HEART SIZE AND ALTITUDE IN PTARMIGAN

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Relative heart weight is known to increase with altitude in several bird species (Hartman, Condor 57: 221, 1955; Norris and Williamson, Wilson Bull. 67:78, 1955; Dunson, Condor 67:215, 1965). The effect of altitude on heart size in birds was first illustrated by Strohl (Compt. Rend. Acad. Sci. Paris 150:1257, 1910) who compared Rock Ptarmigan (*Lagopus mutus*) from 2000 to 3000 meters elevation with Willow Ptarmigan (*Lagopus lagopus*) from 600 meters, but these data have since been discounted as being the result of interspecific differences (Stieve 1934, *in* Hartman, Smithsonian Misc. Publ. 143:1, 1961). Johnston (Wilson Bull. 75:435, 1963) and Stieve (*loc. cit.*) found similar heart-size differences between these species when captured at the same elevation. Selection, however, might still be expected to favor a larger relative heart size in the species whose range has a higher elevation on the average, and, therefore, these heart-size differences may still reflect adaptations to altitude. A third species, the White-tailed Ptarmigan (*Lagopus leucurus*), occurs at still higher average elevations than the ptarmigan previously studied. It was felt that information from this species might clarify this relationship.

Heart-to-body weight ratios were obtained from 18 White-tailed Ptarmigan that died during a temperature-regulation study. The birds had been captured on Logan Pass (2100–2300 meters) in Glacier National Park, Montana, in June through August 1965. The period from capture until death ranged from one hour to eight days. Birds were frozen immediately after their death and were kept for several months before hearts were weighed. The method for determining heart weights is similar to that described by Norris and Williamson (*op. cit.*) and Johnston and Williamson (Wilson Bull. 72:248, 1960). Whereas some birds lost considerable weight after their capture, their heart ratios did not differ noticeably from six others that died an hour after capture and had not lost weight.

The White-tailed Ptarmigan has the smallest heart-to-body ratio of the three ptarmigan species (table 1), even though this species occurs at the highest elevations. This contradiction clearly illustrates the limitations of the generalization that heart-to-body ratio increases with elevation in closely related species; but even more important, it points to differences in the biology and ecology of the three species that need to be investigated. For example, a smaller heart could mean that pectoral muscles are smaller (Hartman, Smithsonian Misc. Publ. 143:1, 1961) and that flight is less important in courtship display and escape from predators. On the other hand Brush (Auk 83:266, 1966) has pointed out that increased heart rate is an equally probable alternative to increased stroke volume (heart size) to augment cardiac output in response to high metabolic demands. Possibly the heart of the White-tailed Ptarmigan beats faster than those of the other species. Comparative data on the ecology and heart rates as well as other physiological variables of these species would be extremely useful in understanding adaptation to high altitudes in birds.

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TABLE 1. Heart-to-body ratio in Ptarmigan.

Species	Sex	*N*	Body wt. (grams)	Heart wt. (grams)	Ratio[c]	Elevation (meters)
L. leucurus	♂	11	258[a]	2.7[a]	1.05	2100–2300
	♀	7	299[a]	2.6[a]	0.87	2100–2300
L. mutus[b]	♂	3	508.1	9.4	1.85	0–500
L. lagopus[b]	♂	5	619.9	8.4	1.35	0–500

[a] Body weight and heart weight at death (see text). Body weights for all live animals handled during the same time interval averaged considerably heavier: males, 323 g ($N = 24$); females, 329 g ($N = 14$).
[b] Data from Johnston (Wilson Bull. 75:435, 1963).
[c] (heart weight × 100)/body weight.

A WINTER RECORD OF THE TRUMPETER SWAN IN WESTERN WASHINGTON

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A male Trumpeter Swan, *Olor buccinator*, was confiscated from a hunter by Arthur Crews of the Washington State Department of Game at North Beach, Grays Harbor County, Washington, on 4 December 1966. The specimen was presented to the Puget Sound Museum of Natural History and is now part of the museum's collection. It is an adult male, heavily yellowed especially on the head and neck. Postmortem examination revealed the typical dorsal loop of the trachea. The syrinx is broad and flattened as is characteristic of the species.

Banko (The Trumpeter Swan, North American Fauna No. 63, U.S. Fish and Wildlife Service, 1960) notes that the Trumpeter Swan formerly wintered in extreme northwestern Washington, along Puget Sound, and along the lower Columbia River. There are apparently no recent records of its occurrence in western Washington.

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