

## PE-2     Cardiorespiratory responses to environmental hypoxia in the yellowtail, *Seriola quinqueradiata*

Kyoung-Seon Lee · Atsushi Ishimatsu · Tatsuya Oda  
Marine Research Institute, Nagasaki University

### Introduction

Cardiovascular and respiratory responses of fish exposed to environmental hypoxia have been the subject of a number of investigations. Although relatively few species have been examined, generalized responses to ambient hypoxia include an elevation of blood pressure, increased systemic vascular resistance and bradycardia (Fritsche and Nilsson, 1990; Bushnell and Brill, 1991). The degree of bradycardia experienced by fish during hypoxia is highly variable and may depend upon the severity of the hypoxia and the rapidity with which it is imposed. In this study, therefore, we investigated the effects of two different levels of acute hypoxia on the cardiorespiratory system of the yellowtail.

### Materials and methods

Yellowtail, *Seriola quinqueradiata* was offered by the Nagasaki Prefectural Institute of Fisheries, and kept in netcages for several months before use. Fish were fed commercial feeds every other day. After temperature acclimation, fish were chronically cannulated in the dorsal aorta for the measurement of blood pressure and blood sampling, and a cuff-type Doppler flow probe was placed around the ventral aorta for the measurement of cardiac output. Fish were exposed to two levels of environmental hypoxia (water  $P_{O_2}$  = 50 mmHg and 80 mmHg) and normoxia (water  $P_{O_2}$  = 140 mmHg) at 25°C.

### Results

In normoxia (N=8, body weight  $1153 \pm 143$ (SD) g), mean cardiac output was  $53.1 \pm 12.4$  ml/min/kg, heart rate  $80 \pm 9$  beats/min, and stroke volume  $0.67 \pm 0.16$

ml/min/kg. Mean blood pressure was  $57.0 \pm 6.0$  cmH<sub>2</sub>O. Arterial P<sub>O</sub><sub>2</sub>, O<sub>2</sub> content, pH, and hematocrit value under normoxia are  $93.4 \pm 11.7$  mmHg,  $9.31 \pm 0.93$  vol%,  $7.833 \pm 0.050$ , and  $21.8 \pm 3.3$  %, respectively. Bradycardia was developed only during the severe hypoxia. Stroke volume did not change significantly during the moderate hypoxia, but decreased progressively during the severe hypoxia. Likewise, Cardiac output changed little during the moderate hypoxia, but during the severe hypoxia, there was a considerably decrease that correlated with both bradycardia and stroke volume. Blood pressure increased transiently both moderate and severe hypoxia. During hypoxia, the arterial P<sub>O</sub><sub>2</sub> immediately reduced. Blood O<sub>2</sub> content, pH, and hematocrit value maintained constant during the moderate hypoxia. However, when arterial P<sub>O</sub><sub>2</sub> fell below 30 - 40 mmHg, blood O<sub>2</sub> content and pH decreased sharply, while hematocrit value increased.

## References

- Bushnell, P. G. and Brill, R. W. 1991. Responses of swimming skipjack (*Katsuwonus pelamis*) and yellowfin (*Thunnus albacares*) tunas to acute hypoxia, and a model of their cardiorespiratory function. *Physiol. Zool.* **64**, 787-811.
- Fritsche, R. and Nilsson, S. 1990. Autonomic nervous control of blood pressure and heart rate during hypoxia in the cod, *Gadus morhua*. *J. Comp. Physiol. [B]* **160**, 287-292.