Project information

Keywords
Harbour porpoise, ecological role, life history, bycatch

Project title
The role of harbour porpoise in Norwegian coastal marine communities

Year
2017/2018

Project leader
Ulf Lindstrøm

Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)
The distribution of the bycaught harbour porpoises collected in 2017 range from Senja (69.30ºN, 17.30ºE) in the south to Varangerfjorden (70.05ºN, 28.05ºE) in the north

Participants

Participants	Institute	Field
Ulf Lindstrøm*	Institute of Marine Research (IMR)	Ecology and modelling
Kjell T. Nilssen	IMR	Marine mammals and feeding ecology
Nils Øien	IMR	Abundance estimation
Arne Bjørge	IMR	Marine mammals and bycatch
Anne K. Frie	IMR	Lifehistory
Martin Biuw[1]	IMR	Ecology and physiology
Kirsteen MacKenzie	IMR	Stable isotopes
Torstein Pedersen	UiT The Arctic University of Norway	Food web modelling
Bjørn M. Jenssen	Norwegian University of Science and Technology (NTNU)	Pollutants
Geneviève Desportes	North Atlantic Marine Mammal Commission (NAMMCO)	Management
Tor Arne Øigård	Norwegian Computer Centre (NR)	Statistical modelling

Flagship
Fjord and Coast

Funding Source

FRAM Centre

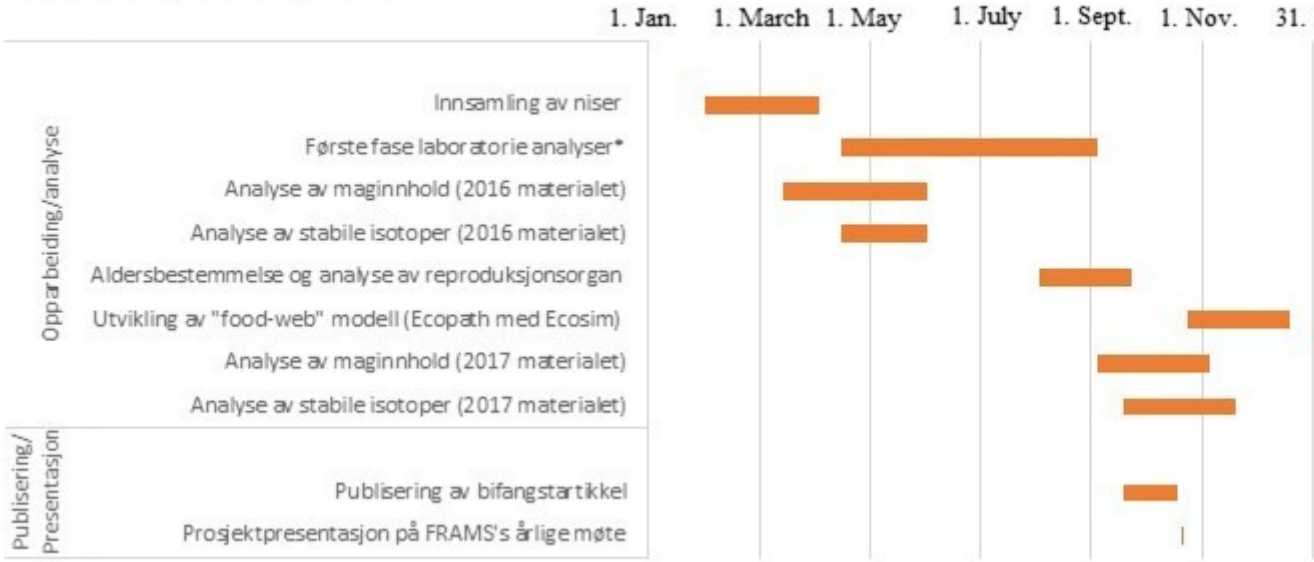
Summary of Results

Project activity in 2017

In 2017, the project has prioritized the collection and the first phase laboratory analysis (FPLA) of bycaught harbour porpoises collected in 2017 and the final laboratory analysis (FLA) of the samples collected in 2016 and 2017. To clarify, the FPLA includes dissection of animals, taking various body morphometric measurements and collecting teeth, stomach/intestines, reproductive organs and various tissues for further analysis. The FLA includes age determination, analysis of reproductive organs, stable isotopes, stomach contents and pollutants. Also, the development of a food web model (Ecopath with Ecosim) for the Vestfjorden (VF) ecosystem started in October. The reason for selecting VF as modelling area is primarily because VF appears to be a hot-spot area for HP and the amount of HP data with respect to abundance, feeding ecology and demography is good. The project activity in 2017 is summarized in Table 1. In addition to the listed activity (Table 1), a complete health examination of the 61 animals collected in 2017 has been

performed by Dr. Vet. Med. Katrine Ryeng (IMR, Tromsø), to evaluate the state of health of harbour porpoises in Norwegian waters.

Table 1. Project activity in 2017



Preliminary results

Distribution of harbour porpoises in 2016 and 2017

A total of 73 and 61 bycaught harbour porpoises were collected in September-October 2016 and February-April 2017, respectively (Fig. 1). The collection of porpoises in 2016 was not spatially constrained resulting in bycaught porpoises from Rogaland (sub-area 1) in the south to Troms (sub-area 4) in the north. In contrast, in 2017 it was decided that the collection of porpoises in 2017 should be limited to Northern Norway (Vestfjorden - Varangerfjorden) for both logistic and scientific reasons. As a result, a total of 61 porpoises were collected in 1. February - 4 April, from Senja in the south (sub-area 4) to Varangerfjorden in the north (sub-area 6). In contrast to 2016, where most porpoises (52%) were caught in Vestfjorden, the bycatch was more evenly distributed between sub-areas in 2017; 27 and 31 porpoises were bycaught in subareas 4 and 6, respectively (Fig. 1).

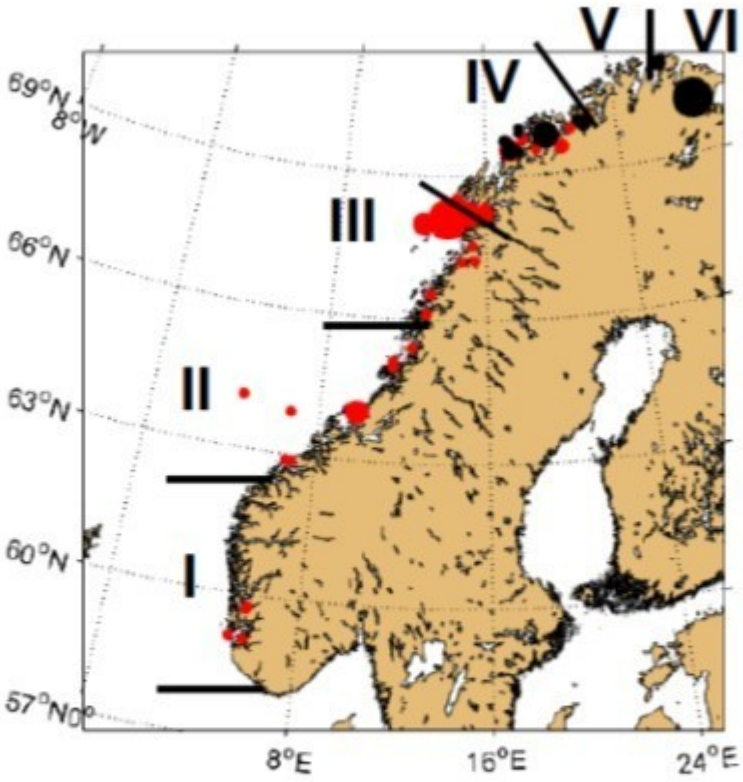


Figure 1. Distribution of bycaught harbour porpoises in six sub-areas in Norwegian coastal waters in September-October 2016 (red circles) and February-April 2017 (black circles). Size of the circles is proportional to number of animals.

Feeding ecology of harbour porpoise (Phocoena phocoena) in Norwegian coastal communities

The gastrointestinal contents of 73 and 61 harbour porpoises, bycaught in gillnets along the coast of Norway (Fig 1), has been analysed in 2017. Additionally, stable isotope signatures of animals collected in 2016 has been analysed. The preliminary results presented below is part of a master thesis.

A total of 19 prey species were identified in the gastrointestinal tracts of the 133 harbour porpoises sampled in 2016 (N=73) and 2017 (N=61). The proportion of empty gastrointestinal tracts was much higher in 2016 (31.5%) compared with 2017 (6.6%). The preliminary results suggest that Pollachius sp. (saithe and pollock) is the overall most important prey species in both 2016 (37%) and 2017 (50%) followed by Blue whiting (18%) in 2016 and pelagic fish (30%) in 2017 (Fig. 2). Saithe constitute the majority of the Pollachius sp. group whereas capelin constitute the majority of the pelagic fish group in 2017. There was less spatio-temporal variation in diet composition than expected, based upon a previous study conducted in 1989. Apart from that, both studies show that pelagic prey (pelagic fish and pollachius sp.) dominate the harbour porpoise diet in the Barents (sub-areas 5 and 6).

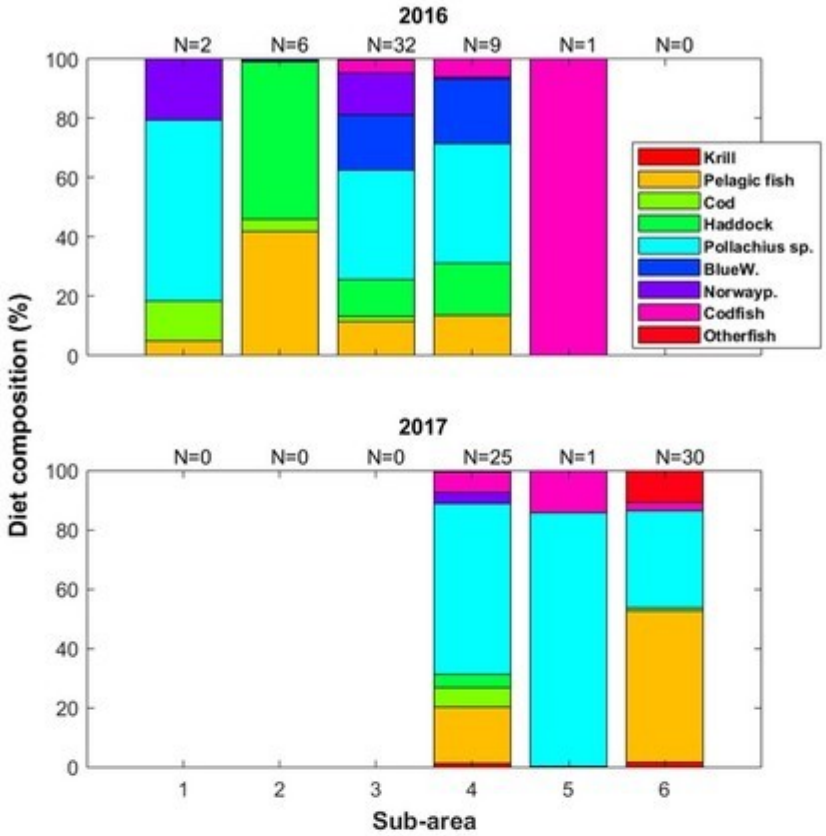


Figure 2. Diet composition, based on biomass, of bycaught harbour porpoises in six sub-areas in Norwegian coastal waters in September-October 2016 (upper panel) and February-April 2017 (lower panel). N is number of porpoises with stomach contents.

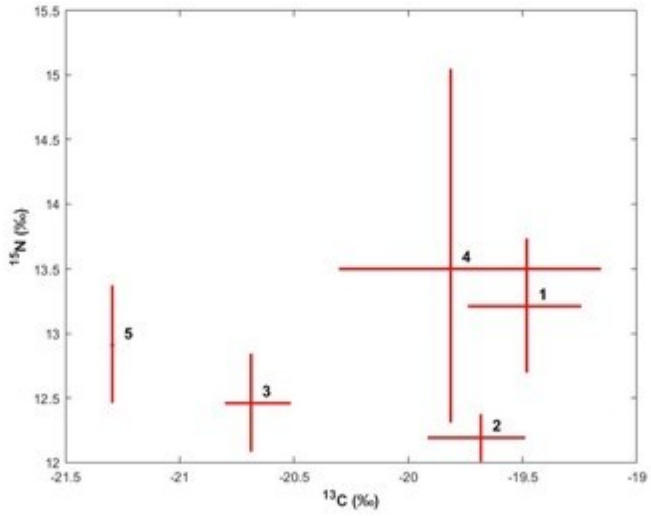


Figure 3. Stable isotope relationships in harbour porpoises bycaught in five sub-areas in Norwegian coastal waters in September-October 2016. The error bars correspond to 95% confidence intervals. The numbers in the figure represents the sub-areas.

The preliminary stable isotope (SI) results, from 2016, is displayed in Figure 3. The stable isotope

values have been lipid-corrected. The wide confidence intervals (95% confidence intervals), with respect to both ^{13}C and ^{15}N, indicate that there is considerable variation in prey use between harbour porpoises within sub-areas. The SI results indicate that harbour porpoises in sub-areas 1, 2 and 4 have more similar in SI signature than the other sub-areas, however, it should be pointed out that these results are based upon few animals; 4, 12 and 10 porpoises were bycaught in sub-areas 1, 2 and 4, respectively. The fact that the ^{15}N level is similar between sub-areas suggest that the porpoises have the same trophic position in all sub-areas. The preliminary results of the stable isotope analysis from 2017 will be available in December 2017.

Growth and life history of harbour porpoise (Phocoena phocoena) in Norwegian waters

The growth and reproduction of the 73 and 61 harbour porpoises sampled in 2016 and 2017, respectively, has been analysed. The preliminary results presented below is part of a master thesis.

Standard methods were used to age determine the animals, which involves decalcifying of the tooth, sectioning the tooth in many sections and staining these sections. Growth layer groups (GLGs) were counted in dentine and cementum under low power magnification with transmitted light. GLGs were taken as representing years. All tooth sections were read independently of biological information about the specimen, by two readers. Each reader read the teeth independently, and final age was determined after comparing the results.

Sexual maturity was determined from examination of the reproductive organs. In females, the ovaries were weighed and examined for the presence of corpora lutea and corpora albicantia to determine sexual maturity and reproductive status. In males, the testes were weighed and measured for volume and, the criterion of combined testes weight >200 g was used as a guide of sexual maturation.

The sex and age distribution of the bycaught animals differed between the two sampling periods (2016 and 2017). The age distribution is biased towards younger animals in both years but particularly in 2016; the oldest animals in 2016 were 6 years old whereas in 2017 14 animals were older than 6 years. Given that 11 of these individuals were males, there might be sexual segregation in the distribution harbour porpoises.

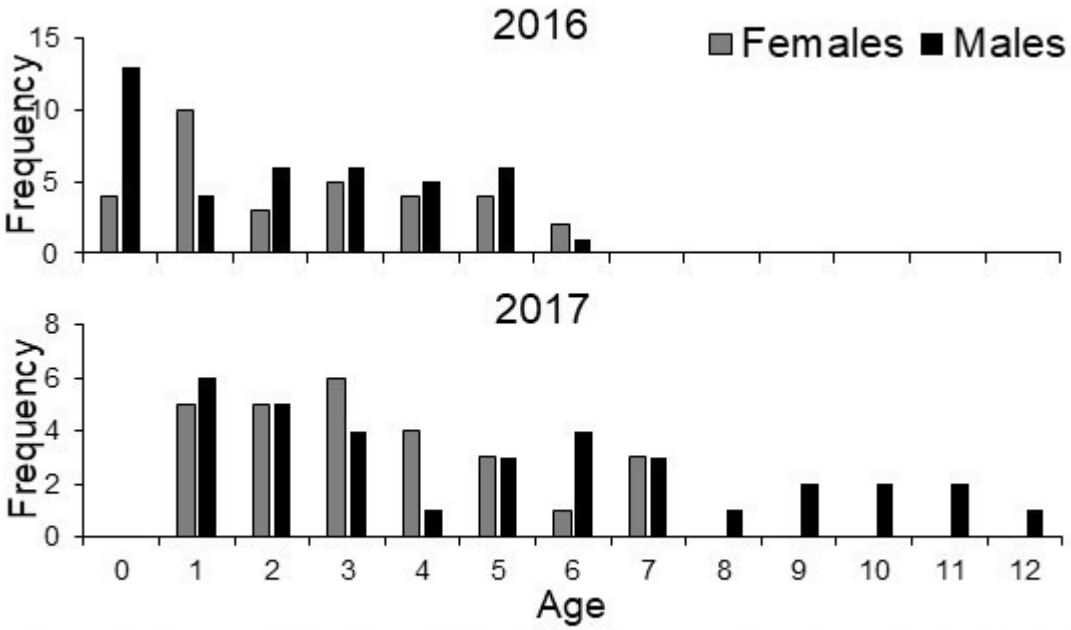


Figure 4. The age distribution of 73 and 61 harbor porpoises bycaught in gillnets in September-October 2016 and February-April 2017, respectively.

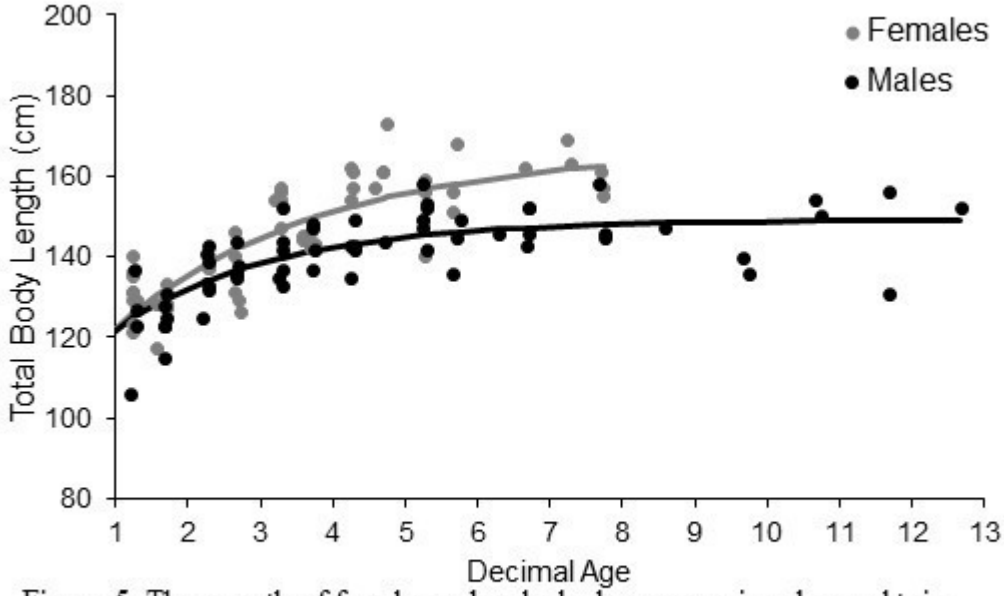
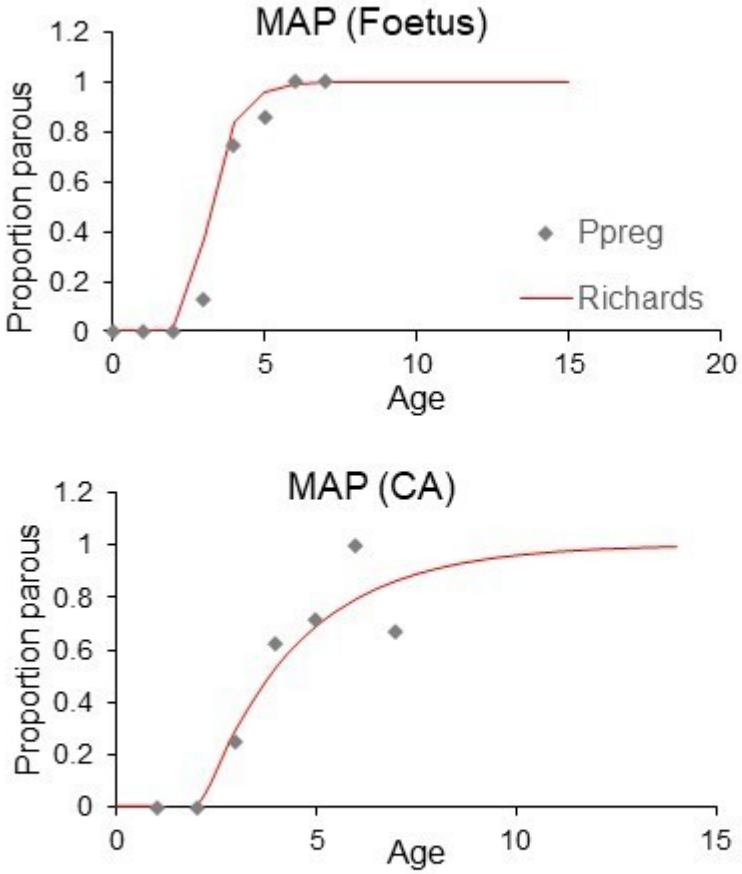


Figure 5. The growth of female and male harbour porpoises bycaught in Norwegian waters in September-October 2016 and February-April 2017. The lines represents the fitted von Bertalanffy growth model (see text).

The growth of harbour porpoises was analyzed by fitting von Bertalanffy growth models ($L_t=L_\infty(1-e^{-kt})$) to the data. L_t, L_∞ and k denote length at age t, asymptotic average length and growth rate, respectively. Females grow both faster and longer than the males (Fig. 5); the asymptotic length in females and males were 166 cm and 149 cm, respectively. These estimates are slightly higher than estimates reported in other studies; males ranged from 142 to 148 cm whereas females ranged from 153 cm to 163 cm. It should be pointed these studies have not used the same model formulation which implies that the model parameters (k and L_∞) are not fully comparable.



Method	MAP (SD)
Foetus	4,48 (0,81)
CA	5,08 (0,67)
Back-calculations	4,07 (1,27)

Figure 6. Mean age at first reproduction (MAP) of female harbour porpoises bycaught in Norwegian waters in September-October 2016 and February-April 2017 using foetus (upper panel), corpora albicantia (CA, lower panel) and back-calculations (age minus number of CA).

Preliminary results from the analysis of reproductive status of female harbour porpoises using three methods suggest that females become sexually mature between 4 and 5 years of age (Fig. 6) whereas males become sexually mature at ca. 3 years of age (Fig. 7). These results are in line with other studies of harbour porpoise reproduction which range from 2 to 3 years in males and 3.5 to 4.5 years in females.

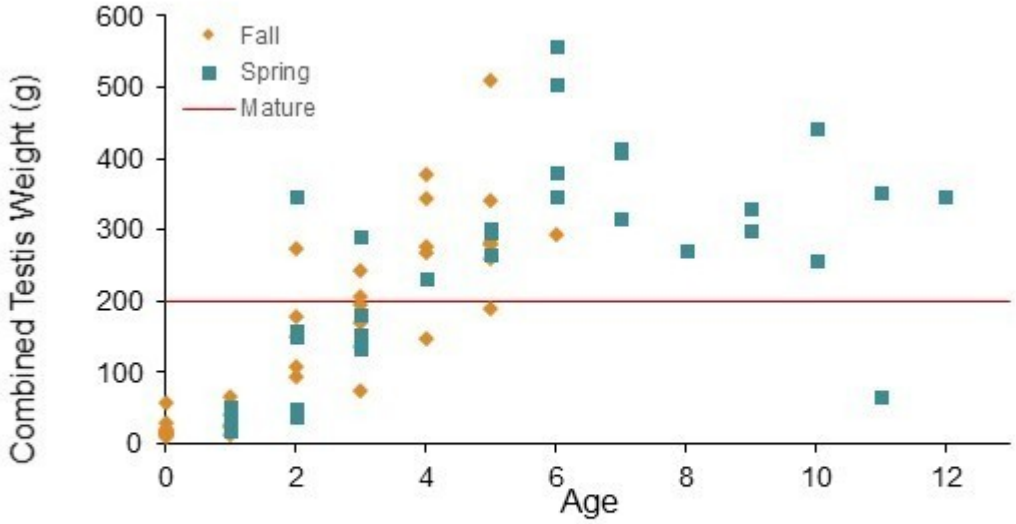


Figure 7. Combined testis weight as a function of age in male harbour porpoises bycaught in Norwegian waters in September-October 2016 and February-April 2017. The horizontal line represents the combined testis weight (>200 g) above which males are assumed to be sexually mature.

The role harbour porpoises in coastal marine communities; top-down and bottom-up effects

An existing food web model (Ecopath with Ecosim) from the Ullsfjorden ecosystem will be used to explore the potential top-down and bottom-up effects of harbour porpoises in Vestfjorden. Vestfjorden has been chosen as a model area because it appears to be a hot-spot area for harbour porpoises and because there is more porpoise data from the area. Diet and life history data from 2016 will be used to parameterize the model. Resource data, collected during the annual coastal survey (October-Novemer) and the Lofoten cruise (March-April) will be used to derive input data to the model.

The structure of the model and the parameterization of the harbour porpoise in the model is finished and the data assimilation with respect to the other prey groups is expected to be finished in December.

Master and PhD-students involved in the project

The project recruited two master students January 2017. The project titles are: 1. Growth and life history of harbour porpoise (Phocoena phocoena) in Norwegian waters and 2. Feeding ecology of harbour porpoise (Phocoena phocoena) in Norwegian coastal communities.

The plan is that they will defend their master thesis during spring 2018, prior to 15 May

A third master student is likely to join the project in 2018. The plan is that she will study prey preference of harbour porpoise.

For the Management

This project may have important implications for conservation and management of marine resources in Norwegian coastal communities because the U.S. National Oceanic and Atmospheric Administration (NOAA) Fisheries issued a final rule earlier this year to implement import provisions of the Marine Mammal Protection Act (MMPA). The rule aims to prohibit seafood imports from countries where fisheries kill more marine mammals such as whales and dolphins than U.S. standards allow. NOAA has established a five-year exemption period that allows foreign harvesting nations time to assess their marine mammal stocks, estimate and lower their bycatch, and develop regulatory programs in order to meet the new criteria on an ongoing basis.

Harbour porpoises (Phocoena phocoena) are abundant but very vulnerable to incidental catches in gillnets. According to ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas) the annual bycatches should not exceed 1.7% of the best population estimate (ASCOBANS, 2000). It is unknown whether the high bycatch rate (3000 animals/year) in the Norwegian fishery is sustainable because knowledge on population size and life history rates are lacking. One of the sub-objectives of this project is to explore whether the present bycatches are sustainable or not.

Published Results/Planned Publications

The plan, which was stated in the 2016 application, was to have two drafts to be submitted in 2017, one on feeding ecology and one on growth and life history. This has been moved to 2018 (see below). We have prioritized collection, processing and analysis of data in 2017. A popular scientific article "Research on harbour porpoise" was submitted to the newspaper "Kystmagasinet" (https: //www. Kystmagasinet.no/) in October and is supposed to be in print 24 November (tomorrow).

Manuscripts 1 and 2 in table 2 (below), which are the two master thesis, is under preparation.

Planned submissions/publications in 2018 is listed in table 2.

Table 2. Planned publications in 2018

1. Feeding ecology of harbour porpoises in Norwegian coastal communities,
2. Lifehistory of harbour porpoises in Norwegian waters,
3. The role harbour porpoises in coastal marine communities; top-down and bottom-up effects,
4. Bycatch of harbour porpoises – is it sustainable? *
5. Population structure of harbour porpoises in Norwegian waters. *

*The publication of manuscripts on bycatch and population structure depend to some extent on whether the project can recruit a masterstudent and get internal financial support, respectively.

Communicated Results

The results have been communicated on:

- The flagship "Fjord and Coast" annual meeting at Sommerøy 17-18 October 2017

- The marine mammal group (IMR) meeting 2 November 2017

Interdisciplinary Cooperation

This is a broad ecological project that covers range of topics such as food web modelling and interaction, feeding ecology, life history, population structure, pollutants and, indirectly, animal health status.

Budget in accordance to results

The budget in 2017 (350.000 kr) has not been in accordance with the activity and deliverables in 2017. Without the internal support by IMR and the sharing of costs with another project, it would not have been possible to fulfill the tasks/deliverables in 2017.

Could results from the project be subject for any commercial utilization

No

Conclusions

Preliminary conclusions with respect to feeding ecology, growth and life history of harbour porpoise:

- The diet of harbour porpoise is dominated by codfish (mainly saithe and Blue whiting) and pelagic fish (mainly capelin and herring)

- The diet appears to be relative consistent in time and space and this is, to some extent, in line with the stable istope results which indicate similar trophic position among sub-areas.

- The harbour porpoises in this study appears to grow slightly bigger than porpoises from other areas

- The female and male harbour porpoises in this study were sexually mature at ca. 4-5 and 3 years of age, respectively, which is similar to other studies.