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Kartlegging og analyser av faunaen i Hardangerfjorden før mulig legging av elektrisk kabel i korridor

Fauna analyses of a possible electrical cable corridor in the Hardanger fjord

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HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

PROSJEKTRAPPORT

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Tittel (norsk/engelsk):
Kartlegging og analyser av faunaen i Hardangerfjorden før mulig legging av elektrisk kabel i korridor
Faunal base-line studies and analyses of a possible electrical cable corridor in the Hardanger fjord, Norway

Forfatter(e):
Lis Lindal Jørgensen, Silje-Kristin Jensen, Børge Holte og Kjell Bakkeplass

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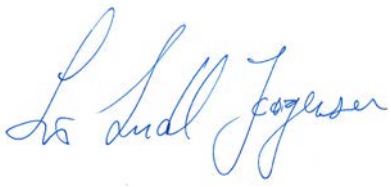
Sammendrag (norsk):
I forbindelse med mulig legging av undersjøisk strømkabel har Havforskningsinstituttet kartlagt bunnfauna på 17 videostasjoner i den aktuelle kabeltrasséen i indre del av Hardangerfjorden i perioden 9.–29. november 2010. Krepsdyret *Munida* sp og dens huler, sjøpølsen *B*ath*yplotes* sp og *Stichopou*s sp, sjø-fjær og echiuran *Bonellia* sp ble hyppig observert langs den dype midtdelen i fjorden. På de bratte veggene langs fjordsidene ble sjøstjernen *Brisingia* sp, skjellet *Acesta* sp og flere typer svamp relativt ofte observert. Selv om tiden for gjenvekst for disse artene er ukjent ser vi ikke at disse populasjonene er true ved en mulig kabel legging. Derimot ble det observert sårbare og/eller rødlistet korall arter (*Lophelia pertusa, Anthomastus grandiflorus* og *Primnoa* sp) i de mulige landfallene i den ytre deler av det undersøkte fjordområdet. Disse artene kan bli skadet ved legging av strømkabler. For å unngå slike skader anbefales det å bruke videoovervåking ved legging av kabel slik at en unngår skader på rødlistede arter i forbindelse med eventuelle kabelarbeider.

Summary (English):
In relation to a possible cable pathway on the sea floor through the inner half of the Hardanger fjord, the Institute for Marine Research has carried out ROV inspections of the benthic faunal communities along 17 selected bottom transects. The surveyed area was restricted to the inner half of the Hardanger fjord – from Sima to Norheimsund in the period 9–29 November 2010.
The deep horizontal seabed along the midline of the investigated part of the fjord was dominated by the crustacean *Munida* sp and its borrow, the sea cucumbers *Bathyplotes* sp and *Stichopous* sp, sea-pens, and the echiuran *Bonellia* sp. The steep walls along the sides of the investigated fjord were populated with less abundant but still relatively frequently-occurring taxa such the sea star *Brisingia* sp, the large bivalve *Acesta* sp, and several species of sponges. Though any local recovery time is unknown, we do not consider these populations to be threatened by the possible cable-laying activities. These are not listed in the Norwegian red-list and are not considered as threatened by the OSPAR Convention. However, in the outer part of the investigated area (transects named Kvamsøy cliff wall and Øystese), the vulnerable corals *Lophelia pertusa* and *Anthomastus grandiflorus* (redlisted) and *Primnoa* sp were observed. To avoid threatening impacts to these groups of corals, we therefore recommend using video monitoring during any cable-laying activities.

Emneord (norsk):	**Subject heading (English):**
1. Faunaundersøkelse Hardangerfjorden 2. Videoobservasjoner 3. Sårbare eller rødlistearter	1. The Hardangerfjord faunistic investigation 2. Video observations 3. Vulnerable or redlisted species



Lis Lindal Jørgensen
prosjektleder

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Content

Preface

In order to increase the electric current line capacity to the Bergen-region, Statnett has started an assessment to find a possible cable pathway on the sea floor through the inner half of the Hardanger fjord. In order to foresee any damage, and to propose possible remedial actions towards such damage, Institute for Marine Research (IMR) has – based on detailed multibeam-derived terrain maps – carried out ROV inspections along selected bottom transects.

We are grateful for the excellent co-operation and service given on board by the crew inclusive of the ROV- and data-engineers in particular. We are also thankful to the project leader and our contact towards Statnett, Jan-Erik Sikkeland.

Thanks also to our colleges at the Institute for Marine Research, dr. Pål Buhl-Mortensen who gave us valuable biological and technical input before the field work started. We will like to say thanks to Elin Hjelset for bringing forward maps with biological information delivered by Buhl-Mortensen, and to Jarle Wangensten who solved some data-challenges regarding the on board logging systems.

Tromsø, 14 January 2011

Dr. Lis Lindal Jørgensen

Introduction

The Institute of Marine Research (IMR) was given the task to investigate the benthic faunal communities and possible vulnerable species from selected ROV video transects along a possible cable pathway on the seabed from Sima to Norheimsund in Hardanger fjord.

Large bottom animals living on the sediment surface or on the bedrock floor or wall (mega-epifauna), and which are possible to recognize on the video monitor with the image quality obtained on board, were highlighted. Particular attention was as well given to long lived, slow growing "vulnerable fauna" which is easily damaged or killed by physical impacts and which need a relatively long recovery period after a possible damage. An example of such vulnerable groups is reef-building corals that are characterized by a calcareous skeleton ("stony corals"). A reef is formed when dead coral skeletons accumulate over thousands of years. *Lophelia pertusa* is a reef-building species and is common in Norway north to about 71 °N. Because corals and sponges grow very slowly, the recovery-time of these habitats may take from decades to centuries, and in some cases they may not recover at all.

Gorgonian cnidarians have a largely upright, plant like growth form (see pictures in appendix 4) and a skeleton of a horny organic material. This category of vulnerable epifauna is defined by its fragile bodies or colonies (habitat-building) that might easily die with physical contact with an outer physical impact as e.g. a bottom trawl, anchoring chains, dredging or other fishing equipment due to breaking or serious cutting of the body. In addition, resuspension of sediment caused by physical impacts might result in clogging of feeding and/or other life functions as e.g. respiration. This is crucial because the water immediately above the seabed contains a naturally high concentration of particles with dead organic matter that corals, as well as sponges, feed upon. Handling of pipelines or dredging of cable tracks may therefore – directly or indirectly – be harmful to benthic communities.

Additionally, resuspension of sediments through physical impacts causes organic matter to mix with mineral particles from the sediments. The result is lower food quality for suspension feeders and a high concentration of mineral particles in suspension that may as well clog the filter-feeding mechanism of cnidarians, sponges and other in particular suspension-feeding benthic invertebrate animal groups.

Single individuals of soft- or stony corals, sea-pens, sponges, reef-building polychaets and calcified bryozoans are usually a nursery and feeding habitat for many species inclusive of fish. Recommendations and species from the Norwegian red list of threatened species as defined by the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) have been included in this study.

Study area

The Hardanger fjord is a steep, ice-carved valley about 180 km long. It has multiple basins separated by sills of bedrock, and reaches its maximum depth of more than 850 m just outside Norheimsund in the middle of the fjord (Figure 1a).

The studied area showed soft, sandy sediment with pebbles and stones in the deeper parts of the fjord, and steep bedrock-walls on each side of the fjord.

The temperatures at the bottom were during the field sampling 7.3–7.5°C and the salinity 36.0–36.3.

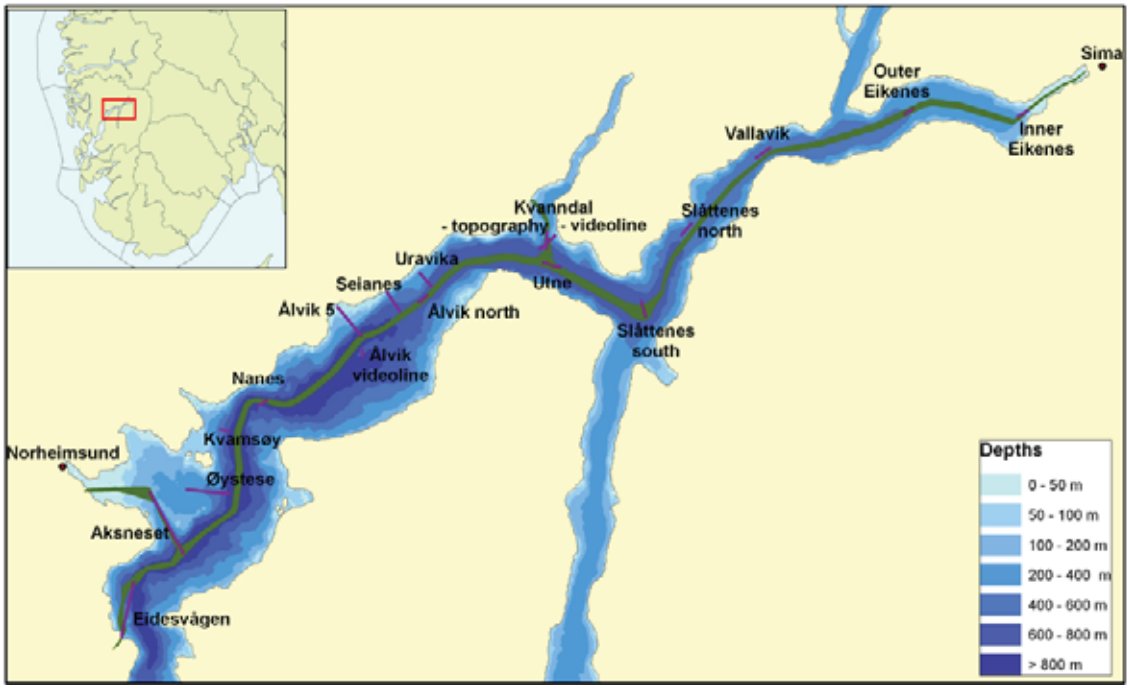


Figure 1a. The Hardangerfjord with all investigated video transects. The water depth is given in colours and in legend. The dark green line shows the possible cable-corridor.

Material and method

The survey was carried out from the survey vessel Geograph with two marine biologists, in the period 9–18 November 2010, in the outer part of the Hardanger fiord (from Kvanndal to Eidesvågen, Figure 1a), and in the inner part of the Hardanger fjord (Sima–Kvanndal) in the period 27–29 November 2010.

Selection of the video transects

Transects for investigation of the fauna was chosen from detailed, high resolution multibeam-derived terrain model, delivered and produced by Statnett on board. These maps are very large and detailed and were therefore not possible to present in this report but are, however, available through Statnett. The map was made available for us as a 3D diagram of the fjord with a high resolution grid-coverage of 1*1m available by PC software. Unfortunately it is not possible to show this kind of terrain model in this report, but Statnett made available a strongly decimated map of the terrain model with a pixel-size of 5*5m grid size solution (Figure 1b).

Based on the detailed sea floor maps ROV-inspection lines were established where the terrain might indicate particular mounds or other physical irregularities that may support vulnerable benthic animals, their colonies or otherwise benthic communities. This selection of ROV transects was made during the first 48 hours of the field survey. The transects were made available for the navigators on board by their geographical coordinates.

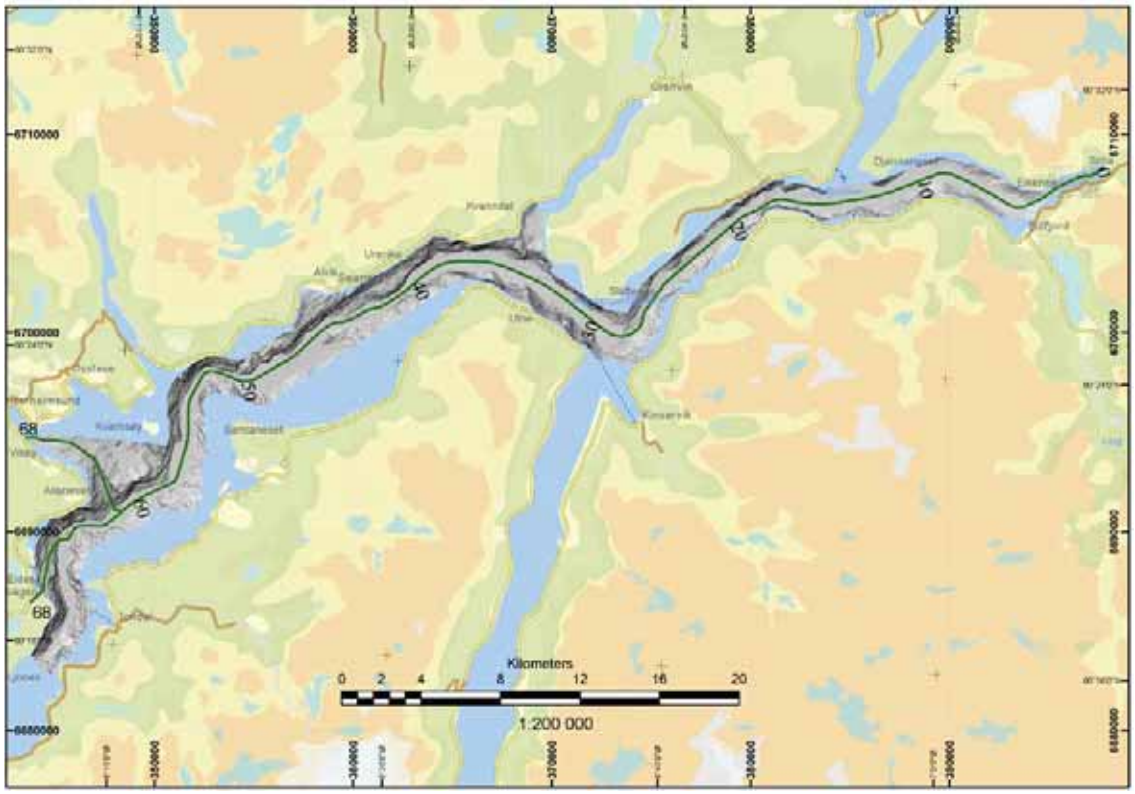


Figure 1b. The Hardanger fjord. The terrain model (grey area) was originally developed as a 1*1m solution model, but is here presented as a decimated map with a pixel-size of 5*5m. The picture is made available by Statnett.

In addition to the biological ROV-transects within the predefined cable corridor, benthos communities as well observed along ROV-transects conducted by the geologists on board in the period 9–18 November. This was biologically advantageous in order to study fauna which might be disturbed by resuspended sediments caused by cable-laying activities, and also to study mega-fauna living at hard-bottom habitats that might be impacted by resuspension although outside the cable-corridor. In order to cover all the variety of fauna along the suggested pre-defined electric cable-track all sort of substrate was thus covered, from soft clayed bottom, through sand and pebbles and scattered stones, and to seabed rocky structures (seamounts) to seabed-inclinations and steep cliff walls.

A total of 17 transect (given a total of >24000m length) were investigated along the sublittoral fjord seabed, and up the fjord-walls to the shallow littoral zone where the cable might be brought on shore. A depth interval from 2 m to 850 m was covered.

ROV

The ROV was operated from the survey vessel “Geograph”, owned by DOF Subsea. The ROV used in the biological and topography surveys was of the brand Triton XLX 38. The ROV had 3 x Kongsberg-Simrad 14-366 Colour camera that was used for the video survey. They were located on the ROV as side and top cameras, together with a Colour centre camera. The top camera was not used to record the fauna but only for steering the ROV. The view

from the cameras was displayed on three separate video screens in the control room and recorded.

Cameras had some overlapping visual fields. The width of the total visualised area was approximately from 3 to 5 meters varying with the altitude of the ROV. The cameras were over-dispersed with green, but we were able to see colours if going close to the fauna.

Eight light systems were equipped to the ROV giving sufficient light to locate and record on video-tape the biological fauna. It was possible to zoom and focus the center and top cameras, and in addition tilts it to the sides and up-down. For monitoring the position 3 x Kongsberg-Simrad MST 319/N transponders, 3 x Kongsberg-Simrad MST 324/N transponders and Kongsberg-Simrad HAIN integrated inertial navigation was used.

Processing of data

For registering the fauna species the software program "Visual Soft" was used, which is an offshore digital video inspection system. The program was set up by the geologist on board to fit our need so we could log the species and take frame grabs from the video. Through the software we were able to log information from all three cameras and take out frame grabs.

All the video transects taken under the cruise were given to the biologists together with CTD-data (conductivity, salinity, density) taken from the fjord. All of which was stored on hard drives provided by DOF Subsea.

Detailed observations and individual registration of all benthic individuals is time consuming and demanding and need to be done after the survey. Observed animals were therefore categorised into groups as

- "dominating" when the same species was abundant and evenly distributed,
- "characteristic" if the species was occasionally observed
- "other species" included all other more rarely observed animals

Thus, this survey was based on a semi-quantitative registration method.

Analyse of data

All fauna data were listed per video transect (Table 1) with abundant species numbered as "10", while all other species numbered as "1". A resemblance matrix was created in PRIMER version 6.1.9, by using the s17 Bray Curtis similarity to measure the similarity between video transects. This similarity was presented as a dendrogram (Figure 3) by using "Group Average" as the linkage option. The dendrogram display the grouped video transects into successively smaller numbers of clusters. A Non-metric Multi-Dimensional Scaling diagram was also presented based on the same Bray Curtis similarity.

Results

The benthic fauna in Hardanger fjord, from Sima to Norheimsund, was mapped by 17 video transects in the period 11–28 2010 (Appendix 1). The ROV (Triton XLX 38) with the mounted video equipment was operated from the survey vessel Geograph, DOF Subsea. The fauna investigation focused on the sea-bed areas that would be affected by the laying of the cable-corridor (Figs. 1a and 1b). A depth interval from 2 m to 820 m was covered with 22740 m of video observation, covering an area of 73220 m^2 (given a 3 m visual range of the camera) (Appendix 1).

Ten of the ROV-transect were established in the middle line of the fjord mainly on more or less horizontal bottom covered with soft-sandy sediment and scattered with boulders, while three transects covered the steep bedrock cliffwalls on the side of the fjord (landings of the cable corridor) with terraces covered with mud or sand. Four video transects were comprised mixed midline and cliffwals transects (Appendix 1).

The benthic invertebrate fauna included in the video analyses belonged to 7 animal groups (table 1): sponges (10 taxa), cnidarians (11 taxa), crustaceans (3 taxa), molluscs (2 taxa), echinoderms (14 taxa), echiurans (1), tunicates (1) and polychaeta (1).

The vertebrate fauna consisted of fish (*Coryphaenoides* sp, *Molva molva, Myxine* sp, *Sebastes* sp, Pleuronectiformes indet, *Gadus morhua, Lophius piscatoriu, Eutrigla* cf, *Melanogrammus aeglefinus*) and sharks (Selachimorpha indet, *Galeus* sp, *Chimaera* sp).

Table 1. Species list of observed taxa on video transects. D = Dominating, x= recorded, B=bottom midline of the fjord, W=walls, I=inner-, M= middle-, and O= outer part of the fjord.

		Eikenes I (B)	Eikenes O (B)	Vallavik (B)	Slåttenes N (B)	Slåttenes S (B)	Kvanndal (W)	Utne	Kvanndal T	Uravika	Ålvik N	Ålvik 5	Ålvik-line	Nanes	Kvamsøy	Øystese	Aksneset	Eidesvågen
Fjord area		**I**	**I**	**I**	**I**	**I**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**O**	**O**	**O**	**O**
Porifera	*Aplysilla* cf.														x			
	Axinella sp.															x	x	
	Isops cf.														x			
	Asbestopluma sp										x							
	Hymedesmia											x				x	x	
	Phakellia sp.														x	x	x	
	Porifera white												x				x	
	Porifera indet	D								x		x			x			
	Coral tree?	x																
	Stylocordyla sp																	X
Cnidara	Actinaria indet										x	x					x	
	Anthomastus grandiflorus	x													x			
	Bolocera sp.					x											x	
	Cerianthidae				x	x					x		x		x	x	x	
	Corymorpha sp.																	X
	Funiculina sp.		D									x						
	Isidella sp.		D	D	D										x		D	X
	Lophelia ?														x			
	Pennatulacea	x						x		x	x		x	x		D	D	X
	Primnoa sp.															D		
	Virgularia sp.						x		X					x				X
Crustacea	Caridea indet														x			
	Munida sp,	D			D	D	D	D	D	D	D	D	D	D	D	D	D	D
	Paguridae																	X
Mollusca	*Acesta* sp.	x			x		x					x			x	x		X
	Octopus											x						

Echinodermata	Asteroidea										x				x		x	X
	Asteroidea (white)					x					x						x	
	Bathyplotes sp.		D	D	D	D		D	D	D	D	D		D	D	D	x	D
	Brisingia sp.				D	x	D		X			x	x	x	x		D	
	Ceramaster sp.														x			
	Echinus sp.																	
	Henricia sp.			x	x	x				x	x	x	x	x	x		x	X
	Hippasterias sp.																	
	Holothuroidea												x	x	x		D	
	M. intestinalis					x					D				D		D	
	Ophiuridea,																	X
	Porania cf.																x	
	Psolus sp.				D				X								x	X
	Stichopus sp.		x				D	D	D	D	x				x		D	D
Echiura	*Bonellia* sp.	D	D	D							x	x			x			X
Polychaeta	Serpulidae												x			x		
Tunicata	Tunicata											x						
Vertebrates	*Eutrigla* cf.																	
	Chimaera sp.		x		x	x	x	x			x	x				x	x	X
	Coryphaenoides			x	x	x		x							x	x	x	X
	Gadus morhua																	X
	G. melastomus											x						
	L. piscatorius																x	
	Macrouridae		x															
	M. aeglefinus																	X
	M. molva						x				x						x	X
	Myxine sp.					x										x		
	Pleuronectiformes	x	x															X
	Sebastes sp,																x	X
	Selachimorpha																x	
	Squalidae	D																
	Teleost	x											x	x				

Some taxa was recorded frequently (Munida sp, *Bathyplotes* sp/Sticopus sp) on almost all video transects, while others occurred more sporadically at several video transect (sea-pens, *Brisingia* sp, *Chimaera* sp, *Henrisia* sp). These widely distributed taxa contributed with more that 60 % similarity (Figure 2 to the right) among 11 out of the 17 investigated video-transects. Other recorded taxa made some video transect very dissimilar to the remaining transects.

As seen in Figure 2, Eikenes (Inner), Eikenes (Outer) and Vallavik transects from the innermost part of Hardangerfjord (Fig. 1a) had less than 40 % fauna similarity compared to the remaining transects further out in the fjord. This was mainly due to the coral- or Porifera like individuals, the soft coral *Anthomastus*, the Squalidae indet (dogfish sharks) and Pleuronectiformes indet (flatfishes, flounders, and soles) recorded at the Eikenes (Inner) transect, while Macrouridae (rattails) at Eikenes (Outer) and high abundances of the soft coral *Isidella* sp occurred in relatively high abundance at Eikenes (Outer) and Vallevik (Fig. 3). The Ålvik-line transect was characterised by Porifera (white), serpulid polychaetes and unidentified fish.

In the innermost part of the investigated Hardanger fjord, close to Sima (Inner Eikenes, Figure 4) at 150-200m depth, a flat seabed with soft-sandy sediment scattered with boulders prevailed together with areas of bedrock. The crustacean *Munida* sp and its borrows, together with the *Bonellia* sp (Echiura) dominated at this bottom, while a species identified as either a sponge or a coral tree dominated the bedrock.

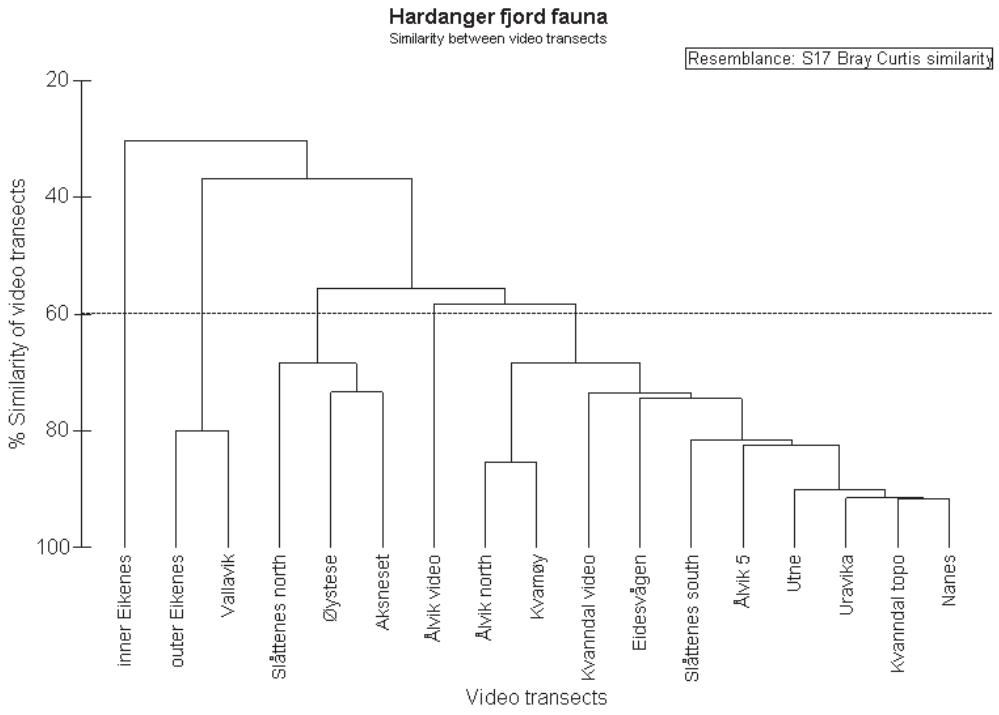


Figure 2. Dendrogram showing the fauna similarity between the video transects. The horizontal line indicates >60 % fauna similarity between transects clustered below the line. The S17 Bray Curtis similarity was used to quantify the compositional similarity between the video transects and build up a resemblance matrices.

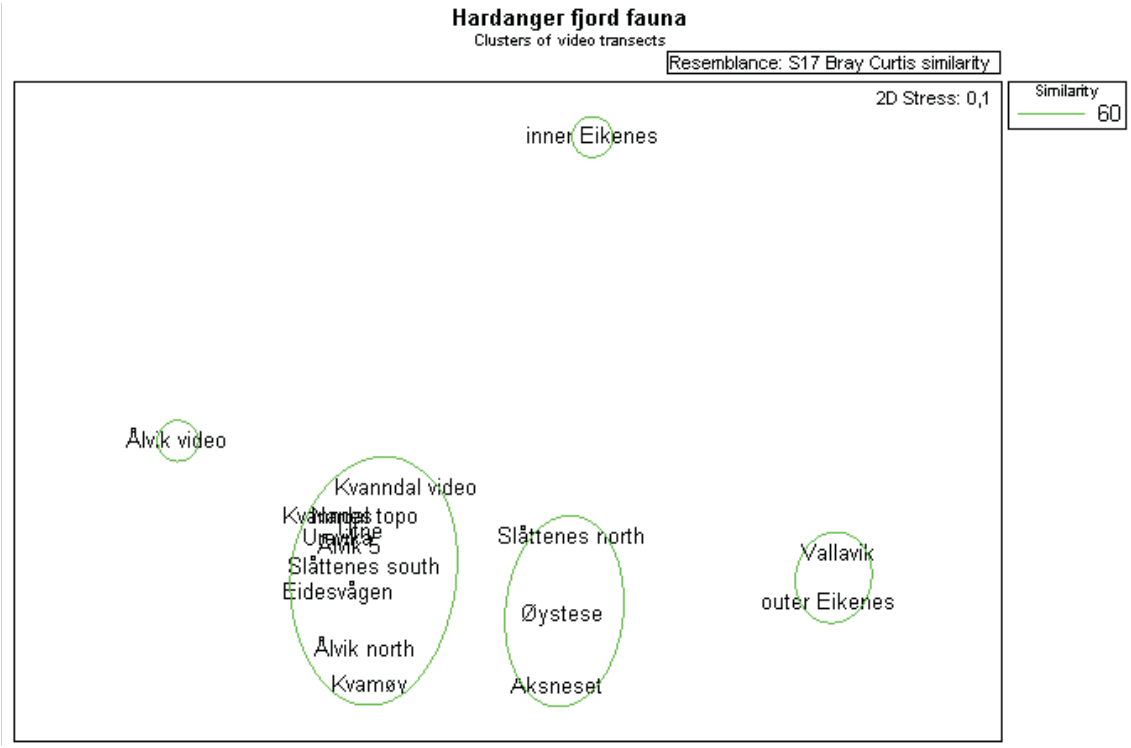


Figure 3. The video transects grouped into green circles indicating a fauna similarity of more than 60%. The S17 Bray Curtis similarity was used to quantify the compositional similarity between the video transects and build up a resemblance matrices.

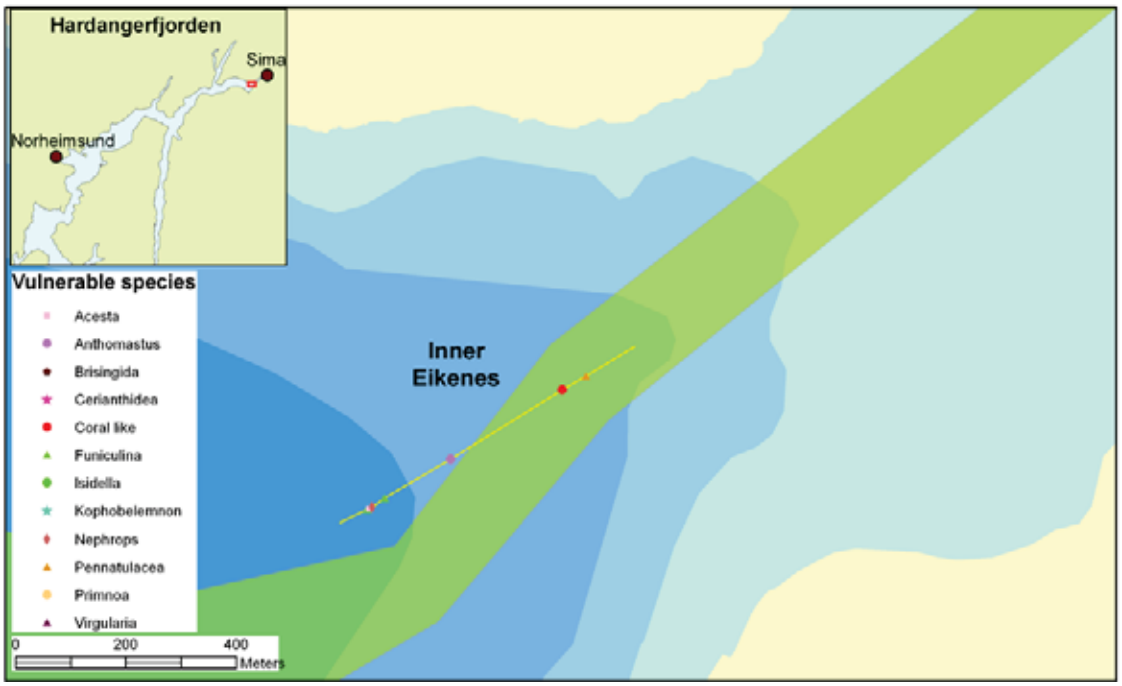


Figure 4. The Inner Hardanger fjord (see embedded chart). Video transect of inner Eikenes in and next to the, by Statnett predefined, planned cable corridor (green area). The names of the species are given in the embedded legend.

At a depth of 300-400 m (Outer Eikenes and Vallavik, Figure 5, 6) the fauna was dominated by the soft-coral *Isidella* sp (see appendix 4), the sea-pen *Funiculina* sp, the sea cucumber *Bathyplotes* sp and the Echiura *Bonellia* sp. At Eikenes (Figure 7, 8) the same fauna predominated, but the sea-feather *Funiculina* sp were not common in this area. At the investigated bedrock transects and cliffsides in this area, colonies of the bivalve *Acesta* sp were frequently recorded together with the sea cucumber *Psolus* sp.

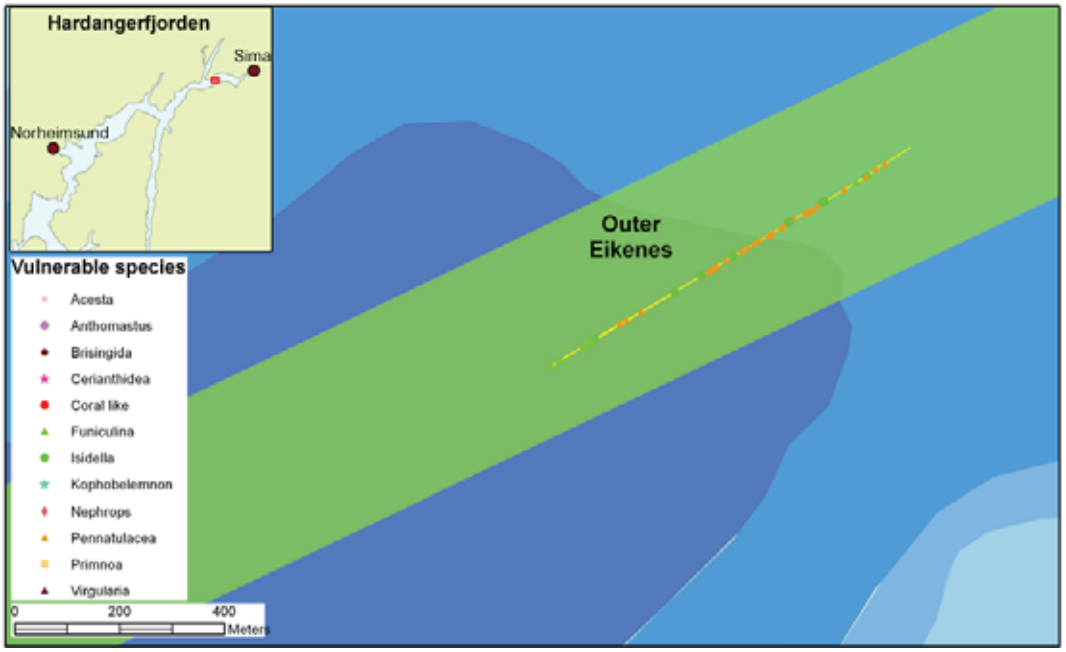


Figure 5. The Inner Hardanger fjord (see embedded chart). Map of Outer Eikenes video transect placed in the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

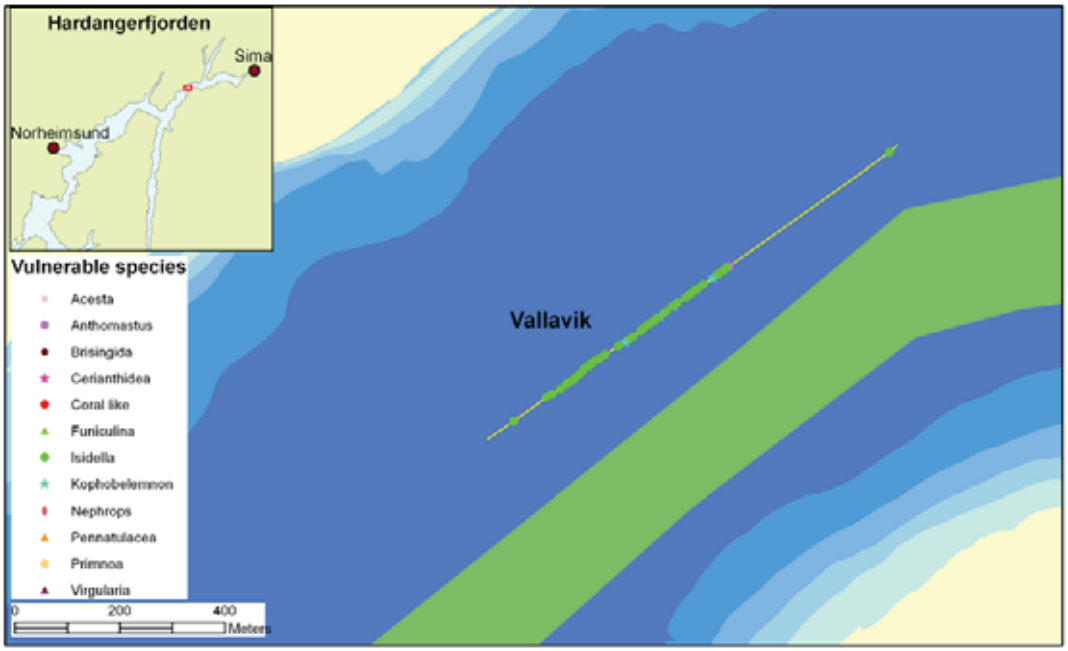


Figure 6. The Inner Hardanger fjord (see embedded chart). Map of the video transect Vallavik next to the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

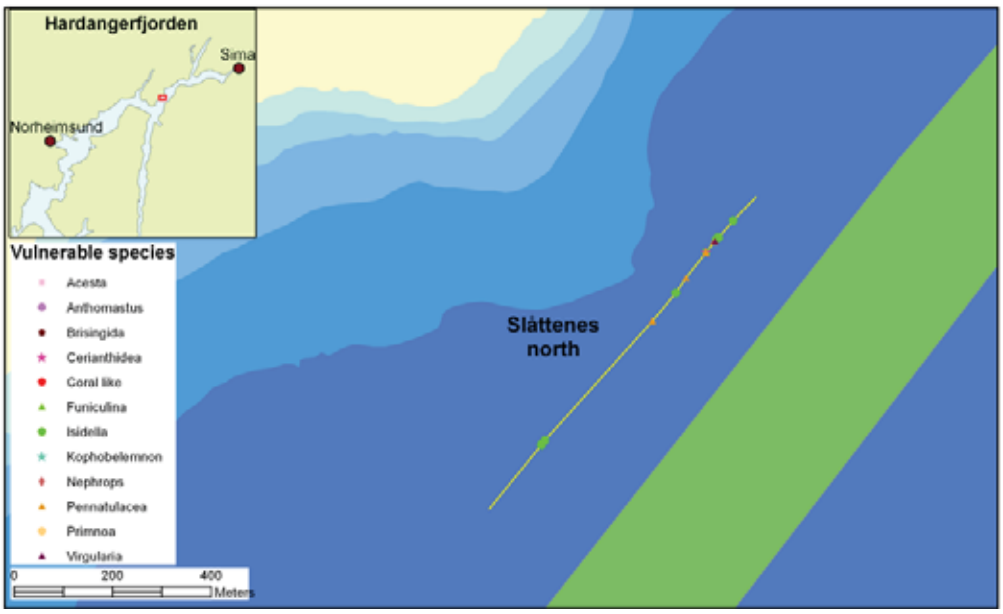


Figure 7. The inner Hardanger fjord (see embedded chart). Video transect of Slåttenes north next to the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend**.**

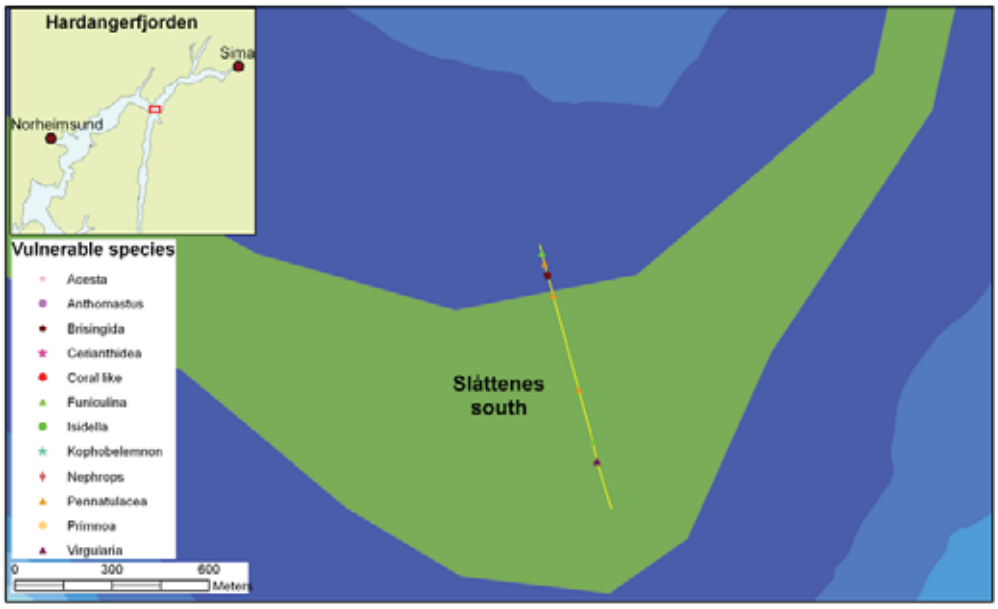


Figure 8. The inner Hardanger fjord (see embedded chart). Video transect of Slåttenes south crossing the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

In the middle parts of Hardanger fjord (Kvanndal, Figure 9) a possible line for landing the cable (landfall). At the seabed at 800 m on soft-sandy mud, the fauna was rather similar to the inner parts of the fjord with frequent observations of the crustacean *Munida* sp and sea-pens (Pennatulacea), but also the sea cucumber *Stichopus* sp, and the sea star *Brisingia* sp. occurred. The steep walls climbing from up from depths of 800 m and up to the break of the wall at 300 m, were clean bedrock with sandy mud on terraces. At 800 m depth, *Brisingia* sp became more abundant and was observed along with sponges *Phakellia* sp, *Axinella* sp and the bivalve *Acesta* sp attached below over-hang on the cliff side.

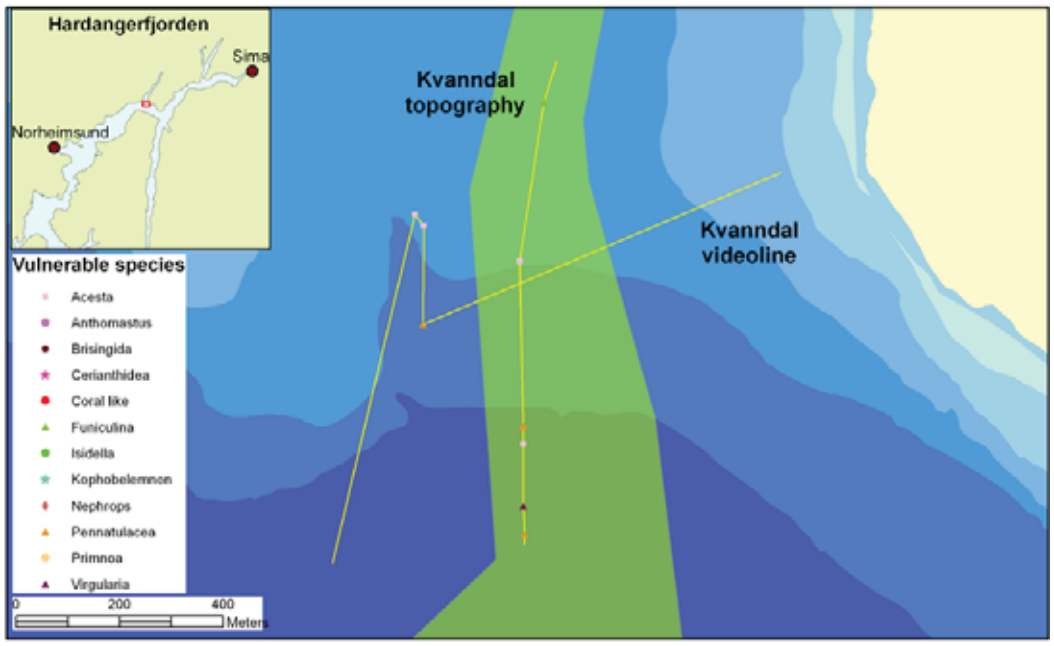


Figure 9. The middle part of the investigated Hardanger fjord (see embedded chart). Kvanndal video-transects and topography line inside and along the planned landfall area for the cable (green area). The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

Along the cabel corridor on the deep fjord sea bed from Utne (Figure 10), outside Kvanndal, and west to Ålvik, *Munida* sp was abundant together with the sea cucumbers *Bathyplotes* sp and *Stichopus* sp which were the dominating species throughout the transect inclusive of observations of Pennatulacea. Further west (Ålvik N, Figure 11) also the sea cucumber *Mesothuria intestinales* became abundant together with *Bonellia* sp.

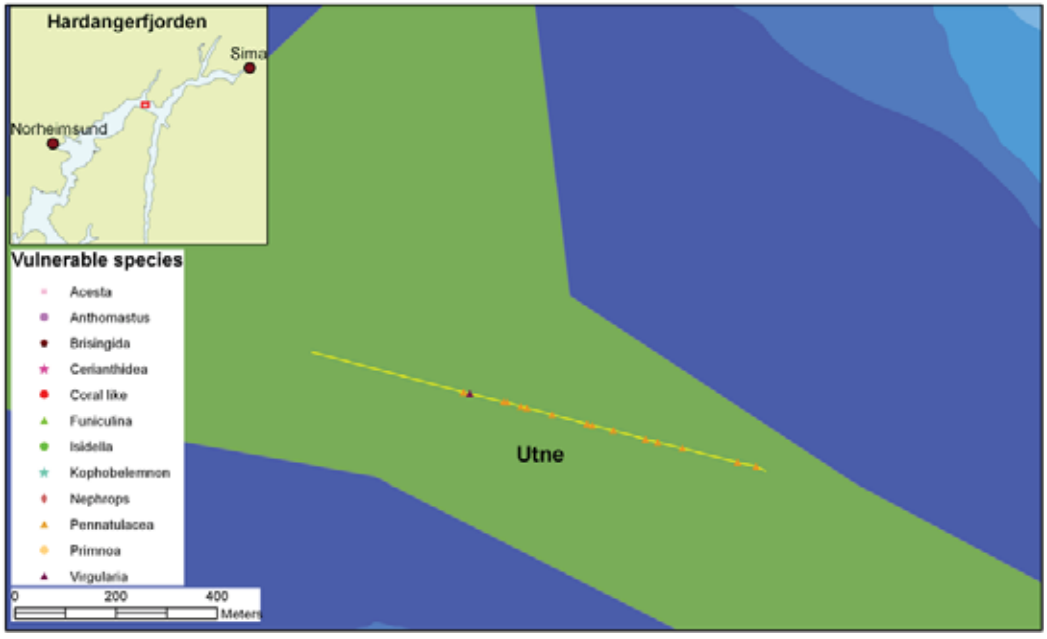


Figure 10. The middle part of the investigated Hardanger fjord (see embedded chart). Utne video-transects inside the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

At Seianes and Uravika (Figure 11), a possible landing of the cabel corridor was investigated. The flat seabed at the foot of the cliff had gravely mud and changing to bed rock and gravely mud with *Munida* sp and *Bathyplotes* sp appearing in high numbers. But on the cliffside *Munida* sp., *Bathyplotes* sp, and *Mesothuria intestinales* were registered in moderate numbers while *Acesta* sp occurred frequently in patches in high numbers along with Pennatulacea, *Brisingia* sp and different sponges.

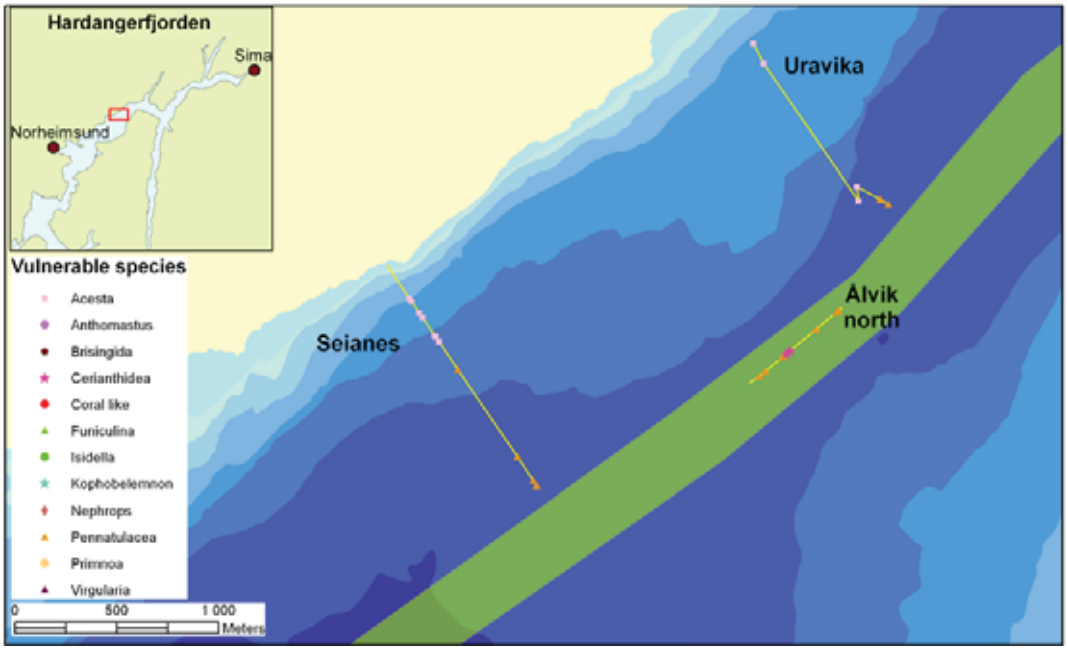


Figure 11. The middle part of the investigated Hardanger fjord (see embedded chart). Video transects of Uravika and Seianes (outside the cable corridor) and Ålvik (inside the corridor) planned cable corridor (green area) in the middle of the fjord. The symbols along the transect shows registered vulnerable species. The names of the species are given in the embedded legend.

When crossing a seabed structure near Ålvik (Figure 12), the substrate went from soft mud over to bedrock, where sponges were hanging from the cliff dominated. *Stichopus* sp dominated where patches of sandy mud with boulders were observed in the bedrock structure. Other species like the sea stars *Henricia* sp and *Ceramaster* sp, Cerianthidae (sea anamones), and Pennatulacea also occurred at these sites.

The video investigation continued along the possible cable corridor in the midline of the fjord. At Nanes (800 m, sandy-mud) (Figure 13) the fauna was, as the other parts of the fjord, dominated by *Munida* sp and Bathyplotes sp with observations of *Brisingia* sp, Pennatulacea, Holoturidea and *Henricia* sp. This area is considered as being as vulnerable as the innermost part of the fjord described above.

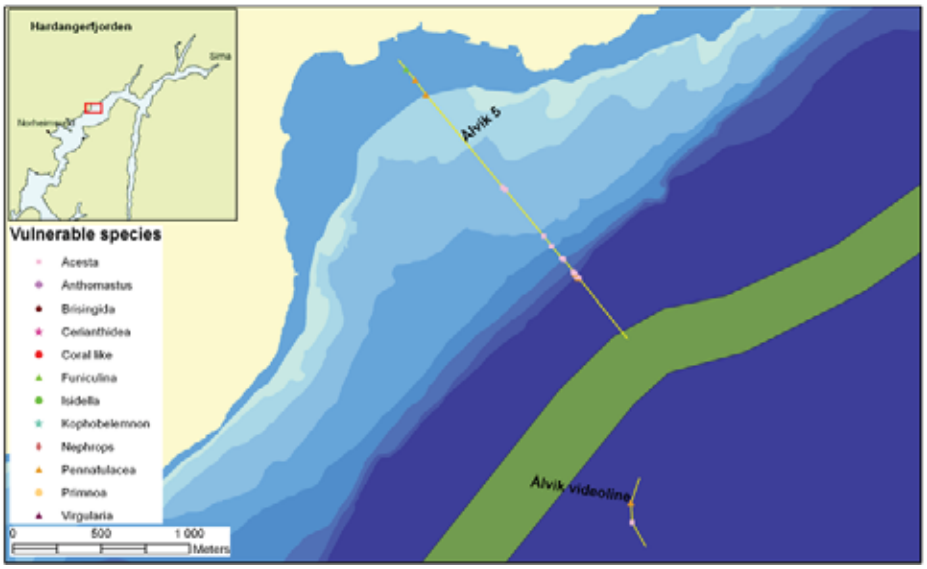


Figure 12. The middle part of the investigated Hardanger fjord (see embedded chart). Video-transect of Ålvik 5 and Ålvik videoline next to the planned landfall area (green area). The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

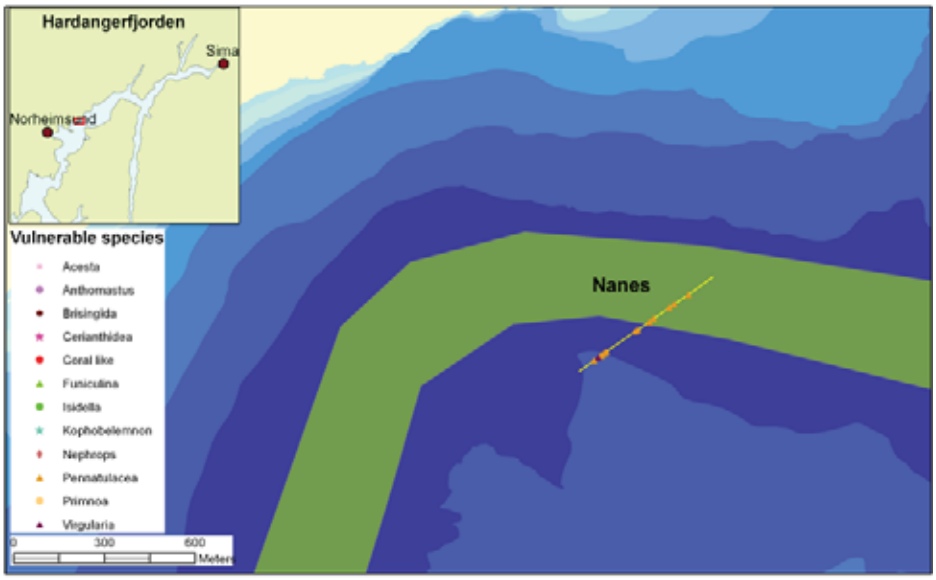


Figure 13. The middle part of the investigated Hardanger fjord (see embedded chart). Nanes video-transect inside and next to planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

At Kvamsøy local fishermen had previously caught the coral *Lophelia pertusa* (Figure 14). In order to investigate this finding, we started the video recordings at 800 m, moving up along the wall. On the horizontal seabed *Munida* sp, *Mesothuria intestinales*, and *Bathyplotes* sp was, as on all the other surveyed horizontal deep areas in Hardanger, recorded in high numbers. However, the number of registrations decreased in areas with bedrock where other species dominated, such as the sea stars *Brisingia* sp, *Henricia* sp, *Ceramaster* sp, the sponges (*Phakellia* sp, *Aplysilla* sp, *Isops* sp) and the soft corals, most probably an *Anthomastus* sp and one *Isidella* colony observed on the top of the cliff at 572 m depth. Also sea anamones (Cerianthidae) together with the bivalve *Acesta* sp were observed. One possible record of a *Lophelia pertusa* colony was made at 520 m depth, appearing to grow on the cable hanging above the bottom wallside.

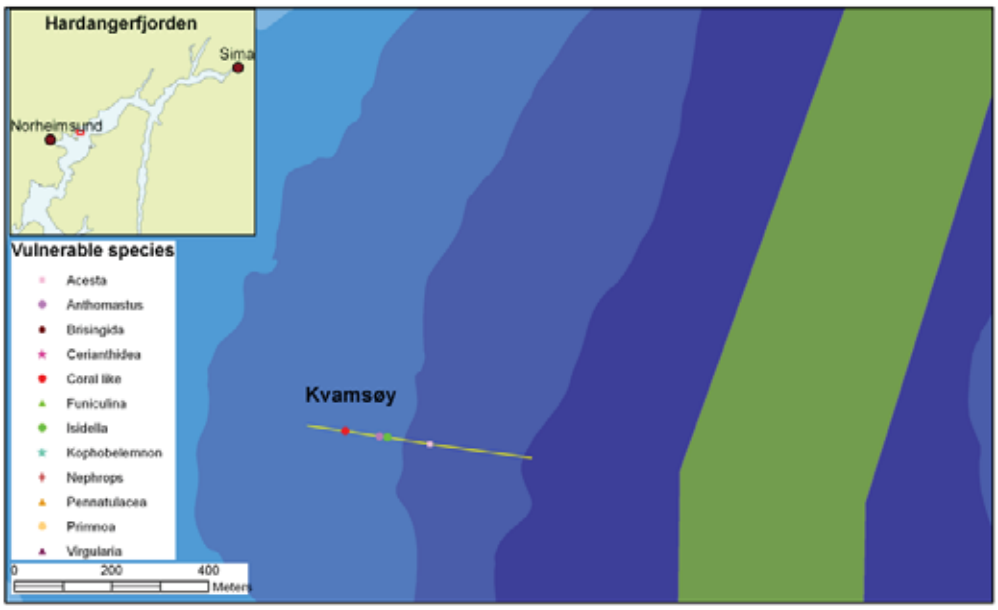


Figure 14. The outer part of the investigated Hardanger fjord (see embedded chart). Kvamsøy video-transect next to the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

In Øystese (Figure 15, 16), when climbing up to 320 m depth, the softcoral *Primnoa* sp and *Isidella* sp together with the seapens (Pennatulacea, *Funiculina* sp) were recorded. On the bedrock in the outermost part of Hardanger (Aksneset, Figure 16) the soft coral *Isidella* sp was numerous but occurred in patches. At Eidesvågen (Figure 17) several Pennatulacea occurred at 200 m depth together with the large solitary bottom-feeding hydroid *Corymorpha* sp.

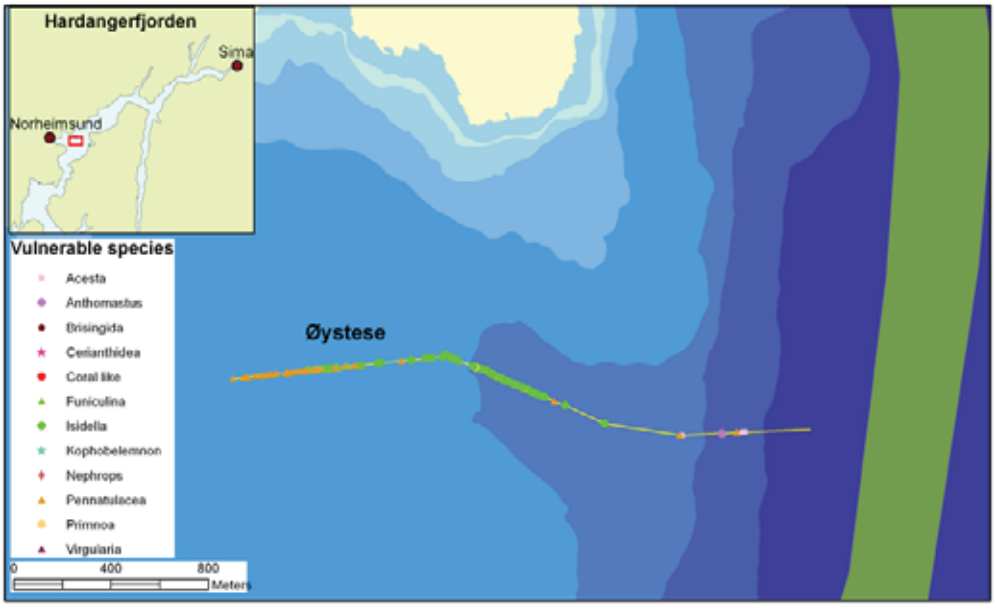


Figure 15. The outer part of the investigated Hardanger fjord (see embedded chart). Øystese video-transect along the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

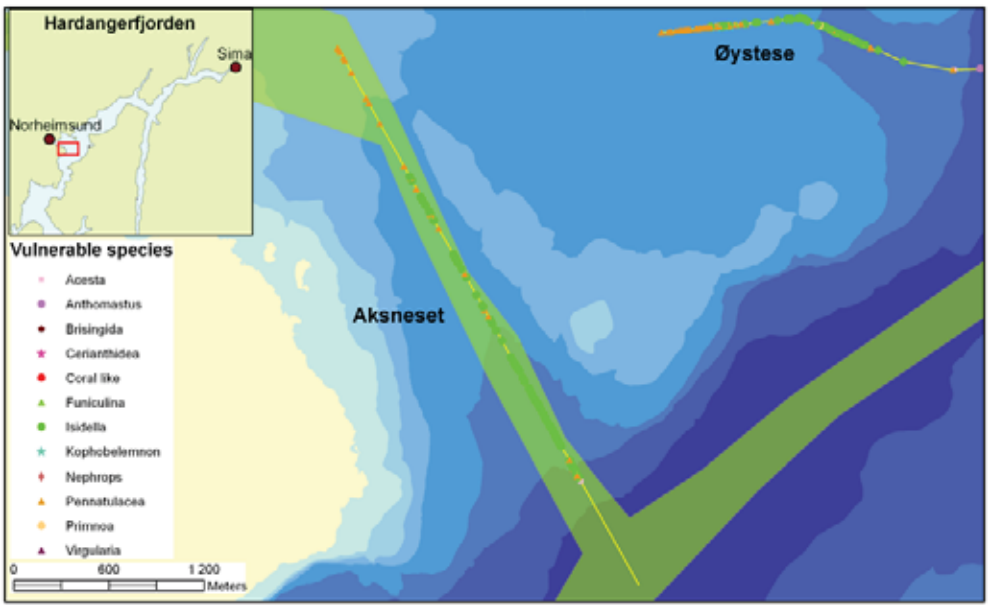


Figure 16. The outer part of the investigated Hardanger fjord (see embedded chart). Akseneset video-transect inside the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

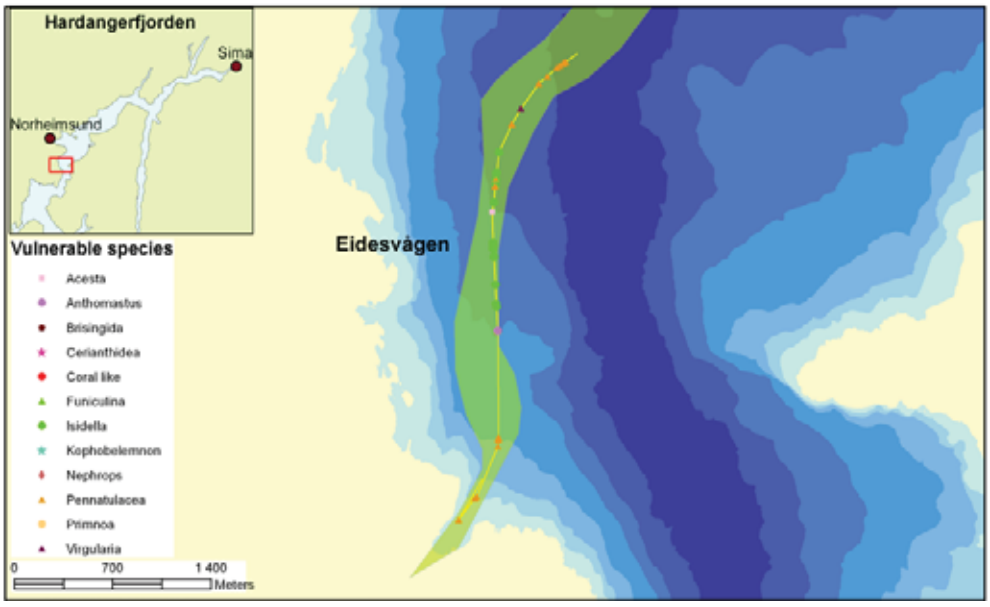


Figure 17. The outer part of the investigated Hardanger fjord (see embedded chart). Eidevågen video-transect inside the planned cable corridor (green area) in the middle of the fjord. The symbols along the transect show registered vulnerable species. The names of the species are given in the embedded legend.

Discussion

The deep flat seabed along the bottom of the investigated fjord was dominated by the crustacean *Munida* sp, the sea cucumbers *Bathyplotes* sp/*Stichopous* sp, sea-pens and the Echiura *Bonellia* sp.

Munida sp is a mobile crustacean, and have the possibility to move away from the cable area and build new borrows in other neighbouring areas. The sea cucumbers *Bathyplotes* sp and *Stichopous* sp lives on soft-bottom but may move over short distances. Such animals might therefore be injured or killed by physical disturbance of the sea bed and the following sedimentation. However, many individuals of this species were scattered all over the seabed in Hardanger fjord which might secure a possible future recovery of the population. The same recovery is suggested to occur for the *Bonellia* sp which lives inside the sediment with its body, but uses an appendix that stretches out on the sediment surface for feeding.

The soft-coral *Isidella* sp is a solitary and colonial suspension-feeding cnidarian and a long-lived habitat former. Together with the fragile sea-pen *Funiculina* sp they will be harmed and killed if being injured by the activities connected to the laying of the cable in or at the seabed. If there will be trench digging or dredging of the cable corridor prior to laying of cables and or post-lay trenching or burial, suspension of sediment during this work will easily cover the corals and the sea-pen. A habitat which occurs in sheltered basins of fjords (OSPAR COMMISSION 2002 and references here) is plains of fine mud at water depths ranging from 15 to 200 m or deeper. These bottom areas are heavily bioturbated by burrowing megafauna such as crustaceans (in the case of Hardanger fjord: *Munida* sp) making burrows and mounds forming prominent features of the sediment surface with conspicuous populations of sea-pens, typically *Virgularia mirabilis* and *Pennatula phosphorea.* In the deeper fjords which are protected by an entrance sill, the tall sea-pen *Funiculina quadrangularis* may also be present.

The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration into the bottom sediments. There is a significant risk of damaging these positive effects from bioturbating animals – and also the animals themselves – through e.g. impacts caused by physical human-derived disturbances of the sea bed such as anchoring activities, physical emplacement or/and trench digging prior to the laying of pipelines or, in this case, the cable corridor.

Sedimentary modifications, due to resuspension of the fine mud particles by trench digging or dredging of the cable corridor, would be a factor that possible could explain modifications observed in macrobenthic fauna communities. The recovery time of sea-pen and coral faunal communities depends on the life-span of the species, and in case of corals, this might take 10-folds of years. In the case of Hardanger fjord and the one-time impact of the laying of the cable, the sea-pen and coral community might recover due to settlement of offspring from unaffected areas in the Hardanger with abundant populations. But the local recovery time and development is unknown.

In the middle parts of Hardanger fjord a possible line for landing (bring the cable from the seabed and up to dry land) the cabel was investigated in Kvanndal (Figure 9). The steep walls climbing from 800 m depth and up to the break of the wall at 300 m, was clean bedrock but with sandy mud on terraces. At 800 m, *Brisingia* sp became more abundant and was observed together with the sponges *Phakellia* sp and *Axinella* sp, and the bivalve *Acesta* sp attached to the substrate below physical over-hangs on the cliff side.

Brisingia is a 6 - 16 armed sea star (Asteroidea). The arms are used for suspension feeding. It is not know how vulnerable this species is to excess sediment resuspension and physical damage. But it is likely that specimens on the cliffside above the deeper sediment sea bed, might avoid a possible lethal sedimentation caused by physical resuspension related to any cable-laying activities. The large bivalve *Acesta* sp and the different species of recorded sponges are not previously recorded as vulnerable to physical impacts. Relative to the local populations, damaged specimens might, as for Brisingia sp, be repopulated by offspring from individuals from the walls above the sediment. Local recoverytime and development is unknown.

At Kvamsøy (Fig. 14), local fishermen had previously caught the coral *Lophelia pertusa*. We recorded here the soft corals *Anthomastus grandiflorus* and one *Isidella* colony (572 m depth), the bivalve *Acesta* sp, and one possible record of a *Lophelia pertusa* colony at 520 m depth on the cliff wall. This particular *Lophelia* colony appeared to have started to grow on the cable hanging above the bottom. Both *Anthomastus grandiflorus* and *Lophelia pertusa* are found among the Norwegian red list of threatened species www.artsdatabanken.no. This should therefore be taken into special reconsideration in case of leading a cable-corridor along this wallside. But in the inner part of the fjord (inner Eikenes, Fig. 4) where *Anthomastus grandiflorus* also was recorded on the wall, the cable corridor is planned to lay on the sea-bed floor in the midline of the fjord and this species should therefore have all possibilities to remain unharmed.

In Øystese (Figure 15, 16), when climbing up to 320 m depth, the softcoral *Primnoa* sp and *Isidella* sp together with the sea-pens (Pennatulacea, *Funiculina* sp) were recorded. The vulnerability of soft corals and the sea-pens has been discussed above. The *Primnoa* coral colony has to be taken into particular consideration because it is rare, and therefore harder to be re-colonised. Analysis of the life span of octocorals indicates that some of the large colonyforming species, such as *Primnoa* sp, can live for centuries but knowledge on recruitment patterns and recovery patterns is sparse (OSPAR 2010 b). Krieger (2001) observed no recruitment of new colonies after seven years in an area where *Primnoa* was removed by trawling. However, six new colonies were observed at a second site one year after trawling. Four of these colonies were attached to the bases of colonies removed by trawling. Recruits of *Primnoa* were also observed on two 7 cm diameter cables (>15 colonies each). These findings might indicate that by reducing the damage (physical damage and sedimentation) to the coral trees to a minimum along the cable corridor, other unharmed coral-trees might be re-recruiting the corridor over long time.

At Aksneset (Figure 16,) a bedrock area in the outermost part of the Hardanger, the soft-coral *Isidella* sp was numerous but occurred in patches, and at Eidesvågen (Figure 17) several Pennatulacea occurred at 200 m depth together with the large solitary hydroid *Corymorpha* sp. *Corymorpha* sp has a remarkable power of regeneration (Torrey 1904) and might therefore not show the same vulnerability as the soft corals as long as it is not covered by sediment.

The fish and shark fauna of the fjord is a highly mobile fauna which most probably will move away from the areas where the cable-corridor are being worked out. When a possible resuspension of sedimentation from the cable-related work has settled down and the benthos recovered, it is believed that this vertebrate fauna will re-establish again.

Conclusion

The deep horizontal seabed along the midline of the investigated fjord was dominated by the crustacean *Munida* sp and its borrows, the sea cucumbers *Bathyplotes* sp/*Stichopous* sp, sea-pens and the *Bonellia* sp (Echiura). Physical activities and anchoring may cause damage to the mobile (*Munida* sp, *Bathyplotes* sp/*Stichopous* sp), and the static (*Bonellia* sp, sea-pens) megafaunal species and cause smothering if there will be any disposal of sediments. But this report concludes that, even though the local recovery time is unknown, the abundant population of these species will be able to re-colonise the area, and therefore there will be no problems by laying the cable on the seabed in, any parts of, the deep middle line of the fjord.

The steep walls along the sides of the investigated fjord are populated with the frequently-occurring taxa as the sea star *Brisingia* sp, the large bivalve *Acesta* sp, and the different species of recorded sponges, which all are not previously recorded as particularly vulnerable species. Any damaged on these populations will most probably be repopulated by offspring from neighboring specimens living on other parts of the rocky walls above the bottom sediments. Though local recovery time and development is unknown, we do not consider these species as threatened by the cable corridor.

But in the outer part of the investigated fjord several observations of corals make these areas vulnerable to physical impacts. At the landfall at Kvamsøy cliff wall we might have records of the corals *Lophelia pertusa* and *Anthomastus grandiflorus*, which both are registered on the "Norwegian red-list". In Øystese the *Primnoa* soft-coral (red trees) was recorded and registered as "abundant". These areas should therefore be taken into special reconsideration and we recommend using video observations to avoid threatened impact on this group of corals during the cable laying.

Reference list

Krieger K.J. 2001. Coral (Primnoa) impacted by fishing gear in the Gulf of Alaska. In: Martin Willison, J.H. et al. (Ed.), Proceedings of the First International Symposium on Deep-Sea Corals. Ecology Action Centre and Nova Scotia Museum, Halifax, Nova Scotia, pp. 106-116.

OSPAR COMMISION 2010a. Background Document for Seapen and Burrowing megafauna communities. ISBN 978-1-907390-22-7; Publication Number: 481/2010.

OSPAR COMMISION 2010b. Background Document for Coral gardens. ISBN 978-1-907390-22-7; Publication Number: 481/2010.

Torrey H.B. 1904. Biological studies on Corymorpha. I. C. palma and environment. Journal of Experimental Zoology, 1: 395–422. doi: 10.1002/jez.1400010304.

APPENDICES

Appendix 1. Ship log.

	Bottom type	Depth (m)	Video length (m) area (m^2)	Date 2010	Time (UTC)	Notes
Kvanndal Start 36859.22E 6703515.6N Stop 369390.59E 9702888.19N	Sandy bottom to steep cliff	300-800	1500 m Min: 4500 m^2	11.nov	21:16-23:17	Trial run. Transect at planned land line.
Utne Start 369456.87E 6702446.59N Stop 669010.75E 6702642.82N	Flat bottom, gravely mud	700	800 m Min: 2400 m^2	13.nov	03:00-04:00	Transect next to cable line in fjord basin.
Kvanndal topography	Soft, sandy bottom to steep cliff	700-300	2000 m Min: 6000 m^2	13.nov		Transect at planned land line.
Uravika start 362777.58E 6702475.38N Stop E362283.88 6703264.36N	Gravely bottom to steep cliff	800-21	1500 m Min: 4500 m^2	13.nov	10:29-12:55	Transect at planned land line.
Ålvik N Start 362017.72E 6701764.9N Stop 362283.9E 6701919.2N	Flat bottom, gravely mud	790	540 m Min: 1620 m^2	13.nov	14:45-15:18	Transect next to cable line in fjord basin.
Seianes 4 Start 360988.32E N9701430 Stop 360486.64E 6702480N	Gravely bottom, elevating bedrock to moderate steep cliff	781-2	1300 m Min: 3900 m	13.nov		Transect at planned land line.
Ålvik 5 Start 358802.8E 6700516.8N Stop 357861.46E 9702096N	Sandy bottom, bedrock, to steep cliff	850-33	1850 m Min: 5550 m^2	13. nov	22:19-01.49	Transect at planned land line.
Ålvik-line Start 358740.15E 6699400.01N Stop 359759.4E 6699782.59N	Sandy bottom and bedrock	800-900	600 m Min: 5550 m^2	14.nov	02:54-05:06	Bottom structure next to cable line
Nanes Start 35396.53E 6697925.42N Stop 353209.65E 6697783.32N	Flat bottom, sandy mud	800	6 00 m Min: 1800 m^2	14.nov	13:08-13:38	Transect next to cable line in fjord basin.
Kvamsøy Start 351346.41E 696674.82N Stop: 348716.34E 6694000.07N	Flat bottom, sandy mud, bedrock, steep cliff	801-496	430 m Min: 1290 m^2	14. nov	20:35-22:41	Transect next to cable line in fjord basin. Coral registration earlier by local fisher
Øystese Start: 351343.97E 6693471.64N Stop: 348739.39E 6694000.07N	Flat bottom, sandy mud, steep cliff	800-92	2000 m Min: 6000 m^2	15. nov	02.19-04.40	Transect at planned land line. From middle of the fjord up to a cliff to the land areas
Aksneset Start: 348100.91E 6690807.39N Stop:346843.52E 6694144.71N	Flat bottom and moderate steep cliff	810-350	3500 m Min: 15500 m^2	15.-16. nov	23.03-04.16	Transect at planned land line. From cable line and N-W to land area.

Eidesvågen Start 345344.13E 6689709.87N Stop 344298.02E 6687009.16N	Flat bottom to steep cliff.	820-15	3800m Min: 11400m^2	16.-17. nov	18.53-23.44	Statnett video survey. From center line along the planned cable line to the landfall in the bay of Eidesvågen.
Inner Eikenes Start: 393924.33E 6706530.53N Stop: 394464.43E 6706750N	Flat muddy bottom	200-150	500m Min: 11400 m^2	28. nov	10.30	Transect next to cable line in fjord basin
Outer Eikenes Start: 388655.9E 6707748.41N Stop: 388198.14E 6707556.41N	Flat sandy bottom	300	704 m Min: 2112 m^2	28. nov	12.15.-12.46	Transect next to cable line in fjord basin.
Vallavik Start: 381095.29E 6706878.97N Stop: 376530.69E 6703681.58N	Flat sandy-muddy bottom	400	848m Min: 2544m^2	28. nov	14.09-1439	Transect next to cable line in fjord basin.
Slåttenes N Start: 376531.71E 6703684.12N Stop: 376007.96E 6703238.74N	Flat sandy-muddy bottom	300	784 m Min. 2352 m^2	28. nov	16.09-17.09	Transect next to cable line in fjord basin.
Slåttenes S Start: 373433.7E 669272.55N Stop: 373342.3E 670073.79N	Flat sandy-muddy bottom	700	784 m Min: 2352m^2	28. nov	19.25-1935	Transect next to cable line in fjord basin. Bottom structure.

APPENDIX 2. Video observations of depth, topography, substrate and fauna

Inner Eikenes (Figure 4)
Transect positioning: Next to cable in the middle of the fjord
Transect length: (original 805 m) 500 m
Transect topography and depth: Various, 200-150 m
Sediment type: Flat seabed with scattered boulders and bedrock
Dominating species: *Munida* sp., *Bonellia* sp., Squalidae, Porifera varia
Characteristic, type, species, other: Pennatulacea, *Anthomastus* sp., *Acesta* sp.
Species other: Flatfish, Teleost indet (bony fishes), Porifera or coral tree

Remarks: The video transect started on a flat seabed with low species number. *Munida* sp. and *Bonellia* sp. together with Squalidae dominated. Moving on the side of bedrocks Porifera varia or coral trees was abundant (see pictures). Flat seabed towards the end, decrease in Squalidae. ROV was stuck in wire and it was necessary to abort the last few hundred meters.

Outer Eikenes (Figure 5)
Transect positioning: Next to cable in the middle of the fjord
Transect length: 704 m
Transect topography and depth: Flat seabed, 300 m
Sediment type: Sandy mud
Dominating species: *Funiculina* sp., *Isidella* sp., *Bathyplotes* sp., *Bonellia* sp.
Characteristic, type, species, other: *Funiculina* sp., *Isidella* sp., *Bathyplotes* sp.
Species other: Pleuronectiformes, *Chimaera* sp., *Stichopus* sp., *Macrouridae* sp.

Remarks: Flat seabed along the entire transects. The sediment type was sandy mud with many burrows. Low species number and it was mostly *Funiculina* sp., *Bathyplotes* sp., and *Isidella* sp. that was recorded.

Vallavik (Figure 6)
Transect positioning: Next to cable in the middle of the fjord
Transect length: 848 m
Transect topography and depth: Flat seabed, 400 m
Sediment type: Sandy mud.
Dominating species: *Isidella* sp., *Bathyplotes* sp., *Bonellia* sp.
Characteristic, type, species, other: *Isidella* sp.
Species other: Coryphaenoides sp., *Henricia* sp.

Remarks: Flat seabed along the entire transects. Low species number in the beginning. *Bathyplotes* sp., *Munida* sp. and *Bonellia* sp. dominating together with burrows from *Munida* sp. *Isidella* sp. appears at 240 m and became abundant together with *Bathyplotes* sp.

Slåttenes north (Figure 7)
Transect positioning: On the cliffside next to cable trasè
Transect length: 784 m
Transect topography and depth: Flat seabed at 300 m
Sediment type: Sandy mud and cliffside
Dominating species: *Munida* sp., *Bathyplotes* sp., *Isidella* sp., *Brisingia* sp., *Psolus* sp.
Characteristic, type, species, other: *Isidella* sp., *Acesta* sp., Cerianthidae
Species other: *Henricia* sp., Coryphaenoides sp., *Chimaera* sp.

Remarks: Started the transect on flat seabed with some scattered boulders and where *Munida* sp and *Bathyplotes* sp. dominated. When moving up the cliffside from 244 m to 226 m, *Acesta* sp. was recorded in a small colonies and *Psolus* sp. becomes abundant. Also lebenspuren from Holoturidea mud appears. At 227 m depth *Isidella* sp. became abundant on a part of the transect, but then *Psolus* sp. took over this dominans. Went down to 245 m depth at the end of the transect, but was flying too high for registering benthos. *Bathyplotes* sp. became abundant in the end on a flat seabed with sandy mud.

Slåttenes south (Figure 8)
Transect positioning: Crossing structure next to cable corridor
Transect length: 784 m
Transect topography and depth: Flat seabed, 700 m
Sediment type: sandy mud, moving over structure
Dominating species: *Munida* sp., *Bathyplotes* sp.
Characteristic, type, species, other: *Bolocera* sp., *Brisingia* sp., Cerianthidae
Species other: *Henricia* sp., Coryphaenoides sp., *Chimaera* sp., *Mesothuria intestinalis*, Asteroidae (white), *Myxine* sp.

Remarks: Moving over a structure in the middle of the fjord next to the cable corridor. Starting at 715 m where *Munida* sp. and *Bathyplotes* sp. was dominating a seabed with burrows and lebenspuren. Holoturidea mud appears regularly. When moving up a small bedrock covered in mud also *Bathyplotes* sp. and *Munida* sp. became dominating again. *Chimaera* sp., Coryphaenoides sp. and *Myxine* sp. was recorded.

Kvanndal videoline (landfall) (Figure 9)
Transect length: 1500 m
Transect topography and depth: Flat terrain to steep cliff. 800-300 m
Sediment type: Sandy mud and bed rock
Dominating species: *Munida* sp., *Stichopus* sp., *Brisingia* sp.
Species other: *Acesta* sp., *Virgularia* sp., *Chimaera* sp., *Molva molva*

Remarks: The video-transect started at 800 m depth. Soft muddy/sandy bottom where the sea star *Brisingia sp.* was abundant together with the sea pen (Pennatulacea) *Virgularia* sp. The

sea cucumber *Stichopus sp.* and the crustacean *Munida* sp. were found distributed all over the seabed. Frequent records of burrows, from the crustacean *Munida sp.*, made up coverage of ~60 % of the seabed. After 100-200 m the transect climbs up a cliff-side ('wall'). *Brisingia* sp. dominated in the start with a few sea cucumbers, the cartilaginous Chondrichthyes (shark-family) *Chimaera* sp. and the Osteichthyes (fish) *Molva molva*. A lower bio-diversity was observed on the cliffside compared to the seabed. A closer investigation was made of the bivalve *Aceasta* sp. which appeared in colonies attached below an over-hang on the cliff side. Moving up on the plateau, the sponges *Phakellia* sp. and *Axinella* sp. appeared frequently. *Stichopus* sp. together with sea cucumber *Psolus* sp. and the Echiura *Bonellia* sp. were the dominating species on the rest of the transect at 300 m depth

Kvanndal statnett topography survey (Landfall) (Figure 9)
Transect positioning: North of the Kvanndal (biological) survey
Transect length: 2000 m
Transect topography: Flat sea bed, transect going towards cliff and moving up cliffside
Sediment type: Soft muddy/sandy bottom and bedrock
Dominating species: *Munida* sp., *Bathyplotes* sp. and *Stichopus* sp. dominating
Species other: *Virgularia* sp., *Brisingia* sp., *Psolus* sp.

Remarks: Videorecording started at 700 m depth where the seabed was flat with soft muddy/sandy sediment. *Munida* sp., *Bathyplotes* and *Stichopus* sp. were dominating. Several burrows from the *Munida* sp. were recorded. *Virgularia* sp. appeared regularly in the beginning. Moving up the cliff, *Brisingia* sp. started to appear regularly and burrows in the flat muddy areas on the bedrock were recorded. *Bonellia* sp. appeared at 550 m depth and was recorded throughout the remaining part of the transect. *Psolus* sp. appeared at 450 m depth and was recorded throughout the transect. At 340 m depth a cable appeared on the seabed, the cable was followed until it was buried under mud at 265 m. Low diversity on bedrock. Patched distribution of several Porifera species and of *Acesta* sp.

Utne (Figure 10)
Transect positioning: Along the planned cable-corridor in the midline of the fjord
Transect length: 800 m
Transect topography and depth: Plain terrain at 700 m
Sediment type: Homogenous gravelly mud throughout the transect line
Dominating species: *Munida* sp. dominated in numbers, evenly distributed along the video-line, *Stichopus tremulus* and *Bathyplotes* sp., also in high abundance
Characteristic, type, species: Pennatulacea (probably *Virgularia* sp.) appeared every 50-70 m
Species other: The deep-sea fish *Coryphaenoides* sp., *Chimaera* sp.

Remarks: Started at 700 m and did a flat transect next to where the cable might go in the middle of the fjord to get an indication of what fauna exist at the seabed. The substrate was very soft, gravelly mud with tracks from the animals and burrows from the crustacean *Munida*

sp. *Munida* sp., *Stichopus* sp./*Bathyplotes* sp. were the most common species we observed in this area. Pennatulacea (probably *Virgularia* sp.) appeared every 50-70 m alone. Some small juvenile fish and the deep-sea fish *Coryphaenoides* sp. (Coryphaenoides sp.) along with *Chimaera* sp. were found. Teleosts (bony fishes)

Uravika statnett topography survey (Figure 11)
Transect positioning: Along the planned land cable area
Transect length: 1500 m
Transect topography and depth: Flat seabed at 800 m, moving up steep cliff
Sediment type: Gravelly mud with burrows and bedrock
Dominating species: *Munida* sp., *Bathyplotes* sp. and *Stichopus* sp. were the dominating species throughout the transect
Characteristic, type, species: Pennatulacea, *Chimaera* sp.
Species other: *Henricia* sp., Porifera indet

Remarks: The transect started at 800 m on soft muddy/sandy sediment. *Munida* sp., *Bathyplotes* and *Stichopus* sp. were the abundant species thoughout the transect. The area was flat until a wall raised up from 790 m to 21 m. Low diversity was recorded on the cliffside, but patches of possibly small Porifera species were registered. *Acesta* sp. colonies appeared at 600 and 500 m. The cliffside flattened out in some areas, and *Munida* sp. and *Bathyplotes* sp. became dominating.

Ålvik north (Figure 11)
Transect positioning: Along the planned cable line in the middle of the fjord
Transect length: 700 m, recorded as 540 m
Transect topography and depth: Flat seabed at 790 m depth
Sediment type: Gravelly mud
Dominating species: *Munida* sp. dominated in numbers and were evenly distributed along the video-line. *Bathyplotes* sp. and *Mesothuria intestinales* were also abundant
Characteristic, type, species, other: Pennatulacea
Species other: Actinaria indet, Cerianthidea, *Bonellia viridis*, *Henricia* sp., Asteroidea indet., *Stichopus tremulus*, *Asbestopluma* cf., *Chimaera monstrosa*, *Molva molva*

Seianes 4 (Landfall) (Figure 11)
Transect positioning: Along the planned landfall cable area
Transect length: 1300 m
Transect topography and depth: Start depth 781 m. The first part of the transect at 235 m was flat seabed ending at bedrock at 760 m depth. Rest of the transect consist of moderate to steep bed rock alternating with flat or inclined seabed. Transect ended in littoral zone at 2 m depth.
Sediment type: Flat seabed with gravely mud and changing to bed rock and gravely mud along the transect

Dominating species: In the flat area *Munida* sp. and *Bathyplotes* sp. appeared in high numbers. On the cliffside *Munida* sp., *Bathyplotes* sp., and *Mesothuria intestinales* were registered in moderate numbers, but with infrequent occurrence. From 450 m depth towards the end of the transect *Acesta* sp. occurred frequently in patches in high numbers
Characteristic, type, species, other: In the flat area *Mesothuria intestinalis*, Pennatulacea. On the cliffside Pennatulacea, *Brisingia* sp.
Species other: On the flat seabed Asteroidea, *Brisingia* sp., and Cerianthidea occurred. On the cliffside Asteroidea, *Molva molva, Coryphaenoides* sp., Cerianthidae, *Chimaera* sp., *Bonellia* sp., Echinoidea, Neuroplectidae hva er dette, Porifera indet., *Phakellia* sp., Serpulidae polychaeter, *Lithodes maja*, Patellidae gastropoda, and the fishes *Lumpenus* sp. (most likely Langebarn) *Sebastes* sp., and *Brosme* sp.

Ålvik 5 (Landfall) (Figure 12)
Transect positioning: Along the planned landfall cable area
Transect length: 1850 m
Transect topography and depth: Flat seabed in beginning of transect ending up a cliff.
Sediment type: Sandy mud to bedrock
Dominating species: *Munida* sp., *Bathyplotes* sp. on flat seabed, while on the cliffside *Munida* sp. and *Acesta* sp.
Characteristic, type, species, other: Tunicate, *Bonellia* sp., *Chimaera* sp., Cephalopoda (Octopus) and Actiniaria
Species other: Porifera, *Hymedesmia* sp., *Henricia* sp., *Brisingia* sp., *Galeus melastomus, Funiculina* sp.

Remarks: Starting on flat seabed with sandy mud and burrows. The dominating species were *Munida* sp. and *Bathyplotes* sp. Other species occurring were Tunicate, *Bonellia* sp., *Chimaera* sp., Cephalopoda (Octopus) and Actiniaria. The transect followed a cliffside from 845 m up to 120 m depth before the wall flattened. Few other species than the dominating *Munida* sp. and patches of *Acesta* sp. were recorded. *Brisingia* sp. occurred at 700 m and up to 120. Patches of Porifera, *Hymedesmia* sp. and *Henricia* sp. were recorded on the cliffside. Colonies of *Acesta* sp. occurred regularly between 200-300 m hanging under the cliffside. At 170, 160 and 120 m, the wall flattened out for some meters with soft sandy mud as substrate and species like Pennatulacea, *Stichopus* sp. and the sea urchin *Echinus* sp. were occurring. At the end of the transect, the wall was flattening out at 120 m. Here boulders and cobbles were recorded. The ROV was flying too high to get images for recognising any species. Possibly *Funiculina* sp. occurred at the end of the transect

Ålvik (structure in the middle of the fjord) (Figure 12)
Transect positioning: Next to cable in the middle of the fjord crossing a bedrock structure
Transect length: 600 m
Transect topography and depth: 800-900 m
Sediment type: Sandy mud with burrows, bedrock

Dominating species: *Munida* sp.
Characteristic, type, species, other: Cerianthidae, Holoturoidea, *Brisingia* sp., Porifera (white irregular)
Species other: Teleost, *Henricia* sp., Pennatulacea

Remarks: The transect crossed a bedrock structure in the middle of the fjord next to the cable corridor. The sediment was sandy mud, and *Munida* sp. was the dominating species. Lots of burrows and lebenspuren found on the sandy mud areas. When crossing the structure, the substrate went over to bedrock where Porifera (white irregular) hanging from the cliff was the dominating species. A few *Munida* sp. appeared on the bedrock. When the transect on the structure crossed patches of sandy mud with boulders, *Stichopus* sp. was dominating. Other species like *Henricia* sp., Cerianthidae, *Ceramaster* sp. and Pennatulacea occurred. Also Serpulidae polychaet-tubes were found on the structure.

Nanes (Figure 13)
Transect positioning: Next to cable in the middle of the fjord
Transect length: 600 m
Transect topography and depth: 800 m
Sediment type: Flat seabed with sandy mud, *burrows and lebenspuren*
Dominating species: *Munida* sp., *Bathyplotes* sp.
Characteristic, type, species, other: *Brisingia* sp., Pennatulacea, Holoturoidea indet, *Henricia* sp.
Species other: Teleost, Virgularia sp.

Remarks: The videotransect passed a flat seabed with sandy mud and burrows. Lots of lebenspuren from animals were recorded in the sand. Dominating species were *Munida* sp. and *Bathyplotes* sp. all through the transect. In the beginning of the transect, the seastar *Brisingia* sp. was recorded a few times together with Pennatulacea. Pennatulacea occurred several times towards the end of transect. *Henricia* sp. and *Mesothuria intestinales* occurred a few times. We had to stop the transect 300 m before the endpoint due to a wire entangling the ROV.

Kvamsøy coral video line (Figure 14)
Transect positioning: moving away from the cable corridor to inspect a previous recorded coral reef in the area nearby
Transect length: 430 m
Transect topography and depth: Starting at 801 m depth. The first 70 m was a flat seabed ending up at bedrock at 770 m depth. The rest of the transect consist of moderate inclinations to steep bed rock cliffs alternating with flat or raising seabed. Transect ended at 496 m depth
Sediment type: In the flat areas, sandy mud with cobbles and boulders. Bedrock.

Dominating species: On the flat seabed *Munida* sp., *Mesothuria intestinales*, and *Bathyplotes* sp. was recorded in high numbers and as frequently occurring. The bedrock areas were dominated by *Munida* sp.
Characteristic, type, species, other: On the bedrock Holothuroidea indet and Porifera occurred in low numbers. Only few records of fauna concentrated on areas with crevices and shelves. *Brisingia* sp., *Henricia* sp., *Aplysilla* cf.
Species other: *Isops* cf., *Phakellia* sp., *Anthomastus* cf., *Isidella* sp., Cerianthidae, *Ceramaster* sp., Asteroidea indet., *Stichopus* sp., *Bonellia* sp., *Acesta* sp., Caridea indet, Coryphaenoides sp., (*Lophelia pertusa* like colony on the cable)

Remarks:
One possible found of *Lophelia pertusa* colony was made on 520 m depth, it appeared that this possible coral had started to grow on the cable hanging above the bottom. One *Isidella* colony observed on the top of the cliff at 572 m depth. Survey stopped 130 m before the end-point of the transect due to ROV entangled in the fishing long-line.

Øystese video line (Figure 15)
Transect positioning: Next to cable in the middle of the fjord and planned land cable site.
Transect length: 2000 m
Transect topography and depth: Sandy mud at 800 m, moving up a cliffside.
Sediment type: Flat seabed with sandy mud, few burrows and lebenspuren
Dominating species: In the deep parts *Munida* sp., *Bathyplotes* sp. were recorded, while in the shallow parts *Primnoa* sp. and Pennatulacea
Characteristic, type, species, other: *Myxine* sp., Cerianthidae, Serpulidae Polychaeta tubes, *Hymedesmia* sp., *Isidella* sp., *Funiculina* sp., *Acesta* sp.
Species other: Teleost, *Hippasterias* sp., *Acesta* sp., *Phakellia* sp., *Axinella* sp., Coryphaenoides sp., *Chimaera* sp.

Remarks: Starting on flat seabed. Sandy mud with lebenspuren. Few burrows although *Munida* sp. was dominating the area together with *Bathyplotes* sp. *Myxine* sp. and Cerianthidae occurred a few times. Moving up the wall from 849 m to 320 m depths, where *Stichopus* sp. and Porifera (white irregular) became the most abundant species together with *Munida* sp. and *Bathyplotes* sp. *Munida* sp. was not recorded on the flat areas of the seabed and only a few *Bathyplotes* sp. were seen. Scattered boulders. Some *Echinus* sp. were seen on the wall. *Acesta* sp. occurred at 690 m, 613 m and 560 m. Coming up to 400 m a patch of many *Isidella* sp. individuals was recorded. The forest of *Isidella* sp. was taken over by *Bathyplotes* sp. in high abundances. In the end of transect Pennatulacea became abundant.

Akseneset (Figure 16)
Transect positioning: Norheimsund, topography survey from planned cable line towards N-W planned landfall area

Transect length: 3500 m
Transect topography and depth: Start of the transect at 850 m depth, on flat seabed with sandy mud and spread boulders and cobbles. Moderate to steep raising bed rock cliffs, or flat - raising sandy, muddy seabed. Scattered boulders and cobbles. Depth range of 810-350 m
From 350-179 m a sandy muddy flat seabed with few scatter boulders was recorded.
Sediment type: In the flat deep area, sandy mud with spread boulders and cobble. In shallower areas bedrock and sandy mud with spread boulders and cobble.
Dominating species: *Munida* sp., *Mesothuria* sp., and *Brisinga* sp. with high and frequent occurrence. On bedrock *Isidella* sp., *Munida* sp., Holothuridae, *Brisinga* sp. were recorded. Moderate but infrequent occurrence on the sandy mud areas. *Isidella* sp. was numerous but in patches, *Brisinga* sp. was recorded on boulders and bedrock. *Stichopus* sp., and Pennatulacea
Characteristic, type, species, other: *Bathyplotes* sp. *Henricia* sp., *Sebastes* sp.
Species other: *Axinella* sp., *Phakellia* sp., Porifera (white), *Hymedesmia* sp., *Porania* cf., Asteroidea indet., Asteroidea (white), *Bolocera* sp., Actiniaria indet., *Psolus* sp., Cerianthidae indet, Selachimorpha indet., *Chimaera monstrosa*, *Lophius piscatorius, Molva molva, Coryphaenoides* sp.

Remarks: *Munida* sp. occurred in high numbers in the flat areas of the fjord, on the bedrock was occurrence at moderate levels although when *Isidella* sp. was present the occurrence of *Munida* sp. was reduced.

Eidesvågen (Figure 17)
Transect positioning: From cable corridor line to landfall in Eidesvågen
Transect length: 3800 m
Transect topography and depth: 820 - 15 m
Sediment type: Seabed varied from flat to cliffwall.
Dominating species: *Munida* sp., *Bathyplotes* sp., *Stichopus* sp.
Characteristic, type, species, other: Pennatulacea, *Eutrigla* sp.
Species other: *Munida* sp., *Mesothuria intestinales*, *Bathyplotes* sp., *Stichopus* sp., *Isidella* sp., *Molva molva, Gadus morhua, Chimaera* sp., *Melanogrammus aeglefinus, Henricia* sp., *Stylocordyla* sp., Asteroidea indet, *Virgularia* sp., *Acesta* sp., *Psolus* sp. *Bonellia* sp., Ophiuridea indet, Paguridae indet, *Corymorpha* sp., Pleuronectiformes indet, *Sebastes* sp., Selachimorpha indet, *Coryphaenoides* sp.

Remarks: Long transect with variable visibility. Starting out on flat seabed with a few scattered boulders, *Munida* sp. and *Bathyplotes* sp. were dominating. Moving up a ‘starcase’ cliff with alternating flat to steep cliff along the transect. Ophiuridea became abundant at 830 m depth. A low diversity of species was recorded at 600 m depths. There was bad visibility for some part of the transect, while in other parts the ROV was flying too high. *Isidella* sp. appeared at 630 m and was abundant up to 540 m. *Bonellia* sp. appeared at 570 m, and Cerianthidae became dominant on the seabed at 560 m. Several Pennatulacea occurred at 200 m, where also some scattered boulders were recorded. Low species number at the end of the transect and lot of dead shells.

APPENDIX 3. Species and substrate

Do to that this investigation was only made by visual images, and no biological sampling, it was not possible to identify all individuals to species names. When a name is followed with a "sp" this is referring to any species within the family given by the name. When a name is followed by a "cf" it means that the identification is unsure, but that the animal might look like belonging to the indicated family. When the name is followed by a "indet", this mean that the animal is indeterminate, but belonging to a large group indicated by the name.

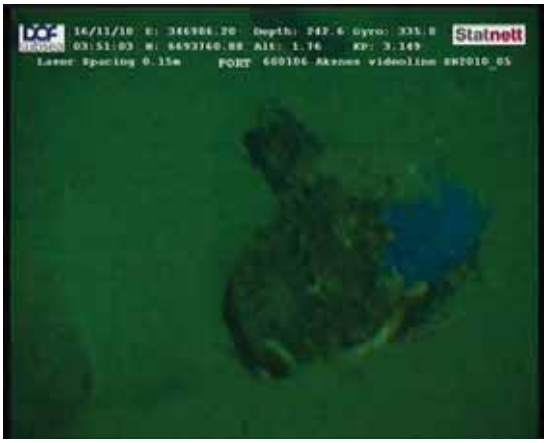
Area transect	**Substrate**	**Species**
Indre Eikenes	Sandy mud	**Porifera:** Porifera indet, Porifera or coral tree **Cnidaria:** Pennatulacea, *Anthomastus* sp, **Crustacea:** *Munida* sp, **Mollusca:** *Acesta* sp **Echinodermata**: **Fish and sharks:** Teleost, Pleuronectiformes indet, Squalidae indet **Other:** *Bonellia* sp
Other Eikenes	Sandy mud	**Porifera:** **Cnidaria:** *Funiculina* sp, *Isidella* sp **Crustacea:** **Mollusca:** **Echinodermata**: *Bathyplotes* sp, *Stichopus* sp **Fish and sharks:** Pleuronectiformes indet, *Chimaera* sp, Macrouridae indet **Other:** *Bonellia* sp
Vallavik	Sandy mud	**Porifera:** **Cnidaria:** *Isidella* sp **Crustacea:** **Mollusca:** **Echinodermata**: *Henricia* sp, *Bathyplotes* sp, **Fish and sharks:** Coryphaenoides sp (Skolest) **Other:** *Bonellia* sp
Eikenes north	Sandy mud	**Porifera:** **Cnidaria:** *Isidella* sp, Cerianthidae indet **Crustacea:** *Munida* sp **Mollusca:** *Acesta* sp **Echinodermata**: *Brisingia* sp, *Henricia* sp, *Psolus* sp, *Bathyplotes* sp **Fish and sharks:** *Coryphaenoides* sp, *Chimaera* sp
Eikenes south	Sandy mud	**Porifera:** **Cnidaria:** *Bolocera* sp, Cerianthidae **Crustacea:** *Munida* sp **Mollusca:** **Echinodermata**: *Brisingia* sp Asteroidea (white), *Henricia* sp, *Mesothuria intestinalis*, *Bathyplotes* sp **Fish and sharks:** *Coryphaenoides* sp, *Chimaera* sp, *Myxine* sp
Kvanndal	Flat gravelly mud to bedrock	**Porifera:** *Phakellia* sp, *Axinella* sp **Cnidaria:** *Virgularia* sp **Crustacea**: *Munida* sp, **Echinodermata**: *Brisingia* sp, *Henricia* sp *Ceramaster* sp, *Stichopus* sp, *Psolus* sp **Fish and sharks**: *Chimaera* sp, *Molva* sp
Utne	Flat muddy-sand bottom	**Cnidaria:** Pennatulacea indet, *Virgularia* sp **Echinodermata**: *Stichopus* sp, *Bathyplotes* sp, Asteroidea indet **Crustacea**: *Munida* sp **Fish and sharks**: *Coryphaenoides* sp, *Chimaera* sp, Teleost indet

Kvanndal statnett topography survey	Flat muddy-sand bottom	**Cnidaria:** Pennatulacea, *Virgularia* sp, *Funiculina* sp, **Crustacea**: *Munida* sp **Mollusca**: *Acesta* sp **Echinodermata**: *Stichopus* sp, *Bathyplotes* sp, *Brisingia* sp, Asteroidea indet **Fish and sharks**: *Coryphaenoides* sp, *Chimaera* sp, Teleost indet
Uravika statnett topography survey	Flat muddy-sand bottom	**Cnidaria:** Pennatulacea **Crustacea:** *Munida* sp **Mollusca:** *Acesta* sp **Echinodermata**: *Stichopus* sp, *Bathyplotes* sp, *Brisingia* sp, Asteroidea indet **Fish and sharkes:** *Coryphaenoides* sp, *Chimaera* sp, Teleost indet
Ålvik north	Flat muddy-sand bottom	**Porifera:** Asbestopluma cf **Cnidaria:** Actinaria indet, Cerianthidea **Crustacea:** *Munida* sp **Echinodermata:** *Stichopus tremulus*, *Bathyplotes* sp, *Mesothuria intestinales*, *Henricia* sp, Asteroidea indet **Fish and sharks:** *Chimaera* monstrosa, *Molva molva.* **Other:** *Bonellia viridis*
Ålvik 5	Sandy mud and bedrock	**Porifera:** *Hymedesmia* sp, Porifera indet **Cnidaria:** *Funiculina* sp, Actiniaria **Mollusca:** Octopus **Echinodermata**: *Brisingia* sp, *Henricia* sp, **Fish and sharks:** *Chimaera* sp, *Galeus* sp **Other:** Tunicata indet, *Bonellia* sp
Ålvik (structure)	Sandy mud, bedrock	**Porifera:** Porifera (white irregular) **Cnidaria:** Pennatulacea indet, Cerianthidae indet **Crustacea:** *Munida* sp **Echinodermata:** *Brisingia* sp, *Henricia* sp, Holoturidea **Fish and sharks:** Teleost indet
Nanes	Sandy mud	**Cnidaria:** Pennatulacea indet, *Virgularia* sp **Crustacea:** *Munida* sp **Echinodermata:** *Brisingia* sp, *Bathyplotes* sp, Holoturidea **Fish and sharks:** Teleost
Kvamsøy coral video line	Sandy mud, bedrock	**Porifera:** *Phakellia* sp, *Aplysilla* cf, Porifera indet **Cnidaria:** *Isidella* sp, *Lophelia pertusa* cf, *Anthomastus* cf., *Isops* cf., Cerianthidae indet **Crustacea:** *Munida* sp, Caridea indet **Mollusca:** *Acesta* sp **Echinodermata:** *Brisingia* sp, *Henricia* sp, *Ceramaster* sp, Asteroidea indet, *Mesothuria intestinales*, *Bathyplotes* sp**,** *Stichopus* sp, Holothurioidea indet **Fish and sharks:** *Coryphaenoides* sp **Other:** *Bonellia* sp
Øystese statnett video survey	Sandy mud, bedrock	**Porifera:** *Phakellia* sp, *Hymedesmia* sp, *Axinella* sp **Cnidaria:** *Funiculina* sp, *Isidella* sp, Cerianthidae **Crustacea:** *Munida* sp **Mollusca:** *Acesta* sp **Echinodermata**: *Hippasterias* sp, *Bathyplotes* sp **Fish and sharks:** *Coryphaenoides* sp, *Chimaera* sp, *Myxine* sp, Teleost **Other:** Serpulidae polychaet tubes
Aksneset statnett video survey	Sandy mud, bedrock, boulders, cobble	**Porifera:** *Phakellia* sp, *Axinella* sp, *Hymedesmia* sp, Porifera white **Cnidaria:** Pennatulacea indet, *Isidella* sp, *Bolocera* sp, Cerianthidae indet, Actiniaria indet **Crustacea:** *Munida* sp **Mollusca**

		Echinodermata: *Porania* cf, *Brisinga* sp, *Henricia* sp, Asteroidea indet, *Mesothuria intestinalis*, *Bathyplotes* sp, *Stichopus* sp, *Psolus* sp **Fish and sharks:** *Sebastes* sp, *Coryphaenoides* sp Selachimorpha indet, *Chimaera monstrosa*, *Lophius piscatorius*, *Molva molva*
Eidesvågen statnett video survey	Sandy mud, bedrock, boulders, cobble, shell bed	**Porifera:** *Stylocordyla* sp, **Cnidaria:** Pennatulacea indet, *Virgularia* sp *Isidella* sp, *Corymorpha* sp **Crustacea:** *Munida* sp, Paguridae indet **Mollusca:** *Acesta* sp **Echinodermata**: *Henricia* sp, Asteroidea indet, *Mesothuria intestinales*, *Bathyplotes sp*, *Stichopus sp*, *Psolus* sp, Ophiuridea, **Fish and sharks:** Selachimorpha indet, *Eutrigla* cf, *Molva molva*, *Gadus morhua*, *Chimaera* sp, *Melanogrammus aeglefinus*, *Coryphaenoides* sp, Pleuronectiformes indet, *Sebastes* sp **Other:** *Bonellia* sp

APPENDIX 4. Species pictures

Porifera: *Hymedesmia* sp



Porifera: *Phakellia* sp

Porifera: *Axinella* sp

Cnidaria: *Actinaria Prontantea simplex*

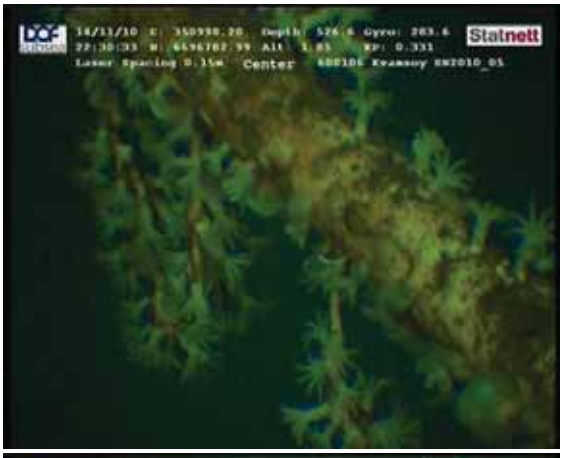
Cnidaria: Actinaria *Bolocera* sp

Cnidaria: Pennatulacea *Virgularia* sp

Cnidaria: Coral – *Funiculina* sp

Cnidaria: Coral *Funiculina* sp

Cnidaria: Coral *Lophelia* sp



Cnidaria: Coral *Primnoa* sp

Cnidaria: Coral *Isidella* sp

Cnidaria: Cerianthidae indet

Crustacea: *Munida* sp

Crustacea: *Munida* sp and borrows

Mollusca: Bivalvia *Acesta* sp

Echinodermata: Holothuroidea *Mesothuria intestinales*

Echinodermata: Holothuroidea *Bathyplotes* sp

Echinodermata: Holothuroidea *Sticopus* sp

Echinodermata: Holothuroidea *Psolus* sp

Echinodermata: Asteroidea *Henrisia* sp

Echinodermata: Asteroidea *Ceramaster* sp

Echinodermata: Echinoidea *Echinus* sp

Echinodermata: Asteroidea *Brisingia* sp

Echiura: *Bonellia* sp

Teleost: Fish *Lophius piscatorius*

Teleost: Fish *Coryphaenoides rupestris*

Teleost: Fish *Brosme brosme*

Teleost: Fish *Sebastes* sp

Teleost: Fish *Molva molva*

Agnatha: *Myxine* sp

Teleost: Fish Pleuronectiformes indet

Chondrichthyes: *Chimaera monstrosa*

APPENDIX 5. XLX 38 ROV Equipment fit

Doppler Log Units
RDI Doppler log 300Khz Ser. No. 1554

Camera systems
3 x Kongsberg-Simrad 14-366 Colour camera's
1 x Colour centre camera

Depth sensor units
Paroscientific Digiquartz 2000m Ser. No. 96321, fitted to ROV stbd
Paroscientific Digiquartz 2000m Ser. No. 96316, fitted to ROV port
Paroscientific Digiquartz 2000m Ser. No. 96334

Profiling Systems
Reson Seabat 7125 Port Process Unit Ser. No. 49878
Reson Seabat 7125 Starboard Process Unit Ser. No. 2108006
Reson Seabat 7125 Spare Process Unit Ser. No. 51529
Projector Ser. No.1908180 STBD side
Projector Ser. No.4005046 PORT side
Receiver Ser. No.4605014 STBD side
Receiver Ser. No.0808033 Port side

Azimuth and Attitude Sensors
1 x CDL MiniRLG2 survey gyro with integral motion sensor (also used for input to HAIN) Ser. No. MP2-146
TSS Orion Gyro compass Ser No.109

Sound Velocity Probes
SAIV SD204 Ser. No. 304, ROV mounted

Positioning Systems
3 x Kongsberg-Simrad MST 319/N transponders
3 x Kongsberg-Simrad MST 324/N transponders
Kongsberg-Simrad HAIN integrated inertial navigation

Obstacle Avoidance Sonar (OAS)
Kongsberg-Simrad Mesotech MS 1000

Side Scan Sonar (SSS)
Edgetech FS 4200 SSS / SBP system (300/600 KHz)

Sub-Bottom Profiler (SBP)
Edgetech FS 2400 2-15kHz

APPENDIX 6. Survey-dairy

Two marine biologists (Silje Jensen and Lis Lindal Jørgensen) from IMR arrived Bergen 08.11.2010 to wait for outcall to the RV Geograph.

The marine biologist and marine archeologist came onboard RV Geograph 09.11.2010 at 13:00 from Norheimsund, Hardanger fjord which was half the way through the cable corridor. Contact person on board the first day was Bård Hornslien from Statnett.
Used 09.11.2010 onboard to investigate the research area. Used digital maps to study the fjord topography.
Bård Hornslien left the boat in the afternoon 09.11.2010. His role on board was taken over by Knut Haldorsen (the primary Company Representative on board) and Steinar Vikør.
Preferred transect lines distributed from the inner to the outer part of Hardanger fjord was made by using the PC program "Navimodel" on RV Geograph. A map was printed to show the positions of the transects. The map was presented to the offshore manager Inge Skagen and the cruise leader (Haldorsen/Vikør) and the geographical position of the transects was digitalized and stored central in the logging system of the vessel.

The 11.11.2010 the first transect with biological observations was done.
The 12.11.2010 Hannu Kopponen (IMR) came onboard the vessel while Lis Lindal Jørgensen (IMR) went off.
After the test run of the first biological fauna video line, Statnett decided to add topographic video lines in possible landing areas for the cable-corridor with laser measurements. In order to use the time more efficiently IMR adjusted the biological video lines to fit the topography video-lines.

From the 11-17.11.2010, 13 video transects were made from the middle (Kvanndal) to the outer parts (Nordheimsund) of the investigated Hardanger fjord.
The 17.11.2010 the cruise leader informed the biologists to leave the vessel due to the geo-technical part of the survey would start. At this time the vessel had not investigated the inner parts (from Sima to Kvanndal) of Hardanger fjord and the biologist were told this would be taken at a later time.

The 19.11.2010 Lis Lindal Jørgensen contacted Bård Hornslien and Jan-Erik Sikkeland in order to get information on when RV "Geograph" would bring the biologist to the inner parts of the fjord for recording the remaining 5 transects that was originally planned (this plan was stored on maps on board).
After a phone meeting with IMR, it was decided by Statnett that we should return to Hardanger to fulfill the work. Silje-Kristin Jensen (IMR) and Gjertrud Jensen (IMR) therefore returned from Bergen 27 Nov 2010 and made the last transect during a 24 hours period.

The 28.11.2010 all transects was ROV-inspected. All video-records, pictures of observed species and CTD data were made available for the biologists and brought to IMR for further analysis and reporting.

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