion (Fig. 30). The oral plate is slightly higher than long in a specimen of 16 mm dd. The abradial muscle area is a bowl-like depression (Fig. 27), the adradial one is an oval, deeply excavated, oblique area (Fig. 28). The adradial articular area, dorsal to the muscle scar, is oval, provided with deep grooves. The abradial articular area along the central border of the oral plate has deep grooves and narrow ridges. The bursal wall is lined with fenestrated plates. In the stomach wall crescent ossicles are found, often divaricate at their ends (Fig. 33).

In larger specimens, the arms are 5 times the length of the dd. Six to 7 arm spines are present throughout the arms. Most of the arm spines are broken. At the arm base and the mid-arm, the dorsalmost spine is slender, 1.5–2 times the length of an arm segment. The second or third spine from mid-dorsal line is the largest one; in the middle of the arm this spine is 5–6 times longer than an arm segment. The following spines are short. At the base and in the middle of the arm, they are 1.2–2 times longer than an arm segment. Some of the spines are almost smooth, others carry rows of glassy spinelets. At the distal end of the arms, most of the arm spines are shorter than the length of an arm segment; they are slightly hook-shaped and provided with a row of spinelets facing outward. The dorsal arm plates are as illustrated in KOEHLER (1906: Fig. 27), with the basal plates overlapping, and the following ones separate. In the posterior half of the arms, usually 2 tiny spinelets insert near the distal margin of the plate (Fig. 32). At the arm base, the ventral arm plates are wide, with narrow lateral wedges, with their distal portions slightly raised, knob-like, while the basal portion forms a cavity between the raised walls of the arm pores. The arm pores are conspicuous at the arm base, the pores open at the end of a wall formed by raised portions of lateral and ventral arm plates. At the distal end of the arms, the ventral arm plates are triangular, with rounded distal margins (Fig. 31); the arm pores are small, the lateral and ventral plates form no wall around the arm pore. The basal arm pores are surrounded by 3–4 tentacle scales. The tentacle scales are elongate, triangular, wide at their base. The 3–4 scales form together a tube. The number of tentacle scales quickly decrease in number. At a distance equalling the dd, only 1 tentacle scale is present, inserted on the lateral arm plate. Terminally, the tentacle scales are similar to the arm spines, they stand close together and form a continuous row with the arm spines.

Several of the specimens of 11–14 mm dd had embryos or juveniles in the bursae. In larger specimens, 15–17 mm dd, no juveniles were found, their bursae often were filled with sediment. The small star-disk stages with spiny spicules and juveniles with up to 4 arm segments were often tightly crammed in the bursae, almost completely filling the body cavity. The stomachs were empty in specimens with juveniles. Up to 25 juveniles per bursa were found, usually all of them at the same stage of development. Some of the specimens with 4 arm segments, of 0.9 mm dd and 3.3 mm in diameter, have their arms stretched out in a vertical plain. Probably, the juveniles leave the adults at this stage of development.

The juveniles are very spiny. In those with 4-segmented arms, several long trifid spinelets stand on the dorsal disk, each arising from a small platelet. Oral plates and adoral plates, the latter with a long spinelet, are present on the ventral side. Teeth are inconspicuous or lacking. Tentacle scales are large both within the disk and on the 4 arm segments. The first arm segment bears 4–5 pairs of spines, the next arm segments each 3 or 4 pairs of spines. The dorsal spines almost meet at the dorsal mid-line. The

spines on the first segments usually have 3 glassy thorns, the other spines are smooth. Dorsal arm plates are present throughout the arms. The first ventral arm plate is large, slightly quadrangular, the second is represented by a small, irregularly formed platelet, the third has the form of a minute, tetra-radiate sclerite, the fourth is lacking. The lateral arm plates meet ventrally. The terminal plate is slender, 0.6–0.8 mm long.

Distribution: The original description of *Ophiocamax dominans* was based on 2 specimens (KOEHLER 1906). Both were taken at 25°39' N and 18°22' W at 882 m depth. The present records are from the same area and from similar depth.

General remarks

Ophiacanthids were present in samples taken with trawls, dredges and sleds; samples taken with grabs yielded no ophiacanthids. Ophiacanthids are epibenthic living species.

Ophiacantha abyssicola and *O. setosa* are abundant and widely distributed in the Atlantic Ocean, both horizontally, from the African coast to northern Europe, and vertically, from shallow waters to the bathyal. According to the present records, *Ophiacantha aristata*, *O. cuspidata*, *O. densa*, *O. lineata*, *O. simulans*, *O. smitti*, *Ophiothamnus affinis* and *Ophiocamax dominans* are inhabitants of bathyal waters.

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References

- BARTSCH, I. 1983: *Ophiambix meteoris* n. sp., ein neuer Schlangensterne aus der Iberischen Tiefsee (Ophiacanthidae, Ophiuroidea). – *Spixiana* **6**: 97–100
- CADENAT, J. 1938: Liste des échinodermes recueillis pendant la cinquième croisière du navire de recherches Président-Théodore-Tissier. – *Revue Trav. Off. Pêch. marit.* **11**: 349–375
- CHERBONNIER, G. 1962: Ophiurides. – *Résult. scient. Expéd. Océanogr. Belge Eaux Côt. Afr. Atlant. Sud.* **3**(8): 1–24
- 1969: Échinodermes récoltés par la «Thalassa» au large des côtes ouest de Bretagne et du Golfe de Gascogne (3–12 Août 1967). – *Bull. Mus. natn. Hist. nat., Paris (2^e Sér.)* **41**: 343–361
- 1970: Échinodermes récoltés par la «Thalassa» au large des côtes d'Espagne et du Golfe de Gascogne (18–25 Octobre 1968). – *Bull. Mus. natn. Hist. nat., Paris (2^e Sér.)* **41**: 1266–1277
- CHERBONNIER, G. & SIBUET, M. 1972: Résultats scientifiques de la campagne Noratlante: Astérides et Ophiurides. – *Bull. Mus. natn. Hist. nat., Paris (3^e Sér.)* **102**: 1333–1394
- CLARK, H. L. 1915: Catalogue of recent Ophiurans. – *Mem. Mus. comp. Zool. Harv.* **25**: 163–376, 20 Taf.
- FARRAN, G. P. 1913: The deep-water Asteroidea, Ophiuroidea and Echinoidea of the west coast of Ireland. – *Scient. Invest. Fish. Brch. Ire.* **1912**(6): 1–66
- GAGE, J. P., PEARSON, M., CLARK, A. M., PATERSON, G. L. J. & TYLER, P. A. 1983: Echinoderms of the Rockall Trough and adjacent areas. I. Crinoidea, Asteroidea and Ophiuroidea. – *Bull. Br. Mus. nat. Hist. (Zool)* **45**: 263–308
- GRIEG, J. A. 1902: Oversigt over det nordliga Norges échinodermer. – *Bergens Mus. Årb.* **1902**(1): 1–36
- 1921: Echinodermata from the “Michael Sars” North Atlantic Deep-Sea Expedition 1910. – *Rep. scient. Results Michael Sars N. Atlant. deep Sea Exped.* **1910**: 1–47, 5 Taf.
- KASPARIS, P. & TORTONESE, E. 1982: Echinoderms from the western seas of Greece. – *Thalassographica* **2**: 27–32
- KOEHLER, R. 1896: Echinodermes. Résultats scientifiques de la Campagne du “Caudan” dans le Golfe de Gascogne. – *Annls Univ. Lyon* **26**: 33–127

- 1898: Echinides et Ophiures provenant des campagnes du yacht l'Hirondelle (Golfe de Gascogne, Açores, Terre-Neuve). Résult. Camp. scient. Prince Albert I **12**: 1–78, 9 Taf.
- 1906: Ophiures. – Expéd. scient. Travailleleur Talisman **8**: 245–311, Taf. 18–21
- 1909: Echinodermes provenant des campagnes du yacht Princesse-Alice (Astéries, Ophiures, Échinides et Crinoïdes) – Résult. Camp. scient. Prince Albert I **34**: 1–317, Taf.
- 1914: A contribution to the study of Ophiurans of the United States National Museum. – Bull U. S. natn. Mus. **84**: 1–173
- 1923: Sur quelques ophiures des côtes de l'Angola et du Cap. – Kungl. Vetensk. o. Vitterh. Samh. Handl. (IV) **15**(3): 1–17, Taf.
- LJUNGMAN, A. V. 1871: Förteckning öfver uti Vestindien af Dr. A. Goës under korvetten Josefines expedition i Atlantiska Oceanen samlade ophiurider. – Öfvers. K. Vetensk. Akad. Förh. **28**(6): 615–658
- LONGHURST, A. R. 1958: An ecological survey of the West African marine benthos. – Fishery Publs colon. Off. **11**: 1–102
- LYMAN, T. 1878: Ophiuridae and Astrophytidae of the exploring voyage of H. M. S. "Challenger". Part I. – Bull. Mus. comp. Zool. Harv. **5**(7): 65–168, 10 Taf.
- 1879: Ophiuridae and Astrophytidae of the exploring voyage of H. M. S. "Challenger". Part II. – Bull. Mus. comp. Zool. Harv. **6**(2): 17–83, Taf. 11–19
- MADSEN, F. J. 1970: West African Ophiuroids. – Atlante Report **11**: 151–243
- MENZIES, R. J., GEORGE, R. Y. & ROWE, G. T. 1973: Abyssal environment and ecology of the World Oceans. 488 pp.
- MONTEIRO-MARQUES, V. 1981: Peuplements des planchers envasés de trois grottes sous-marines de la région de Marseille. Etude préliminaire. – Tethys **10**: 89–96
- MORTENSEN, T. 1913: Grönlands Echinodermer. – Meddr Grönland **23**: 299–379
- 1927: Handbook of the echinoderms of the British Isles. 471 pp.
- 1933: Ophiuroidea. – Dan. Ingolf-Exped. **4**(8): 1–121, 3 Taf.
- 1936: Echinoidea and Ophiuroidea. – "Discovery" Rep. **12**: 199–348, 8 Taf.
- MÜLLER, J. & TROSCHER, F. H. 1842: System der Asteriden. II. Ophiuridae. 79–134, Taf. 7–10
- REYS, J. F. 1961: Deux ophiures nouvelles. – Rec. Trav. St. Mar. End. **22**: 153–157
- ROWE, G. T. 1971: Observations on bottom currents and epibenthic populations in Hatteras submarine canyon. – Deep Sea Res. **18**: 569–581
- ROWE, G. T. & MENZIES, R. J. 1969: Zonation of large benthic invertebrates in the deep-sea off the Carolinas. – Deep Sea Res. **16**: 531–537
- THIEL, H. 1970: Bericht über die Benthosuntersuchungen während der „Atlantischen Kuppenfahrten 1967“ von F. S. „Meteor“. – „Meteor“ Forsch.-Ergebnisse, D, **7**: 23–42
- 1981: Benthic investigations in the Northwest African upwelling area. Report on the cruises 26, 36, 44 and 53 of R. V. „Meteor“. – „Meteor“ Forsch. Ergebnisse, D, **33**: 1–15
- TOMMASI, L. R. 1967: Ophiuroidea de la Côte-d'Ivoire. – Bull. L. I. F. A. N. (A) **29**: 521–585
- VERRILL, A. E. 1880: Notice on recent additions to the marine invertebrates of the North-East coast of America. – Proc. U. S. Nat. Mus. **2**: 165–205
- 1885: Results of the explorations made by the steamer "Albatross", off the Northern Coast of the United States, in 1883. – Rep. U. S. Commnr Fish. **11**: 503–699

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