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Studies in Respiratory Physiology, I, II, and III

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I. Respiration and song production in birds

A study at Virginia Polytechnic Institute this Spring revealed that canaries breathe at very high frequencies during singing. There is a 1:1 correspondence between sound pulses and dorso-ventral thoracic movements even during fast trills of 22-27 notes and "mini-breaths" per second (Calder, in press, Comp. Biochem. Physiol. and The Physiologist). This finding indicated the desirability of comparative studies.

Tape recordings of songs and calls were collected in the vicinity of the Station, from 26 species of birds selected for varying degrees of vocal complexity. These are being analyzed at reduced speeds to aid in the selection of subjects for future laboratory studies. Because of new complications in the requirements for a National Park collecting permit, no attempt was made to collect birds at this time.

II. Respiratory and circulatory responses of a eurythermal fish

(In collaboration with Dr. Edward Lonsdale, Department of Electrical Engineering, University of Wyoming.)

The Utah chub (Gila atraria is abundant in the Snake River (13-16°C in July and August) and has also been reported in warm waters of Witch Creek, Yellowstone National Park (31°C) and Kelly Warm Springs (28°C) by Simon (1949: Wyoming Fishes, p. 79). Ultimately the respiratory and circulatory physiology of fish from cold and thermal area populations will be compared.

This Summer's efforts have been twofold: (1) Baseline data have been accumulated from Snake River chubs in a thermostated and aerated aquarium in the laboratory. Respiratory and heart rates were recorded for analysis as functions of (a) body size and (b) water temperature of inactive fish acclimated to Snake River temperatures (approximately 16°C where the fish were taken). Resting respiratory rates appear to be proportional to (body weight)⁻¹/³, heart rates proportional to (body weight)⁻¹/². When not upset or undergoing the increased metabolic demands of struggling, these fish did not show evidence of disturbance until water temperatures were increased to 28 to over 30°C.

Q₁₀ values have not yet been calculated, but respiratory rates appear to increase proportionately more than heart rates with increasing temperature. This seems reasonable since the respiratory rate would be affected by not only temperature directly, but the reduced amount of dissolved oxygen in warm water.
(2) Preliminary tests were made of FM radiotelemetry devices and improvements were made in lead placement for (a) EKG, (b) respiratory, and (c) location-tracking. This was done using chubs swimming free in a small stream outlet which was fenced off to restrict the fish for recovery of the telemetry units. These units were modifications of those used previously by Lonsdale (1968 Annual Report, Jackson Hole Research Station).

Preliminary site inspections were made in the Kelly Warm Springs and Polecata Creek areas for future field studies. The numbers and sizes of chubs observed there were not encouraging. Field studies planned for the Witch Creek area were not possible because of (1) shortage of time, (2) recent complication of Park Service procedure for obtaining a permit to seine and trap the chubs in Yellowstone National Park, the warmest and therefore most interesting place for this problem, (3) failure of some telemetry units, apparently because of defective batteries.

III. Comparative functional morphology of the avian respiratory system

A treasured acquisition here was the preserved trachea and syrinx of a trumpeter swan (Olor buccinator). This will be used for measurements as part of a study of respiration in long-necked birds during the academic year at the University of Arizona. I am indebted to Mr. Robert Wood, National Park Service, Grand Teton National Park, for making this available and to the Southwestern Archeological staff of the National Park Service for a beautiful job of preserving and mounting the specimen.