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# BLOOD SAMPLING IN JUVENILE BUFF-BREASTED SANDPIPERS: MOVEMENT, MASS CHANGE AND SURVIVAL

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Abstract.—The effect of blood sampling on juvenile Buff-breasted Sandpipers (*Tryngites subruficollis*) was evaluated by comparing movements, mass, and survival of 10 broods (37 chicks) that were bled and eight broods (31 chicks) that were not bled. Blood was sampled from the jugular vein of chicks when they weighed 9.1 ± 0.9 g ($\bar{x}$ ± SD) on or within 1 d of hatch. Chicks showed few short-term negative effects from blood sampling. Individual chicks suffered little physical injury, and five of eight chicks where injury occurred (i.e., hematomas formed) survived to fledging. Furthermore, bled broods gained mass at a comparable rate during the first 5 d post-hatch, and were resighted at similar frequencies as broods that were not bled. Bled broods moved slightly longer distances than control broods 1 d after hatch, however. This increased activity may have been stress-induced, but was only temporary; bled and control broods made similar long-term movements, and the probability of resighting was similar at fledging. With the proper precautions, it appears that Buff-breasted Sandpiper young can be safely sampled for blood at an early age without causing undue harm.

**MUESTREO DE SANGRE EN *TRYNGITES SUBRUFICOLLIS* JUVENILES: MOVIMIENTO, CAMBIO EN MASA Y SUPERVIVENCIA**

Sinopsis.—El efecto de muestrear sangre en juveniles de *Tryngites subruficollis* se evaluó comparando los movimientos, la masa y la supervivencia de 10 camadas (37 pichones) que se sangraron y ocho camadas (31 pichones) no sangradas. Se sangraron los pichones por la vena yugular cuando éstos pesaban 9.1 ± 0.9 g ($\bar{x}$ ± D.E.) en o dentro de un día de nacidos. Los pichones mostraron pocos efectos negativos de corto plazo por el muestreo de sangre. Pichones individuales sufrieron pocas lesiones físicas, y cinco de los ocho pichones donde éstas ocurrieron (i.e., formación de hematomas) llegaron a emplumar. Más aún, las camadas sangradas ganaron en masa a una razón comparable durante los primeros cinco días posterior a la eclosión, y se detectaron a frecuencias similares que camadas no sangradas. Las camadas sangradas se movieron a distancias ligeramente mayores que camadas de control un día después de nacer. Este aumento en acatividad puede haber sido inducido por el estrés, pero sólo temporalmente; camadas control y sangradas tuvieron similares movimientos a largo plazo, y la probabilidad de redetectarlas fue similar al emplumar. Juveniles de *Tryngites subruficollis* aparentemente se pueden muestrear para sangre de forma segura a una edad temprana sin causarles daño si se toman las precausiones apropiadas.

Blood sampling is required in many ornithological studies (Oring et al. 1988). With adult birds it is a relatively easy procedure with few detrimental effects (Hoysak and Weatherhead 1991). Sampling blood from juvenile birds is less common but important in studies of genealogy (Burke 1989, Haig et al. 1994), population differentiation (Haig and Oring 1988), population viability (Haig et al. 1993), and age-related hematology (Puerta et al. 1990). Although a limited number of studies have

indicated little or no negative effect of sampling blood from altricial young (see Hoysak and Weatherhead 1991, Stangel and Lennartz 1988), little information is available on precocial species (but see Haig and Oring 1988, Stangel 1986).

Several factors pose problems for obtaining blood from juvenile birds. Among precocial species in particular, the young usually leave the nest within 24 h of hatching and may not be accessible again. This problem has been partially solved, at least for some larger waterfowl, by collecting blood from the chorioallantois membrane of eggs or from the femoral artery of ducklings still inside pipping eggs (R. Titman, pers. comm.). Applying this technique to eggs or young of smaller precocial species, such as many shorebird species, may be more difficult, however, because of fragility of eggs and small size of chicks.

Assessing the effects of any blood sampling procedure on newly-hatched young also is problematic. As young often disperse great distances from the nest site and hide in vegetation when approached, they are difficult to find and to recapture. Thus, variables critical to evaluating the effects of any procedure at hatch, such as repeated measures of post-hatch mass and survival, are difficult to obtain. In addition, blood sampling is an invasive procedure that probably adds stress at a time when chicks have difficulty thermoregulating, are learning to forage independently, and are often travelling long distances to reach suitable brood-rearing habitat (Hale 1980). Indeed, prefledgling survival has been reported to be lower during the first few days after hatching in other shorebird species (Miller 1983, Pienkowski 1984, Redmond and Jenni 1986).

As part of a study of the behavioral ecology of Buff-breasted Sandpipers (*Tryngites subruficollis*), I collected blood from juveniles to assess parentage. Buff-breasted Sandpiper chicks are precocial, and most leave the nest within 12 h post-hatch and begin feeding independently. Adult females perform distraction displays towards predators (pers. obs.) and brood young for several days. Young fledge at 16–20 d of age (R. Lanctot, unpubl. data). Here I describe a technique for sampling blood from newly-hatched young and evaluate the effects of the procedure by comparing movements, changes in mass, and survival of broods from which blood was and was not taken.

## STUDY AREA AND METHODS

I studied Buff-breasted Sandpipers at Prudhoe Bay (70°12′N, 148°15′W) in northern Alaska during June–August in 1992 and in 1993. The 16 $km^2$ study site was located within the braided channel of the Sagavanirktok River, a mosaic of moist and wet graminoid meadows intersected by numerous creeks. A detailed description of the area is provided in Walker et al. (1980).

*Locating nests and chicks.*—Nests were located by searching near displaying males, by following females seen on incubation breaks and by flushing females off nests while dragging a rope stretched between two people across the tundra. Chicks were found either in the nest or by

searching where females responded most aggressively to observers. Captured individuals were weighed with a 50-g Pesola scale, and uniquely identified with colored tarsus bands. Three adult females had 1.4-g radio transmitters (AVM Instrument Co., LTD., Livermore, CA./P1 model) glued to their backs in 1992.

I relocated broods by tracking radio-equipped females, by searching areas where broods were last seen and by conducting systematic searches throughout the study area. During each visit, I recorded the number and identity of all young seen and recorded their locations on topographic maps (scale 1 mm = 13.6 m). When I could not find chicks, I used the level of aggression exhibited by the parent to approximate the location of the brood.

*Blood collection.*—I used blood sampling guidelines approved by the American Ornithologists' Union (Oring et al. 1988). Blood from juveniles was collected directly from the jugular vein with a 28-g 12.5-mm needle on a 0.5-cc Becton Dickinson syringe (after Hoyzak and Weatherhead 1991). As much as 0.05 cc of blood was collected from each chick. This represented less than 10% of a chick's circulating blood volume based on body weight (Coles 1985). The best results were obtained when an assistant pulled the skin tight around the jugular to allow easy needle insertion. Direct pressure was applied at the needle hole with a cotton swab to minimize the occurrence of hematomas.

*Experimental design.*—As blood was collected from chicks in 1993 only, my assessment of the effects of blood sampling was hampered by a nonrandom experimental design. To minimize potential confounding effects of environmental variation within and between years, I relied primarily on data collected within 5 d after blood sampling (although less reliable long-term data are also presented). I expected the effects of blood sampling to be most evident at this time because lost blood is quickly replaced (Jones and Johansen 1972) and chicks are probably most vulnerable at hatch. This 5-d assessment combined with the relatively long hatching period of Buff-breasted Sandpipers (1992: 19 d, $n = 7$; 1993: 9 d, $n = 11$) should have reduced any negative effects from short-term unfavorable environmental conditions within a year. A comparison of the weather conditions between years also indicated minor differences in temperature extremes and rainfall (Table 1). Furthermore, there were no heavy rain or snow falls during either brood-rearing period; such conditions may reduce food availability and cause starvation in newly-hatched chicks (Evans and Pienkowski 1984).

*Assessing the effects of the procedure.*—To assess the effects of blood sampling, I first measured the distance chicks moved from their nests 1-d after sampling and again at fledging. Although the distance broods move may be affected by the availability of food, cover, risk of predation (Sonerud 1985) and human disturbance, I predicted that broods that were bled would move shorter distances if affected by blood sampling (i.e., unhealthy chicks may move less).

Second, I constructed growth curves for broods that were bled and not

TABLE 1. Weather conditions at Prudhoe Bay, Alaska, in 1992 and 1993.[1]

| | | Temperature (C)[2] | | | | Precipitation (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Maximum | Minimum | Proportion of days | | Total rainfall | Greatest day | Proportion of day | |
| Year | Dates | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ | >10 | <0 | | | Trace[3] | >1.2 |
| 1992 | 5–28 July | 13.1 ± 6.2 | 3.9 ± 3.0 | 0.58 | 0.08 | 4.06 | 15.2 | 0.33 | 0.04 |
| 1993 | 4–17 July | 16.6 ± 4.4 | 7.2 ± 3.2 | 0.85 | 0.0 | 0.51 | <2.5 | 0.14 | 0.0( |

[1] Weather summaries begin on the day the first brood hatched and end 5 d after the last brood hatched. Source: National Oceanic and A spheric Administration (1992) and unpubl. data from the Alaska State Climate Center.

[2] There were no significant differences in the average maximum and minimum temperatures between years ($P > 0.05$).

[3] Trace = rainfall less than 0.254 mm.

TABLE 2. Resightings and fledging success of bled and control Buff-breasted Sandpiper broods from Prudhoe Bay, Alaska, in 1992 and 1993.

| Brood | Proportion of chicks bled | # seen ≥1 d after capture | # seen at fledging |
|---|---|---|---|
| 1992 | | | |
| OfBK/ | 0/4 | 2/4 | 2/4 |
| RfY/ | 0/4 | 4/4 | 2/4[b] |
| OfBL/ | 0/4 | 4/4 | 3/4[b] |
| YfBK/ | 0/4 | 4/4 | 3/4[b] |
| RfO/ | 0/4 | 1/4 | 0/4[b] |
| BKfO/ | 0/3 | 1/3 | 1/3 |
| RfBK/ | 0/4 | —/4[a] | 0/4[b] |
| 1993 | | | |
| /RBKf | 0/4 | —/4[a] | 0/4[b] |
| /OBKf | 4/4 | 4/4 | 0/4[b] |
| /OfBL | 4/4 | 0/4 | 0/4 |
| /RBLf | 4/4 | 4/4 | 2/4[b] |
| /RGf | 3/3 | 1/3 | 1/3 |
| /ROf | 4/4 | 3/4 | 3/4 |
| /RYf | 2/2 | —/2[a] | 0/2[b] |
| /YBKf | 4/4 | —/4[a] | 0/4[b] |
| /YRf | 4/4 | 3/4 | 0/4[b] |
| ROf/ | 4/4 | 1/4 | 1/4 |
| /YBLf | 4/4 | 0/4 | 0/4 |

[a] Female behavior indicated a brood was present but no chicks were seen.
[b] Brood lost chicks after short-term effects of capture and blood sampling may have occurred.

bled (hereafter, bled broods and control broods) by plotting the average mass of chicks (within a brood) at hatch and during subsequent recaptures. As I was unable to locate and recapture chicks repeatedly, I used at most one mean recapture mass per brood to construct the curve. I predicted bled chicks would gain mass slower if affected by blood sampling.

Finally, I estimated survival of bled broods and control broods from resightings of broods seen ≥1 d after hatch and at fledging. Broods were considered alive if the attending female exhibited anti-predator behavior towards me or at least one chick was seen. I predicted brood survival of bled chicks to be reduced if affected by blood sampling.

To avoid the problem of non-independence among brood mates (see e.g., Winterstein 1992), I used the brood as the statistical unit for all analyses and tested for differences between average masses (two-sample *t*-test) and survival (Fisher-Exact test of independence) with the SAS Statistical Package (SAS Institute Inc. 1989). All tests were two-tailed and used an $\alpha$ of 0.05.

## RESULTS

Movements, mass change and survival were compared between eight control broods (31 chicks) and 10 bled broods (37 chicks, Table 2). All

chicks were bled within 1 d of hatch when most could stand, all had dry natal down, and their average mass was 9.1 g (0.9 SD, range 7.5–11.0 g, $n = 37$). Most individual chicks (90%) were sampled in 2–3 min and all exhibited listless behavior during blood collection. Within 15–20 min (time to process the brood), however, chicks had become active again. Eight (21%) chicks from two broods developed hematomas.

*Brood movements.*—Both bled and control broods moved long distances 1 d after hatch. Two bled broods were resighted 250 and 440 m from their nests 1 d post-hatch, whereas five control broods moved an average of 152 m (78.5 SD, range 40–260 m) 1 d post-hatch. I was unsuccessful at relocating the remaining broods 1 d post-hatch and could not reliably locate broods on successive days after this time because females and chicks often hid in vegetation. On one occasion, however, I observed a 1-d-old bled brood travel 375 m in 6.5 h, and I occasionally observed bled and control broods moving greater than 250 m from one day to the next when less than 5 d old. At fledging, both bled and control broods were relatively close to their nest sites (bled: 340 ± 10 m, [$\bar{x}$ ± SD], $n = 3$; control: 652 ± 382 m, $n = 5$). One fledgling that was bled was with a second brood 3.4 km from its nest at 19 d of age.

*Mass change.*—There was no initial difference in mass between bled and control broods at hatch (bled: 8.8 ± 0.6, $n = 9$; non-bled: 8.8 ± 0.3, $n = 4$, $t$-test = −0.19, $P = 0.86$). Mass gain after this age was slow for the first few days but increased rapidly thereafter, with bled and control chicks tripling their masses in 7–8 d (Fig. 1).

*Survival.*—All eight control broods and eight of the 10 bled broods (minimum of 18 chicks in each category) were resighted one or more days after capture (Table 2; Fisher Exact, $P = 0.48$). Of these resighted broods, six control broods and five bled broods lost some or all their chicks by fledging. There was no significant difference in fledging success between control (5/8) broods and bled (4/10) broods (Fisher Exact, $P = 0.64$). Eleven of the original 31 control chicks and seven of the original 37 bled chicks were resighted at fledging. Five of the eight chicks (two and three chicks from each brood, respectively) that developed a hematoma were resighted at 20 d of age.

## DISCUSSION

Previous studies assessing blood sampling from chicks revealed no negative effects. For example, survival and development were not affected in altricial Red-cockaded Woodpeckers, *Picoides borealis* (Haig et al. 1994, Stangel and Lennartz 1988) or in precocial Northern Bobwhite Quail (*Colinus virginianus*) and Domestic Chickens (*Gallus gallus*, Stangel 1986). The ability of these researchers to assess the effects of blood sampling on juveniles may have been limited, however. Red-cockaded Woodpecker young were sampled 7–12 d after hatch (Stangel and Lennartz 1988; S. M. Haig, pers. comm.) and were able to remain in the nest for several more days, perhaps allowing them to recover. The two precocial

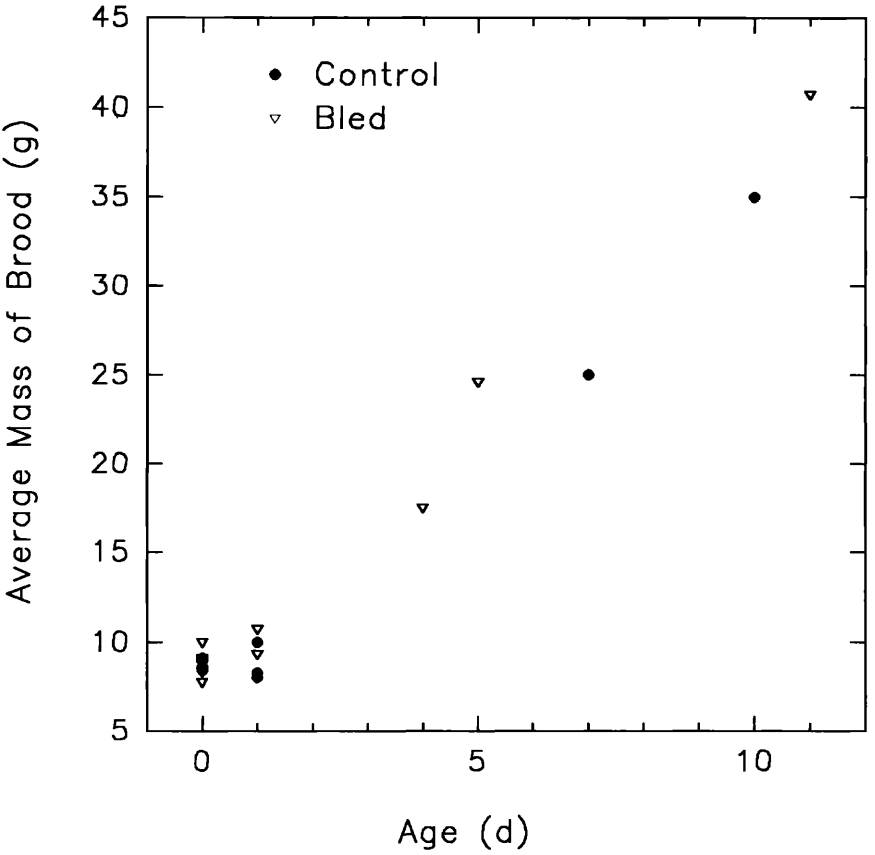


FIGURE 1. Average mass of Buff-breasted Sandpiper broods that were bled and not bled. Twelve chicks from four bled broods and six chicks from two control broods were recaptured (day 0 = hatch).

species also were sampled at an older age (5–15 d), were fairly large (50–114 g) and were kept in captivity (Stangel 1986).

Despite experiencing blood collection shortly after hatch, their small body size and their subsequent exposure to ambient conditions, Buff-breasted Sandpiper chicks showed few short-term negative effects from blood sampling. Most chicks suffered little physical injury, and those that did (i.e., hematomas formed) generally survived to fledging. Further, bled broods gained mass at a comparable rate during the first 5 d and were resighted at frequencies similar to controls. Bled broods, however, unexpectedly moved distances that were outside or close to the top of the range of distances moved by control broods one day after hatch. It is possible that the added stress associated with blood sampling (beyond the normal banding procedure) may have resulted in elevated levels of cor-

ticosterone, a hormone known to stimulate increased foraging and activity levels in passerine birds (Astheimer et al. 1992). Although this suggests bled broods may have been initially stressed by blood sampling, similar long-distance movements have been documented in other non-disturbed shorebird species (Sonerud 1985). Resightings of bled and control broods at similar distances from their original nest sites at fledging also indicate that any potential stress was short-lived.

Long-term effects of blood sampling often are evaluated by looking at annual return rates of birds (Colwell et al. 1988, Dufty 1988, Hoysak and Weatherhead 1991). This approach is not possible for Buff-breasted Sandpipers because juveniles exhibit no natal philopatry (Pruett-Jones 1988; K. Moitoret, pers. comm.). Nonetheless, bled broods and control broods made similar long-term movements and were just as likely to be resighted at fledging. These long-term assessments must be viewed with caution, however, because environmental variation and difficulties in locating broods may have biased the results. Although the effects of inter- and intra-year environmental variation on the results may have been reduced by randomly sampling either a portion of each brood within a year or a sample of the available broods each year, the necessity to sample as many chicks as possible for the paternity study precluded this design.

Clearly, more studies are needed to evaluate critically long-term effects of blood sampling in precocial young (perhaps by using radio-transmitters; Flint 1993, Redmond and Jenni 1986) and to test how applicable these results are to other species. Until more studies are completed, researchers may wish to avoid sampling chicks prior to or during inclement weather, and if possible, wait until chicks have matured and are capable of thermoregulating and foraging efficiently before collecting blood. Chicks that are close to fledging may also be sampled by pulling newly emerging feather shafts (Haig and Oring 1988), avoiding the possible effects from invasive blood sampling. With the proper precautions, however, Buff-breasted Sandpiper young can seemingly be safely sampled for blood at an early age without causing undue harm.

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