

# Studies of Respiration in Antarctic Hemoglobin-Free Fishes

EDVARD A. HEMMINGSEN

*Scripps Institution of Oceanography  
University of California, San Diego*

and

EVERETT L. DOUGLAS

*Department of Zoology  
University of Missouri, Columbia*

The mobility provided by R/V *Hero* to the Antarctic Peninsula biology programs has solved earlier problems of collection of marine material. The new, well-equipped laboratory at Palmer Station has added further capabilities for experimental studies in the area. Utilizing these facilities during the past austral summer, physiological studies were carried out on fishes of the family Chaenichthyidae. These fishes, found only in antarctic and subantarctic waters, lack hemoglobin in their blood, and oxygen is transported only in physical solution. With the exception of some fish larvae, and a few other trivial cases, the absence of hemoglobin is unique among the vertebrates.

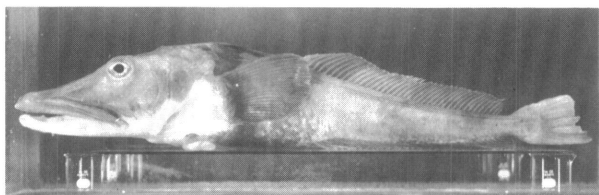


Photo: E. A. Hemmingsen

*Chaenocephalus aceratus*. This specimen is 61 cm long.

Thirty-four specimens of *Chaenocephalus aceratus* and one specimen of *Pseudochaenichthys georgianus* were collected in the vicinity of Arthur Harbor. Most of the specimens were caught on baited set-lines, which proved more effective than bottom trawling. The fishes were kept at the station up to four weeks in improvised holding tanks with running seawater. The temperature-controlled aquaria in the wet laboratory were used for the experiments. Oxygen consumption at rest was determined in either closed or flow-through respirometers. Twenty-three determinations in 13 specimens of *C. aceratus*, weighing from 566 to 2,160 g, gave a mean rate of  $0.020 \text{ cm}^3 \text{ O}_2/\text{g/hr.}$  at  $1^\circ\text{C}$ . The oxygen consumption of *P. georgianus* (35.7 g) was  $0.028 \text{ cm}^3 \text{ O}_2/\text{g/hr.}$  under the same conditions. These rates are one-third to two-thirds those of most other antarctic and arctic fishes which possess hemoglobin. The rate of oxygen uptake was little af-

ected by the oxygen tension in the water at values higher than 50 mm Hg. However, the rate decreased sharply below this oxygen tension. Cutaneous respiration was found to be substantial and may be of importance. Measurements of the oxygen tension in pre- and post-gill water indicated that the gill efficiency was moderate; only 10 to 15 percent of the inflowing oxygen was taken up. The lactic acid concentration in arterial and venous blood was strikingly low, even after moderate anoxic stress; this indicates that conventional anaerobic metabolism does not play an especially important role in these animals. The blood volume was found to be about 8 percent of the body weight, a value 2 to 4 times higher than that of other teleosts. Thus, the major adjustment to the lack of hemoglobin in the blood appears to be in the circulatory system. Material was prepared and preserved for studies of vascularization of the tissues, fins, gills, etc.

The following fishes were incidentally collected near the station: *Notothenia gibberifrons*, *N. coriiceps*, *N. nudifrons*, *Parachaenichthys charcoti*, *Harpagifer bispinis*, and *Cygnodraco mawsoni*.

## Systematic Survey of Ciliated Protozoa from the Antarctic Peninsula

JESSE C. THOMPSON, JR.

*Department of Biology  
Queens College*

and

JOHN M. CROOM

*Department of Biology  
Davidson College*

A taxonomic survey of ciliated Protozoa, primarily of the order Hymenostomatidae, was extended to the Antarctic Peninsula during the period of December 17, 1968, to February 5, 1969. Extensive collections were made within a 40-mile radius of Palmer Station with helicopter support from USCGC *Edisto*; support by R/V *Hero* permitted collecting from more distant areas, such as Deception Island, Aitcho Islands, Livingston Island, and King George Island.

Bacterized cultures were made from 434 water samples. Selected ciliates were studied with phase microscopy, and phase cinematography was used to record morphological data from living Protozoa. Animals were subsequently fixed and 244 permanent slides were made, using the Chatton-Lwoff silver-nitrate impregnation technique. Preliminary studies of these slides have revealed the following marine genera: *Pseudocohnilembus*, *Uronema*, *Cyclidium*, *Pleu-*