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List of Species as recorded by Canadian and EU Bottom Trawl Surveys in Flemish Cap

by

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A list of species has been prepared with all records in each haul of both Canadian (1977-1985) and EU (1988-2002 and 2003-2012) bottom trawl surveys. Even though sampling intensity and taxonomic interest changed with time, the three periods can be considered almost homogeneous. Main change occurred when the EU survey increased the depth range, from 730 to 1460 meters depth, and all invertebrates were recorded.

Material and methods

Table 1 contains percentage of hauls in which each species has been recorded in each survey, but three periods are identified:

1977-1985: Canadian bottom-trawl surveys (Wells and Baird 1989) on board RV A.T. Cameron (1977) and RV *Gadus Atlantica* (1978-1985).

1988-2002: EU bottom-trawl survey up to 730 m depth on board RV Cornide de Saavedra – period indicated in light grey in Table 1.

2003-2012: EU bottom-trawl survey up to 1460 m depth on board RV Vizconde de Eza, and emphasis in benthonic invertebrates.

The table contains species as well as higher level taxonomic levels used as working categories. Some lines were added with names of families, orders, etc., to facilitate classification, but those names were not working categories, so they do not have a line with dots and numbers. More detailed studies on some groups have been done, e.g., on corals (Murillo *et al.* 2011) and sponges (Murillo *et al.* 2012).

The nomenclature used was the same as in World Register of Marine Species (WoRMS) (Appeltans *et al.* 2012). It creates some uncommon names, such as *Sebastes norvegicus* instead of the more familiar *S. marinus*.

Discussion

Table 1 should be primarily interpreted as indices of occurrence of each species; however there were additional circumstances that modified the uniformity of the series; among them: changes in criteria, effort in identifying species, remaining classification uncertainties, apart from real changes in species abundance. So, the list is an

instrument to review the catch recording process, e.g., how identification species increased since 1988 in the EU survey, where only 60 of them were identified (Vázquez 1989). But still it can be used to test similarities with close areas such as those off Nova Scotia (Halliday *et al.* 2012).

Examples of the above mentioned circumstances are:

Changes in criteria – lack of *Malacoraja senta* in 1989-90, while *Raja sp.* appeared in those years.

- *Sebastes mentella* in 1977-1985 also comprises *S. fasciatus*.
- *Sebastes marinus* is now call *S. norvegicus*.
- *Lepidion eques* is now *L. lepidion* (Bañón *et al.* 2012).

Effort in identifying species – Myctophidae: there was an increasing interest for the species of this Family.

- redfish in 1991, when *S. mentella* and *S. fasciatus* were first separated.
- lack of *Illex illecebrosus* and *Pandalus borealis* in 1977-85.
- occurrence of *AcanthePHYra pelagica* and *Pasiphaea tarda* from 1993 onwards.
- isolated records of medusas (Scyphozoa) in 1990.
- 2003 and 2007 were steps for benthonic invertebrates' identification.
- *Semmirrosia sp.* until 2007 and Sepiolidae from 2008 onwards

Remaining classification uncertainties – *Notolepis rissoi* in 1994-95?

- *Urophycis chuss* in 1988-91?
- missing of *Nezumia bairdi* and *Lumpenus lumpretaeformis* in 1988.
- occurrence of *Gersemia sp.* in 2009-2011?

Real changes in species abundance – *Mallotus villosus*

The table covers a 36 years period, and these examples illustrate difficulties in maintaining uniform recording criteria along the period. The table also illustrates the consistency with most characteristic species in Flemish Cap.

References

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Table 1 – Percentage of hauls with catches for each species or group. Percentages were rounded to the nearest integer. Three bottom-trawl survey periods were included: the 1977-1985 Canadian survey on board RV A.T. Cameron (1977) and RV Gadus Atlantica (1978-1985), the 1988-2002 EU survey up to 730 m depth on board RV Cornide de Saavedra –in light grey, and the 2003-2012 EU survey up to 1460 m depth on board RV Vizconde de Eza.

Phylum	Class	Order	Family	Species	year:	77	78	79	80	81	82	83	84	85	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12					
Chordata																																												
Agnatha (Superclass)																																												
<u>Petromyzontiformes</u>																																												
Petromyzontidae																																												
<i>Petromyzon marinus</i>																																												
						.	1				
Pisces (Superclass)																																												
<u>Carcharhiniformes</u>																																												
Scyliorhinidae																																												
<i>Apristurus</i> sp.																																												
								
<u>Squaliformes</u>																																												
Squalidae																																												
<i>Squalus acanthias</i>																																												
						.	.	.	2	.	.	1	.	1	.	1	.	1	.	1	.	1	2	2	1	4			
Somniosidae																																												
<i>Somniosus microcephalus</i>																																												
						1	2			
Etmopteridae																																												
<i>Etmopterus princeps</i>																																												
						1	.	.	1	.	1	.	1			
<i>Centroscyllium fabricii</i>																																												
						.	4	3	5	1	.	3	1	6	.	.	2	1	.	.	1	.	.	1	2	.	.	1	2	.	20	27	30	25	26	25	29	29	22	.	.			
<u>Rajiformes</u>																																												
Rajidae																																												
<i>Raja</i> sp.																																												
						10	5	5	.	.	2	1	.	.	1	.	.	1	1	2	1	4	.	1	.	2	1				
						47	63	25	50	50	51	49	53	43	54	37	41	68	63	68	59	60	41	46	52	49	51	66	46	84	68	49	50	38	51	36	37	34	24	.	.			
						1	1		
						1	.	1	1	.	10	18	9	4	5	6	7	8	4	.	.			
						42	26	6	20	13	16	14	18	20	15	.	7	5	5	3	4	3	3	3	4	8	4	2	20	15	3	2	3	8	1	3	5	2	.	.				
							
						.	7	1	3	1	1	5	3	4	1	.	.	.	2	1	1	4	2	4	5	2	2	1	4	2	5	1	1	.	.				
							
						1	3	3	.	2	.	1	5	1	9	1	1	1	3	1	.	.	.				
Arhynchobatidae																																												
<i>Bathyraja spinicauda</i>																																												
						19	19	9	15	9	12	12	14	15	22	13	20	18	13	22	16	12	15	11	9	18	16	18	11	14	14	15	13	10	13	6	7	7	10	.	.			
<u>Chimaeriformes</u>																																												
Chimaeridae																																												
<i>Hydrolagus affinis</i>																																												
						3	5	1
<i>Hydrolagus mirabilis</i>																																												
						1	.
<u>Anguilliformes</u>																																												
Nettastomatidae																																												
<i>Venefica proboscidea</i>																																												
						
Synphobranchidae																																												
<i>Synphobranchus kaupii</i>																																												
						.	1	3	9	3	.	1	2	3	14	11	9	20	11	8	3	3	1	3	7	2	.	7	2	5	29	40	40	41	40	38	39	46	35	.	.			
<i>Simenchelys parasitica</i>																																												
						.	1	1	2	1	.	.	2	1
Serrivomeridae																																												
<i>Serrivomer beanii</i>																																												
						.	3	5	1	1	1	6	3	5	7	11	7	11	13	22	10	15	18	14	22	24	14	15	13	13	24	35	39	36	36	35	42	43	34	.	.			
Nemichthyidae																																												
<i>Nemichthys scolopaceus</i>																																												
						.	1	1	.	.	.	1	.	3	1	1	2	1	4	8	2	1	1	9	4	10	3	11	8	9	9	14	15	17	11	15	20	14	15	.	.			

<i>Antimora rostrata</i>	. 10 14 15 10 2 13 14 15	11 13 10 12 10 8 9 6 11 9 11 11 10 15 7	14 31 44 44 43 43 42 46 50 42
<i>Lepidion lepidion</i>	. . 1 . . . 1 . .	. . . 1 . . . . . . . . . .	. . . 1 . . . 1 . 1
<i>Halargyreus johnsonii</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . .	. . . . 1 . 1
Gadidae			
<i>Boreogadus saida</i>	. . . . . . . . . .	. . . . . . . . . . . 1 . . . . . . . . . .	. . . . . . . . . . . . . . . .
<i>Gadus morhua</i>	100 94 85 80 74 86 73 75 81	75 85 80 72 57 71 55 40 45 56 46 41 36 41 32	46 24 16 36 37 49 53 52 49 60
<i>Pollachius virens</i>	. . . . . . . . . .	. . . . . 1 . . . . . . . . . . . . . . . .	. 1 . . . 1
<i>Melanogrammus aeglefinus</i>	. . . . . 6 5 4 2	2 4 2 1 3 4 9 13 2	5 1 1 . 6 6 8 6 4 9
<i>Micromesistius poutassou</i>	. 3 1 2 . 1 . 2 1	3 4 . 3 . . 1 3 2 2 4 1 1 1 2	. 1 5 3 1 1 2 2 2 15
Phycidae			
<i>Urophycis</i> sp.	19 21 22 28 24 16 23 23 29	17 34 30 40 25 36 31 40 50 26 59 54 54 57 42	66 50 44 39 32 32 20 32 25 25
<i>Urophycis chuss</i>	. . . . . . . . . .	3 . . 1 . . . . . . . . . . . . . . . .	. . . . . . . . . 1
<i>Urophycis tenuis</i>	. . . . . . . . . .	25 . 2 3 1	1
<i>Phycis chesteri</i>	. . . . . . . . . 1 3	10 2 . 5 4 9 10	3 9 7 3 . 4 . 1 1 1
Lotidae			
<i>Brosme brosme</i>	. 1 . . 1 1 1 . .	3 1 1 1 2	1 . . 2 1 1 . . . 1
<i>Enchelyopus cimbrius</i>	. . . 5 . . 1 1 1	3 2 1 . 3 2 1 2 4 4 3 1 2 . 9	15 9 9 5 3 1 . . 1 .
<i>Gaidropsarus argentatus</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	1 1 1 1 .
<i>Gaidropsarus ensis</i>	. 1 . 2 1 . 1 . . .	13 8 6 16 9 17 8 20 21 15 23 24 17 27 23	39 40 57 44 40 41 33 37 41 30
Merlucciidae			
<i>Merluccius bilinearis</i>	. . . . . . . . . .	2 1 . . . . . . . . . .	. . . . . . 1 1
<i>Lyconus</i> sp.	. . . . . . . . . .	. . . . . 1 1 . . . . . . . . . .	. . . . . . . . . . . . . . . .
Melanonidae			
<i>Melanonus zugmayeri</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . 1 . . . . . . . . . .	. . . . . . . . . . . . . . . .
Macrouridae			
<i>Coryphaenoides armatus</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. . . . . . . . . . . 1 1 . .
<i>Coryphaenoides rupestris</i>	. . . 2 1 . . . 2	43 7 . 7 4 1 3 2 . 1 1 6 2 6 1	9 27 37 40 37 39 39 41 44 37
<i>Coryphaenoides guentheri</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. 2 3 2 3 4 3 4 10 3
<i>Coryphaenoides carapinus</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. . . . . . . . . . . . 4 .
<i>Coryphaenoides brevibarbis</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. . . . . . . . . . . 1 1 .
<i>Coryphaenoides rudis</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. . . . . . . . . . . 1 . . .
<i>Coryphaenoides mediterraneus</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. . . . . 1 1 . 1 3 . . .
<i>Coelorinchus caelorhincus</i>	. . . . . . . . . .	3 1 . . . . .	. . . . . . . . . . . . . . . 1
<i>Nezumia bairdii</i>	8 22 29 35 26 11 33 26 23	. 36 38 51 50 45 44 55 60 52 63 60 57 67 64	66 75 83 78 73 66 63 71 67 68
<i>Trachyrincus scabrus</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. . . . . 1 . 1
<i>Trachyrincus murrayi</i>	. . . . . . . . . .	1 .	. 2 1 3 . . 2 2 . 2
<i>Macrourus berglax</i>	11 28 26 31 35 15 33 30 30	34 31 23 32 32 25 29 30 32 31 34 37 43 45 31	35 49 58 60 49 53 46 51 55 44
Ophidiiformes			
Ophidiidae			
<i>Brotulotaenia</i> sp.	. . . . . . . . . .	. . . . . 1 . . . . . . . . . . . . . . . .	. . . . . . . . . . . . . . . .
Perciiformes			
Zoarcidae			
<i>Lycenchelys paxillus</i>	. 1 . . 1 . . . . .	. . . . . . . . . . . . . . . . . 3 1 . . 2	1
<i>Lycodes</i> sp.	3	44 9 3 . 3 . . . . . . . . . . . . . . . .	. . . . . . . . . . . . 1 1 .
<i>Lycodes vahlii</i>	6 19 16 22 18 7 26 16 19	. . 5 11 12 12 11 8 14 14 10 8 4 13 7	6 16 22 17 15 16 9 10 10 3
<i>Lycodes esmarkii</i>	. 7 3 8 4 6 6 4 3	. 15 12 26 17 18 11 25 32 38 48 43 39 36 16	35 20 16 13 1 5 . 1 1 1
<i>Lycodes reticulatus</i>	. 4	10 43 48 48 52 55 53 63 70 72 70 76 66 66 67	57 52 48 41 30 20 10 11 4 5
<i>Melanostigma atlanticum</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. . . . . . . . . . . 2 1 2 2
<i>Lycodonus flagellicauda</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	3 1 1 1 6 2 2 . 1 . .
Polyprionidae			
<i>Polyprion americanus</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. . . . . . 1
Howellidae			
<i>Howella sherborni</i>	. . . . . . . . . .	. . . . . . . . . . . . . . . . . . . . . .	. + . . . . 1 1 . . 1
Chiasmodontidae			
<i>Chiasmodon niger</i>	. 1	1 . 1 3 1 . . 5 1 . . . 1 2 2	1 5 18 16 14 11 17 20 16 10
Anarhichadidae			
<i>Anarhichas</i> sp.	. . . . . . . . . .	1 . 1 2 . . . . . . . . . .	. . . . . . . . . . . . . . . .
<i>Anarhichas lupus</i>	78 71 59 64 58 80 62 64 69	70 71 71 76 75 83 83 79 85 80 78 74 74 74 70	77 62 52 45 45 45 34 31 28 18

<i>Anarhichas minor</i>	14	41	31	28	32	29	42	29	26	45	50	56	68	62	62	77	73	84	82	82	72	60	54	56	50	48	40	40	33	34	24	25	16	21			
<i>Anarhichas denticulatus</i>	14	33	28	31	37	31	40	26	14	18	16	9	23	31	31	37	54	44	41	40	29	25	35	55	39	39	48	44	42	44	26	37	32	37			
Stichaeidae																																					
<i>Lumpenus</i> sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lumpenus lampretæformis</i>	8	.	.	.	.	.	.	.	.	.	7	4	2	4	15	6	4	7	7	42	13	11	32	31	47	40	36	20	22	14	13	1	.	.			
<i>Leptoclinus maculatus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	2	.	.	.			
Ammodytidae																																					
<i>Ammodytes</i> sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ammodytes dubius</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1		
Trichiuridae																																					
<i>Aphanopus carbo</i>	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1		
Centrolophidae																																					
<i>Centrolophus niger</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caristiidae																																					
<i>Caristius fasciatus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Beloniformes																																					
Scomberesocidae																																					
<i>Scomberesox saurus</i>	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stephanoberyciformes																																					
Melamphaidae																																					
<i>Poromitra</i> sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	2	.	1	2	2	16	11		
<i>Poromitra megalops</i>	.	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.	2	3	.	1	3	2	6	7	4	13	26	22	7	7	6	8	1	2			
<i>Scopelogadus beanii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	1	1	.	.	.	.	.	.	.	.	22	26	28	29	35	25		
Beryciformes																																					
Diretmidae																																					
<i>Diretmus argenteus</i>	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	
Trachichthyidae																																					
<i>Hoplostethus atlanticus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anoplogastridae																																					
<i>Anoplogaster cornuta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2	1	1	.	1	1	.	.	1	2	7	4	6	1	4	5	9	1		
Scorpaeniformes																																					
Sebastidae																																					
<i>Sebastes</i> sp.	3	2	.	.	.	.	12	2	.	71	78	73	79	85	.	.	.	.	.	.	.	.	.	.	.	31	29	1	.	.	2	.	.	1	.		
<i>Sebastes norvegicus</i>	58	57	42	45	34	45	39	40	47	57	43	55	61	54	67	68	74	79	77	76	75	76	68	75	58	44	53	49	48	53	48	46	41	41			
<i>Sebastes mentella</i>	72	76	83	86	85	89	91	85	83	.	.	.	65	63	51	60	82	83	80	81	75	79	79	83	53	40	56	49	49	40	34	58	48	44			
<i>Sebastes fasciatus</i>	.	.	.	.	.	.	.	.	.	.	.	.	51	63	62	81	85	85	85	90	84	86	87	95	65	46	65	58	63	57	58	56	52	57			
<i>Sebastes</i> (juvenile)	.	.	.	.	.	.	.	.	.	.	.	.	73	72	80	75	41	29	44	34	45	44	58	68	74	92	39	44	42	44	52	47	44	39	36		
Cyclopteridae																																					
Cottidae																																					
<i>Triglops</i> sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Triglops murrayi</i>	8	.	.	.	1	.	.	.	1	2	4	8	26	31	44	23	44	56	46	57	51	49	51	30	33	5	1	1	.	.	.	1	.	.			
Psychrolutidae																																					
<i>Cottunculus</i> sp.	.	3	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	1	
<i>Cottunculus microps</i>	.	.	2	.	4	.	8	2	3	8	2	3	10	11	10	6	8	5	10	7	11	7	11	9	17	20	18	24	9	20	5	3	2	2			
<i>Cottunculus thomsonii</i>	.	.	.	.	4	1	.	.	.	.	7	1	2	.	11	3	1	.	.	1	4	.	.	1	5	10	10	10	4	6	6	4	2	1			
Agonidae																																					
<i>Aspidophoroides monoptyerygius</i>	.	.	.	.	.	.	.	.	.	5	4	3	9	6	14	1	6	12	3	18	1	15	7	12	16	6	5	5	3	4	3	1	1	1	.		
<i>Leptagonus decagonus</i>	.	.	.	.	.	.	.	.	.	.	.	.	3	3	6	3	6	18	6	6	6	2	1	2	2	.	.	.	1	.	.	.	.	.	.
<i>Ulcina olrikii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Liparidae																																					
<i>Careproctus micropus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	2	4	.	.	1	.	.	10		
<i>Careproctus reinhardtii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	.	1	.	1	3	.	.		
<i>Liparis</i> sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Liparis liparis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Liparis fabricii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Paraliparis copei</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pleuronectiformes																																					
Pleuronectidae																																					

<i>Psilaster andromeda</i>	. . . . .	. . . . .	. . . . .	9	17	7	5	3	3
<i>Bathybiaster vexillifer</i>	. . . . .	. . . . .	. . . . .	9	13	7	.	3	1
Brisingidae	. . . . .	. . . . .	. . . . .	2	5	2	2	2	3
Asterinidae									
<i>Tremaster mirabilis</i>	. . . . .	. . . . .	. . . . .	2	1	2	2	1	.
Ctenodiscidae									
<i>Ctenodiscus crispatus</i>	. . . . .	. . . . .	. . . . .	9	5	6	4	3	4
Benthopectinidae	. . . . .	. . . . .	. . . . .	33	13	18	18	28	33
Goniasteridae									
<i>Ceramaster granularis</i>	. . . . .	. . . . .	. . . . .	36	37	30	13	20	23
<i>Hippasteria phrygiana</i>	. . . . .	. . . . .	. . . . .	14	13	9	2	7	2
<i>Mediaster bairdi</i>	. . . . .	. . . . .	. . . . .	18	16	13	3	9	5
Pseudarchasteridae									
<i>Pseudarchaster</i> sp.	. . . . .	. . . . .	. . . . .	.	1	2	.	.	1
<i>Pseudarchaster parelii</i>	. . . . .	. . . . .	. . . . .	2	.	.	.	.	.
<i>Pseudarchaster gracilis</i>	. . . . .	. . . . .	. . . . .	1	.	.	.	.	.
Solasteridae									
<i>Lophaster furcifer</i>	. . . . .	. . . . .	. . . . .	1	4	1	1	.	2
Pterasteridae	. . . . .	. . . . .	. . . . .	16	19	10	7	7	3
Poraniidae	. . . . .	. . . . .	. . . . .	.	.	2	2	1	1
<i>Poraniomorpha hispida</i>	. . . . .	. . . . .	. . . . .	5	7	6	2	1	2
Echinasteridae	. . . . .	. . . . .	. . . . .	43	47	31	17	25	21
Zoroasteridae									
<i>Zoroaster fulgens</i>	. . . . .	. . . . .	. . . . .	6	17	4	1	1	1
Asteriidae									
<i>Stephanasterias albula</i>	. . . . .	. . . . .	. . . . .	5	1	7	2	8	3
Ophiuroidea	. . . . .	. . . . .	. . . . .	1	+	17	23	27	21
Asteronychidae									
<i>Asteronyx loveni</i>	. . . . .	. . . . .	. . . . .	.	1	.	.	1	.
Gorgonocephalidae	. . . . .	. . . . .	. . . . .	7	2	3	3	3	1
Ophiuridae									
<i>Ophiura sarsii</i>	. . . . .	. . . . .	. . . . .	7	7	8	5	20	15
<i>Ophioplinthus</i> sp.	. . . . .	. . . . .	. . . . .	.	.	.	1	.	.
Ophiolepididae									
<i>Ophiomusium lymani</i>	. . . . .	. . . . .	. . . . .	12	14	7	1	7	2
Ophiacanthidae									
<i>Ophiacantha</i> sp.	. . . . .	. . . . .	. . . . .	5	.	.	.	.	.
Ophiactidae									
<i>Ophiopholis aculeata</i>	. . . . .	. . . . .	. . . . .	35	11	22	11	9	10
Echinoidea	. . . . .	. . . . .	. . . . .	9	+	25	37	2	8
Echinothuriidae	. . . . .	. . . . .	. . . . .	1	.	3	1	3	1
Phormosomatidae									
<i>Phormosoma placenta</i>	. . . . .	. . . . .	. . . . .	25	35	29	18	27	20
Schizasteridae									
<i>Brisaster fragilis</i>	. . . . .	. . . . .	. . . . .	14	4	.	1	2	3
Crinoidea	. . . . .	. . . . .	. . . . .	1	1	.	3	1	.
Holothuroidea	. . . . .	. . . . .	. . . . .	3	1	5	.	.	3
Chaetognatha	. . . . .	. . . . .	. . . . .	1	.	23	14	2	4

+) Presence in only one haul among 264, which is less than 0.5%.