

Project information

Keywords

Invasive species, red king crab, food web

Project title

The invasive red king crab as a stressor on coastal marine food webs (CRABFOOD)

Year

2015

Project leader

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Participants

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Flagship

Fjord and Coast

Funding Source

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Summary of Results

The project are divided in three working packages and the result summaries are presented for each WP below.

WP 1 Crab predation

About 150 red king crab stomachs from Varangerfjorden have been analyzed and data are presented below. No crab stomachs from Porsangerfjorde are analyzed due to the comprehensive investigations performed by others earlier (Torstein Pedersen and Mona Fuhrmann, UiT).

Dominating prey groups identified for the red king crab in Varangerfjord has suprisingly not changed much since earlier studies carried out in the late 1990s, which indicate presence of important preys for the crab although the benthic system have been impacted by the red king crab through 20 years. There are however, an increased occurence of king crabs in the stomachs indicating increased cannibalism.

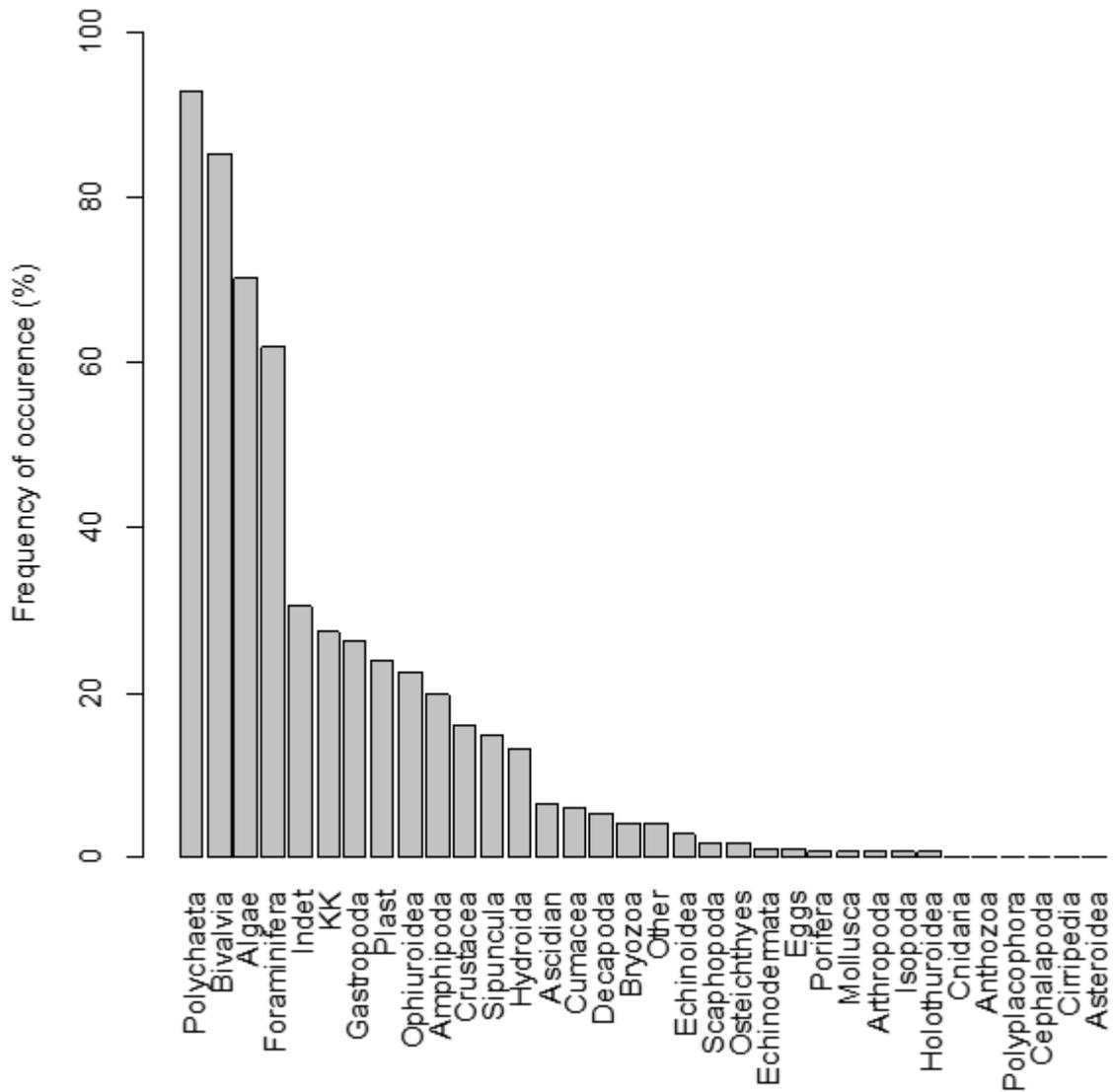


Figure 1. Frequency of occurrence of different prey groups of the red king crab in Varangerfjorden during 2015.

WP 2. Fish predation

In total 92 fish stomachs were sampled from Porsangerfjorden and 102 from Varangerfjorden during the annual red king crab cruise in 2015. Of these, 46 and 26 from Porsangerfjorden and Varangerfjorden respectively, have been analyzed. We expect that the remaining fish stomachs will be finalized during December 2015. Figure 2 show the preliminary results of the fish stomach analysis so far.

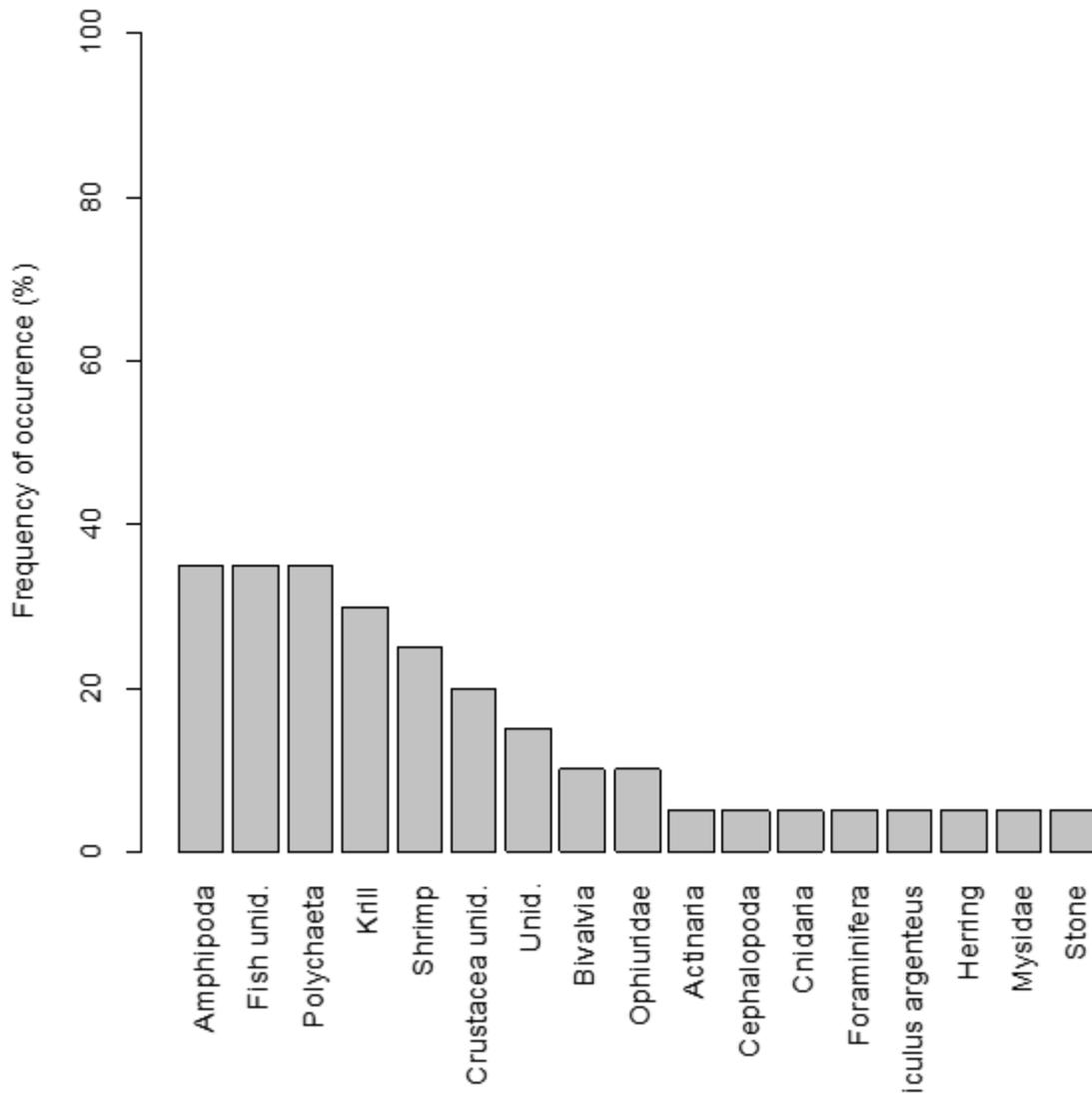


Figure 2. Occurrence of different prey groups in fish stomachs from Porsangerfjorden and Varangerfjorden combined.

When all fish stomachs are analyzed the occurrence of different prey groups will be presented by species and sampling area. However, so far no red king crabs have been identified in any of the fish stomachs analyzed.

WP 3. Preliminary food web.

Which groups may red king crab affect – assessed using output from mass-balance model

Ecopath mass-balance models have been developed for five sub-areas of Porsangerfjorden. These models have a total of 63 ecological groups and red king crab (RKC) is represented by four groups; larvae, small RKC < 70 mm carapax length (CL),

medium RKC ($70 < CL < 130$ mm) and large RKC ($CL > 130$ mm). The model is based on comprehensive sampling, analysis and modelling of input data including diet for all non-autotroph groups. At the present, it represents the best data and knowledge of a fjord-system with RKC in Norway that is available. Here we approach the question of which other ecological groups the RKC is likely to affect. We used the Ecopath model for area 3 in Porsangerfjord which is the mid-inner part of the fjord extending from Veineset in the inner and extends outwards to about 5 km south of Ytre Svartvik. This area has had high density of RKC since the invasion reached Porsangerfjord around 2006.

Mixed trophic impact is a calculated output from an Ecopath model and is the direct and indirect effect of a small incremental increase in one group (medium sized RKC in this case) on other affected groups. Medium sized RKC was the RKC-group with the highest generally largest impacts due to its high biomass and food consumption. Estimation of mixed trophic impact from the medium sized RKC showed that negative impacts were most pronounced for some longlived benthic invertebrates such as; herbivore echinoids (sea urchins), the asteroid *Ctenodiscus crispatus*, predatory gastropods, predatory asteroids and other large crustacea.

The positive effect from medium RKC on large bivalves is probably due to predation from RKC on predatory gastropods and predatory asteroids which are predators on large bivalves in the model. There are generally small impacts on fish groups and vertebrate top-predators except for negative effects (competition for food) on benthic invertebrate feeding birds (dominated by eiders) and surface feeding birds (sea gulls). The positive impact from RKC on macroalgae groups is due to predation from RKC on sea urchin which is a major grazer on macroalgae. This suggests that RKC may indirectly have a positive effect on cod juvenile macroalgae covered nursery areas.

By converting the Ecopath model to a dynamic model by using ECOSIM, it was possible to run experiments over time. Two scenarios were simulated to explore possible effects of changing exploitation regime on RKC; i) stopping the RKC fishery and thereby increasing the biomass of RKC further and ii) fishing out RKC by very large fishing effort on all of the life stages.

The results of the RKC-fishery stop experiment resulted in the following changes in biomass; all stages of RKC increased but large RKC increased mostly, a number of other groups decreased; predatory gastropods, predatory asteroids, *Ctenodiscus crispatus*, detritivore echinoderms, large epibenthic suspension feeders, other large crustacea, surface feeding birds, benthic invertebrate feeding birds and herbivore echinoids. Macroalgae groups and benthic microalgae increased.

The experiment where RKC were fished out resulted in the opposite responses for the groups mentioned above, but the effects were generally larger than in the no fishing

experiment. This may indicate that most of the potential RKC-effect on other groups have already taken place in 2009-2010 in area 3 in Porsangerfjord. In general, the effects of the simulations were very similar to the results from the mixed trophic impact analysis given above.

Mixed trophic impact of medium sized red king crab on other groups

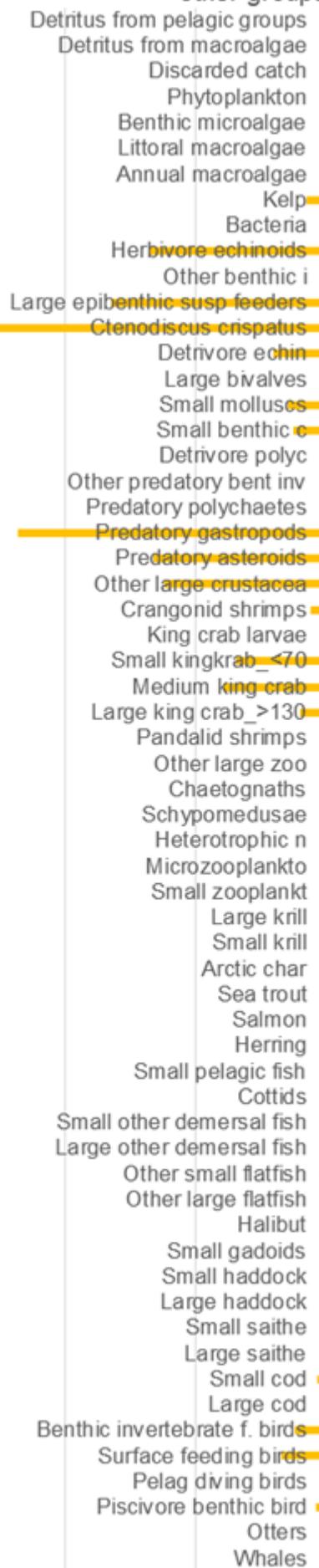


Figure 1. Mixed trophic impact of medium sized red king crab on other ecological groups in the Ecopath model for area 3 (middle – inner) in Porsangerfjord.

For the Management

Improved advises on the ecosystem impact of the red king crab where the crab have inhabited for many years.

Published Results/Planned Publications

None

Could results from the project be subject for any commercial utilization

No

Conclusions

There are still som work to do in this project particularly regarding the food web model for Varangerfjorden, which we anticipate will be available before December 15. We expect that the model simulstions (Ecosim) based on these data (crab diet and fish diet) will provide a profound understanding of the role of the red king crab in the coastal ecosystems in Finnmark, and what effects alternative management regimes of the red king crab stock will have on the native ecosystem.