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Food stimulation in Bottlenose Dolphin (*Tursiops truncatus*) activates the autonomic nervous system, causing heart rate reduction.

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Introduction and purpose of the study

Heart rate (HR) and its physiological variability (HRV) are important indexes of metabolism, energy expenditure and unconscious responses to stress or relaxation, mediated by the autonomic nervous system. In particular the autonomic modulation of cardiac activity could indicate how cetaceans react to external stimuli, giving insight on their perception of the surrounding environment. However, HR monitoring in cetaceans, even under managed care, is complicated by the need to record a tiny biopotential in a very conductive water medium. To overcome these difficulties we developed a submersible electrocardiogram-accelerator logger based on a suction cup attachment technique. With this new device we recorded high resolution electrocardiograms (ECGs) that allowed us to study physiological and behavioural reactions of bottlenose dolphins to external stimuli such as intermittent feeding.

Fig. 1: Autonomic regulation of heart rate

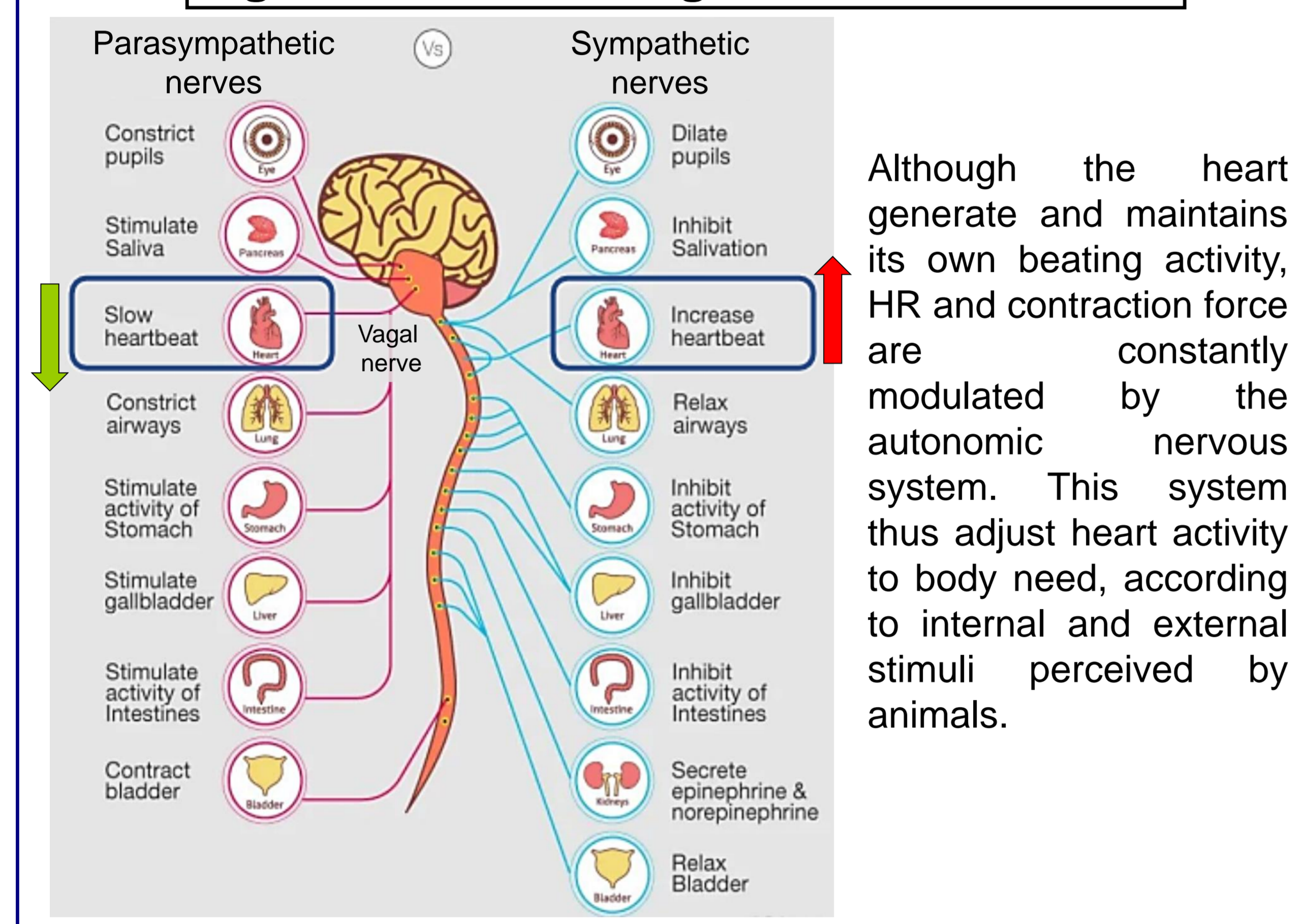


Fig. 2: ECG device employed in bottlenose dolphins

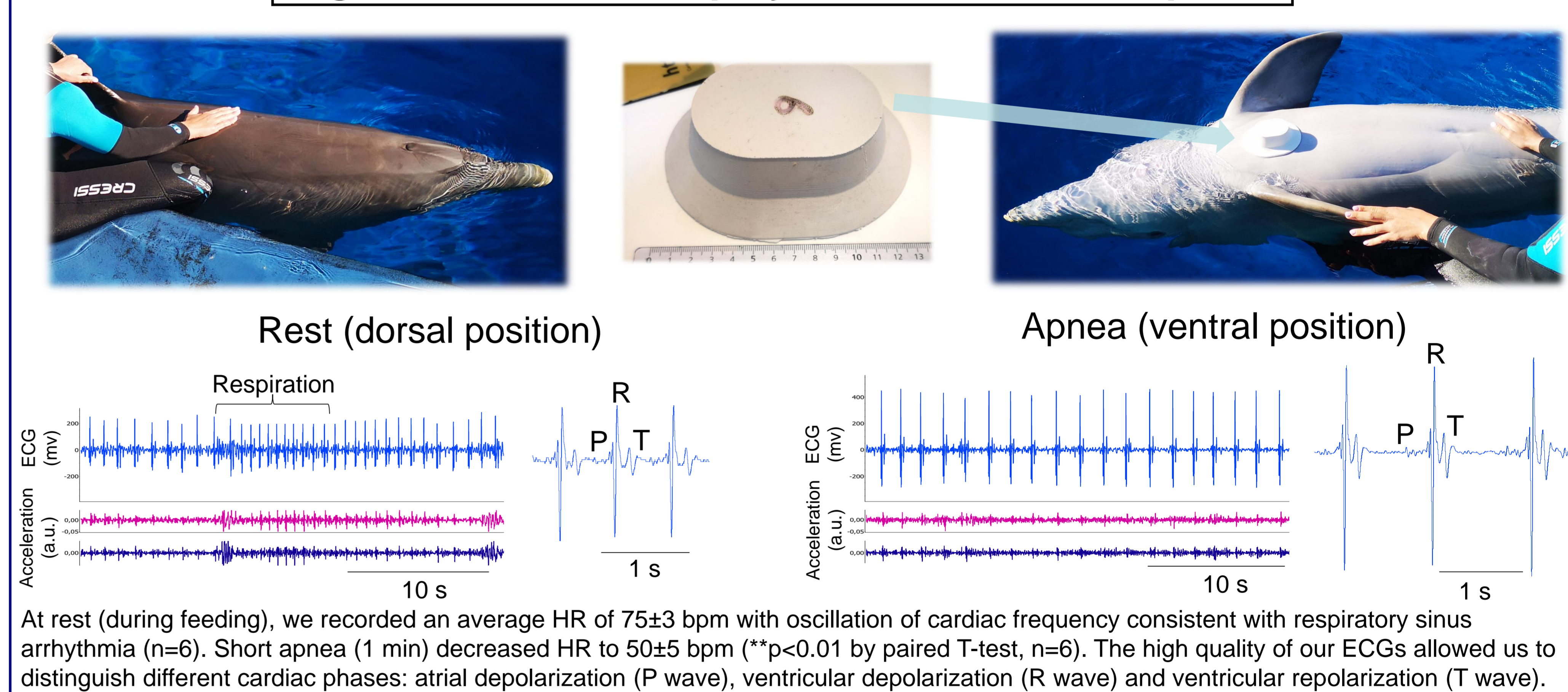
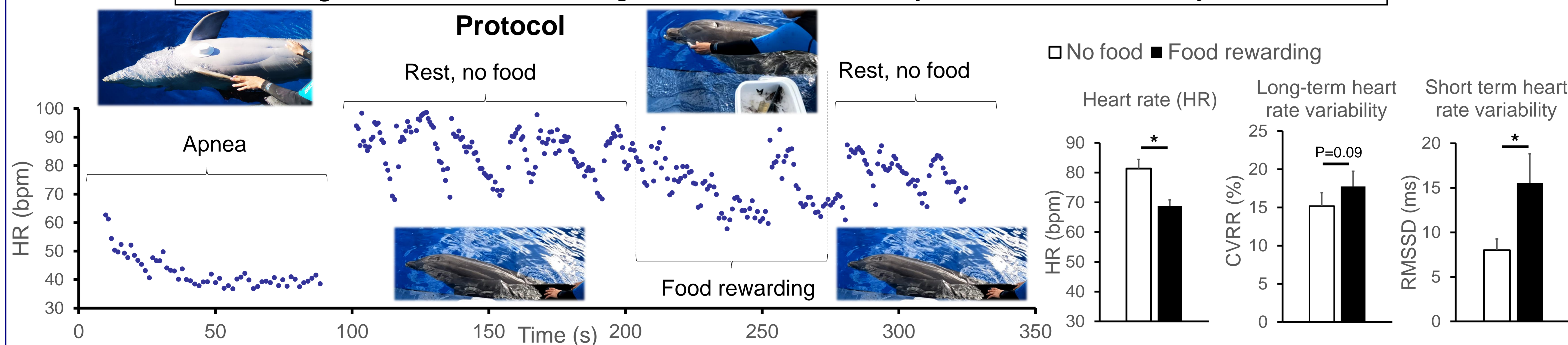


Fig. 3: Effect of food rewarding on heart rate modulation by the autonomic nervous system.



To test the activation of the autonomic nervous system in bottlenose dolphins we selected food (fish, squids, etc) as one of the strongest rewarding stimuli. For that, animals maintained in a stationary position were deprived of food for 2 min (No food) and then rewarded with continuous feeding for 1 min (Food rewarding). During the 2 min of food deprivation HR and HRV were equivalent to resting conditions of fig. 2. Conversely, 1 min of feeding significantly decreased HR (81 ± 3 vs. 69 ± 2 bpm, n=6, p=0.013 by paired T-test) and increased HRV, consistent with stress decrease. Such HRV increase touched different indexes of variability (long term HRV, coefficient of variability of heartbeat intervals [CVRR] and short term HRV, root mean square of successive differences between heartbeat intervals [RMSSD]), suggesting parasympathetic increase and sympathetic decrease in the autonomic tone as expected under stress decrease.

Conclusions

With small size and minimal invasiveness our new ECG device detected subtle variation in HR and acceleration even underwater, allowing us to test the effect of external stimuli such as food rewarding in bottlenose dolphins. Food rewarding decreased HR and increased HRV, indicating stress decrease and autonomic modulation of HR. These experiments suggest that the analysis of heart rhythm could provide a powerful method to test cetaceans perception to external stimuli.