OXYGEN CONSUMPTION OF TWO TROPICAL SPINY LOBSTERS,
*PANULIRUS ARGUS* (LATREILLE) AND *P. GUTTATUS* (LATREILLE)
(DECAPODA, PALINURIDAE)

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INTRODUCTION

Information about metabolic rates, generally determined by measuring oxygen consumption (\( Q \) or \( Q_{O_2} \)), is of basic importance in defining the energy budget of an animal. Such knowledge can be essential for the establishment of fishery facilities, such as long term confinement of animals, and for the evaluation of aquaculture perspectives of the species involved.

Relatively little information is available on large crustaceans although some of them are of well known commercial importance.

The relation between \( Q \) and the unit body weight \( (Q/W) \) is a well documented phenomenon in the animal kingdom and seems to be most evident in animals weighing from 1 to 1000 grams (vide Wolvekamp & Waterman, 1960). It is also known that, in poikilotherms, metabolism generally varies directly with the environmental temperature. Also respiration has been correlated with annual population production in this type of animal (McNeill & Lawton, 1970).

In this study weight-specific respiration rates and the effects of body weight, environmental oxygen concentration, salinity and temperature were determined for *Panulirus argus* as a measure of metabolic energy loss under various conditions.

Work with *P. guttatus* was more limited due to scarcity of material. Major attention was paid to the first of the two species because of its economic importance for coastal tropical fisheries (Buesa & Paiva, 1969).

MATERIALS AND METHODS

Specimens of *P. argus* used in this study weighed from 0.1 up to 1270 g. They ranged from the first postlarvae to animals of some nine years old (Buesa, Paiva & Costa, 1968). Specimens of *P. guttatus*, a much less abundant species in Cuban waters, which is not commercially fished, ranged from 75 to 275 g. Eighteen specimens of *P. guttatus* and almost 20,000 individuals of *P. argus*, isolated or in large groups of more than 4000 at a time, were studied.

Animals to be used in isolated respiration measurements were held in 1 m\(^3\) tanks at ambient sea water temperatures and fed fish (*Sardinops*) every second day. Respiratory experiments were always conducted more than a week after the beginning of the captivity period.
Respiration of animals from 0.1 to 25 g wet weight was measured in closed vessels with capacities of 0.5 to 1.5 l. For larger specimens round glass continuous flowing respirometers of 8 l capacity were used. Water flow rate was regulated and oxygen consumption was determined by the difference in oxygen contents of the water coming in and out of the chamber at a known flow rate. In respiration experiments with closed vessels there were always empty control vessels. Winkler's iodometric method was used for oxygen analysis.

Respirometric experiments were conducted at room temperature (ranging between 25 and 30°C) for periods from 2 to 3 hours after one hour adaptation to confinement conditions in the respirometric chamber at ambient light (ca. 2 klx). After every experiment the wet weight of the animal was recorded after vigorously shaking the animal to remove excess water, and total length was measured according to the current methodology (Buesa, 1965).

Animals were not fed for 2 to 3 days before the experiments, which were always conducted during daytime in order to reproduce as much as possible resting metabolic conditions in these animals, which have nocturnal habits.

Special attention was paid to water flow rate, since at small rates oxygen consumption was reduced because of evident affection of the animal's condition. In order to evaluate this aspect, different water flow rates (WFR) were used, from 100 to 2500 ml min⁻¹, for lobsters weighing from 50 to 1000 g (W). Flow rate was considered adequate for a given lobster weight, when the recorded respiration was apparently maximal. In this respect, the results were statistically treated using the following correlation equation for P. argus:

\[ WFR = 19.32 W^{0.61} \quad (r = 0.997^*) \]

Optimal water flow rates in relation to the weight of the experimental animal ensured oxygen consumption rates of 5 to 19%/h from the available oxygen contents, that was always near saturation level for “resting metabolism” experiments.

In order to standardize results, the actual \( Q_{O_2} \) at different water temperatures and the theoretical \( Q_{O_2} \) obtained by correction of the data using thermal conversion coefficients (Krogh, 1959), were compared. Both series of data proved to be not significantly different \( (t_{114} = 1.64; P > 0.8) \).

According to these results, \( Q_{O_2} \) values at different water temperatures were standardized to a selected temperature of 27°C, which is the mean annual seawater temperature for coastal areas in Cuba (Tápanes, 1972).

Respiration in undersaturated oxygen concentrations was measured during several hours with lobsters in closed respirometers. Oxygen determinations were made hourly and the contents at the end of every one hour interval was considered as the initial oxygen concentration for the following one hour period. Respiration of large numbers of lobsters was registered inside lobster-live-cars by measuring water oxygen contents at known time intervals.

Exponential relations were fitted by the least square method, to correlate \( Q \) and \( Q^{-1} \) values to the wet weights (in g) of the animals.