Project information

Project title

Drift of fish larvae, fish-stock interactions and their effects on seabird dynamics

Year

2012/2013

Project leader

Kjell Einar Erikstad, NINA

Participants

Project leader

- Kjell Einar Erikstad, NINA

Project participants

- Frode Vikebø IMR
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- Børge Moe (NINA)
- Leif Nøttestad IMR
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- Sebastien Descamps NP
- Per Fauchald (NINA)
- Thierry Boulinier (CNRS, University of Montpellier, France)
- Morten Frederiksen (Århus, University, Denmark)

Flagship

Fjord and coast, Theme: Physical-biological coupling: Oceanography and habitat use by predators and their prey

Funding Source

Fram Centre (MD): 300 000 NOK FKD: 300 000 NOK NFR: 2700 000 NOK

Summary of Results

In agreement with the Flagship leaders, the scientific report covers all sources of funding (NFR, FRAM Centre and FKD).

All the funding from the Fram Centre was used to hire a competent post doc for 3.5 months (Hanno Sandvik), who was skilled in population modeling and mark-recapture analyses of demographic time series. He has contributed to 5 scientific papers and held one oral presentation at a fish larvae conference (see publication list). The funding from FKD to IMR was used to develop further the fish larvae drift models and to organize the acoustic fish data from the ecosystem cruises in the Barents Sea for the period 1990 to 2010. These have been used in one scientific paper so far (see highlights). Scientists from IMR have also participated in smaller workshops and will also attend the annual workshop of the NFR project 4-5 December 2012 at the Fram Center.

2012 included a very extensive field season in several seabird colonies. This involved monitoring population sizes and demographic traits and applying new geolocation techniques. More than 500 loggers were attached to 7 different species spread in several colonies. These included GLS, GPS and time depth recorders (TDR) that will give us huge amounts of information on large spatial and temporal scale, including feeding distribution of breeding birds around colonies, winter distribution and diving depths of some species in relation to their diet. This will result in a large database for the years to come and the possibility to sort out the link between oceanographic conditions, prey distribution and their effects on seabird populations.

Some highlights for 2012

1) Years of high inflow of Atlantic water in the Barents Sea has a positive effect on breeding success of Common Guillemots

In this analysis we have used the larval drifts model to estimate the variance in the inflow of Atlantic and Coastal waters to the Barents Sea

(Fig.1) and how this may affect the drift of cod larvae from different spawning grounds along the Norwegian coast. The influx of Atlantic waters varies greatly and in warm years the relative density of cod larvae from southern spawning grounds reaching the Barents Sea area increases during the common guillemot breeding season **(Fig.2).** By the time they reach the Barents Sea, larvae from southern spawning ground have had a longer growth period in warm water and are of higher quality (larger size) as food for the birds than larvae from the more northern spawning grounds. This is important as the quality of cod larvae may be more important than the total larvae density as a source of guillemot food, and that changes in oceanographic conditions may cause a "mismatch" between time

of breeding and quality of food for the seabirds in the area.

2) Prey density in non-breeding areas affects adult survival of Black-Legged Kittiwakes

Investigating the relationship between demographic traits such as adult survival in long-lived migratory species and environmental conditions in both the breeding and non-breeding areas has been hampered by the lack of knowledge about their distribution outside the breeding season. Using new tracking technology (GLS and PTT) we have now been able to follow the kittiwake outside the breeding season. Kittiwakes from Hornøya use three distinct areas in the non-breeding period (**Fig.3**). In autumn they concentrate in an area east of Svalbard, in winter they stay in the Grand Banks/Labrador Sea area and in late winter/early spring they migrate back to the Barents Sea. By analyzing a 22-year time series of colour-ringed adults Kittiwakes (using a capture-mark-recapture framework), we identified two prey categories that are important for the survival of kittiwakes in these areas; Thecosomata in the Grand Banks/Labrador Sea area in winter and capelin in the Barents Sea in late winter/early spring. Together, these explained 58% of the variation in adult survival **(Fig.4).** These results have important implications for the conservation of ittiwakes, not only the Hornøya population but also the many other populations that use these same wintering areas. Kittiwake populations are declining globally and both the Barents Sea and the Grand Banks/Labrador Sea are areas with high antropogenic activities, including fisheries, international shipping and offshore oil- and gas- industry.

Fig.1. The different spawning grounds of cod along the Norwegian coast (1 to 15). Larvae from the southern areas (11 to 1) only reach the Barents Sea in time for the breeding
season of guillemots during years of high inflow of Atlantic water.

Published Results/Planned Publications

Relevant papers printed, accepted and in revision (authors from the project team in bold)

Barrett, R.T. and **Erikstad, K.E**. 2012. Environmental variability and body condition in departing Common Guillemot chicks. Marine

Biology (in revision).

Barrett, R.,Nilsen, E.B., & **Anker-Nilssen, T**. 2012. Long-term decline in egg size of Atlantic puffins Fratercula arctica is related to changes in forage fish stocks and climate conditions. Marine Ecology Progress Series 457: 1-10. (doi: 10.3354/meps09813)

Erikstad, K.E.,Reiertsen, **T.K., Barrett, R.T., Vikebø, F. and Sandvik, H**. 2012. Seabirds and fish-interactions-The fall and rise of a Common guillemot population. Mar Ecol Prog Ser (accpeted 25.9.2012).

Frederiksen, M., Anker-Nilssen, T., Beaugrand, G. & Wanless, S. 2012. Climate, copepods and seabirds in the boreal Northeast Atlantic – current state and future outlook. Global Change Biology (doi: 10.1111/gcb.12072)

Gimenez, O.,**Anker-Nilssen, T**. & Grosbois, V. 2012. Exploring causal pathways in demographic parameter variation: path analysis of mark-recapture data. Methods in Ecology and Evolution 3(2): 427-432. (doi: 10.1111/j.2041-210X.2011.00150.x)

Hanssen, S.A. and **Erikstad, K.E.** 2012. The long term effects of nest predation. Behavioral Ecology (accepted 22.10.2012).

Lyngbo-Kristensen, **Erikstad, K.E.,** Reiertsen, T.K.,Moum. **T.K. Barrett**, R.T. Jenni-Eiermann, S. 2012. Are female offspring from a single-egg seabird more costly to raise? Behavioral Ecology doi:10.1093/beheco/ars144 .

Muller, M., Roelofs, Y.,**Erikstad, K.E**. and Groothius, T.G.G. 2012 Maternal androgens increase sibling aggression, dominance and competitive ability, but not begging displays in the siblicidal black-legged kittiwake (Rissa tridactyla).PlosOne 7:1-9.

Myksvoll, M.S., Sandvik, A.D., **Skardhamar, J**., and Sundby, S., 2012, Importance of high resolution wind forcing on eddy activity and particle dispersion in a Norwegian fjord, Estuarine, Coastal and Shelf Science, 113:293-304.

Pettex, E., Lorentsen, S.-H., Grémillet, D., Gimenez, O., **Barrett, R.T.,** Pons, J.-B., Le Bohec, C & Bonadonna, F. 2012. Multi-scale foraging variability in northern gannet (Morus bassanus) fuels potential foraging plasticity. Mar. Biol. doi 10.1007/s00227-012-2035-1

Reiertsen, T., **Erikstad, K.E., Barrett, R.T., Sandvik,** H Yoccoz, N-G. , 2012. Climate fluctuations and differential survival of bridled and non-bridled Common Guillemots Uria aalge. Ecosphere 3:52(1–16).

Sandvik, H., Erikstad, K.E. and Sæther, B.E. 2012. Climate affects seabird population dynamics both via reproduction and adult survival. Mar Ecol Prog Ser 454: 273–284.

Stenevik EK, Nash R, **Vikebø FB**, Fossum P, Bakkeplass K (2012) The effects of survey design and circulation pattern on the perceived abundance of herring larvae: a case study for Norwegian spring spawning herring (Clupea harengus). Fisheries Oceanography, 21: 363-373.

Vikebø FB, Korosov A, Stenevik EK and Slotte A (2012) Match-mismatch in Norwegian spring spawning herring and spring phytoplankton bloom - observational records from herring larval surveys and SeaWIFS. ICES JMS. Doi:10.1093/icesjms/fss083.

Manuscripts in preparation

Castano PR**, Vikebø FB**, Sundby S (Submitted) A model approach to identify the spawning grounds and describing the early life history of North-East Arctic haddock (Melanogrammus aeglefinus). ICES JMS.

Erikstad, K.E. Myksvoll, MS, Vikebø, F. and Barrett, R.T and **Sandvik,** H . Variation in influx of Atlantic waters determine availability of cod larvae for breeding Common Guillemots in eastern Finnmark.(in preparation).

Langangen Ø., Stige LC, Yaragina N, **Vikebø FB**, Bogstad B and Gusdal Y (Submitted) Egg mortality of Northeast Arctic cod (Gadhus morhua) and haddock (Melangogrammus aeglefinus). ICES JMS.

Mauritzen, M, Fauchald, P, Johannesen, E, Lindstrøm, U, Eriksen, E, Olsen, E and Øyen, N. Spatial organization of the Barents Sea pelagic community. Mar Ecol Prog Series (submitted)

Ponchon, A., Gremillet, D., Authier, M., Dahlsgaard-Christensen, S., **Erikstad, K.E.,** Solis, J.G., Reiertsen, T.K., Tveraa, T., **Boulinier, T**. When things go wrong: dynamics of breeding failure in an Arctic seabird. Functional Ecology (about to be submitted).

Ratrimoharinosy, Y, **Fauchald, P**, Stenseth, NC and Durant, J. A large population of herring may affect the recruitment of the Atlantic cod to the Barents Sea (Ecology submitted).

Reiertsen, TK, **Erikstad, KE**., **Moe, B, Barrett, RT., Mauritsen**, M, Ponchon, **A., Boulinier, Frederiksen, M, Anker-Nilssen,** T.,

Johns, D and Yoccoz, N. Prey density in non-breeding areas affects adult survival of Black-Legged Kittiwakes Rissa Tridactyla from the southern Barents Sea. (PLos One (about to be submitted).

Sandvik, H, Erikstad, K.E., Reiertsen, TK, Barrett, RT., Anker-Nilssen, T, Lorentsen, SH, Systad, GH. Large scale climatic variation and population dynamics in 5 kittiwake colonies (in Preparation)

Vikebø FB**,** Rønningen P, Lien V, Meier S, Reed M, Ådlandsvik B, (To be submitted) Spatiotemporal overlap of oil spill and early life stages of fish. ICES JMS.

Presentations on conferences

Faghmous, J.H., Chamer, Y., Boriah, S., Liess, S., Kumar, V., **Vikebø, F**. and Mesquita, M.d.S. (Accepted) A novel and scalable spatio-temporal technique for ocean eddy monitoring.IEEE Conference on Intelligent Data Understanding 2012, Boulder, CO, USA.

Myksvoll, M.S., 2012, Modeling transport of coastal cod eggs in fjords and coastal regions, Seminar på Forskningsdagene, University of Nordland, 24. September

Myksvoll, M.S., Sandvik, A.D., Asplin, L., and Sundby, S., 2012, Effects of river regulations on fjord dynamics and retention of coastal cod eggs, ICES Annual Science Conference, Bergen, 17.-21. September

Myksvoll, M.S., Jung, K.-M., Albretsen, J. and Sundby, S., 2012, Modeling dispersal of egg and quantifying connectivity among Norwegian Coastal cod subpopulations, 36th Annual Larval Fish Conference, Os, Norway, 2.-6. July

Myksvoll, M.S., Sandvik A.D. and Sundby, S., 2012, Climate effects on fjord populations of cod caused by variations in river runoff, Bjerknes Getaway, Geilo, 16.-18. January.

Sandvik, H. 2012. Seabirds and fish-interactions-The fall and rise of a Common guillemot population, 36th Annual Larval Fish Conference, Os, Norway, 2.-6. July

Vikebø, F. Annual meeting of the European Science Science Academy (Academia Europaea) 11-13 September 2012, invited talk. 'Ocean circulation & fish recruitment - is there a risk of collapse if currents change?'

Vikebø, F. Nordic-Climate 2nd conference, Risør, August 13-17, 2012, oral presentation. 'Climate effects on spawning and early life stages of Northeast Arctic cod and Norwegian Spring Spawning herring'

Vikebø, F. 36th Larval Conference, Solstrand, Norway, July 2-6, 2012, oral presentation. 'Spatiotemporal overlap of oil spill and early life stages of fish'

Posters conferances

Myksvoll, M.S.,Sandvik, A.D., Asplin, L. and Sundby, S., 2012, Modeling a Norwegian fjord with high resolution wind forcing, Ocean Science Meeting 2012, Salt Lake City, 20.- February

Communicated Results

There has been several small workshops during 2012 and the 4-5 of December there will be held a large workshop at the Fram Center covering all aspects of the project. There has also been great interest from the media especially related to the steep declines in some seabird species in the Barents Sea area.

Interdisciplinary Cooperation

The project is inter-diciplinary and brings together the disciplines of oceanography, fishery biology, ecology and population modelling. This is a challenge but has so far been a very constructive approach which has given us new insight to marine ecological processes.

Budget in accordance to results

The funding from the Fram Center has been important in several ways. The funding from 2011 made it possible to write the interdisciplinary application to the NFR. The funding for 2012 has made it possible to hire a post doc with skills in population modeling to work closely with a post doc in oceanographic modeling at IMR. The funding from FKD has also made it possible for the fishery people at IMR to work closely with rest of the project team with the use of acoustic data from their cruises.

Could results from the project be subject for any commercial utilization

No

If Yes

Not directly, but the oil companies have shown interest especially to the extensive use of logging technology to get detailed data on both the spatial and temporal variation in seabird distribution outside the breeding season.

Conclusions

a) The project has so far given an important contribution to the understanding of oceanographic processes and how these may influence both prey distribution and seabird dynamics. The challenge for the next two years is to further develop statistical methods and use population modeling in order to separate such effects both on a small and large scale. By using the large database on seabird dynamics, fish prey distribution and important demographic traits in seabirds this will give a novel understanding of marine processes.

b) We have not developed any new methods but uses recent geolocation techniques in order to follow the spatial movement’s seabirds both in the areas around the colony during the breeding season and in their wintering areas.