

Modelling population viability and demographic trends of endangered Caspian seals (*Pusa caspica*) in relation to climate change and sea level variation scenarios

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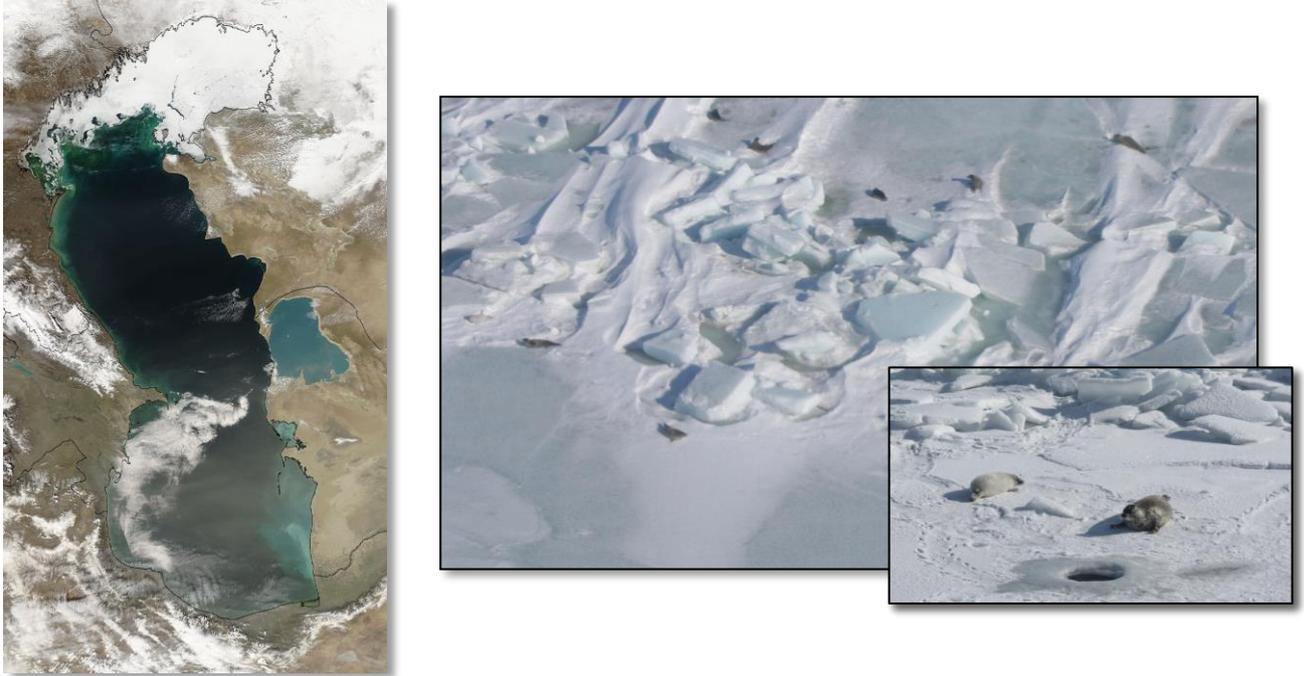
Project Summary

Climate change is expected to have significant impacts on polar ice-dependent species, such as ice-breeding seals, as this century proceeds (Kovacs et al. 2012), by reducing the availability of ice habitat, and shifting prey distributions and abundance. However, ice-breeding seals are also present outside polar-latitudes in the Baltic Sea, Caspian Sea, Lake Saimaa, Lake Ladoga and Lake Baikal. These landlocked seals are perhaps the most vulnerable of all pinnipeds to climate change impacts since they have limited/no option to migrate to other habitats to track environmental change. In this project we will examine the potential sensitivity of Caspian seals to climate warming and sea level variation, and the consequences for extinction risk. The work has direct relevance for informing conservation strategies for the species.



Caspian seals (*Pusa caspica*) are endemic to the Caspian Sea in central Asia, which is the largest landlocked waterbody on the planet. Caspian seals have declined by more than 90%, from more than 500,000 breeding females in 1900, to around 34,000 now. This decline was driven primarily by unsustainable hunting through much of the 20th Century (Harkonen et al, 2008, 2012; Dmitrieva et al. 2015), and now the population is still subject to ongoing threats such as very high rates of mortality from bycatch in illegal fisheries and habitat loss (Dmitrieva et al. 2013). Other factors such as pollution, disease,

ecosystem change due to invasive species and over fishing, climate and environmental change may also be concerns but are not well studied (Goodman & Dmitrieva 2016). The combination of population decline and ongoing threats led IUCN to list the species as Endangered in 2008.



Caspian winter ice field (left), and breeding seals on the ice (right)

Caspian seals are dependent on the winter ice field which forms January-March in the northern Caspian each year for breeding (Wilson et al. 2017). Climate change is expected to reduce the icefield extent, stability and duration over the next 100 years, while elevated air temperatures will while increase evaporation relative to water in flow, which has potential to reduce Caspian Sea level by as much as 5m metres (Tamara-Wicks et al. 2015; Chen et al. 2017). There is an urgent need to understand how these environmental changes might impact Caspian seal habitat, and the demographic consequences (quasi-extinction risk) for the population. Such questions can be addressed through population demographic models, informed by a detailed understanding of seal habitat requirements. As well as providing critical information for Caspian seal conservation this work can also provide more general insights into the climate vulnerability of other Arctic pinnipeds.

Project aims

- Use aerial survey and satellite telemetry data to develop models of winter habitat use and ice type associations for Caspian seals
- Evaluate climate and sea level change scenarios and how these may influence the availability of Caspian winter ice for breeding and summer water temperatures
- Develop population demographic models for Caspian seals accounting for environmental change as well other ongoing conservation threats including fishing bycatch, pollution and prey availability
- Use model predictions to identify conservation priorities and management strategies for Caspian seals

Expected outcomes

New knowledge on the environmental and ecological factors influencing winter habitat use by Caspian seals, and dependency on different ice types for breeding; an understanding of the potential impacts of future environmental change on habitat availability for Caspian seals and related demographic consequences, and other ice dependent pinnipeds more generally; insights into how this new

knowledge can be used for conservation management of Caspian seals development of protection measures.

Methodologies

The student will use data derived from our aerial survey and satellite telemetry projects (see Dmitrieva et al. 2015, 2016) to parameterise models of Caspian seal winter habitat use and ice type association. Habitat usage models will be integrated with remote sensing datasets on Caspian ice sheet and seal level variation to understand the potential impact of future environmental change on Caspian habitat availability. Bayesian population demographic modelling will be used to explore the potential demographic consequences of different climate and sea level change scenarios, as well as the impact of other ongoing conservation threats. This project is primarily computational ecology/population biology research, and will best suit a numerate student with some statistical programming experience, interested in developing modelling approaches to assess marine mammal vulnerability to climate change.

Requirements

Hons degree and/or Masters in a topic relating to Biology, Zoology, Ecology, Biodiversity, Evolution, Maths & Biology etc. An interest in working with statistical models to address questions in ecology and population biology is essential. While some experience of statistical modelling/programming and GIS is desirable, academic strength and research potential are the main criteria.

Training

Amongst other topics, training will be provided in population biology and ecology, marine mammal ecology, statistical modelling in R, population demographic modelling, climate modelling, working with remote sensing and satellite telemetry datasets, use of high performance computing facilities. As well as on the job training within our research groups, the student will have chance to participate in national and international training workshops on these topics, and to present results at various conferences at home and overseas.

Research context and partners

This project is part of our ongoing programme on Caspian seal ecology and conservation based at the University of Leeds. The student will join the Ecology and Evolution group in the School of Biology, Leeds, and will collaborate with the Earth observation and ice sheet modelling group in the School of Earth and Environment, under [Prof. Andy Shepherd](#). They will also be integrated with the [LIDA](#) and [Priestley Centre](#) virtual institutes which encompass a large group of researchers working on 'big data' and climate related projects. The student will also have opportunity to visit collaborators in Europe and potentially to participate in fieldwork in Kazakhstan.

Studentship type

Funded Competition University of Leeds PhD Scholarship

Eligibility

UK, EU and international students

Closing date

9th March 2018

How to apply

- For details on how to apply, please see our graduate school website here: <http://www.fbs.leeds.ac.uk/postgraduate/researchdegree.php>
- More details about the scholarship scheme here: http://www.leeds.ac.uk/info/130541/university_scholarships_and_funding/247/leeds_doctoral_scholarships

- General information about our graduate school here: <http://www.fbs.leeds.ac.uk/postgraduate/>
- More Leeds scholarships: <http://www.fbs.leeds.ac.uk/postgraduate/phdopportunities.php>
- For informal inquiries email me at: s.j.goodman@leeds.ac.uk

Further reading / bibliography

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