Supplementary materials and methods

Description for cADL calculation

The cADL was estimated by applying the methodology described in Kooyman (1989) and using specific estimates of tissues and oxygen-binding proteins proportions for walruses when available. The following assumptions were used to estimate the tissues (blood, muscle, and lungs) O_2 storage capacity and utilization during the dive. The total blood volume (BV, l) was calculated using the mass-specific estimation of 0.106 l blood kg^{-1} (Lenfant et al., 1970). The estimated proportions of arterial and venous blood were considered as 33% and 67% respectively (Lenfant et al., 1970). The initial and final arterial haemoglobin (Hb) saturation were assumed to be 95% and 20%, respectively. The initial venous O_2 content was assumed to be 5 vol% less than the initial arterial O_2 content, with a final venous O_2 content of zero (Ponganis, 2011). The Hb content of adult female walruses has been reported to be 16.8 g Hb 100 ml^{-1} of blood (Wołk and Kosygin, 1979), and the oxygen-binding capacity is 1.34 ml O_2 g^{-1} Hb (Kooyman, 1989). The final equations utilized for the calculation of total volume of blood O_2 (l) were:

$$1)\quad \text{Arterial } O_2 = (\text{BV x } M_b \text{ x } 0.33) \text{ x } (0.95 - 0.20 \text{ saturation}) \text{ x } ([\text{Hb}] \text{ x } 0.00134)$$

$$2)\quad \text{Venous } O_2 = (\text{BV x } M_b \text{ x } 0.67) \text{ x } (\text{initial arterial } O_2 \text{ content} - 5\text{vol\%})$$

The total muscle O_2 storage capacity was estimated by calculating the total muscular myoglobin (Mg) content. The total muscle mass (kg) was calculated as 0.2410 $M_b^{1.084}$, an equation derived from excised tissues of Atlantic walruses (Knutsen and Born, 1994). The specific Mg content for the longissimus dorsi muscle in adult walruses has been estimated to be 3.8 g Mg 100 g^{-1} of wet muscle mass (Noren et al., 2015) and was assumed equal for all muscle groups. However, this approach can potentially overestimate the overall muscle O_2 storage capacity as lower levels of Mg have been reported for non-swimming muscles in pinnipeds (Kanatous et al., 1999). The Mg has been reported to possess the same oxygen-binding capacity than that reported for Hg (Kooyman, 1989). Thus, the equation used for the calculation of total volume of muscle O_2 (l) was:

$$3)\quad \text{Muscle } O_2 = \text{Total muscle mass x } ([\text{Mg}] \text{ x } 0.00134)$$

The total lung O_2 storage capacity was computed by calculating the estimated total lung capacity (TLC_{est}, l) using previous equation for marine mammals ($TLC_{est} = 0.135\ M_b^{0.92}$, Fahlman et al., 2011; Kooyman, 1973). The diving lung volume was assumed to be 50% of TLC_{est} for pinnipeds with a 15% of available O_2 concentration in the lungs to be extracted during the dive (Ponganis, 2011). The final equation to yield the calculation of total volume of lung O_2 (l) was:

$$4)\quad \text{Lung } O_2 = M_b \text{ x } TLC_{est} \text{ x } 0.5 \text{ x } 0.15$$

All calculations were made using the overall average M_b for the three participating female walruses during the experiments (835 kg). The total body O_2 storage capacity (37.62 l O_2) was computed by summing the estimated O_2 storage capacity for each tissue. The cADL was computed by dividing the resulted total body O_2 storage capacity by the measured average DMR_{Swim} (4.91 l O_2 min^{-1}).

Supplementary tables

Table S1. Body mass and respiratory variables for each metabolic experiment

Experiment	M_b (kg)	f_R (breaths min^{-1})	$\dot{V}CO_2$ (l CO_2 min^{-1})	RER
Floating at the water surface	844 ± 124 (697-1030)	5.8 ± 2.3 (3.1-9.6)	4.47 ± 0.94 (2.93-5.92)	0.97 ± 0.05 (0.90-1.04)
Stationary dive	827 ± 108 (697-967)	6.0 ± 1.9 (3.7-9.9)	3.58 ± 0.62 (2.84-4.47)	0.94 ± 0.07 (0.81-1.06)
Subsurface swimming	834 ± 113 (688-972)	6.6 ± 1.9 (3.6-9.7)	4.58 ± 0.58 (3.67-5.49)	0.94 ± 0.06 (0.85-1.05)

For the three adult female Pacific walruses participating in metabolic measurements while floating at the water surface, and after performing stationary dives and horizontal subsurface swimming (n = 15 for each respirometry experiment), average (± s.d.) and ranges of: body mass (M_b), respiratory frequency (f_R), CO_2 production rate ($\dot{V}CO_2$) and respiratory exchange ratio (RER).

Table S2. Summary of metabolic measurements converted to daily energetic requirements using obtained RER.

ANIMAL ID	$MR_{Surface}$ (MJ day^{-1})	$sMR_{Surface}$ (kJ kg^{-1} day^{-1})	$DMR_{Stationary}$ (MJ day^{-1})	$sDMR_{Stationary}$ (kJ kg^{-1} day^{-1})	DMR_{Swim} (MJ day^{-1})	$sDMR_{Swim}$ (kJ kg^{-1} day^{-1})
26005388	109.3 ± 13.4	154.0 ± 17.9	105.6 ± 9.4	149.9 ± 12.2	117.9 ± 8.0	167.9 ± 9.4
26005389	165.5 ± 20.2	166.6 ± 24.8	132.5 ± 6.9	138.1 ± 6.7	165.5 ± 5.9	171.0 ± 5.8
26005390	141.5 ± 26.4	171.3 ± 30.7	102.2 ± 13.4	124.8 ± 16.3	154.0 ± 3.7	185.2 ± 4.6
Grand Mean	138.8 ± 30.6 (95.0-193.7)	164.0 ± 24.4 (126.3-203.9)	113.4 ± 16.9 (87.0-139.8)	137.6 ± 15.6 (105.9-163.0)	145.8 ± 21.7 (106.5-172.7)	174.7 ± 10.1 (154.8-190.1)

For each participating female Pacific walrus (Animal ID) and behaviour, average (± s.d) of measured metabolic rate (floating at the water surface: $MR_{Surface}$; stationary dives: $DMR_{Stationary}$; subsurface swimming: DMR_{Swim}) and mass-specific metabolic rate (floating at the water surface: $sMR_{Surface}$; stationary dives: $sDMR_{Stationary}$; subsurface swimming: $sDMR_{Swim}$). N = 5 for all experiments with each individual. Overall average (± s.d) and ranges are also reported for each behaviour.

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