NOVASARC: *Mapping Vulnerable Marine Ecosystems and anthropogenic activities in Arctic and sub-Arctic waters*

Kortlægning af sårbare marine økosystemer og menneskelige aktiviteter i arktiske og sub-arktiske områder

Second workshop in 2017 20 – 24 November in Torshavn, Færøyene



The 20-24 November the fourth workshop of the NOVASARC project was held in Torshavn at Havstovan.

<u>The main participants were:</u> Petur Steingrund (Far), Julian Burgos (Ice), Steinunn Hilma Ólafsdóttir (Ice, on Monday and Tuesday), Pål Buhl-Mortensen (No), Lene Buhl-Mortensen (No).

<u>Guests participating at smaller parts of the meeting were</u>: Øystein Skagseth (No), Hanna Sundahl (No), Hjálmar Hátún (Far), Helga Bára Mohr Vang (Far), Una Matras (Far), Ebba Mortensen (Far), and Poul Vestergaard (Far)

The key task for the workshop was to develop and test the analysis chain for the VME/impact analysis including:

- 1. Making a habitat suitability model (using Maxent) for one or two VMEs based on observations of occurrence and available abiotic setting eg.: temperature (max, min, variation), substratum, current, topography.
- 2. Produce a VME distribution map for the larger study area based on the habitat suitability model and environmental settings
- 3. Produce fishing pressure map based on trawling data for the larger area.
- 4. Making impact estimates based on GIS analysis of overlap between the VME distribution and fishing intensity.

Other tasks that were pursued were:

- Update content of the project Web site and
- Continue to develop the VME key species identification guide for video analyses and fishermen

At the workshop Hanna Sundahl (master student from Bergen, Norway) working on habitat suitability models for corals in Norwegian waters presented VME model results. The oceanographers Hjálmar Hátún (Havstovan) and Øystein Skagseth (IMR) providing data for bottom temperature and discussed available data on temperature, salinity and currents for the study area. Other participants from Havstovan were Ebba Mortensen and Poul Vestergaard who demonstrated the video-rig "Jørgen" developed at the Faroes, Helga Bára Mohr Vang presenting the web-site developed for presentation of mapping results from the Faroe part of the project, and Una Matras got an introduction to the program "VideoNavigator" for video analysis developed at IMR.

The rest of this document contains the time table for the workshop and associated activities. Appendices are included in the end of the document.

Monday 20

12:30 – 16:00 Lunch and arrival

16:00 – 17:00 Discussing meeting plans and exchange of ideas related to strategy for VME habitat suitability model construction (All).

Tuesday 21

09:00 – 09:15 Plans for the day

09:15 – 10:00 Available environmental data (Julian).

Environmental variables are: GEBCO: depth, terrain analysis; geomorphology (from Harris et al. 2014); and NISE temperature.

10:00 – 10:15 Coffee break

10:15 – 11:00 Experience from making habitat suitability models for corals (Hanna and Pål). Hanna participated from Bergen on Skype from 10:15. She presented modelled distribution for corals from her master thesis (Appendix A).

11:00 – 12:00 The NISE oceanographic dataset.

Øystein (participating via Skype from IMR in Bergen) presented the available data from the NISE database (Appendix B) and possible ways to analysing these to produce temperature min, max and variation. Hjálmar had to leave but the oceanography data session was continued on Wednesday.

12:00 – 14:00 Lunch and excursion

14:00 - 15:00

<u>Status on the fishing data</u> (Julian): The project has now all fishing data for 2013-15 from Norway and Iceland. During the meeting data for 2013 was delivered from the Faroes.

Lene requested data on fishing activity from The Greenland Institute of Natural Resources (Grønlands Naturinstitut), but due to low capacity and an internal project using the same data, they could not help with information.

<u>New information on VME distribution from the Faroes (Petur)</u>: Results from a cruise with RV Magnus Heinason, July 2017, and experience with the video equipment used was presented

by Petur (see Appendix C and D). Petur exchanged videos from the July cruise with project participants.

14:00 – 18:00 <u>Working on the VME distribution/Fishing pressure analysis (all).</u>

-The "Gerritsen method" (Gerritsen 2013) ¹ for fishing activity was compared with set cell size. - For the risk/pressure analysis swept area information for the cells is needed and this requires input on gear width of the different trawling gear in use in the study area. -Areas of increased geographic uncertainty should be identified. These would typically be

areas of high topographical relief.

-Test VMEs for the first total analysis was chosen to be: Sea pen (deep), Sea pen (shallow) and Lophelia.

- Environmental variables are: GEBCO bathymetry (depth and terrain analysis);

geomorphology from Harris et al (2014)², and temperature from the NISE-database.

18:00 Dinner (on behalf of Havstovan)21:00 Jazz in Hotel Torshavn (Optional)

Wednesday 22

09:00-09:15 Planning the day

09:15 -11:00 Update from partners on activities in 2017 (continued)

Activities from Iceland (Julian): New interesting information on VME distribution from cruise in June. New Information has been put on the website (see Appendix E).

Activities from the Faroes: By catches of VME species reported. Cruise in June video filming the seafloor on 60 locations (Petur). Equipment assembled by local engineers. The experience from putting the video-equipment together and adjusting in field (Ebba and Poul). How the video records will be made available for the public on maps at the home page of Havstovan (Helga).

Activities in Norway: IMR plan to put together a mini video-rig based on experiences from the Faroe video-rig (Pål). New data is available for the Skagerrak based on ROV material delivered by OCEANA, data will be delivered before end of year (Lene). New data from Mareano on VMEs (Appendix F).

11:00-12:00 Oceanography (continued from yesterday)

¹ Gerritsen et al. (2013). How much of the seabed is impacted by mobile fishing gear? Absolute estimates from Vessel Monitoring System (VMS) point data. – ICES Journal of Marine Science, 70: 523–531.

² Harris et al. (2014). Geomorphology of the oceans. Marine Geology 352: 4-24.

Hjálmar informed about possibilities related to NISE database. The easiest way of getting relevant data (temperature and salinity at bottom) with values for max, min, and variation could be to use the same method as Jochumsen et al. 2016³. Hjálmar will contact the first author to find out if we can use their model/script and if they are open for collaboration on this. If this is not possible we will pursue the method proposed by Øystein. Hjámar and Øystein will meet next week to discuss what the possibilities are when using the NISE data. The suggested output from the involvement of the oceanographers is likely at least two publications:

- Oceanography paper using the method of Jochumsen et al. 2016. But for a larger geographic area
- Biology paper "Distribution of VMEs in the Nordic Seas with risk analysis"

12:00-13:00 Lunch

13:00-14:00 Demonstration of the mini video-rig "Jørgen" constructed at the Faroes (Ebba and Poul) (See Appendix C).

14:00 – 17:00 Working on the VME distribution/Fishing pressure analysis (continued) -A habitat suitability model was made for Sea pen (deep and shallow VME) and *Lophelia*.

-Available fishing data was imported to the Gerritsen model (irregular grid) and results was discussed.

Thursday 23

09:00 Continue with the model and getting fisheries data (all)

10:15-11:00 Presentation at Havstovan (Lene)

Results from litter mapping off Norway based on a recent publication by Buhl-Mortensen & Buhl-Mortensen (2017) was presented.

11:00-12:00 Julian presented results from the model of fishing data and the habitat suitability model (300 m cell size) (Appendix E and F).

Environmental variables are:

-Depth (GEBCO) 300 m: slope, aspect, BPI, Rugosity (1 km and 25 km)

-Geomorphology: Abyss, Slope, Shelf: Rugosity: High, medium and low rugosity,

-Temperature: mean temperature from NISE database as delivered by Øystein.

12:00 -13:00 Lunch

³ Jochumsen et al. (2016) Bottom temperature and salinity distribution and its variability around Iceland, Deep-Sea Research I, 111(2016)79–90

13:00 - 15:00

Exchange of experience on video analysis from IMR:

Pål shared experience from video analysis from IMR. This approach will be used for the analysis of videos from the Faroe cruise in June 2017. Una Matras (Havstovan) participated in this part of the meeting.

Continue with the model and getting fisheries data (all):

The Maxent habitat analysis for *Lophelia* not using geomorphology was completed, Julian presented results. AUC value of 0.93 indicating a very good fit, and bottom temperature from the NISE database is the most important environmental variable, accounting for 70 % of the variability. Julian completed the Maxent prediction of geographical distribution for *Lophelia* and the results looked very promising (Appendix F).

Julian presented the distribution of fishing intensity using the Gerritsen gridding for fishing with trawl based on data from Norway, Iceland (Appendix G).

15:00-17:30 How to do the pressure/impact calculation and to identify the proportion of VME areas at risk.

-Calculation of area covered by VMEs in terrain with high relief must be undertaken with adjusments for slope angle.

-Habitat suitability scores range from 0.1 - 1, this scale should be changed to a scale of 5 cut-off levels.

-Fishing pressure cut-off levels should also be on a scale of 5 intensities. Percent swept area will be calculated using the Gerritsen method for 300 x 300 grid.

- Areas at risk will be identified using a relation between habitat suitability scores x % area swept by trawled/year.
- Swept area calculation will use 150 m for otter trawl and 60 m for shrimp trawl. In Skagerrak single trawl are used for shrimp fishing while in the Barents Sea 1/3 of the shrimp trawls are used in pairs and 2/3 are triple shrimp trawls.

Friday 24

09:00 - 12:00 Complete models and plan for next year

-Models for Sea pen VMEs, shallow, deep and only for the key species *Funiculina* was made by Julian. Distribution results are promising (Appendix F).

-Information on cable specification for video equipment was exchanged between IMR and Havstovan, in relation to the building of a new research vessel.

-The results from Faroe video cruise in June will be delivered before end of February to be included in large scale model. Pål provides the analysis software from IMR together with a user manual and identification guide for VME key species within the next few weeks. A meeting sharing experience with the use of this software will be conducted via video or visit from IMR to the Faroes.

Tasks for spring 2018 -Working om project report. -Present results on Web and meetings

-NovasArc WS I 2018: 19 – 23/2 or 26/2 -2/3 (Petur not available) Bergen (IMR)

Paper I: Before summer: Finish paper on large scale distribution of VMEs and identification of areas at risk of impact from human activities (Julian lead author).

Tasks for autumn 2018

Paper II: October finish paper on national cases of distribution of VMEs and identification of areas at risk of impact from human activities (Pål lead author)

-NovasArc WS II 2018: 22-26/10 or 29/10 - 2/11 Iceland

Cruises relevant for collaboration

-Faroe trawl survey in March (data). By-catch data will be used in the large-scale analysis.

-Cruise on the Faroes in June for video mapping of VMEs (room for two gests). Video records will be used in the case based study.

-Norwegian Mareano cruises in May/June and August/September with room for guests.





Species distribution for *Lophelia pertusa*, *Paragorgia arborea*, and *Primnoa resedaeformis* modeled with Maxent using the 15 variables: depth, aspect easterness, aspect northerness, surface chlorophyll *a* concentration, currentaspect angle, current direction easterness, current direction northerness, mean current speed, mean salinity, terrain slope, broad BPI, fine BPI, mean temperature March through May, sediment type, and marine landscape type.

Taken from Sundahl H., Master's Thesis 2017.

Appendix B: Bottom temperature data from the NISE database presented by Øistein Skagseth (IMR). Data overview top left, followed by temperature at depth for 0, 2, 5, 8, 10, and 14 degrees from top right. This data will be valuable input to the habitat suitability model and subsequent prediction of VMEs distribution.





Depth [m] @ Temperature [C]=0



Depth [m] @ Temperature [C]=5



Depin [m] (g) 1 emperature [C]=8 80°N 70°N 60°N 60°N 40°W 20°W 20°W 0° 20°E 0 20°E 0 20°E



Appendix C

The video equipment "Jørgen" used at the Faroes cruise in June 2017. It consists of a metal bar with two led lamps, a GOPRO camera (for detailed videos) and a driver's camera providing video to deck via the cable and an amplifies. Weights 20 kg at each side of the metal bar is keeping the cable at a narrow angle and the camera close to the seafloor. The cable is hooked on the wire of the hydrography winch. Working depth was 400 m (For more details se own report).



Appendix D

New information on VMEs from the Faroes based on the summer cruise in 2017. Map shows preliminary results based on a coarse analysis at cruise. A finer analysis providing densities of VME species will be conducted before end of February.



Appendix E

New information on occurrence of VMEs off Iceland based on trawling survey bycatches from 2015-16 (Figure A) and mapping with video from 2017 (Figure B and C).



Figure A. Distribution of VME key species based on bycatches from trawl survey.



Figure B. Localities mapped with video.



Figure C. *Lophelia* documented during mapping on the west coast, and sponge occurrence recorded in Westfjord.

Appendix F. New information on VMEs from Mareano mapping activities in 2017. The map shows records of sea pens in the Barents Sea. Information is delivered to the NovasArc database.



Appendix G. Results from test run of the habitat suitability model for sea pen VMEs and *Lophelia* reefs. Green is 1 and white is zero probability of occurrence.



Distribution of the VME deep sea pen based on first test run of model.



Distribution of the VME shallow sea pen based on first test run of model.



Distribution of the sea pen *Funiculina* based on the first test run of model.

Appendix G. (continued)



Distribution of the VME Lophelia reef based on the first test run of model.

Appendix H.

Some results from the first preliminary analysis of fishing pressure using the Gerritsen (2013) method based VMS data related to otter trawling for Norwegian and Icelandic from 2013-15 together with newly available Faroe data from 2013. With decreased cell size and bluer colour indicating higher fishing intensity. To the left is an overview of the whole study area and upper right zoomed inn details and below some areas in higher resolution (Data from Greenland is not available).

