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Avian influenza H5N1 threatens imperiled krill-dependent predators in Antarctica

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1 Introduction

The panzootic high pathogenicity avian influenza subtype H5N1 clade 2.3.4.4b (hereafter H5N1) has spread globally in recent years at unprecedented rates (Klaassen and Wille, 2023). This novel H5N1 differs from previous outbreaks because the barrier of transmission from birds to pinnipeds (seals and sea lions) is low (Dewar et al., 2023; Tomás et al., 2024), direct mammal to mammal transmission is likely (Restori et al., 2024; Rimondi et al., 2024; Uhart et al., 2024; Plaza et al., 2024a), and even small doses are virulent in mammals (Restori et al., 2024). During 2023 the virus spread around South America from the Pacific to the Atlantic Ocean, killing hundreds of thousands of seabirds and tens of thousands of pinnipeds (Leguia et al., 2023; Ulloa et al., 2023; Azat et al., 2024; Campagna et al., 2024; De Lima et al., 2024; Plaza et al., 2024b). Fears of H5N1 following wildlife migration routes and infecting Antarctic seabird and pinniped colonies (Boulinier, 2023; Dewar et al., 2023; Stokstad, 2024) have recently been realized by confirmed infections at several locations on the Antarctic Peninsula (AP) (Bennett Lazo et al., 2024; SCAR-AWHN, 2024; WAHIS, 2024). Given the geographic proximity of South Georgia in the southwest Atlantic (Figure 1), where Antarctic fur seals (*Arctocephalus gazella*) and southern elephant seals (*Mirounga leonina*) have been infected (Bennison et al., 2024), and the common, direct behavioral interactions with regional H5N1-infected seabird species, the risk to Antarctic pinnipeds is extremely high.

The vast majority of Antarctic seabirds and marine mammals depend on Antarctic krill (*Euphausia superba*, hereafter krill) as their main prey source (Laws, 1985). Krill is also the target of the largest commercial fishery in the Southern Ocean, which is managed by the

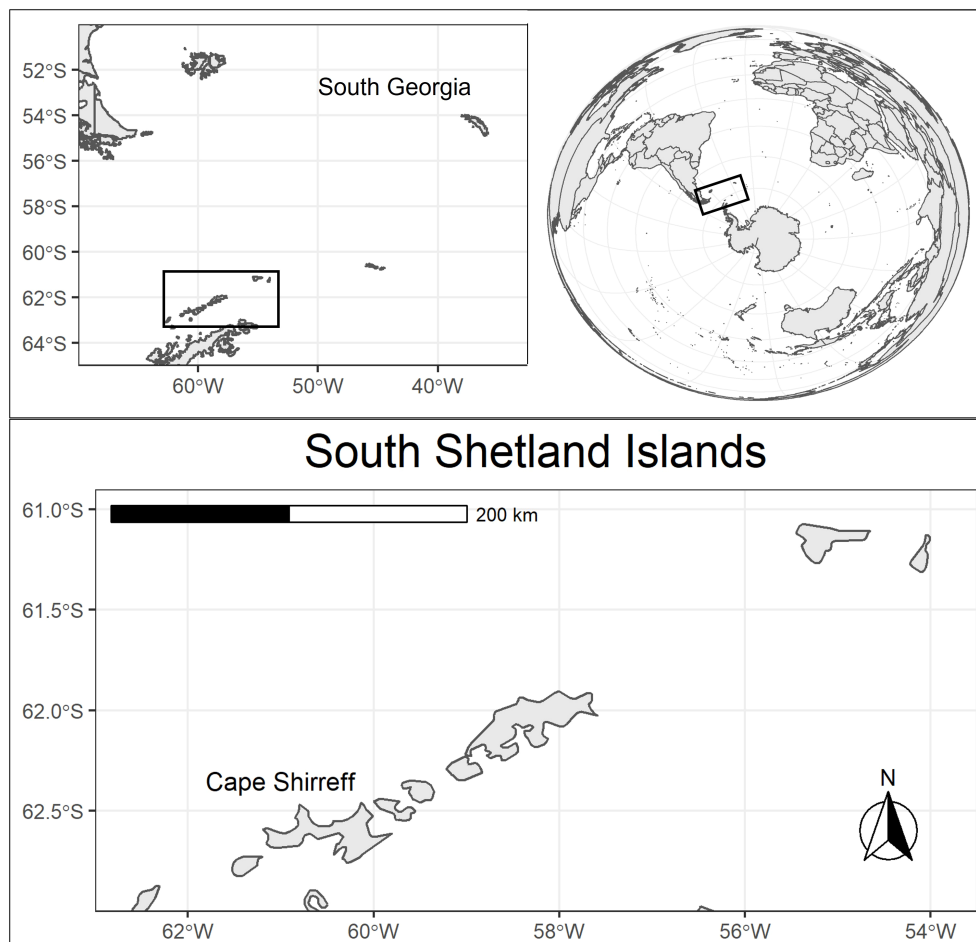


FIGURE 1

A regional map of the Antarctic Peninsula illustrating the proximity of H5N1-infected seabird and pinniped colonies along migratory pathways from South America via South Georgia to the Peninsula, particularly the South Shetland Island archipelago.



FIGURE 2

A mother-pup pair of South Shetland Antarctic fur seals (*Arctocephalus gazella*), a genetically-distinct population of the species that is at extreme conservation risk due to high pathogenicity avian influenza H5N1, potential incidental mortality in the krill fishery, and other factors. Photo taken in accordance with Marine Mammal Protection Act Permit No. 25786.

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR, 1980). The krill fishery has grown substantially in recent decades, and has temporally and spatially concentrated its effort into small areas that overlap with krill-dependent predators (Santa Cruz et al., 2018; Watters et al., 2020). Empirical observations indicate that, given natural variability in the system, such concentrated catches pose plausible risks to predator populations (Watters et al., 2020; Krüger et al., 2021). The current krill fishery management strategy is not adaptable based on changes in the ecosystem and has not been updated for over a decade. However, CCAMLR is currently considering the adoption of management strategies that are annually adaptable and spread the allowable catch in space and time, which could alleviate risks to krill predators (Warwick-Evans et al., 2022; Watters and Hinke, 2022). Trawling vessels fishing for krill are required to use marine mammal-exclusion devices; nevertheless, pinnipeds and whales are occasionally killed incidentally (e.g., CCAMLR Secretariat, 2024). Therefore, CCAMLR is also considering time-area closures to limit interactions between the krill fishery and Antarctic seabirds and marine mammals during biologically critical periods.

Given the novel, highly-transmissible nature of H5N1 resulting in mass die-offs in marine mammals, we have grave concern about the potential negative effects on krill-dependent predators, including some already-vulnerable populations. Particularly, South Shetland Antarctic fur seals (SSAFS, Figure 2), a genetically-distinct population of the species that is experiencing a catastrophic population collapse (Krause et al., 2022). Since 2007, the abundance estimates of SSAFS have dropped extraordinarily from over 40,000 to under 1,500 animals. While there have been demographically-positive changes in the region like the substantial reduction of predation on SSAFS pups by leopard seals since 2017 (Krause et al., 2024), other high risk conservation threats remain. Immediate threats to this long-lived, low-fecundity population include competition for prey from other krill predators and the krill fishery, incidental mortality in fishing trawls, and most urgently, H5N1 mortality (Krause et al., 2024).

2 Discussion

This influenza virus alone can devastate pinniped populations within months (Leguia et al., 2023; Campagna et al., 2024; Plaza et al., 2024b), and cumulatively these threats imperil adequate SSAFS conservation and require urgent management action. To minimize the negative impacts of H5N1 on SSAFS and other small or vulnerable populations, we recommend: 1) adoption of conservation measures to reduce non-H5N1 mortality for SSAFS including adaptive krill fishery management and targeted time-area closures, 2) enhanced surveillance

and testing of H5N1 in the AP, 3) real-time communication of suspected cases (SCAR-AWHN, 2024), 4) using biosecurity best practices during interactions with wildlife (WOAH, 2024), and 5) removal and proper disposal of H5N1-infected carcasses when possible (Dewar et al., 2023; Knief et al., 2024).

Author contributions

RB: Writing – review & editing, Writing – original draft, Project administration, Conceptualization. DK: Writing – review & editing, Writing – original draft, Project administration. AB: Writing – review & editing, Writing – original draft. CB: Writing – review & editing, Writing – original draft. LO: Writing – review & editing, Writing – original draft. MMU: Writing – review & editing, Writing – original draft. MU: Writing – review & editing, Writing – original draft. GW: Writing – review & editing, Writing – original draft.

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