Progress Report, Action #63

2018-2020 Bilateral and Multilateral Actions, Circumpolar Action Plan: Conservation Strategy for the Polar Bear

Action	Explore methods for improving the design of polar bear population studies
Point(s) of contact or Lead country	Eric Regehr (eric_regehr@fws.gov), Jim Wilder (james_wilder@fws.gov)
Partner countries	n/a
Timeline description as per 2018-2020 implementation table	2015-2019
Baseline status	Methods not developed
Planned Outputs	Progress report to the Range States at the 2017 Meeting of the Parties. Peer-reviewed publications in 2019 and 2020.
Modifications	Work has progressed slower than the Range States initially estimated; therefore, the timeline has been modified above.
Progress Report Date	September 30, 2019

Progress Report on Activity

Funding for this work has been provided by the US Geological Survey (Science Support Program) and the North Pacific Research Board, with Sarah Converse, US Geological Survey, Washington Cooperative Fish and Wildlife Research Unit, University of Washington, as lead PI and Eric Regehr, University of Washington, as co-PI. Nathan Hostetter, a University of Washington post-doctoral scientist, has been day-to-day lead on the work. One focal area has been developing a spatial capture-recapture framework for polar bear population studies, to allow for spatially explicit sampling effort and population distribution/dynamics. One paper describing this framework is in preparation and will be submitted for publication in 2019. Another area of focus is the development of analytical techniques to better use the variety of data that are collected in monitoring programs to improve inference about population abundance/dynamics. A paper on the use of age data to improve estimates from open population models is in preparation and will be submitted for publication in 2019. An additional paper that combines these two focal areas, with an open spatial capture-recapture model for the Western Hudson Bay population, will be submitted for publication in 2020.

PRESENTATIONS AND SEMINARS

- Hostetter NJ, NJ Lunn, ES Richardson, EV Regehr, and SJ Converse. 2019. Integrating age data to improve estimation of polar bear abundance, survival, and recruitment in open-

population Jolly-Seber models. The Wildlife Society Annual Conference, Reno, Nevada. 27 September – 4 October.

- Converse SJ. 2019. In search of the polar bear: building better methods for monitoring a threatened carnivore. Bevan Series Symposium, University of Washington, School of Aquatic and Fishery Sciences, Seattle Washington, 16 – 18 April.

- Hostetter NJ. 2019. Integrated modeling approaches to inform polar bear conservation and management. University of Washington, School of Aquatic and Fishery Sciences Seminar Series, Seattle Washington, 14 March.

- Hostetter NJ, SJ Converse, EV Regehr, RR Wilson, and JA Royle. 2019. Integrating spatial capture-recapture and telemetry data to jointly estimate polar bear abundance and movement. International Conference on Polar Bear Science and Monitoring. Hosted by the Polar Bear Specialist Group and Norwegian Polar Institute. Lyngen, Norway. 12 – 14 February.

- Hostetter NJ, SJ Converse, EV Regehr, and JA Royle. 2018. Integrating spatial capture-recapture and telemetry data to jointly estimate density and movement. The Wildlife Society Annual Conference, Cleveland, Ohio. 7 – 11 October.

WORKSHOPS

- Eric V Regehr, Sarah J Converse, and Nathan J Hostetter were invited participants and presenters at the 2019 International Conference on Polar Bear Science and Monitoring hosted by the Polar Bear Specialist Group of the IUCN Species Survival Commission and Norwegian Polar Institute (Presentation Title: Integrating spatial capture-recapture and telemetry data to jointly estimate polar bear abundance and movement).

- Sarah J Converse, and Nathan J Hostetter were invited participants and presenters at a workshop focused on integrating abundance and movement modeling (July-August 2019). This workshop brought together experts in the fields of mark-recapture and movement modeling from the University of Washington and the NOAA Marine Mammal Laboratory.

PUBLICATIONS

- Hostetter NJ, NJ Lunn, ES Richardson, EV Regehr, and SJ Converse. *In-prep*. Age-structured Jolly-Seber model improves estimation of abundance, survival, and recruitment from capture-recapture data. Methods in Ecology and Evolution (Anticipated)

- Hostetter NJ, SJ Converse, EV Regehr, RR Wilson, and JA Royle. *In-prep*. Integrating spatial capture-recapture and telemetry data to jointly estimate polar bear abundance and movement. Methods in Ecology and Evolution (Invited paper for a special issue on the integration of movement and abundance modelling)

- Regehr EV, NJ Hostetter, RR Wilson, KD Rode, M St. Martin, and SJ Converse. 2018. Integrated population modeling provides the first empirical estimates of vital rates and abundance for polar bears in the Chukchi Sea. Scientific Reports. 8:16780.

Next Steps

- Submission of the two *in-preparation* manuscripts (see previous section) for peer review in 2019/2020.

- We are developing a spatially explicit open-population model combining the concepts from our capture-recapture and telemetry model (see above) and age-structured Jolly-Seber model (see above) to estimate multi-year abundance, movement, and demographic parameters (survival and recruitment). Anticipated peer-review publication in 2019-2020. Demonstration of these methods are applied to a multi-year polar bear data set in collaboration with USGS, Washington Cooperative Fish and Wildlife Research Unit, University of Washington, and Environment and Climate Change Canada.

- Consideration of developing an additional funding proposal focusing on optimal allocation of sampling effort between physical captures and recently developed biopsy sampling methods.

Considerations Going Forward:

The focus of polar bear studies is shifting towards broader spatial extents and the effects of rapidly changing environments on population dynamics. As such, it is increasingly beneficial to integrate multiple data sources to better characterize populations across their entire geographic range while simultaneously addressing multiple management and conservation objectives (e.g., population-specific harvest management, trends in abundance, assessing viability; Regehr et al. 2018). As part of this CAP Action, we demonstrated how collaborative efforts among managers, biologists, and quantitative ecologists improved population-level and study-specific monitoring programs. The ability of study designs to provide robust inferences, however, should be tailored to population-specific sampling constraints (e.g., spring vs fall sampling, ability to capture bears) and objectives (e.g., harvest management vs demographic analyses). For example, in the Chukchi Sea, integration of telemetry, mark-recapture, and count data proved vital to reducing biases in abundance and demographic rates by explicitly accounting for seasonal movements. In western Hudson Bay, integration of readily available

age data and mark-recapture data allowed simultaneous estimation of demographic rates (e.g., survival, recruitment, and age-structure) and dramatically improved our ability detect changes in abundance relative to methods that simply used capture-recapture data. While these approaches utilized different survey methods, they demonstrate a broadly applicable framework: integrating multiple data sources to improve estimation of polar bear abundance and population dynamics.

We highly recommend extending this CAP Action with a focus on population-specific approaches for data integration involving collaboration among managers, biologists, and quantitative ecologists. To efficiently disseminate these concepts, we also recommend supporting a polar bear data integration workshop. This workshop would bring together polar bear researchers and quantitative ecologists from each of the representative Range States to develop consistent survey and analytical approaches to improve within- and across-population monitoring programs. Results of this workshop will benefit population monitoring across the Arctic and can be directly integrated into on-going and future research activities.