

## **Proposed SOOS Working Group**

Censusing Animal Populations from Space (CAPS): A circumpolar assessment of the status and trends of Antarctic pack-ice seals based on satellite remote sensing

### **SOOS Objective Addressed by this Working Group**

The development of cost-effective monitoring approaches to assess changes in Southern Ocean ecosystems is central to Theme Six of SOOS. SOOS's objective to monitor all aspects of the Southern Ocean ecosystem has a fundamental requirement for accurate estimates of population status and trends of significant predators. Despite being the greatest consumers of krill in the Southern Ocean, our understanding of the status and trends in pack-ice seal populations and their relationship with key habitat characteristics, such as sea-ice, currently represents a major knowledge gap. Until now, it has been too logistically challenging and expensive to conduct regular pack-ice seal surveys at a spatial scale sufficient for assessing their regional-scale abundance and distribution; as a result, pack-ice seals have been largely neglected, with the notable exception of a large international survey of pack-ice seals conducted between 1999-2001 (APIS I). Remote sensing based methods provide a cost-effective approach to monitoring seals that will enable these otherwise elusive data be made available.

### **Terms of Reference**

The APIS II working group will aim to fulfill the following terms of reference over four years:

1. Coordinate research and development into the use of satellite remote sensing with the ultimate aims of (i) undertaking a global census of Antarctic pack-ice seals and (ii) implementing regular monitoring of pack-ice seals in the Southern Ocean, which provide an integrated signal on the state of the Southern Ocean;
2. Hold annual meetings of the working group, and to source funding to enable this;
3. Develop standardized methods that are easily understood by different Antarctic stakeholders, including policy stakeholders, which are repeatable, and easily transferred to other research teams looking to contribute to these surveys;
4. Develop methods for validation, and algorithms for transformation of images to estimates of abundance as well as undertake ground truthing of satellite-derived abundance estimates using direct observations;
5. Determine the optimal division of labor to achieve regular continental-scale surveys. One option might be to perform regional assessments that could be combined post-facto into a global assessment. The advantage of this approach is that it naturally accommodates regionally specific approaches that account for differences in satellite coverage, regional climate differences *e.g.* cloud cover, sea ice conditions, the spatial distribution and composition of the seal assemblages, and the capacity to perform ground truth surveys.
6. Develop analytical/statistical procedures for estimating seal abundance and associated estimates of error, with particular consideration of estimator bias and precision;
7. Establish how population estimates and other products would be delivered to end users such as CCAMLR, SOOS, and SCAR.

### **Participants**

The proposed co-chairs will be Prof Mark Hindell (IMAS, AUS) and Dr Peter Fretwell (BAS, UK). Other participants will be a multi-disciplinary team of seal ecologists, remote sensing experts and southern Ocean ecosystem specialists.

Phil Trathan (BAS, UK),  
Heather Lynch (Stony Brook University, US),  
Dan Costa (SOOS, US),  
Kit Kovacs (Norwegian Polar Institute, NOR),  
Andrew Lowther (Norwegian Polar Institute, NOR),

Andrew Constable (Australian Antarctic Division, AUS),  
Colin Southwell (Australian Antarctic Division, AUS),  
Bill de la Mare (Australian Antarctic Division, AUS),  
Michelle LaRue (University of Minnesota, AUS),  
Clive McMahon (Integrated Marine Observing System, AUS)

### **Products and Outcomes**

1. The working group will facilitate the development of tools that enable high resolution satellite images to be used to estimate the numbers of pack-ice seals. Such data are needed for assessing and presenting results of the state of Southern Ocean ecosystems for use by managers. The outputs will be automated algorithms for reliably detecting seals in satellite images. An important aspect of this work will be to assess the algorithms against known presence and absence of seals to provide ground truthing and ultimately measures of estimate uncertainty. We further intend to develop and test the applicability of automated and semi-automated routines using different resolution of VHR imagery. Sampling approaches and recommendations will be made available on the SOOS Web site.
2. Design and implement a cost-effective survey design based on the use of satellite images, to assess the circumpolar status of pack-ice seals. The outputs will be a robust survey design including (a) the number of images needed to sample the region and to minimize uncertainty of the resulting estimates and (b) the spatial sampling arrangement, taking into account the stratified nature of the distribution of pack-ice seals with respect to the continental shelf.
3. If outcomes 1 and 2 are successfully achieved, to assess the state of the krill predator (pack-ice seals) component of the Antarctic marine ecosystem. The last quantitative assessment of crabeater seal numbers was from surveys conducted 15 years ago, so a new assessment will address key questions regarding the trends in seal abundance.
4. To develop a habitat model for pack-ice seals based on seal distribution and physical parameters including sea-ice concentration (taken directly from the images), bathymetry and a suite of derived variables such as age of ice.

### **Mode of Operation**

The group will have dedicated meetings at least once a year, as well as opportunistic side meetings at appropriate scientific meetings (e.g. SCAR Open Science, Marine Mammal Science conferences).