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Author(s)	小川, 萌日香
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博士 (環境科学)

氏 名 小川 萌日香

審査委員 主査 教授 宮下 和士
副査 教授 杉山 慎
副査 准教授 南 憲吏
副査 教授 三谷 曜子

(京都大学野生動物研究センター)

学 位 論 文 題 名

Marine mammals in a warming Arctic: Connections with ecosystem, environment and
Inuit in Inglefield Bredning, northwest Greenland

(温暖化する北極域の海棲哺乳類:北西グリーンランドにおける海洋生態系、環境、イヌイットとのつながり)

The Arctic is one of the most rapidly warming regions on Earth, raising concerns about cascading effects on the interconnected relationships among the environment, marine ecosystems, marine mammals, and Indigenous communities that depend on them as vital resources. To assess and predict climate change impacts, particularly on marine mammals and local people at the top of this network, the applicant investigated these connections during the open-water season in Inglefield Bredning, home to Greenland's northernmost Inuit communities. This study combined analyses of marine mammal biological samples with interviews of Inuit people, who hold deep knowledge of the local environment and animals. During summer, four species of marine mammals, including ringed seal (*Pusa hispida*), harp seal (*Pagophilus groenlandicus*), bearded seal (*Erignathus barbatus*), and narwhal (*Monodon monoceros*), inhabit this area and serve as key targets for Inuit hunters.

In Chapter 2, she reports on feeding ecology and niche overlap among marine mammals based on stomach contents collected between 2022 and 2024, providing insights into relationships between marine mammals and their prey. Polar cod (*Boreogadus saida*), the Arctic's most abundant fish, was the dominant prey for marine mammals. Red fish (*Sebastes fasciatus*), typically found in southern waters, was identified in stomach contents for the first time in this region. Additionally, zooplankton composition showed a shift toward Atlantic species compared to previous studies, suggesting climate change-driven ecosystem changes. Among the four marine mammals, narwhals exhibited the narrowest dietary niche, making them the most vulnerable to environmental changes.

In Chapter 3, she combined stomach content data with location information where each animal was hunted to conduct a spatial analysis of foraging ecology. This revealed how sympatric species partition foraging areas and highlighted the importance of tidewater

glacier fronts, particularly for ringed seals. Continued glacier retreat due to climate change could eliminate these crucial foraging sites, potentially altering the diet and habitat use of marine mammals.

In Chapter 4, she focused on ringed seals' foraging grounds, particularly their use of glacier fronts. By comparing data collected in 2003 with recent findings, this study examined changes in foraging areas over two decades, clarifying climate change's impact on their feeding ecology. Results showed increased glacier dependence, likely driven by enhanced ocean productivity near glacier fronts due to rising glacial discharge.

In Chapter 5, she examined the trophic levels of organisms in the food web, from zooplankton to marine mammals, and assessed pollutant levels in marine mammals accumulated through the food web. Findings revealed that even sympatric species are affected differently by pollutants, depending on foraging ecology, such as benthic or pelagic feeding habits.

In Chapter 6, she conducted interviews with Inuit people to obtain insights not reflected in biological analyses, including knowledge from decades of lived experiences and intergenerational wisdom. These interviews revealed that melting glaciers, sea ice, and icebergs have significantly impacted traditional practices like dog sled hunting, making it harder to hunt marine mammals using traditional methods. Additionally, global societal changes were found to indirectly but profoundly affect Inuit culture and ecosystems. Inuit communities in this area face dual challenges: a rapidly changing environment and ongoing societal transformations.

This study is the first to comprehensively reveal connections between the marine ecosystem, environment, and people in this region, with a focus on marine mammals. It provides vital insights for assessing and predicting climate change impacts. The results demonstrate that for both marine mammals and the Inuit people who depend on them, climate change poses a serious threat, underscoring the urgency of strengthening resilience to environmental changes. While this study focused on the summer period, the only time the sea is open in this region, investigating conditions during the frozen sea period is also essential due to the significant influence of climate change on sea ice. Given the interconnected and complex impacts of climate change on the environment, marine ecosystems, marine mammals, and local communities, it is crucial to adopt multidisciplinary approaches to develop effective strategies.

As described above, the applicant's study has significantly advanced our understanding of the links between marine ecosystems, marine environments, and the lives of local residents in the Arctic, which are facing rapid environmental changes due to global warming, and has made important progress regarding future prospects in the Arctic. We highly evaluated these results and concluded that Monika Ogawa was a sincere and dedicated researcher with sufficient qualifications for a doctoral degree, and that she was suitable for a Doctor of Philosophy (Environmental Science).