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Reference Intervals for Serum Biochemistries of Molting Pacific Black Brant (*Branta bernicla nigricans*) in Northern Alaska, USA

J. Christian Franson,[1,3] Paul L. Flint,[2] and Joel A. Schmutz[2] [1]US Geological Survey, National Wildlife Health Center, 6006 Schroeder Road, Madison, Wisconsin 53711, USA; [2]US Geological Survey, Alaska Science Center, 4210 University Drive, Anchorage, Alaska 99508, USA; [3]Corresponding author (email: jfranson@usgs.gov)

ABSTRACT: We determined reference intervals for nine serum biochemistries in samples from 329 molting, after-hatch-year, Pacific Black Brant (*Branta bernicla nigricans*) in Alaska, US. Cholesterol and nonesterified fatty acids differed by sex, but no other differences were noted.

Serum and plasma biochemistries have been used to evaluate nutritional status, metabolic parameters, and health of wild birds (Dabbert et al. 1997; Guglielmo et al. 2002; Scott et al. 2010). Biochemistry reference intervals provide a basis for comparison to assess physiological perturbations on individual and population levels. Serum biochemistries have been reported from at least three species of the genus *Branta*, including the Aleutian Goose (*Branta canadensis leucopareia*) and the Hawaiian Goose (*Branta sandvicensis*) in captivity, and the Canada Goose (*Branta canadensis interior*) in the wild (Mori and George 1978; Gee et al. 1981). However, biochemistry reference intervals have not been reported from Pacific Black Brant (*Branta bernicla nigricans*). These geese winter in estuaries along the Pacific coast from Alaska, US to Mexico and nest in coastal sedge communities in Arctic Canada and Alaska (Lewis et al. 2013). Many Black Brant that do not attempt to nest or fail to complete nesting or brood rearing migrate to high Arctic lakes before molting their flight feathers (Bollinger and Derksen 1996). Although molting Black Brant lose body mass, rates of loss vary over broad temporal scales, molting locations, and by breeding status (Lewis et al. 2011; Fondell et al. 2013). The largest concentration of molting Black Brant congregates on Alaska's Arctic Coastal Plain, particularly the Teshekpuk Lake Special Area.

In July 2006 and 2007, we collected blood samples from 329 Black Brant molting on lakes of the Teshekpuk Lake Special Area. Aircraft on floats were used to slowly move flightless geese toward shore, where they were herded into corral traps (Bollinger and Derksen 1996). Sex was determined by cloacal examination. No goslings were observed at the molting areas; thus, the age of all geese sampled was after-hatch-year, as confirmed on the basis of plumage characteristics (Harris and Shepherd 1965). Females were categorized as those with a brood patch (an indication that incubation was initiated) or those without a brood patch (incubation was not initiated). Blood was collected by jugular venipuncture, placed in serum separator tubes, and kept on ice for up to 4 h before centrifugation. Serum samples were stored in cryovials in a liquid nitrogen vapor shipper (–150 C) in the field, at –80 C after return to the laboratory, and they were analyzed within 4 wk of collection.

Sera were assayed for glucose, cholesterol (CHOL), total protein, albumin, calcium, uric acid, triglycerides, β-hydroxybutyrate, and nonesterified fatty acids (NEFAs; Marshfield Laboratories, Marshfield, Wisconsin, USA), with a Roche Modular Analytics analyzer (Roche Diagnostics, Indianapolis, Indiana, USA). We examined the data for outliers and found none (Horowitz 2015). The nonparametric Kruskal-Wallis test was used to evaluate differences in serum biochemistries between males and females and between females with and without a brood patch. We calculated reference intervals based on the central 95% interval bounded by 2.5 and 97.5 percentiles (Horowitz 2015). Samples were collected from 166 male and 163 female Black

TABLE 1. Reference intervals for seven serum biochemistries in wild after-hatch-year Pacific Black Brant (*Branta bernicla nigricans*) sampled in northern Alaska, USA in 2006 and 2007. Data from males and females were combined (n=329) because no differences (P>0.05) were noted between sexes.

Biochemistry	Reference interval	Mean (SE)	Minimum–maximum	Other *Branta* spp. (mean)
Glucose (mg/dL)	193–362	277 (2.40)	136–431	219–320[a], 223[b], 232[c]
Total protein (g/dL)	2.80–4.50	3.63 (0.02)	2.10–5.60	3.89–5.36[a], 4.8[b], 4.4[c]
Albumin (g/dL)	1.10–1.70	1.45 (0.01)	1.00–2.20	1.45–2.18[a], 2.0[b], 1.8[c]
Calcium (mg/dL)	8.42–11.1	9.90 (0.04)	6.50–13.3	9.22–22.57[a], 10.3[b], 10.3[c]
Uric acid (mg/dL)	3.10–14.5	7.05 (0.16)	2.60–18.1	3.43–9.32[a], 8.3[b], 8.0[c]
Triglycerides (mg/dL)	50.4–142	85.0 (1.37)	35.0–269	79.8–1244[a], 151[b], 163[c]
β-Hydroxybutyrate (mg/dL)	5.14–18.6	10.1 (0.19)	2.40–23.0	—[d]

[a] Canada Goose (*Branta canadensis interior*) (Mori and George 1978). Minimum–maximum of means from geese sampled six times during 1 yr.

[b] Aleutian Goose (*Branta canadensis leucopareia*) (Gee et al. 1981).

[c] Hawaiian Goose (*Branta sandvicensis*) (Gee et al. 1981).

[d] Not reported.

Brant. No differences (P>0.05) were noted in any biochemistries according to the presence or absence of a brood patch. Because no differences (P>0.05) were noted between sexes for seven of the nine biochemistries, those results were combined (Table 1).

Mean Black Brant biochemistry values were within ±50% of most (81%) means of analytes reported from three other species of *Branta* (Tables 1, 2). The levels of CHOL and NEFAs were greater in serum of males than in serum of females (Table 2). Although male Black Brant had significantly higher serum CHOL and NEFAs than females, the difference in both cases was <10%. One cause of higher CHOL is a higher dietary fat content, but we do not suspect such a difference in our study because males and females were sampled within the same areas. No difference was noted in plasma CHOL levels between molting male and female Emperor Geese (*Chen canagica*; Franson et al. 2009). Among other waterfowl, however, Canvasbacks (*Aythya valisineria*) and King Eiders (*Somateria spectabilis*) were reported to have higher CHOL levels in males versus females (Perry

TABLE 2. Reference intervals for two serum biochemistries in wild male and female after-hatch-year Pacific Black Brant (*Branta bernicla nigricans*) sampled in northern Alaska, USA in 2006 and 2007.

Sex/biochemistry	Reference interval	Mean (SE)	Minimum–maximum	Other *Branta* spp. (mean)
Male (n=166)				
Cholesterol (mg/dL)	106–190	148 (1.70)[a]	79.0–200	132–307[c], 172[d], 230[e]
Nonesterified fatty acids (mEq/L)	0.41–1.44	0.86 (0.02)[b]	0.37–1.65	—[f]
Female (n=163)				
Cholesterol (mg/dL)	100–174	137 (1.56)	74.0–187	132–307[c], 172[d], 233[e]
Nonesterified fatty acids (mEq/L)	0.39–1.31	0.78 (0.02)	0.26–1.56	—[f]

[a] Significantly different from females (P<0.001).

[b] Significantly different from females (P=0.028).

[c] Canada Goose (*Branta canadensis interior*), data for males and females combined (Mori and George 1978). Minimum–maximum of means from geese sampled six times during 1 yr.

[d] Aleutian Goose (*Branta canadensis leucopareia*) (Gee et al. 1981).

[e] Hawaiian Goose (*Branta sandvicensis*) (Gee et al. 1981).

[f] Not reported.

et al. 1986; Scott et al. 2010). Gee et al. (1981) suggested a possible hormonal influence on sex differences in CHOL and several other serum chemistry parameters. Use of fat stores may result in elevated serum NEFAs (Jenni-Eiermann and Jenni 2012). The fact that males had higher serum NEFAs than females indicates a sex difference in fat metabolism of molting Black Brant, but the cause is unknown.

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