



## Research papers

## Fauna associated with cold water gorgonians and sea pens

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## ABSTRACT

This paper describes the fauna associated with the gorgonians *Paragorgia arborea* (530 colonies), *Primnoa resedaeformis* (370 colonies) and *Paramuricea placomus* (68 colonies) and the sea pens *Kophobelemnon stelliferum* (584 colonies), *Virgularia mirabilis* (114 colonies), *Funiculina quadrangularis* (278 colonies) and *Pennatula phosphorea* (36 colonies) recorded by video from 18 locations on the Norwegian continental margin. The fauna associated with gorgonians was more diverse than that of the sea pens, with 21 and 12 taxa recorded. *P. arborea* had the highest number of associates; in total ~38% of the colonies had associates on them. Amphipods dominated numerically contributing with 72% to the total number of taxa observed. Shrimps and the basket star *Gorgonocephalus* sp. were frequently observed on all gorgonian species. Rarefaction analysis indicated that the number of associated taxa was richest for *P. resedaeformis*. The fauna associated with the sea pens consisted mainly of shrimps and ophiuroids, for which the sea pens play a key role as a shelter and/or as a feeding platform. The ophiuroid *Asteronyx loveni* was only observed on *F. quadrangularis*, which is used as a platform to reach better feeding conditions. The squat lobster *Munida* sp. was often observed close to the sea pen *K. stelliferum* which presumably offer shelter against predators. We argue that both sea pens and gorgonians play an important role as a habitat, and that a better understanding of their ecological importance is essential to develop sound scientific advice on sustainable habitats and fisheries management of deep-water ecosystems.

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## 1. Introduction

Studies on cold-water corals have expanded dramatically in recent years and their role as habitat providers for a rich fauna has been shown in several studies (Patton, 1972; Krieger and Wing, 2002; Buhl-Mortensen and Mortensen, 2004, 2004a, 2005; Buhl-Mortensen et al., 2010; Carvalho et al., 2014).

Even though the role of gorgonians and sea pens as habitats is understudied it is known that they house a large assemblage of mobile crustaceans, mollusks and attached ophiuroids (Storm, 1901; Stromgren, 1971; Fujita and Ohta, 1988a, 1988b; Buhl-Mortensen and Mortensen, 2004a; Baillon et al., 2014). These organisms can use corals as a substrate for attachment and shelter (Vytopil and Willis, 2001), for feeding (Burkepile and Hay, 2007; Garcia-Matucheski and Muniain, 2011), parasitism (Buhl-Mortensen and Mortensen, 2004b).

The mobile fauna is particularly difficult to document (Buhl-Mortensen and Mortensen, 2004a, 2005, Buhl-Mortensen et al., 2010; Baillon et al., 2014), but with the recent development of underwater video equipment it has become possible to inspect

coral colonies for even rather small associated organism. “Coral gardens” (aggregations of gorgonians and sea pens) are classified by the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) as ‘Threatened and/or declining (OSPAR, 2004) and the associated “sea pen and burrowing megafauna communities” habitats types is also of key conservation importance as defined habitat under Annex V of the 1992 OSPAR Convention (OSPAR, 1992; Curd, 2010). Coral gardens are sensitive to physical disturbance impacts caused by bottom trawling and the installation of oil rigs (Troffe et al., 2005; Malecha and Stone, 2009; Tyler-Walters et al., 2009). Bottom trawling is known to be one of the most destructive ways of fishing and causes reductions in habitat complexity, changes in species composition, and reductions in biodiversity (Watling and Norse, 1998; Chuenpagdee et al., 2003). These threats highlight that it is crucial to assess the ecological importance of these deep-water communities, to develop sound scientific advice for management of cold-water ecosystems (Greathead et al., 2007; Buhl-Mortensen et al., 2010).

The main goal of this study was to expand our knowledge on the role gorgonians and sea pens play as habitat providers in cold-water ecosystems. The diversity and abundance of the associated fauna of the studied coral species was compared and related to host morphology and the surrounding habitat. The added value of the high quality video recordings is that it gives us the opportunity

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**Table 1**

List of locations with number of host specimens inspected. Tot: Total number of colonies. WA.

Area	Station	Date	Lat (N)	Lon (E)	Depth (m)	<i>P. arborea</i>	<i>P. placomus</i>	<i>P. resedaeformis</i>	<i>K. stelliferum</i>	<i>F. quadrangularis</i>	<i>V. mirabilis</i>	<i>P. phosphorea</i>
						Tot (WA)	Tot (WA)	Tot (WA)	Tot (WA)	Tot (WA)	Tot (WA)	Tot (WA)
Andfjorden												
	R153	09/10/2007	69° 16.77'	16° 13.78'	284					5 (2)		
	R154	09/10/2007	69° 11.10'	16° 12.75'	365					16 (5)		1
	R155	09/10/2007	69° 12.52'	16° 29.28'	199		1 (1)					
Hola												
	R160	16/10/2007	68° 55.99'	14° 21.38'	237	2 (0)		14 (3)				
	R164	15/10/2007	68° 55.30'	14° 19.94'	218	3 (1)		9 (1)				
	R165	15/10/2007	68° 54.75'	14° 23.23'	262	1 (1)		3 (1)				
	R166	15/10/2007	68° 57.06'	14° 17.69'	201	4 (2)		1				
Sveinsgrunnen												
	R129	06/10/2007	69° 45.48'	17° 05.18'	176					5		
	R220	08/06/2008	69° 04.29'	16° 14.18'	342				18 (6)	4	18 (1)	4 (1)
	R221	09/06/2008	69° 08.81'	16° 17.20'	419	2			178 (25)	6		2 (1)
	R223	09/06/2008	69° 15.74'	16° 19.71'	482	1			185 (22)	4	1	
	R224									2		
	R338	25/10/2008	69° 14.47'	16° 38.80'	262	15 (7)		3				
	R339	25/10/2008	69° 14.23'	16° 39.23'	261	7 (6)		3				
Bjørnøyaset												
	R376	09/04/2009	72° 11.65'	15° 04.04'	518						1	
	R377	09/04/2009	72° 12.59'	15° 01.70'	700						3	
	R378	09/04/2009	72° 14.19'	15° 02.39'	629						1	
	R381	10/04/2009	72° 15.22'	14° 20.52'	854						1	
	R388	11/04/2009	72° 09.45'	15° 09.94'	739						2	
	R389	11/04/2009	72° 08.53'	15° 08.16'	799						2	
	R391	12/04/2009	72° 10.19'	15° 23.57'	728						4	
	R410	21/04/2009	72° 07.48'	15° 06.09'	863						5	
	R416	22/04/2009	71° 33.80'	15° 18.60'	779						6 (2)	
	R440	19/09/2009	71° 55.76'	15° 37.27'	730						23 (5)	
Bleiksdjupet												
	R334	24/10/2008	69° 37.02'	15° 51.86'	457	1		14				
Eggagrunnen												
	R243	17/06/2008	68° 34.85'	13° 42.58'	143					74 (8)		
	R296	13/10/2008	68° 37.14'	12° 40.68'	190					1		
	R317	18/10/2008	68° 28.12'	12° 52.61'	176					14 (2)		
	R318	18/10/2008	68° 27.71'	12° 55.62'	210					1 (1)		1
	R297	13/10/2008	68° 39.17'	11° 54.46'	805						1	
Eggakanten skråning												
	R433	26/04/2009	71° 24.46'	16° 09.41'	533						3	
	R447	21/09/2009	71° 42.34'	15° 45.05'	778						7 (3)	
Hola incl. slope												
	R254	21/06/2008	69° 03.21'	14° 09.77'	193					1		
Korallen												
	Campod3	12/08/2006	70° 55.76'	22° 11.61'	180	3 (3)		1				
	1000-1	14/10/2010	70° 55.82'	22° 11.70'	158	3 (3)		3				
	1000-4	14/10/2010	70° 55.85'	22° 11.73'	163	9 (3)		21 (2)				
	1001-3	14/10/2010	70° 55.58'	22° 11.17'	131	5 (2)		2				
	1003-6	15/10/2010	70° 36.71'	21° 33.86'	168			1 (1)				
	1006-14	16/10/2010	70° 26.84'	21° 10.68'	184	1 (1)		2 (1)				
	1007-16	16/10/2010	70° 26.56'	21° 10.77'	281	7 (5)		20 (6)				
	Hermi-10	03/04/2009	70° 55.68'	22° 11.54'	167	1 (1)		1				

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