Exploitation of Antarctic krill *Euphausia superba* by three air-breathing predators with contrasting foraging strategies – implications for fisheries feedback management

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The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) regulates the fishery for Antarctic krill. In the southwest Atlantic sector where all harvesting currently takes place, a 620,000 ton interim catch limit has been spatially distributed across four management subareas. This limit represents ~1% of the estimated stock in the area, and is thought to provide a highly precautionary catch limit. The limit has also been spatially subdivided within the four management subareas (small-scale management units; SSMU) to prevent potential overharvesting; reaching the limit for a SSMU results in its closure. After 20 years of this management strategy, CCAMLR has agreed to move towards an ecosystem-based feedback management (FBM) approach to regulate the fishery, which is expected to utilize indicators of reproductive and foraging success of several key krill-dependent predator species such as Antarctic fur seals and various penguin species to adaptively manage quotas. Thus, understanding interactions between predators, krill and the fishery are therefore crucial in determining whether variability in predator indices can be used in any FBM approach. Our study integrates spatial and temporal data collected in 2015/2016 of three key krill "predators"; post-breeding male Antarctic fur seals, breeding chinstrap penguins and commercial fishers. We present data at two spatial scales; the first is a brief, coarse-scale overview of predator movements in relation to krill fishing effort across CCAMLR management subarea scales in which over 95% of krill are caught. The second is a fine-scale characterization of the spatial and temporal overlap between the three "predators" at the South Orkney Islands. We show movement in relation to krill abundance and oceanographic conditions measured in the study region via concurrently-conducted ship surveys. We instrumented 29 Antarctic fur seals with satellite-relayed-data-loggers (SRDL's) which provided location, dive and water column temperature information; 2 of these individuals were fitted with conductivity, temperature and depth (CTD) SRDL's to characterize in more detail the oceanographic properties of the water column they exploited. We also instrumented 122 chinstrap penguins at two field sites with archival fastloc GPS devices and time depth recorders that also logged water temperature. Both fur seals and penguins visited regions that were exploited by the fishery. Additionally, fur seals also moved further west and south, as far as Adelaide Island and Chinstraps also foraged further offshore around the South Orkneys, in areas not used by the fishery. The nature of spatial interactions between these three krill predators requires further investigation, particularly in terms of krill biomass removal and the response of each predator to krill, prior to CCAMLR implementing any FBM approach. Certainly spatial overlap is evident between natural predators and the fishery, but the level of functional overlap requires better quantification.