

Research Article

Heart Rhythm of the Ocean Quahog *Arctica Islandica*

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Abstract. We studied the cardiac activity of the ocean quahog (*Arctica islandica*) and identified the precise point on the mollusc's shell at which the heart rate can be successfully monitored remotely. The heartbeat pattern was markedly unstable. Moreover, irregular cardiac arrests were observed in every monitored mollusc.

Keywords: *Arctica islandica*, cardiac activity, heart rate

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1. Introduction

After a remote-monitoring technique had become available [1, 2], a number of recent studies have investigated the heart function of diverse species of molluscs (e.g., [3, 4, 5]). However, these studies mostly investigated the cardiac activity of epifaunal animals, such as blue mussels (*Mytilus edulis*), green mussels (*Perna perna*), and oysters (*Crassostrea brasiliana*). The heart rhythms of these molluscs are very stable under static conditions. Naturally, because molluscs are cold-blooded animals, their heart rate declines as the environmental temperature decreases. Even under suboptimal temperatures (-1.5°C), however, the blue and horse mussels' heart rhythms remain stable, albeit relatively low (4–5 beats per minute) [6]. We observed cardiac arrest in only two cases: (1) when animals faced adverse conditions (e.g., pollution) [4] and (2) in unhealthy molluscs (e.g., parasitized animals) [7]. To broaden the scope of the research, it would be very useful to estimate the cardiac activity of infaunal molluscs, i.e., those that live under the sea bed rather than upon it. One such animal is *Arctica islandica* (also known as the Iceland Cyprina, ocean quahog, and mahogany clam), which usually dwells approximately 5–10 cm under the ocean floor.

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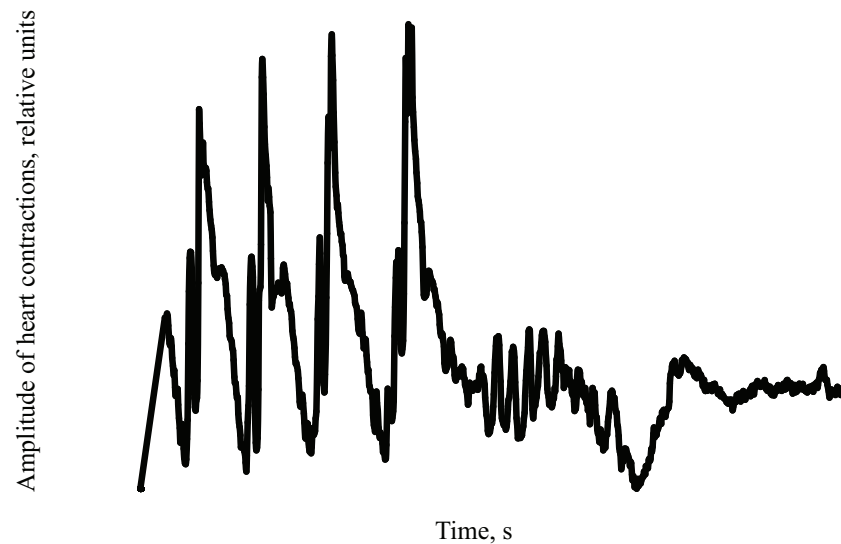


Figure 1: An example of *A. islandica* heart beat.

2. Methods and Equipment

The research was conducted at the White Sea Biological Research Station Kartesh of the Russian Academy of Sciences' Zoological Institute (Chupa Inlet, Gulf of Kandalaksha, White Sea). Molluscs were collected in the Chupa Inlet by scuba diving and dredging. After sorting the animals by size (retaining 35.5 ± 0.5 mm ones), two fibre optic cables were connected to each mollusc in the position corresponding to the heart. One group of molluscs (N=9) was then placed in tanks with aerated, filtered seawater and natural sediment; the second group (N=9) was placed on the sea floor under approximately 6 metres of water. The animals' heart rate (HR) was monitored by a method developed in 1999 in a laboratory for the experimental ecology of aquatic systems [2].

3. Results

All the investigated animals (both groups) were characterised by extremely unstable cardiac activity, with abrupt cardiac arrest lasting from 1 to 9 hours observed in every clam. Thus, the HR was highly variable, ranging from 0 to 9.7 beats per minute. A stable HR was tracked for only 2 to 16 minutes; after that, tachycardia with subsequent absence of heartbeats was observed (Fig. 1). It is worth noting that cardiac activity characteristics were strictly individual, i.e., they did not coincide between individuals.

4. Discussion

The extremely unstable HR of *A. islandica* suggests that this species has a very changeable metabolism, further evidence of which can be found in the literature, where a significant fluctuation in oxygen consumption by this species has been reported [8]. Moreover, Taylor [9] carried out a field investigation of *A. islandica* cardiac activity and found a non-rhythmic HR with a period of cardiac arrest over the course of 1 to 7 days. There was no obvious rhythmicity in behaviour and oxygen consumption. These data are in good agreement with our results.

The aetiology of *A. islandica*'s highly distinctive physiology is unclear, but the ability to tolerate severe environmental hypoxia/anoxia for long periods represents a very useful adaptation, especially for sluggish infaunal molluscs such as *A. islandica*. Another potential explanation of the species' 'silent' periods may be habitats with poor food supply. Widdows [10] concludes his article on energetic studies of marine molluscs by noting that "Valve closure and metabolic suppression can also be spontaneous in bivalves, particularly during periods of low food availability, and this may be an important means of conserving energy". This unusual behaviour of clams may be associated with the animal's remarkable lifespan. It is the longest-living non-colonial animal known to science, attaining ages in excess of 400 years [11].

5. Conclusions

To conclude, this species is undoubtedly very interesting due to its ability to halt heart beat if needed. However, it is not fit for applied biomonitoring studies.

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Conflict of Interest

The authors report no conflicts of interest.

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