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Monitoring distribution and abundance of Weddell seal populations using citizen scientist crowds

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Weddell seals are a top predator of the Antarctic marine food web. An ongoing toothfish fishery may severely impact seal populations, as the fish is an important prey of the seals at a critical time of their life cycle. Seal colonies are distributed throughout inaccessible fast-ice regions around the Antarctic continent, making direct monitoring through on-site counts logistically challenging. But because female Weddell seals spend several weeks every spring on fast ice lactating, it may be possible to count individuals in high-resolution satellite images, due to the high contrast of seal bodies on the ice. However, these images span relatively small areas, thus requiring large numbers of them every year to survey large areas. Here we report on crowd-sourcing to utilize citizen scientists in identifying seal colonies, features associated with these, and in estimating seal population numbers. We used a patented crowd ranking algorithm to estimate seal numbers, along with a correction based on Bayes theorem, and a regression modeling approach. We compare the results of these three methodologies in estimating seal numbers in relation to ground counts for the few colonies for which data exist. We also report the suitability of our methods for correctly identifying colonies and thus, for monitoring at the colony level. Preliminary results show that the crowd-ranking algorithm is effective in estimating the number of features an observer may find on an image, but not in ascertaining the feature correctly as a seal. The Bayes correction and the linear regression method offer significant improvement. Citizen scientists are very reliable for identifying seal colonies, and provide an efficient and cost-effective approach to monitoring the presence or absence of Weddell seal colonies, though not the size of colonies, throughout Antarctica. Higher-resolution geophysical data can potentially increase accuracy in estimating seal presence and abundance.