Gas exchange and heart rate in the harbour porpoise, Phocoena phocoena

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The respiratory physiology, heart rates and metabolic rates of two captive juvenile male harbour porpoises (both 28 kg) were measured using a rapid-response respiratory gas analysis system in the laboratory. Breath-hold durations in the laboratory (12 +/- 0.3 s, mean +/- SEM) were shorter than field observations, although a few breath-holds of over 40 s were recorded. The mean percentage time spent submerged was 89 +/- 0.4%. Relative to similarly-sized terrestrial mammals, the respiratory frequency was low (4.9 +/- 0.19 breaths min(-1)) but with high tidal volumes (1.1 +/- 0.01 l), enabling a comparatively high minute rate of gas exchange. Oxygen consumption under these experimental conditions (247 +/- 13.8 ml O-2. min(-1)) was 1.9-fold higher than predicted by standard scaling relations. These data together with an estimate of the total oxygen stores predicted an aerobic dive limit of 5.4 min. The peak end-tidal O-2 values were related to the length of the previous breath-hold, demonstrating the increased oxygen uptake from the lung for the longer dives. Blood oxygen capacity was 23.5 +/- 1.0 ml.100 ml(-1), and the oxygen affinity was high, enabling rapid oxygen loading during ventilation.