Observations of body-icing on Rock Sandpipers during winter in upper Cook Inlet, Alaska

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The effects of severe winter weather on birds are well documented and include forced migration (Dobinson & Richards 1964, McIlhenny 1940), reduced physiological condition (Davidson & Evans 1982, Dugan *et al.* 1981, Piersma *et al.* 1994), and direct mortality (Dobinson & Richards 1964, Scott 1937, Ticehurst & Hartley 1948). Direct mortality is typically manifested through starvation or hypothermia; birds lacking sufficient energy reserves to emigrate may succumb to starvation or cold if food resources are depleted or inaccessible (Davidson & Evans 1982, Piersma *et al.* 1994). Less commonly, mortality may be due to ice accumulation, often reported as the consequence of ice accretion on auxiliary markers (e.g., nasal saddles, neck collars (Byers 1987, Greenwood & Bair 1974, Zicus *et al.* 1983)), typically on waterfowl species. Markers can become heavily laden with ice, hindering a bird's ability to feed, swim, or fly, often resulting in death. Less commonly, others have reported the effects of icing on unmarked birds. Ticehurst & Witherby (1940) and Ticehurst & Hartley (1948) reported instances of numerous bird species (including shorebirds) suffering body-icing during severe winters in Britain. In general, however, observations of body-icing on unmarked birds are rare, and all reports mention obvious negative impacts due to the icing (e.g. inability to fly, loss of plumage, death).

On 14 Mar 2006, 20 Nov 2006, and 17–19 Dec 2007, we observed numerous individual Rock Sandpipers *Calidris ptilocnemis* with extensive body-icing on their plumage and/or tarsi (Figs 1 and 2). Birds were observed near the mouth of the Kasilof River, upper Cook Inlet, Alaska (60.390°N, 151.297°W). Approximately 6,300, 6,000, and 7,000 Rock

Fig. 1. Two Rock Sandpipers exhibiting body icing observed near the mouth of the Kasilof River, Alaska, 18 Dec 2007. The bird to the right has its left tarsus encased in ice and the bird to the left exhibits limited plumage icing on its lower right breast. (Photo D. Ruthrauff.)

Fig. 2. Rock Sandpipers roosting at high tide near the mouth of the Kasilof River, Alaska, 19 Dec 2007. Birds bathe in the splash zone while others roost on frozen ground. Numerous individuals exhibit plumage icing (red arrows), and two individuals also exhibit icing on their left tarsi (red circles). (Photo D. Ruthrauff.)

Sandpipers were present at the site on 14 Mar 2006, 20 Nov 2006, and 17–19 Dec 2007, respectively. Although we were unable to systematically assess the prevalence of icing due to the sandpipers' rapid feeding movements and their attempts to shelter their legs under their plumage, we estimated that approximately 5% of birds were affected with body-icing. Due to the high number of birds present at the site and their frenetic feeding activity, it was impossible to follow any one individual for a prolonged period. Nonetheless, all of the iced birds that we observed behaved normally and fed actively side by side with unaffected birds. We did not note any lethargic, listless, or otherwise obviously impacted birds, nor did we note any dead birds. Furthermore, we did not observe any of the iced birds attempting to dislodge the ice from their bodies. The fact that only approximately 5% of all birds were afflicted, however, may indicate a selective predisposition that reflects an individual's 'quality' (e.g. body condition, thermogenic capacity, etc.).

Our observations indicate that Rock Sandpipers do not appear to be obviously impacted by body-icing, and we are unaware of similar observations for other shorebird species. The persistence of such icing is unknown and likely affects the overall severity of the condition. For instance, it may be that the ice only forms while birds are relatively inactive (e.g. while roosting) but quickly melts once the birds increase metabolic activity (e.g. while flying, feeding, or simply wading back into the water). Alternatively, the icing may endure or even increase for as long as cold weather conditions persist,

and birds that endure longer periods of body-icing are likely incurring increased thermogenic costs. Severe icing may also increase predation risk due to the diminished flight capabilities of heavier birds. Rock Sandpipers average approximately 100 g during winter in upper Cook Inlet (Gill *et al.* 2002), and extensive icing (e.g. Fig. 1) could conceivably increase a bird's mass by 2–4%, predisposing an iced individual to increased predation risk compared to non-iced conspecifics (e.g. Burns & Ydenberg 2002, Lima 1986). As with the previously mentioned waterfowl markers, leg bands may predispose banded individuals to ice accumulation, and Rock Sandpipers in upper Cook Inlet may thus be especially susceptible to negative band-related impacts. Rock Sandpipers wintering in upper Cook Inlet are almost exclusively individuals of the nominate race (Gill *et al.* 2002), and less than 200 individuals of this race of approximately 25,000 birds (Alaska Shorebird Group 2008) have been marked with leg bands. We detected no banded birds during the aforementioned observation periods, but subsequently observed banded Rock Sandpipers during other more benign periods in upper Cook Inlet. Thus, banding may not necessarily predispose Rock Sandpipers in upper Cook Inlet to increased negative impacts related to body-icing, but this threat should be acknowledged and more rigorously assessed by researchers in the future.

Our observations coincided with periods of severe, but not unprecedented, cold. The minimum temperatures recorded at Kenai, Alaska, a coastal town approximately 18 km north of the Kasilof River was –23°C, –17°C, and –22°C for Mar 2006, Nov 2006, and Dec 2007, respectively (unless otherwise noted, all meteorological information from National Oceanic and Atmospheric Administration 2009). In contrast, we did not encounter any iced birds during recent observations of approximately 4,000 Rock Sandpipers at the same location from 4–5 and 18–20 Feb 2009 when the coldest temperatures recorded at Kenai were –19°C and –15°C, respectively. These temperatures were sufficiently cold to freeze standing water on the exposed mudflats (brackish water at this site freezes at approximately –2°C), but not cold enough to cause the accumulation of ice on the birds. When feeding, the Rock Sandpipers often stand in water as deep as their bellies, but the water apparently does not freeze to the bird unless the air temperature is considerably lower than –2°C (e.g. approaching –20°C).

Studies of marine structures indicate that as sea temperatures approach freezing the main factors contributing to ice accretion are air temperature and wind speed (Pease & Comiskey 1985). Like many other bird species, Rock Sandpipers likely rely upon countercurrent circulation to minimize heat loss through their legs (Johansen & Bech 1983), and during extreme cold the temperature of the feet and tarsi of Rock Sandpipers likely approaches 0°C. Similarly, Rock Sandpiper plumage is clearly an extremely effective insulator, and the temperature of outer plumage layers are essentially at ambient temperature. Thus, in cold, windy conditions, legs and plumage are suitably cold structures upon which ice can accumulate. While air temperature is likely the most significant factor promoting this phenomenon, a combination of wind and near-freezing water seems to be required to produce body-icing as evidenced by the absence of iced birds during calm, –19°C conditions on 4–5 Feb 2009.

Our observations are unique and intriguing, but may not necessarily be uncommon. Rock Sandpipers are present at sites throughout upper Cook Inlet during winter (Gill *et al.* 2002), and weather conditions similar to those that induced the body-icing described above are common throughout the winter. For instance, the average daily minimum temperature in Kenai during Jan and Feb is –15°C and –13°C, respectively (Western Regional Climate Center 2009). Additionally, Kenai has an average of 48 days where minimum temperatures are –18°C or lower, and annual extremes <–30°C are not uncommon, demonstrating that the cold temperatures that promote body-icing can occur throughout the winter. The fact that this phenomenon has gone unreported is not surprising, however, because during the winter most Rock Sandpipers in Cook Inlet occur at sites unfrequented by humans. At the few locations where Rock Sandpipers co-occur with humans, the weather conditions that induce body icing on birds are the same weather conditions that typically encourage humans to stay indoors. Hence, few observers are present to note the occurrence of this phenomenon. However common the accretion of body-ice on Rock Sandpipers may be, the survival implications of this phenomenon are fascinating, especially in the broader context of the species' ability to survive long, dark, cold winters in upper Cook Inlet, Alaska.

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Alaska Shorebird Group. 2008. *Alaska Shorebird Conservation Plan. Version II.* Alaska Shorebird Group, Anchorage, AK.

Burns, J.G. & R.C. Ydenberg. 2002. The effects of wing loading and gender on the escape flights of least sandpipers (*Calidris minutilla*) and western sandpipers (*Calidris mauri*). *Behav. Ecol. Sociobiol.* 52: 128–136.

Byers, S.M. 1987. Extent and severity of nasal saddle icing on mallards. *J. Field Ornithol.* 58: 499–504.

Davidson, N.C. & P.R. Evans. 1982. Mortality of redshanks and oystercatchers from starvation during severe weather. *Bird Study* 29: 183–188.

Dobinson, H.M. & A.J. Richards. 1964. The effects of the severe winter of 1962/63 on birds in Britain. *Br. Birds* 57: 373–434.

Dugan, P.J., P.R. Evans, L.R. Goodyer & N.C. Davidson. 1981. Winter fat reserves in shorebirds: disturbance of regulated levels by severe weather conditions. *Ibis* 123: 359–363.

Gill, R.E., P.S. Tomkovich & B.J. McCaffery. 2002. Rock Sandpiper (*Calidris ptilocnemis*). *In:* The Birds of North America, No. 686. A. Poole & F. Gill (eds). The Birds of North America Inc., Philadelphia, PA.

Greenwood, R.J. & W.C. Bair. 1974. Ice on waterfowl markers. *Wildl. Soc. Bull.* 2: 130–134.

Johansen, K. & C. Bech. 1983. Heat conservation during cold exposure in birds (vasomotor and respiratory implications). *Polar Res.* 1: 259–268.

Lima, S.L. 1986. Predation risk and unpredictable feeding conditions: determinants of body mass in birds. *Ecology* 67: 377–385.

McIlhenny, E.A. 1940. Effects of excessive cold on birds in southern Louisiana. *Auk* 57: 408–410.

National Oceanic and Atmospheric Administration. 2009. *Local Climatological Data for Kenai Municipal Airport, Version 3.* National Climate Data Center, Asheville North Carolina. Web address: *http://cdo.ncdc.noaa.gov/qclcd/QCLCD*. Accessed 19 March 2009.

Pease, C.H. & A.L. Comiskey. 1985. *Vessel icing in Alaskan waters – 1979 to 1984 data set.* Pacific marine Environmental Laboratory, U.S. National Oceanic & Atmospheric Administration, Seattle, WA. NOAA Data Report REL PMEL-14. 16 pp.

Piersma, T., I. Tulp & H. Schekkerman. 1994. Final countdown of waders during starvation: terminal use of nutrients in relation to structural size and concurrent energy expenditure. In: *Close to the Edge: Energetic Bottlenecks and the Evolution of Migratory Pathways in Knots*. T. Piersma (ed.). pp. 220–227. Uitgeverij Het Open Boek, Den Burg, Texel, The Netherlands.

Scott, T.G. 1937. Snow-killing of the bob-white. *Wilson Bull.* 49: 21–27.

Ticehurst, N.F. & P.H.T. Hartley. 1948. Report on the effect of the severe winter of 1946–1947 on bird-life. *Br. Birds* 41: 322–344.

Ticehurst, N.F. & H.F. Witherby. 1940. Report on the effect of the severe winter of 1939–1940 on bird-life in the British Isles. *Br. Birds* 34: 118–132.

Western Regional Climate Center. 2009. Kenai FAA Airport Monthly Climate Summary. Web address: *http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak4546*. Accessed 17 March 2009.

Zicus, M.C., D.F. Schultz & J.A. Cooper. 1983. Canada goose mortality from neckband icing. *Wildl. Soc. Bull.* 11: 286–290.