Table S2. Values used in the calculation of the theoretical aerobic dive limit (TADL).

Parameter	Symbol	Unit	Computational	Blue	Fin	Humpback	Reference
(1) Morphology							
Body length	L_{body}	m		25	20	14	Lockyer, 1976
Body mass	M_c	kg		92,671	52,584	35,692	Lockyer, 1976
Body volume	U_c	m^3		86.4	45.9	31.5	
Body surface area	A_{body}	m^2	$SA = 0.08M_c^{0.65}$	131.5	87.1	68.2	Fish, 1993
Fluke total surface area (m^2)	A_{fluke}	m^2		9.19	6.26	10.43	Woodward et al. 2006; Goldbogen J. unpub.
(2) Oxygen stores							
O_2 stores (Lungs)							
Total lunge capacity	TLC	l	$0.1 \times M_c^{0.96}$	5865	3404	2347	Kooyman, 1989
Diving lunge volume	DLV	l	0.75 X TLC	4399	2553	1760	Goforth, 1986
Total O_2 in lungs	O_{lung}	l	0.15 X DLV	660	383	264	Kooyman, 1989
O_2 stores (muscle)							
Muscle mass	M_m	$\%M_c$		39.4	45.6	30.6	Lockyer, 1976
Muscle mass	M_m	kg		36,512	23,978	10,922	
Myoglobin	M_b	g	34 g kg^{-1}	1,241,421	815,262	371,340	Noren & Williams, 2000
O_2 combining capacity	η_O	1 g^{-1} Mb		0.0013	0.0013	0.0013	Kooyman, 1989
Total O_2 in muscle	O_{muscle}	l		1614	1060	483	
O_2 stores (Blood)							
Blood volume	BV	l	0.127 l kg-1	11,769	6,678	4,533	Ridgway et al., 1984
Arterial volume	AV	l	0.33BV	3,884	2,204	1,496	Lenfant et al., 1970
Venous volume	VV	l	0.67BV	7,885	4,474	3,037	Lenfant et al., 1970
Arterial haemoglobin	AHB	g	209 g l^{-1}	811,723	460,593	312,633	Ridgway et al., 1984
Venous haemoglobin	VHB	g	209 g l^{-1}	1,648,043	935,144	634,740	Ridgway et al., 1984
O_2 combining capacity	η_O	1 g^{-1} Mb		0.0013	0.0013	0.0013	
arterial blood O_2	ABO	l	98% saturation	1034	587	398	Kooyman, 1989
venous blood O_2	VBO	l	75% saturation	1656	940	638	Kooyman, 1989
Total O_2 in blood	O_{blood}	l	ABO + VBO	2690	1527	1036	
Total Body O_2 stores	O_{body}	l	$O_{lung} + O_{muscle} + O_{blood}$	4964	2969	1783	
(3) O_2 usage (diving)							
Basal metabolic rate	BMR	kJ s^{-1}	$3.6M_c^{0.74}$	19.1	12.5	9.3	Ahlborn, 2004
Basal metabolic rate	BMR	l O_2 min^{-1}		57.1	37.3	27.9	
Diving metabolic rate	DMR	l O_2 min^{-1}	4BMR	228.3	149.3	111.6	Boyd & Croxall, 1996
DMR - gliding savings	DMRg	l O_2 min^{-1}	DMR - 27.8%	164.8	107.8	80.6	Williams et al., 2000
TADL (No lunges)	TADL	min	O_{body} / DMRg	30.1	27.6	22.1	Croll et al. 2001

Table S2. Continued

(4) Lunge feeding (mechanical energy)							
Initial speed	V_i	m s^{-1}		0.9	0.6	0.5	Goldbogen et al. 2006, 2008, 2011
Maximum lunge speed	V_0	m s^{-1}		3.7	3	2.3	Goldbogen et al. 2006, 2008, 2011
Cost of pre-engulfment accleration	$\Delta Qpre = \Delta KE$	kJ	$0.5M_c(V_0^2-V_i^2)$	597	227	90	Potvin et al. 2009, 2010; Goldbogen et al. 2011
Cost of engulfment, work against total drag	$\Delta Q_{Dengulf} + \Delta Q_{Dshape}$	J kg^{-1}	see fig. 5	5.7	4.0	2.4	Potvin et al. 2009, 2010;Goldbogen et al. 2011
Cost of engulfment, work against total drag	$\Delta Q_{Dengulf} + \Delta Q_{Dshape}$	kJ		524	212	84	
Total cost of a single lunge	ΔQ_{lunge}	kJ	$\Delta Q_{pre} + (\Delta Q_{Dengulf} + \Delta Q_{Dshape})$	1120	439	174	
max # of lunges (mean across individuals)	L_{max}		see Fig. 3	6	9	15	this study
Lunge feeding costs during dive	$\sum Q_{lunge}$	kJ		6723	3953	2608	this study
(5) Unsteady locomotor performance							
Fluke aspect ratio (rank, 1 to 3, 3 = best)	AR_{fluke}			6.16 (1)	5.30 (2)	4.07 (3)	Woodward et al. 2006; Goldbogen J. unpub.
Fluke area : body surface area (rank)	$A_{fluke} : A_{body}$			0.07 (2)	0.07 (2)	0.15 (3)	Woodward et al. 2006; Goldbogen J. unpub.
Total fluke $area^{1/2}$: Body $volume^{1/3}$ (rank)	$A_{fluke}^{1/2} : U_c^{1/3}$			0.69 (2)	0.45 (1)	1.02 (3)	Woodward et al. 2006; Goldbogen J. unpub.
Acceleration performance rank (3 to 9)	PR			5	5	9	
(6) Lunge feeding (metabolic energy)							
Bulk efficiency	η_{bulk}			0.25	0.25	0.25	Ahlborn, 2004
Propulsive efficiency(predicted, as modified by PR)	η_{prop}			0.86	0.86	0.91	Fish and Rohr, 1999
Combined efficiency	$\eta_{combined}$		$1-[(1-\eta_{bulk}) + (1-\eta_{prop})]$	0.11	0.11	0.16	
Lunge feeding costs during dive (metabolic energy)	$\sum Q_{lunge}$	kJ	$\sum Q_{lunge} / \eta_{combined}$	61117	35934	16824	
Lunge feedings costs during dive (metabolic energy)	$\sum Q_{lunge}$	l O2		3041	1788	837	
(7) O_2 usage (diving and lunge feeding)							
Engulfment costs / Body oxygen stores			$\sum Q_{lunge} / O_{body}$	0.61	0.60	0.47	
Body oxygen stores - engulfment costs		l O2	$O_{body} - \sum Q_{lunge}$	1923	1182	946	
TADL (max no. of lunges)	TADL	min	$(O_{body} - \sum Q_{lunge})/DMRg$	11.67	10.96	11.74	
Observed max. dive time (mean across individuals)				11.61	9.33	11.32	this study