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Baseline

Mercury concentrations in breast feathers of three upper trophic level marine predators from the western Aleutian Islands, Alaska

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ABSTRACT

Mercury (Hg) is a toxic element distributed globally through atmospheric transport. Agattu Island, located in the western Aleutian Islands, Alaska, has no history of point-sources of Hg contamination. We provide baseline levels of total mercury (THg) concentrations in breast feathers of three birds that breed on the island. Geometric mean THg concentrations in feathers of fork-tailed storm-petrels (*Oceanodroma furcata*; 6703 ± 1635, ng/g fresh weight [fw]) were higher than all other species, including snowy owl (*Bubo scandiacus*; 2105 ± 1631, ng/g fw), a raptor with a diet composed largely of storm-petrels at Agattu Island. There were no significant differences in mean THg concentrations of breast feathers among adult Kittlitz's murrelet (*Brachyramphus brevirostris*; 1658 ± 1276, ng/g fw) and chicks (1475 ± 671, ng/g fw) and snowy owls. The observed THg concentrations in fork-tailed storm-petrel feathers emphasizes the need for further study of Hg pollution in the western Aleutian Islands.

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Mercury (Hg) is a toxic metal with a global distribution that can negatively influence wildlife health (Scheuhammer et al., 2007). Microbial activity can convert inorganic Hg into its most toxic form, methylmercury (MeHg; Benoit et al., 2003), where it is rapidly incorporated into the food web and biomagnifies from one trophic level to the next (Ochoa-acuna et al., 2002). Atmospheric mercury concentrations are increasing globally, due in large part to anthropogenic releases, such as industrial emissions, waste incinerators, and coal-fired power plants (Pirrone et al., 2010). As a result of global transport paired with localized MeHg production, even isolated ecosystems can contain elevated Hg concentrations in resident biota (Landers et al., 2008). In Alaska, atmospheric deposition of Hg is attributed to long-range transport, associated in part with large-scale increases in coal combustion and expanding industry in several developing countries (AMAP, 2002). Additionally, the proportionally faster warming temperatures in Arctic regions may further exacerbate Hg exposure in northern latitudes by both releasing snowpack- and permafrost-entrained Hg, and by enhancing conditions that facilitate MeHg production (AMAP, 2002).

Several studies in the Aleutian archipelago (hereafter, Aleutians), a remote 1900 km island chain that extends westward from the tip of the Alaska Peninsula (Fig. 1), have shown that avian species are exposed to high concentrations of Hg and other contaminants (Anthony et al., 1999, 2007; Stout and Trust, 2002; Burger et al., 2007, 2009; Ricca et al., 2008). Specifically, an increasing east–west gradient along the archipelago was detected for Hg concentrations in tissues of glaucous-winged gulls (*Larus glaucescens*) and bald eagles (*Haliaeetus leucocephalus*; Anthony et al., 2007; Ricca et al., 2008). Recent studies focused on freshwater fishes and marine mammals documented similar patterns, with highest Hg concentrations at Agattu Island (hereafter, Agattu; Fig. 1) compared to eastern Aleutian Islands and mainland Alaska (Kenney, unpublished data; Rea et al., 2013).

Avian feathers provide an effective, non-invasive tool to examine Hg exposure in birds, particularly when monitoring Hg exposure in species of conservation concern, or birds that are sensitive to disturbance during the breeding season. Mercury from internal tissues (e.g., blood, liver, kidney, muscle) is depurated and sequestered in growing feathers during molt, where it is tightly bound to the keratin protein matrix. Because feathers are regularly molted, feather replacement can serve as a major pathway for the elimination of Hg body burden (Braune, 1987; Bearhop et al., 2000). Research has increasingly demonstrated that MeHg can impair growth and development, behavior, motor skills, and

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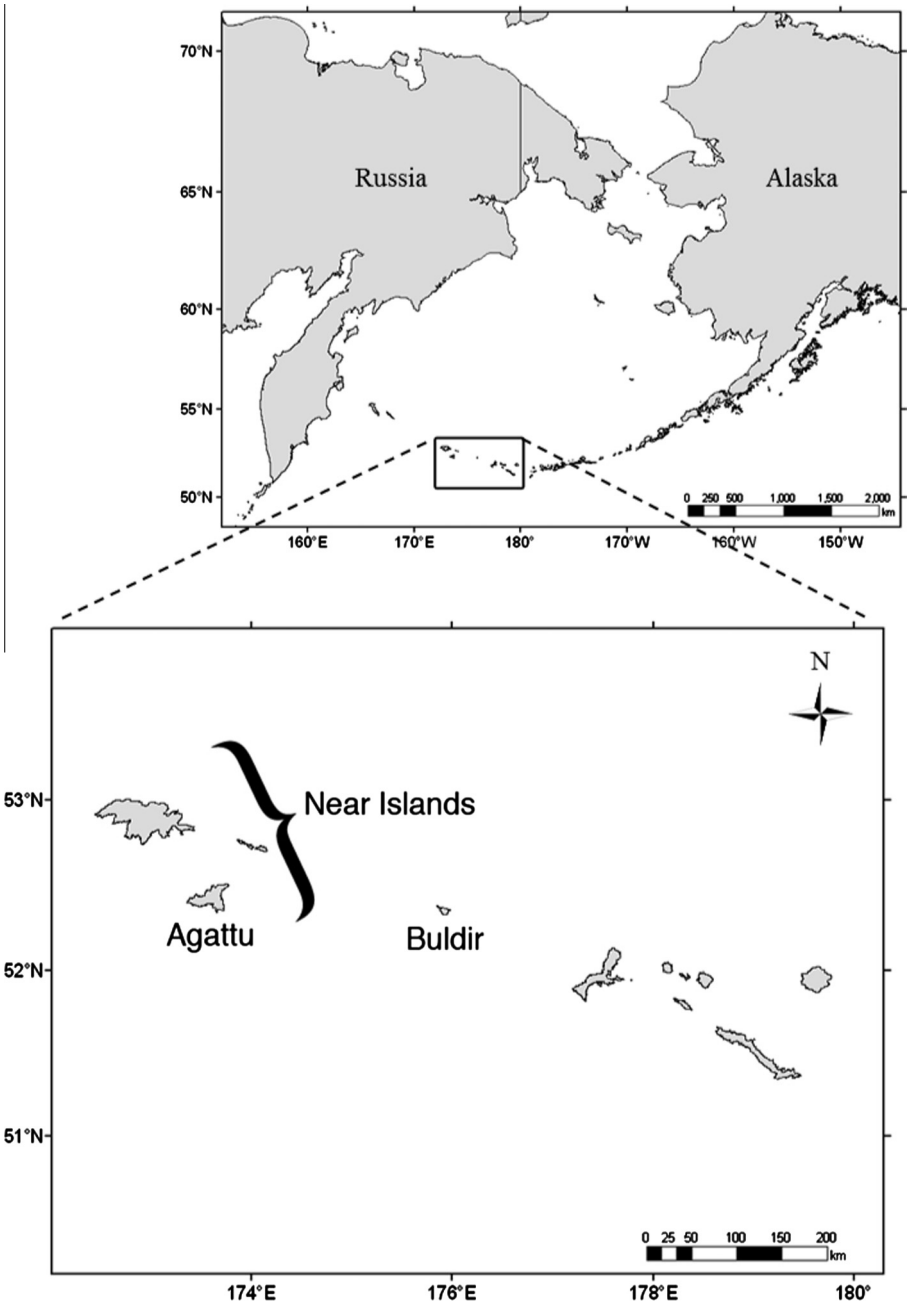

Fig. 1. Location of study at Agattu Island, in the Near Islands in the western Aleutians, Alaska.

survivorship in birds (Scheuhammer et al., 2007; Bennet et al., 2009). Interpreting the toxicity of Hg in feathers can be difficult due to the time lag of exposure that feathers may represent, as well as species-specific variation in tissue-feather Hg partition coefficients (Eagles-Smith et al., 2008). However, in some bird species feather Hg concentrations of 5000–40,000 ng/g have been related to reduced reproductive performance and lifetime productivity (Burger and Gochfeld, 1997; Evers et al., 2008), especially in piscivorous birds and upper trophic level species (Eisler, 1987).

We evaluated Hg levels among three species of birds, representing a range of trophic positions as indicators of regional Hg exposure in the western Aleutians. Kittlitz's murrelet (*Brachyramphus brevirostris*) is a pursuit-diving piscivore-planktivore endemic to Alaska and the Russian Far East that feeds on both marine forage fish and macrozooplankton (Day et al., 1999; Hatch, 2011). Little is known about the diet and migration habits of Kittlitz's murrelets during the non-breeding season. The fork-tailed storm-petrel (*Oceanodroma furcata*) is an abundant and widespread surface-feeding piscivore-planktivore that nests on islands from California to Alaska and northeastern Asia and winters at-sea near their breeding grounds (Boersma and Silva, 2001; Gibson and Byrd, 2007). In the western Aleutians, the fork-tailed storm-petrel diet is composed of macrozooplankton and mesopelagic marine fishes (Dragoo et al., 2012). The snowy owl (*Bubo scandiacus*) is a non-migratory apex predator in the western Aleutians and subsists entirely on a diet of birds at Agattu Island (Fig. 1), an island lacking terrestrial mammals (Kenney unpublished data; Williams and Frank, 1979).

Breast feathers from our focal species were collected during the course of four field seasons at Agattu (2008–2011). Breast feather