The potential impacts of 21st Century climate change on Caspian seals (*Pusa caspica*)

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Introduction

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- Endemic to, and the only marine mammal in the Caspian Sea
- Keystone species for the Caspian Sea ecosystem
- Listed as Endangered by IUCN, in Red book of all Caspian states
- Current main threats: Fisheries related mortality, habitat loss and degradation
- Other concerns: Pollution, invasive species, over-fishing, disease, and **climate change**
- Caspian seals have persisted through previous cycles of climate change and sea level variation, but the key question is whether they can now do this with the presence of the additional current anthropogenic pressures

Goodman, S. J. & Dmitrieva, L. (2016). *Pusa caspica*. The IUCN Red List of Threatened Species 2016: e.T41669A45230700

Effects of sea ice loss

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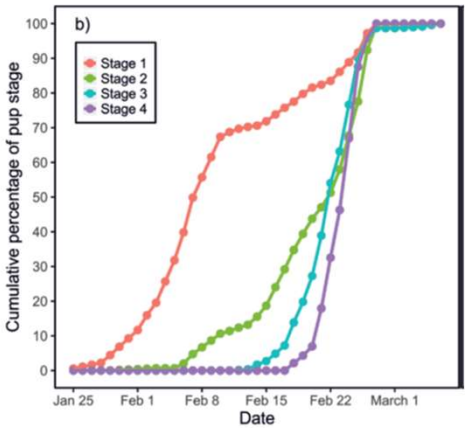
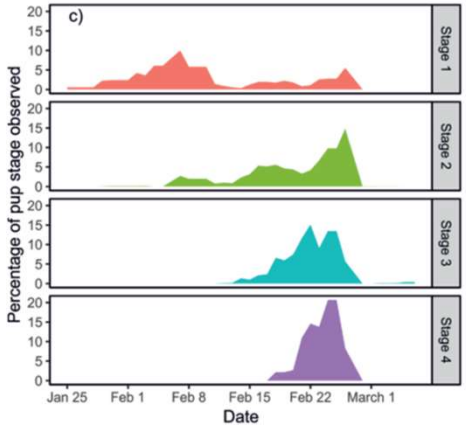
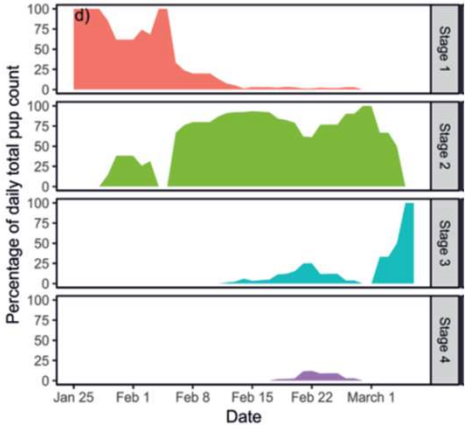
- Caspian seal breeding takes place on the northern winter ice sheet
- Pups are born late January to early March, with a peak in early February
- Lactation lasts 3 to 5 weeks
- Pups will have low survival rates if immersed in water before weaning and completing moulting
- Pups are therefore vulnerable to premature ice melting







Wilson, S. C., Dolgova, E., Trukhanova, I., Dmitrieva, L., Crawford, I., Baimukanov, M., Goodman, S. J. (2017). Breeding behavior and pup development of the Caspian seal, *Pusa caspica. Journal of Mammalogy*, 98(1):143–153, doi: 10.1093/jmammal/gyw176

Effects of sea ice loss

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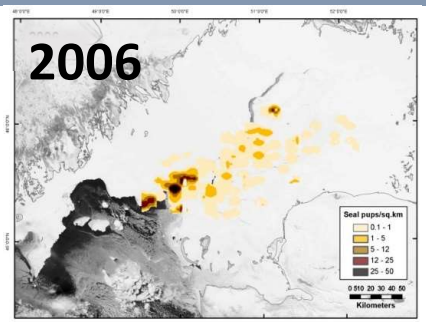
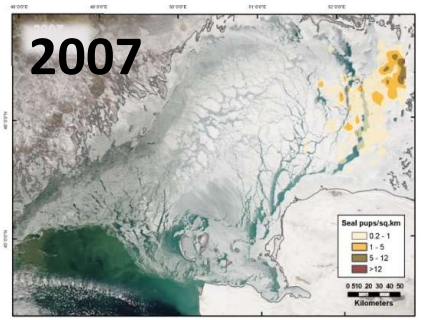
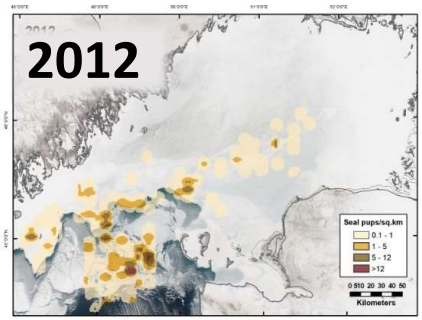
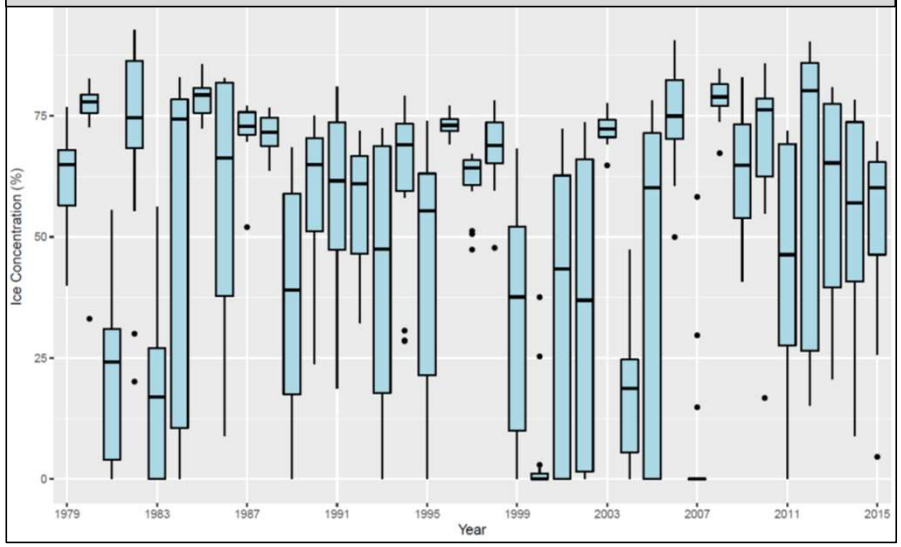
- Caspian seal breeding distribution is dependent on ice conditions
- Most important factor is ice stability
- No clear current trend in ice concentration in the seal breeding season
- Two recent cases (2016 & 2020) where ice has melted before end of lactation period – most pups are likely to have perished in these years
- Seal life-history strategies are adapted to cope with repeated breeding failures, but interaction with other stressors like fisheries mortality will reduce resilience dramatically
- Lots of uncertainty around predictions of future ice conditions (published models to date don't factor in sea level reduction)
- But reductions expected in ice extent and duration, and increased variability (more years with limited ice, or early ice melt)
- Loss of North Caspian due to sea level decline likely to push breeding seals to north boundary of mid-Caspian basin







Average daily ice concentration in seal breeding area 1979-2015



Feb 28th 2016

Feb 26th 2020

Can Caspian seals adapt to terrestrial breeding?

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- If the northern ice disappears can Caspian seals adapt to breeding on land?
- There are rare reports of very small numbers (10s at most) of seals breeding on offshore islands in the southern Caspian (e.g Ogurchinsky in Turkmenistan (Krylov 1990))
- The survival of Caspian seal pups born on land is not documented
- Breeding on land brings increased vulnerability to terrestrial predators and human disturbance
- Grey seals shifting to terrestrial breeding sites in the Baltic have lower pup survival compared to pups born on ice
- Likely to be few locations where large numbers of seals could breed successfully on land in the Caspian (free of predators and human disturbance), and the prospects for adaptation is very uncertain

Photo: Pavel Erokhin, (Ogurchinsky Island 2002)

Effects of sea level regression on Caspian seal resting and foraging habitat

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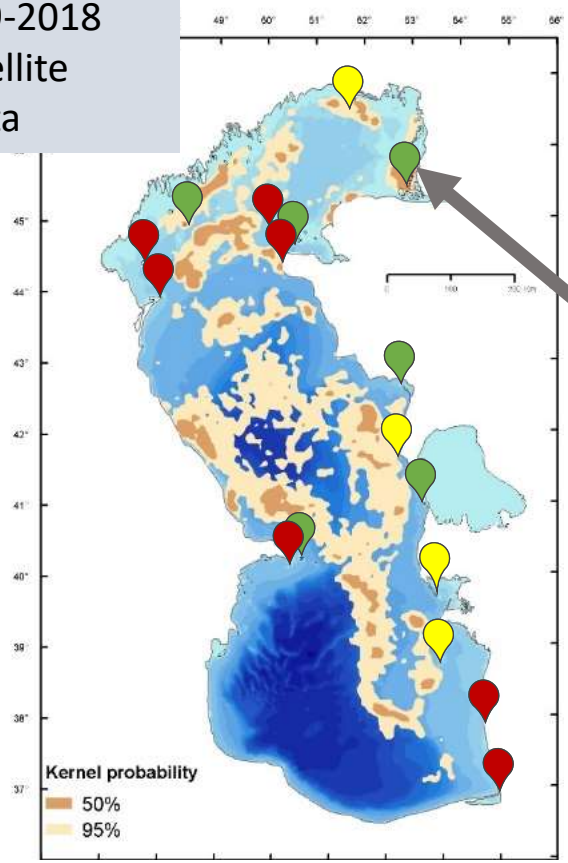
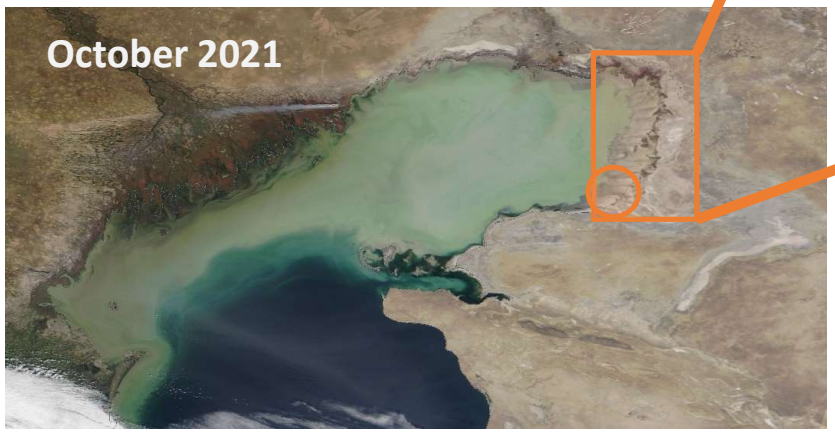
Caspian seal summer foraging 2009-2018 based on satellite telemetry data

Haul out locations



Dmitrieva et al. (2016) Individual variation in seasonal movements and foraging strategies of a land-locked, ice-breeding pinniped. *Marine Ecology Progress Series*, 554:241-256. doi: 10.3354/meps11804.

Sea level regression in the northern Caspian 2005-2021

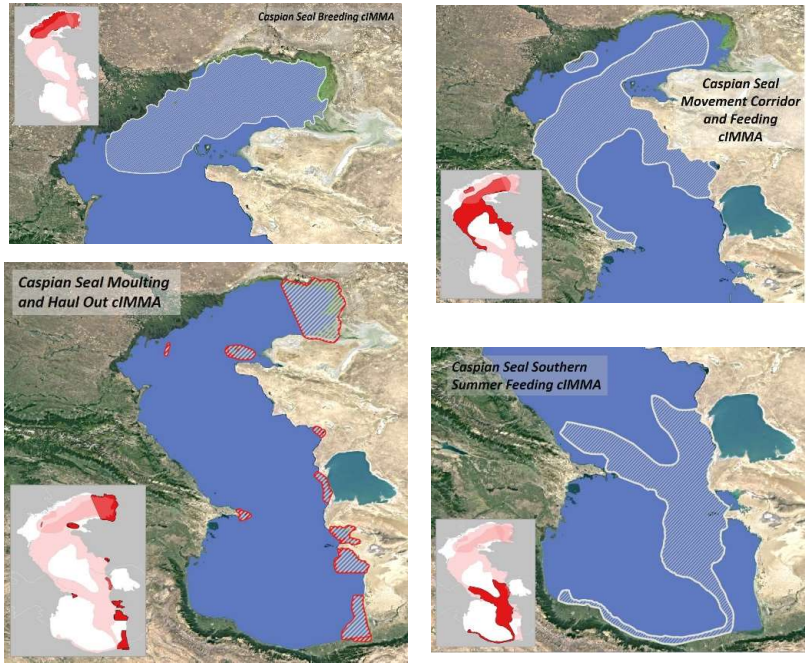


Regression ~50km compared to 2005

https://worldview.earthdata.nasa.gov/

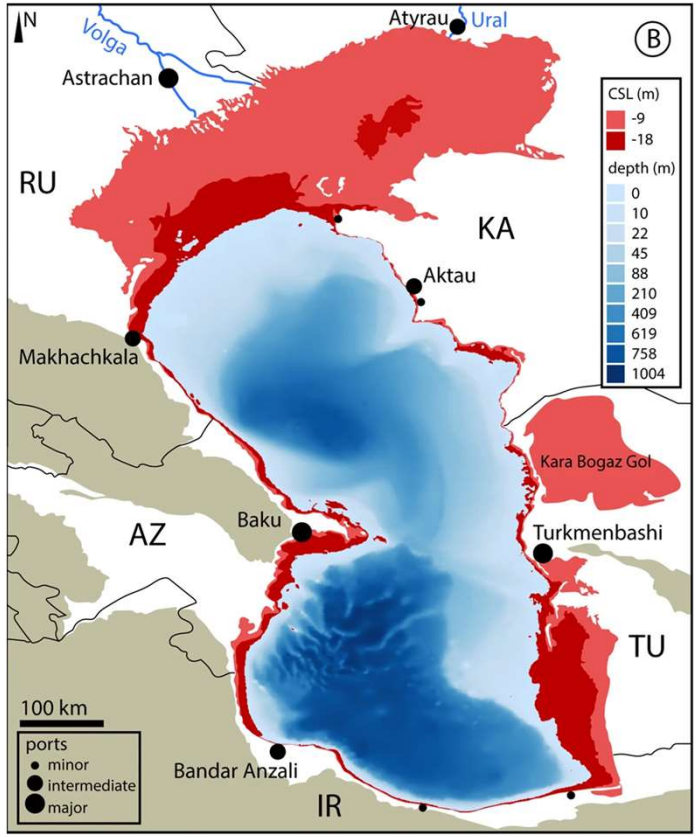
Sea level changes will require adaptation of current and future protected area designations

Caspian Sea EBSAs
https://www.cbd.int/ebsa/



Caspian seal Important Marine Mammal Areas (IMMAs)
https://www.marinemammalhabitat.org/immas/

Even under conservative estimates of sea level change there are likely to be significant impacts on current and proposed protected areas



Prange, M., Wilke, T. & Wesselingh, F.P. The other side of sea level change. *Commun Earth Environ* **1,** 69 (2020). https://doi.org/10.1038/s43247-020-00075-6

Risks of summer thermal stress

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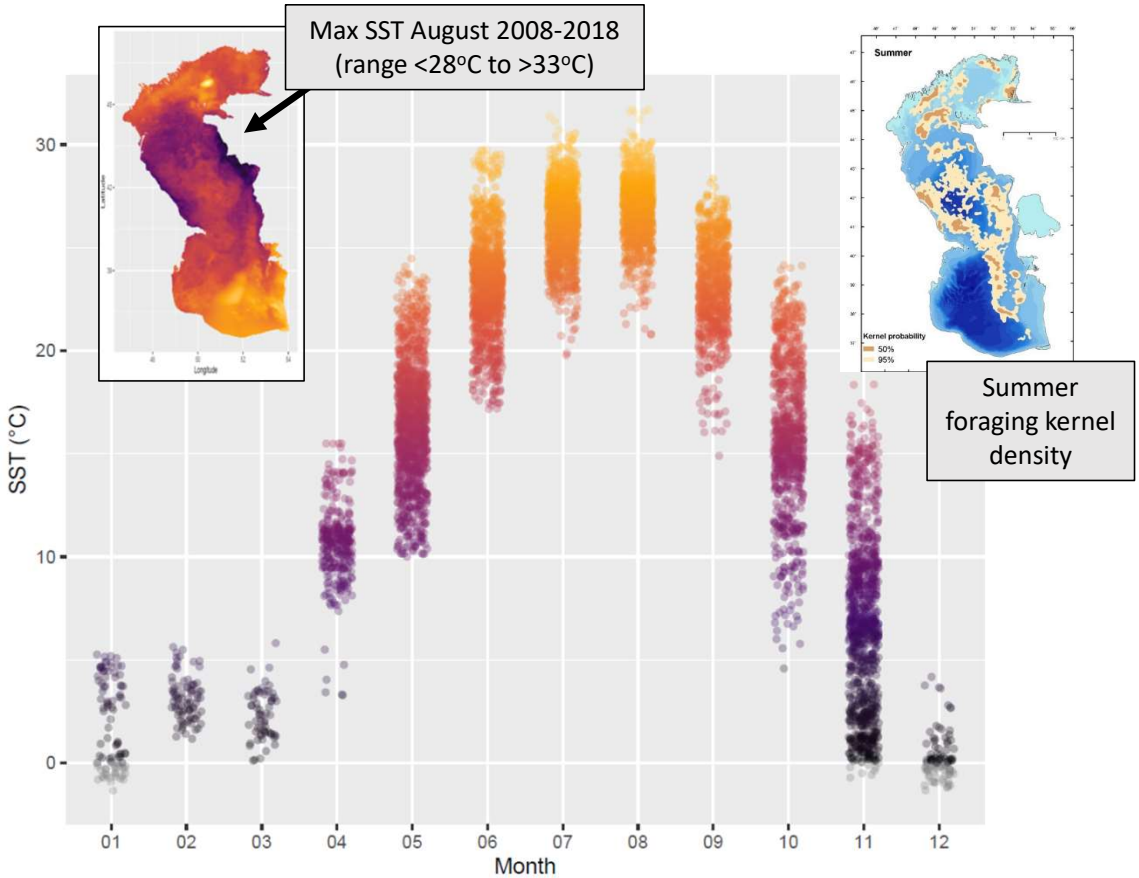
- Increased air and sea surface temperatures may reduce the effectiveness of thermoregulation behaviours
- Modelling of Caspian seal thermoregulation capacity suggests above water temperatures of 36°C, the risk of acute heat stress may increase
- Below this, warmer summer water temperatures could affect the balance of time between being active (foraging), and thermoregulation behaviours
- But we currently have a limited understanding of exactly how marine heat waves could impact Caspian seal behaviour and demography



Observed sea surface temperatures at seal foraging locations 2008-2018 (satellite telemetry data)

Key recommendations

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- **Urgently** address current conservation threats to Caspian seals, particularly high fisheries mortality and lack of protected areas, to increase resilience to climate impacts
- Current and future spatial planning decisions (protected areas and industrial development) must allow for substantial changes in seal habitat – areas which are likely to be important **future** seal habitat must be protected to give seals the best chance to adapt to environmental changes
- More support is needed for research to monitor and understand Caspian seal responses and ability to adapt to climate change impacts