OXYGEN CONSUMPTION AND SALINITY TOLERANCE IN FOUR BRAZILIAN CRABS

BY
SANDRA E. SHUMWAY

Department of Ecology and Evolution, State University of New York at Stony Brook, Stony Brook, New York, 11794, U.S.A.

ABSTRACT

Oxygen consumption and mean tolerance level at varying salinities were determined for four species of Brazilian crabs: Panopeus herbstii, Callinectes danae, Petrolisthes armatus and Pachygrapsus transversus. The oxygen consumption increased and tolerance levels decreased in dilute seawater in all species. The tolerance level of each crab reflects its lifestyle and habitat. P. armatus, found only in channels of free-moving salt water, had the lowest tolerance level to dilute seawater and P. transversus, a shore crab, had the highest level of all the species studied. C. danae showed the highest oxygen consumption rate at all salinities. This is presumed to be a result of its more active nature. P. transversus demonstrated the lowest rate of oxygen consumption in all salinities less than 60% seawater.

INTRODUCTION

Marine animals occupying the intertidal zone are frequently subject to variations in the ambient salinity. While there have been numerous studies on the effect of salinity on tolerance and oxygen consumption in crustaceans (for review see Kinne, 1971), there have been few studies of this sort comparing species from the same general area. Four species of decapod crustaceans are found commonly on the shore at the Marine Laboratory, São Sebastião, Brazil, and a study was undertaken to determine the effect of salinity on the oxygen consumption and the species' tolerance to seawater dilution.

MATERIALS AND METHODS

Three species of brachyuran crabs, Panopeus herbstii H. Milne Edwards, 1934, Callinectes danae Smith, 1869, Pachygrapsus transversus (Gibbes, 1850) and one species of Porcellanid, Petrolisthes armatus (Gibbes, 1850) were collected at São Sebastião, Brazil (23°49'44"S 45°25'27"W). Panopeus herbstii is a mud crab found under rocks and in small tidepools and crevices, C. danae, a swim-
ming crab, is an entirely aquatic species, *Petrolisthes armatus*, a porcellanid crab, is found commonly under stones near free-flowing seawater and *Pachygrapsus transversus* is a species commonly found under rocks and crawling on the underside of boulders and is normally exposed to full strength seawater; however, heavy rains often subject the crabs to dilution in tidepools.

Oxygen consumption and salinity tolerance of these species were measured in 0, 20, 40, 60, 80 and 100% seawater (100% s.w. = 34%o) at ambient temperature (25°C). Seawater dilutions were prepared by adding distilled water to local seawater. The dry weight for each specimen was determined by oven drying for 24 hours at 60°C.

Ten crabs were placed in covered glass crystallizing dishes with equal volumes (3 litres) of each experimental salinity. Sexes were not separated. Since *C. danae* is much larger than the other species studied, five animals were placed in each of 2 dishes at each salinity. The water was aerated continuously and changed every 24 hours to prevent the build-up of toxic wastes. Experiments were carried out in duplicate. The crabs were checked for survival and activity every 30 minutes for the first 8 hours, and then at 24 hour intervals for 5 days. The animals were not fed during the experiments. The activity of each crab was assessed using a system previously described by Preece (1970) and Jones (1976): freely moving and active, 2 points; lethargic and failure to move after gentle prodding, 1 point; dead, 0 points. Thus a maximum tolerance score (20) indicated that all 10 crabs in a given salinity were active and healthy. Scores less than maximum indicated reduced tolerance and suggested that animals were under stress.

The acute response of oxygen consumption to salinity change was measured in all four species. Crabs were exposed to the experimental salinities for 1 hour prior to measurement of oxygen consumption. Oxygen consumption was monitored using a Radiometer oxygen electrode connected to a Beckman gas analyser.

**RESULTS**

The mean tolerance scores for the four species of crabs exposed to 0, 20, 40 and 60% seawater are shown in fig. 1. There were no adverse effects on any species at 80 or 100% (control) seawater. The first indication that the tolerance level was diminished occurred at 60% seawater for *Petrolisthes armatus*, 40% seawater for *Panopeus herbstii*, 20% seawater for *C. danae* and only at 0% seawater for *Pachygrapsus transversus*. It appears then, that *Petrolisthes armatus* has the lowest tolerance of the four species to reduced salinity, although all four of the species studied showed some tolerance to seawater dilution.

Fig. 2 shows the effect of salinity on oxygen consumption for the four species studied. *C. danae* and *Pachygrapsus transversus* showed the same general pattern in their response to salinity change. Oxygen consumption for both species was unaffected by salinity concentrations from 40-100% seawater; further dilution