



Impact of climate warming and human activities on population dynamics of Adélie Penguins in Antarctic Peninsula

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Climate warming and associated sea ice reductions in Antarctica Peninsula have modified habitat conditions for Adélie Penguins (*Pygoscelis adeliae*). However, little attention has been paid to the impact of human activities such as tourism and Antarctic Krill catch on the population dynamics of Adélie Penguins. Based on the dataset of Mapping Application for Penguin Populations and Projected Dynamic (MAPPPD), we analyzed the spatial and temporal distribution of Adélie Penguins population in Antarctica Peninsula during the period from 1960 to 2015. Moreover, we indicated the major factors that affecting penguin population, i.e. sea ice area and extent, air temperature, and ocean chlorophyll-a concentration. Results indicated that Adélie Penguins population in the Antarctic Peninsula has been decreased during the past 30 years, especially in some islands such as Litchfield Island, Cormorant Island, and Humble Island. There were 118 penguin colonies with the averaged population of 1.1 million in Antarctica Peninsula during the last decades. Population decreasing sites were mainly found in the Western Antarctic Peninsula, accounting for 49 of the total site amount. Air temperature increased in Bellinghshausen meteorological station in Antarctica Peninsula during 1968 and 2016. Both sea ice extent and sea ice area decreased during 1978 and 2012, and the same trend was found in chlorophyll-a concentration. For the human activities, both krill catches and tourisms increased during in Antarctica Peninsula in recent years, and the Antarctic krill catches increased in Antarctica Peninsula, ranging from 2333 to 154442 tons with the mean annual value of 60596 tons. The decrease in Adélie penguin populations was attributed to the increase of air temperature, landing tourists and Krill catch and the decrease of sea ice and phytoplankton biomass.