Antarctic Ecosystem Recovery: Recolonization of Adélie Penguins at Cape Hallett (ASPA No. 106), Ross Sea

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***Summary***

Human-induced disturbances in Antarctica have caused changes in the structure and function of its ecosystems. Since the decommissioning and removal of Cape Hallett Station in the Ross Sea and associated environmental remediation that took place from 2000 to 2007, recolonization of Adélie penguins was visually confirmed at Cape Hallett for the first time. The site of the former station was found to be recolonized by 6,175 Adélie penguin nests in 2019. Recolonization may be facilitated by enhancing the habitat (Nevins, 2001; Kim et al., 2023). This paper provides information about the recovery of a region in Antarctica that was impacted by human-induced changes and draws attention to the importance of planning and undertaking remediation as well as long-term monitoring based on environmental assessment in the Antarctic regions.

***Introduction***

Antarctica is the most remote and pristine region on earth. However, Antarctic fauna and flora are affected by climate changes and human activities (Southwell et al., 2017). The human-induced disturbances in Antarctica have caused changes in the structure and functioning of its ecosystems (Frenot et al., 2005). Some nesting sites of Adélie penguin (Pygocelis adeliae) were destroyed due to construction activities. Stations built near a penguin colony posed direct threats to the penguins. The Cape Hallett Station was one of these stations, which was a joint scientific base between the United States and New Zealand, established in 1957 and abandoned in 1973 (Gordon 2003). The station was located inside an Adélie penguin colony, and many penguins were displaced during the operation period. Studies examining the impacts of the station’s presence were undertaken over the decades, and initial clean-up, remediation works and several assessments were conducted for environmental restoration after the station was closed (Foster, 1987; Gilmore, 2001; Carson 2008; ATCM XXIX– IP115). To provide verified scientific information about the recolonization of Adélie penguins and to present evaluation of station clean-up efforts at Cape Hallett (ASPA No. 106), the number of breeding pairs and the temporal-spatial changes of nest distribution were compared across different time periods using historical materials and literatures as well as field survey data by Korean scientists as a part of CCAMLR Ecosystem Monitoring Program (CEMP).

***Antarctic ecosystem recovery following human-induced habitat change***

The Cape Hallett Station occupied 4.77 ha within the Adélie penguin breeding area, and 349 nests were identified inside the station boundary in 1960. The station area decreased to 4.2 ha in 1983 and 1,683 breeding pairs were counted in the old station area. Initial clean-up of the station was undertaken over several seasons by 1996 without comprehensive assessment (ATCM XXIX– IP115). After the implementation of the Environmental Protocol in 1998, environmental assessment and clean-up efforts were carried out from 2000 to 2007 by the two national Antarctic programmes of New Zealand and United States.

For investigating the number of breeding pairs with reduced human disturbances, UAV (RPAS) was applied. It was identified that a large number of nests expanded in to the site previously occupied by the station, and the former station area was recolonized by 6,175 Adélie penguin nests in 2019.The results of the study indicate numerous recolonized breeding pairs compared to the aerial surveys from previous reports (see Figure 1). This demonstrates that successful restoration is possible based on proper planning and long-term commitments (Nevins, 2001; Kildaw et al., 2005; ATCM XXIX– IP115). Forty-six years after station decommissioning, it is confirmed that Adélie penguin recolonization has occurred at that site. In addition, artificially created mounds drove penguins to inhabit them with beneficial results in the case of the Cape Hallett penguin colony (see Figure 2).



Figure 1. Spatial-temporal changes of nest distribution in penguin colonies at Cape Hallett (Figure 6 in Kim et al., 2023)



Figure 2. Artificial mounds in use by recolonized Adélie penguins (Figure 7. in Kim et al., 2023)

***Conclusion***

This study suggests that in order to successfully restore a penguin colony that has been affected by human-induced disturbances, enhancing the habitats would be beneficial. This includes loosening the soil compacted by human activities for facilitating nesting and restoring habitats to be as close to nearby natural habitats as possible, such as creating artificial mounds as in the case of Cape Hallett. Without detailed historical notes, well-documented pioneering researches, and long-term research and monitoring, it is impossible to evaluate the effectiveness of clean-up and remediation efforts. Planning and commencing the remediation process based on a comprehensive assessment is also crucial for the recovery of Antarctic ecosystems.

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