Palomares, M.L.D., P.M.E. Sorsogon, A. Hunter and D. Pauly. 2008. Growth of marine mammals. p. 2-26 In: M.L.D. Palomares and D. Pauly (eds.). *Fisheries Centre Research Report* 16(10), 138 p.

GROWTH OF MARINE MAMMALS[1]

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ABSTRACT

Growth and length-weight data were obtained from the literature for 187 populations of 61 species of marine mammals ranging from sea otters to pygmy blue whales. Length-weight parameter estimates yielded a mean *b* value of 2.86. Estimates of the von Bertalanffy growth function indicate that smaller marine mammals, i.e., seals, sea lions, walruses and dolphins, tend to have growth performance indices between 3.5 to 4.5 and that larger marine mammals, i.e., male fur and elephant seals and whales, tend to have indices higher than 4.5. However, the auximetric plot of log K *vs* log W_∞ shows a decreasing trend in growth performance, similar to that shown for fishes, seabirds and aquatic reptiles.

INTRODUCTION

Interest in marine mammals, primarily harvesting and use of products derived from them (e.g., fur/hide, oil and meat), can be traced back to ancient times (Cotté & Guinet, 2007; Allen & Keay, 2006; Christensen, 2006; Tillman & Donovan, 1983). This interest evolved through time, graduating from the need to know of their seasonal whereabouts for obvious reasons connected to the hunt (Christensen, 2006), to a need to know how much fish they consume, i.e., the extent of their competition with fisheries (Kaschner & Pauly, 2005; Kastelein & Vaughan, 1989; Goode, 1884). For some rare species, interest is also growing as to the effect of climate change on their populations (see, e.g., Laidre *et al.*, 2006; Cotté & Guinet, 2007; Newsome *et al.*, 2007).

Studying animals living in aquatic environments has always been a challenge because of their inaccessibility to us, their observers. This inconvenience is compounded when the subject are marine mammals, many of which are highly migratory, or which can, on rare occasions, pose a threat to their human observers, as is the case with polar bears. Studying marine mammals is more difficult now that many have become in danger of extinction and, in most parts of the world, are protected species. Traditional life-history studies involve field sampling, and usually sacrificing a subset of the population being studied (see, e.g., True, 1885), or laboratory experiments following the life stages and growth of individual specimens. Nowadays, field sampling of marine mammal populations is done in the context of

[1] Cite as: Palomares, M.L.D., Sorongon, P.M.E., Hunter, A., Pauly, D., 2008. Growth of marine mammals. In: Palomares, M.L.D., Pauly, D. (eds.), Von Bertalanffy Growth Parameters of Non-Fish Marine Organisms. Fisheries Centre Research Reports 16(10). Fisheries Centre, University of British Columbia [ISSN 1198-6727], pp. 2-26.

'scientific whaling' (see, e.g., Tamura & Konishi, 2006; Amano & Miyazaki, 2004; Bryden & Harrison, 1986) or when they are caught as by-catch (see, e.g., Miller *et al.*, 1998; Yoshida *et al.*, 1994; Bryden & Harrison, 1986), or stranded.

Marine mammal field studies, some dating back to the early 1970s (see, e.g., Stirling, 2002; Burns & Harbo, 1972), employed expensive field observation methods, e.g., helicopter observations or tagging and recapture methods, and were aimed primarily at collecting biogeographical data. There was no known method of determining ages of cetaceans and pinnipeds until the 1950s, and thus, the data required for growth analyses could not be obtained (Gaskin & Blair, 1977). This has changed, however, and length-at-age data are available and may be obtained from studies of: bones; GLG's (growth layer groups) of dentine, e.g., in odontocete cetaceans (Scheffer & Myrick, 1980); weight of eye lenses (Gaskin & Blair, 1977); track width measurements, e.g., in harbor seals (Reijnders 1976); amino acid racemisation (Bada *et al.*, 1980); counts of ovarian *corpora albicantia* (Kleinenberg & Klevezal, 1962); counts of periosteal bones (van Bree *et al.*, 1986; Brodie, 1969; Kleinenberg & Klevezal, 1962; Laws, 1960); and skeletal and external morphology (Stuart & Morejohn, 1980), e.g., in sea otters (Schneider, 1973). Such data were used to describe the growth of marine mammals using the Gompertz equation (Laird, 1969), logistic equations and, occasionally, the von Bertalanffy growth function (VBGF).

This paper assembles growth parameters for marine mammals, estimated using a variety of methods, and standardizes them using the VBGF, along with length-weight relationships. These life-history parameters are available through SeaLifeBase (www.sealifeabase.org), an information system on non-fish marine organisms patterned after the successful model for fish, FishBase (www.fishbase.org). Thus, a preliminary comparison of the growth performance of marine mammal can be presented.

MATERIALS AND METHODS

Growth parameter estimation

Growth parameters of marine mammal populations were obtained from published literature, and cover the following: (i) the parameters of growth equations other than the VBGF, notably the logistic and Gompertz curves; (ii) age-at-length or growth increment data; and (iii) time series of size frequency distributions. The parameters of the VBGF were recalculated from age-at-length data generated from (i), and all age-at-length and growth increment data were fitted to the VBGF (see von Bertalanffy, 1957) of the form:

$$L_t = L_\infty \, (1 - e^{-K \cdot (t - t_0)}) \qquad \ldots (1)$$

where L_t is the length at age t, L_∞ is the asymptotic length, i.e., the mean length the animal would reach if it could grow forever, K is a coefficient of dimension t^{-1}, and t_o is a parameter setting the origin of the curve on the age-axis.

Size frequency distributions were fitted to the Powell-Wetherall Plot (PW-Plot; see Pauly, 1998; Wetherall, 1986; Powell, 1979) to estimate L_∞, based on the assumption that the resulting distribution is representative of the population. Plotting of successive mean lengths (L_{mean}), computed from successive cut-off lengths (L_{i+1}), minus the L_i (i.e., $L_{mean} - L_i$) against L_i. The downward trend of the points were then fitted with a linear regression of the form $Y = a + bX$, with $L_\infty = a/-b$) and $Z/K = (1+b)/(-b)$, where Z is the instantaneous rate of total mortality (Pauly, 1998). This method allows the estimation of L_∞ and Z/K, i.e., exploited populations, where Z is the instantaneous rate of total mortality. Z/K is equivalent to M/K in unexploited populations.

In cases where only L_∞ estimates are available, e.g., results of the PW-Plot, values of K were obtained using the growth performance index (Φ') defined by Pauly & Munro (1984) as $\Phi' = \log_{10} K + 2 \cdot \log_{10} L_\infty$, and mean values of Φ', available from L_∞ and K pairs for: (a) the same species in different localities; (b) other species in the same genus; (c) other species in the same family. Growth parameters obtained through this method are marked as such in SeaLifeBase.

Asymptotic weight estimation

Asymptotic weight, W_∞, was estimated using the length-weight relationship of the form

$$W = a \cdot L^b \quad \text{... (2)}$$

where a is a multiplicative term equivalent to the y-intercept of the log-log transformed linear regression, L the length, and b the exponent, equivalent to the slope of the regression. In many cases, sufficient length-weight data pairs were not available for linear regression analyses. Thus, condition factors (*c.f.*) using individual length-weight pairs were estimated with $c.f. = W \cdot 100/L^3$, where W is the weight in grams, and L the length in centimeters (Pauly, 1984). The value of the length-weight parameter a was then obtained as $a = c.f./100$, assuming that b=3.

Table 1. Summary of marine mammal species and populations for which data on growth, length-weight relationships (L/W) and condition factors (*c.f.*) were obtained from the literature.

Order	Family	Species	L/W	*c.f.*	VBGF
Carnivora	Mustelidae	1	-	2	12
	Odobenidae	1	-	2	11
	Otariidae	10	8	17	24
	Phocidae	16	7	28	88
	Ursidae	1	-	2	2
Cetacea	Balaenidae	1	-	2	1
	Balaenopteridae	8	13	32	9
	Delphinidae	14	14	12	19
	Eschrichtiidae	1	1	4	1
	Iniidae	1	-	2	4
	Monodontidae	2	3	2	2
	Phocoenidae	3	3	4	11
	Physeteridae	1	3	11	3
	Ziphiidae	1	1	-	-

RESULTS AND DISCUSSION

Our literature search, which relied heavily on Internet sources and electronic or 'soft' reprints, resulted in 173 length-weight relationships covering 61 species (Table A1), 187 asymptotic size estimates for 47 species and 179 L_∞ and K pairs for 46 species (Table A2). Table 1 summarizes the results obtained from this exercise. Note that only two estimates of Z/K were obtained (see Table A2 for values of Z/K calculated through the Powell-Wetherall Plot for the killer whale, *Orcinus orca* (Linnaeus, 1758)). The over-representation of phocids and otariids may be due to the fact that their populations remain on- or near-shore and are thus accessible for research. Among cetacean families, delphinids and balaenopterids are best represented. This may be a product of improved ageing techniques, but may also be a by product of whaling and fisheries by-catch. Few data are available for the oceanic Ziphiidae (Baird's beaked whale).

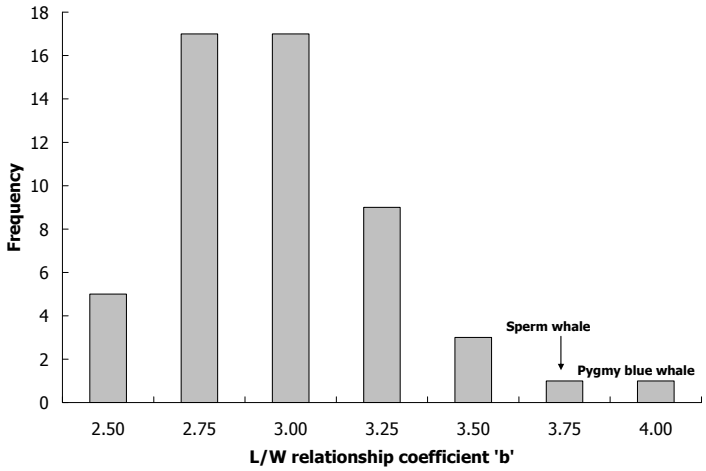

Figure 1. Frequency distribution of the length-weight relationship coefficient b for 53 populations of marine mammals with length-weight data pairs (see Table A1 for details). Note that the outliers (pygmy blue and sperm whales) were obtained from Lockyer (1976; see Table A2 and text for discussion).

Asymptotic weights using equation (2) were obtained, based on the following criteria: i) species of the same sex, with length-weight and VBGF parameters from the same locality; ii) species from the same body of water; and iii) species with different sex/locality. Details of the methods used in solving for asymptotic weights are indicated in Table A2.

Values of the parameter b of the length-weight relationship ranged from 2.31 to 3.97, with 120 estimates computed through condition factors (and the assumption of allometric growth; thus b=3), while 53 were obtained from regression analyses of several length-weight data pairs. Figure 1 shows the distribution of b

values for these 53 populations (mode at 2.74 and median at 2.86). The outliers at b=3.75 and 4.00 were obtained from Lockyer (1976, Table 1), which were based on weight of parts and not on whole individuals. Lockyer (1976) notes that fluid losses may account for the high b values and weights calculated from these L/W relationships. Discounting these outliers, we get a spread of b values between 2.50 and 3.50 with a mean at 2.86. This appears to justify our use of b=3 values to estimate the coefficient a from condition factors for other species for which several L/W data pairs are not available. Thus, we were able to obtain asymptotic weight values for all of the populations for which asymptotic length values were available (see Table A2).

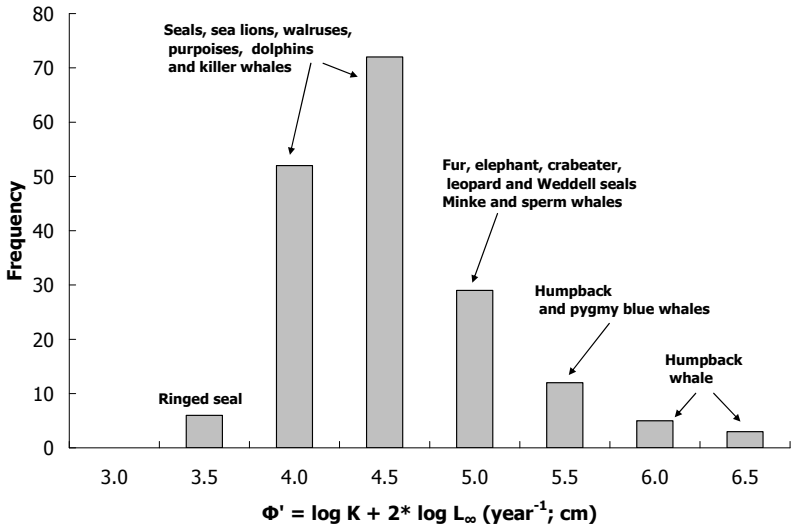

Figure 2. Frequency distribution of the growth performance index Φ' for 179 populations of marine mammals.

Asymptotic lengths ranged from 110 cm for a female *Enhydra lutris* (Linnaeus, 1758) (sea otter) from the Aleutian Islands (Alaska) to 2,190 cm for a female *Balaenoptera musculus brevicauda* (pygmy blue whale) from an unspecified location. The distribution of growth performance indices calculated for these 179 populations (Figure 2) indicated that, in general, seals, sea lions, walruses and dolphins (i.e., smaller

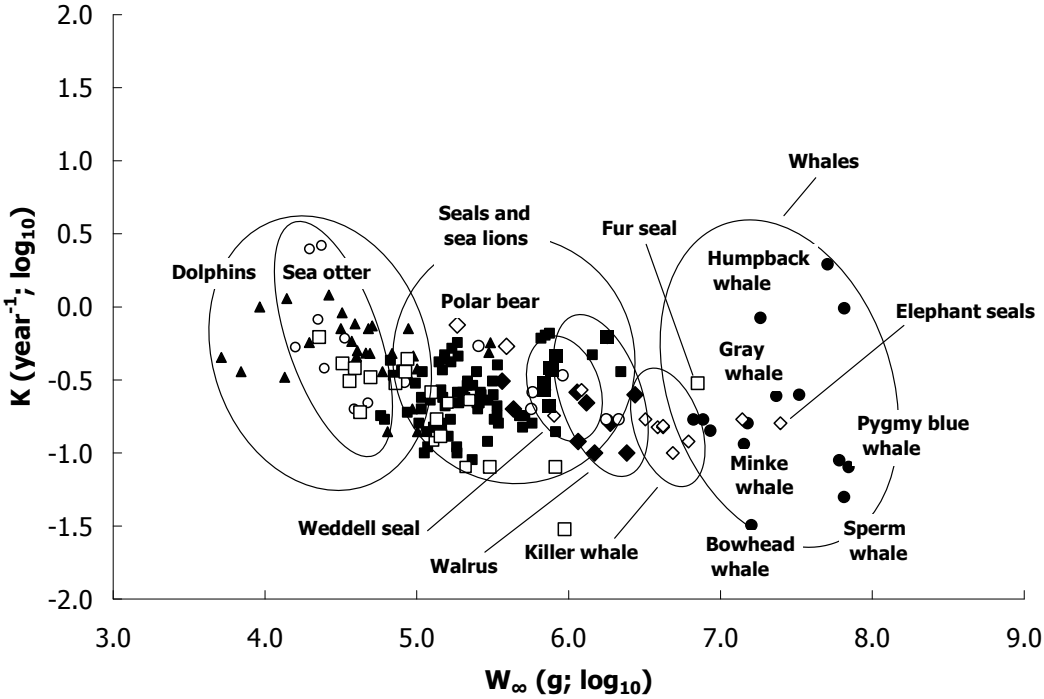

Figure 3. Auximetric plot of 179 populations of marine mammals (see Table A2 for details). Note that, in this plot, the growth of killer whales (which are basically large dolphins), and that of fur and elephant seals are similar to that of minke whales. Also note that the growth of polar bears is similar to that of seals and sea lions.

marine mammals), have indices between 3.5 and 4.5, while larger marine mammals tend to have indices higher than 4.5. These indices might be useful as a quick and easy test for the reliability of growth parameter estimates, notably in cases where the age-at-length or frequency distribution data might be biased or based on a small number of samples, not representing the population. Similarly, the auximetric plot of W_∞ ($\log_{10}$; g) and K ($\log_{10}$; year^{-1};) in Figure 3, indicates that: a) sea otters, small species of dolphins, seals, sea lions and polar bears have similar growth patterns, typical of small marine mammals with W_∞ ranging from 10^4 to 10^5 g; b) there is a medium sized group, i.e., walruses, Weddell seals, fur and elephant seals and killer whales, with W_∞ ranging from 10^5 to 10^7 g; and c) the group of marine mammals, with W_∞ ranging from 10^7 to 10^8 g, which include male fur and elephant seals and the great whales. Note that female fur and elephant seals grow in a fashion similar to sea otters, seals and sea lions. Figure 3 also indicates a downward trend in the growth performance of marine mammals, from smaller marine mammals with fast metabolic rates (K values around 3.2 year^{-1}).

Overall, we find, as we did previously for fishes (Pauly *et al.*, 2000; Pauly, 1979), and, as we document in this report, for seabirds (Karpouzi & Pauly, 2008) and aquatic reptiles (Dar *et al.*, 2008), that auximetric plots (i.e., plots of $logK$ *vs* $logW_\infty$) can be used to show and interpret patterns in the growth of marine mammals.

ACKNOWLEDGEMENTS

This study was made possible by the generous support by the Oak Foundation (Geneva, Switzerland), Dr. Andrew Wright (Vancouver, Canada) and the Pew Charitable Trusts (Philadelphia, USA).

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APPENDIX

Table A1. Summary of 173 populations of 61 species of marine mammals for which length-weight relationships were found (t=tonnes; kg=kilograms; m=meters).

Spec. No.	Species	Stock	Locality	Method	Sex	*b*	*a*	Source
1	*Arctocephalus australis* (South American fur seal)	a	Rio Grande, Brazil	a from cf	F	3.00	0.0488	Fossi *et al.* (1997; Tab. 1)
		b	Rio Grande, Brazil	a from mean cf	M	3.00	0.0544	idem
		c	San Clemente, Argentina	a from cf	F	3.00	0.0385	idem
2	*Arctocephalus gazelle* (Antarctic fur seal)	a	Not specified	a from cf	F	3.00	0.0081	Trites & Pauly (1998; Tab. 2)
		b	Not specified	a from cf	M	3.00	0.00396	Idem
3	*Arctocephalus forsteri* (New Zealand fur seal)	a	New Zealand	a from cf	F	3.00	0.0191	Dickie & Dawson (2003; p. 177)
		b	New Zealand	a from cf	M	3.00	0.0216	idem
4	*Arctocephalus pusillus doriferus* (Australian fur seal)	a	Seal Rocks, Bass Strait, Australia	Recomputed kg	F	3.13	0.00993	Arnould & Warneke (2002; p. 56)
		b	Seal Rocks, Bass Strait, Australia	Recomputed from juv./adults, kg	M	3.30	0.004726	idem
5	*Arctocephalus tropicalis* (Subantarctic fur seal)	a	Not specified	a from cf	F	3.00	0.00841	Trites & Pauly (1998; Tab. 2)
		b	Not specified	a from cf	M	3.00	0.00508	idem
6	*Balaena mysticetus* (bowhead whale)	a	Not specified	a from cf	F	3.00	0.00384	Trites & Pauly (1998; Tab 4)
		b	Not specified	a from cf	male	3.00	0.00393	idem
7	*Balaenoptera acutorostrata* (minke whale)	a	Washington	a from cf	F	3.00	0.00927	Lockyer (1976; p. 272)
		b	Unspecified, Antarctic	a from mean cf	F	3.00	0.0112	idem
		c	Unspecified, Antarctic	a from mean cf	M	3.00	0.0133	idem
		d	Not specified	Recomputed from t and m	mixed	2.31	1.189	Lockyer (1976; Tab. 1)
		e	Unspecified, Antarctic	a from mean cf	unsexed	3.00	0.00687	Lockyer (1976; p. 272)
		f	Unspecified, Antarctic	Recomputed from t and m	unsexed	3.23	0.00264	Lockyer (1976; Tab. 2)
8	*Balaenoptera bonaerensis* (Antarctic minke whale)	a	Southern Ocean	a from cf (pregnant)	F	3.00	0.0115	Tamura & Konishi (2006; Tab. 5)
		b	Southern Ocean	a from cf	M	3.00	0.0115	idem
9	*Balaenoptera musculus brevicauda* (pygmy blue whale)	a	Unspecified, Antarctic	a from cf	F	3.00	0.00666	Lockyer (1976; p. 269)
		b	Unspecified, Antarctic	a from mean cf	M	3.00	0.00644	idem
		c	Unspecified, Antarctic	Recomputed from t and m	mixed	3.97	0.0000046	Lockyer (1976; Tab. 2)

Table A1. Continued.

Spec. No.	Species	Stock	Locality	Method	Sex	*b*	*a*	Source
10	*Callorhinus ursinus* (northern fur seal)	a	Sanriku, Japan	a from mean cf	F	3.00	0.019	Ikemoto *et al.* (2004; Tab. 1)
		b	Sanriku, Japan	a from mean cf	M	3.00	0.0194	Idem
		c	Sanriku, Japan	a from mean cf	mixed	3.00	0.019	Idem
		d	Not specified		F	2.74	0.0608	Hunter (2005; Tab. A.8)
		e	Not specified (pregnant)		F	2.67	0.0979	idem
		f	Not specified		M	2.83	0.0432	idem
11	*Cystophora cristata* (hooded seal)	a	Not specified	a from cf	F	3.00	0.0115	Trites & Pauly (1998; Tab. 4)
		b	Not specified	a from cf	M	3.00	0.00471	idem
12	*Delphinus delphis* (common dolphin)	a	Hawke Bay, North Island, New Zealand	a from mean cf	F	3.00	0.0124	Kastelein *et al.* (2000; Tab. 1)
		b	Northeast, USA	a from mean cf	unsexed	3.00	0.0119	Kastelein *et al.* (2000; Tab. 3)
13	*Enhydra lutris* (sea otter)	a	western Alaska	a from cf	F	3.00	0.0119	Estes (1980, p. 2)
		b	western Alaska	a from cf	M	3.00	0.0147	Idem
14	*Erignathus barbatus* (bearded seal)	a	Not specified	a from cf	F	3.00	0.0107	Trites & Pauly (1998; Tab. 2)
		b	Not specified	a from cf	M	3.00	0.0128	Idem
15	*Eschrichtius robustus* (gray whale)	a	California, USA	a from mean cf	F	3.00	0.0107	Lockyer (1976; p. 268)
		b	California, USA	a from mean cf	M	3.00	0.00933	Idem
		c	California, USA	a from cf	unsexed	3.00	0.0108	Idem
		d	Bering Sea	a from cf	F	3.00	0.0131	Idem
		e	Northern Pacific	Recomputed from t and m	mixed	3.28	0.0014	Lockyer (1976; Tab. 2)
16	*Eumetopias jubatus* (steller sea lion)	a	Not specified		F	2.92	0.0332	Hunter (2005; Tab. A.8)
		b	Alaska	Recomputed from kg and m	F	2.89	0.0363	Idem
		c	Alaska (pregnant)	Recomputed from kg and m	F	2.79	0.0692	Idem
17	*Grampus griseus* (Risso's dolphin)	a	Mediterranean Sea, Italy	Recomputed from kilograms	F	3.00	0.0153	Storelli & Marcotrigiano (2000; Tab. 1)
		b	Mediterranean Sea, Italy	Recomputed from kilograms	F	3.00	0.0152	Idem
		c	Mediterranean Sea, Italy	Recomputed from kilograms	F	3.00	0.0146	Idem
18	*Halichoerus grypus* (grey seal)	a	Not specified		mixed	2.86	0.0522	Hunter (2005; Tab. A.8)

Table A1. Continued.

Spec. No.	Species	Stock	Locality	Method	Sex	*b*	*a*	Source
19	*Histriophoca fasciata* (ribbon seal)	a	Not specified	a from cf	F	3.00	0.0104	Trites & Pauly (1998; Tab. 4)
		b	Not specified	a from cf	M	3.00	0.0104	Idem
20	*Hydrurga leptonyx* (leopard seal)	a	Not specified	a from cf	F	3.00	0.0141	Idem
		b	Not specified	a from cf	M	3.00	0.0117	Idem
21	*Lagenodelphis hosei* (Fraser's dolphin)	a	Not specified	a from cf	mixed	3.00	0.00519	Idem
22	*Lagenorhynchus obliquidens* (Pacific white-sided dolphin)	a	Not specified		mixed	2.82	0.035	Hunter (2005; Tab. A.8)
23	*Leptonychotes weddellii* (Weddell seal)	a	Unspecified, Antarctic		mixed	2.53	0.202	Hunter (2005; Tab. A.8)
24	*Lobodon carcinophaga* (crabeater seal)	a	Not specified	a from cf	F	3.00	0.0123	Trites & Pauly (1998; Tab. 4)
		b	Not specified	a from cf	M	3	0.0112	Idem
25	*Megaptera noveangliae* (humpback whale)	a	California, USA	a from mean cf	F	3	0.0171	Lockyer (1976; p. 272)
		b	Unspecified, Antarctic	a from cf	F	3	0.0103	Idem
		c	Unspecified, Antarctic	Recomputed from t and m	F	2.95	0.0158	Lockyer (1976; Tab. 2)
		d	Puget Sound, Washington, USA	a from cf	F	3	0.0104	Lockyer (1976; p. 272)
		e	Bering Sea	a from cf	F	3	0.0121	Idem
		f	Bering Sea	a from cf	M	3	0.0129	Lockyer (1976; p. 272)
		g	Not specified	Recomputed from t and m	mixed	2.95	0.062	Lockyer (1976; Tab. 1)
26	*Mirounga angustirostris* (northern elephant seal)	a	Año Nuevo State Reserve, California, USA	Recomputed from kg and m	M	3.02	0.0281	Haley *et al.* (1991; Tab. 1)
27	*Mirounga leonine* (southern elephant seal)	a	Not specified	a from cf	F	3	0.0116	Trites & Pauly (1998; Tab. 2)
		b	Not specified	a from cf	M	3	0.00462	Idem
28	*Monachus schauinslandi* (Hawaiian monk seal)	a	Not specified	a from cf	F	3	0.0118	Trites & Pauly (1998; Tab. 4)
		b	Not specified	a from cf	M	3	0.0106	Idem
29	*Monodon monoceros* (narwhal)	a	Western Greenland	a from mean cf	F	3	0.0161	Garde *et al.* (2007, p. 57-58)
		b	Western Greenland	a from mean cf	M	3	0.0168	Idem
30	*Neophocaena phocaenoides* (finless porpoise)	a	Kyushu around Nagasaki and Kanmon Pass, Japan	a from mean cf	F	3	0.0157	Shirakihara *et al.* (1993; Tab. 2)
		b	Kyushu around Nagasaki and Kanmon Pass, Japan	a from mean cf	M	3	0.0144	Shirakihara *et al.* (1993; Tab. 3)
		c	Not specified	a from cf	mixed	3	0.00576	Trites & Pauly (1998; Tab. 4)

Table A1. Continued.

Spec. No.	Species	Stock	Locality	Method	Sex	*b*	*a*	Source
31	*Odobenus rosmarus* (walrus)	a	Not specified	a from cf	F	3	0.0175	Trites & Pauly (1998; Tab. 2)
		b	Not specified	a from cf	M	3	0.0143	Idem
32	*Orcinus orca* (killer whale)	a	Not specified		mixed	3.2	0.006	Hunter (2005; Tab. A.8)
		b	Not specified		mixed	2.58	0.208	Idem
33	*Otaria flavescens* (South American sea lion)	a	Not specified	a from cf	F	3	0.0113	Trites & Pauly (1998; Tab. 4)
		b	Not specified	a from cf	M	3	0.00469	Idem
34	*Pagophilus groenlandicus* (harp seal)	a	Not specified		mixed	2.81	0.0645	Hunter (2005; Tab. A.8)
35	*Phoca largha* (larga seal)	a	Not specified	a from cf	F	3	0.0095	Trites & Pauly (1998; Tab. 4)
		b	Not specified	a from cf	M	3	0.0102	Idem
36	*Phoca vitulina* (Harbour seal)	a	Not specified		mixed	2.89	0.0404	Hunter (2005; Tab. A.8)
37	*Phocoena phocoena* (harbour porpoise)	a	Not specified		F	2.43	0.216	Idem
		b	Not specified		M	2.74	0.051	Idem
		c	Not specified		mixed	2.63	0.083	Hunter (2005; Tab. A.8)
38	*Phocoenoides dalli* (Dall's porpoise)	a	Not specified	a from cf	mixed	3	0.00576	Trites & Pauly (1998; Tab. 4)
39	*Physeter macrocephalus* (sperm whale)	a	Japan	a from mean cf	F	3	0.00893	Lockyer (1976; p. 273)
		b	Japan	a from mean cf	M	3	0.00964	Lockyer (1976; p. 272-273)
		c	Japan	Recomputed from t and m	mixed	3.18	0.0029	Lockyer (1976; Tab. 1)
		d	Natal, South Africa	a from mean cf	F	3	0.0131	Lockyer (1976; p. 273)
		e	Natal, South Africa	Recomputed from t and m	F	3.55	0.00023	Lockyer (1976; Tab. 2)
		f	Natal, South Africa	a from cf	M	3	0.0131	Lockyer (1976; p. 273)
		g	Bering Sea	a from mean cf	M	3	0.00918	Idem
		h	Bering Sea	a from mean cf	unsexed	3	0.00797	Idem
		i	Iceland	a from cf	M	3	0.00997	Idem
		j	Canada	a from cf	M	3	0.0139	Idem
		k	Antarctic and Pacific	Recomputed from t and m	mixed	2.74	0.0649	Lockyer (1976; Tab. 2)
		l	Unspecified, Antarctic	a from mean cf	unsexed	3	0.0109	Lockyer (1976; p. 273)
		m	Not specified	a from cf	F	3	0.00584	Trites & Pauly (1998; Tab. 2)
		n	Not specified	a from cf	M	3	0.00462	Idem
40	*Pontoporia blainvillei* (franciscana dolphin)	a	Not specified	a from cf	F	3	0.00626	Idem
		b	Not specified	a from cf	M	3	0.00635	Idem

Table A1. Continued.

Spec. No.	Species	Stock	Locality	Method	Sex	*b*	*a*	Source
41	*Pusa caspica* (Caspian seal)	a	Caspian Sea	a from cf	F	3	0.0341	Ikemoto *et al.* (2004; Tab. 1)
		b	Caspian Sea	a from cf	M	3	0.0285	Idem
		c	Caspian Sea	a from cf	mixed	3	0.033	Idem
		d	northern Caspian Sea	a from mean cf	F	3	0.031	Watanabe *et al.* (2002;Tab. 1)
		e	northern Caspian Sea	a from mean cf (pregnant)	F	3	0.0362	Idem
		f	northern Caspian Sea	a from mean cf (non-pregnant)	F	3	0.027	Idem
		g	northern Caspian Sea	a from mean cf	M	3	0.0327	Idem
42	*Pusa hispida* (ringed seal)	a	Svalbard	Recomputed from kg and m	F	3.15	0.0145	Hunter (2005; Tab. A.8)
		b	Svalbard	Recomputed from kg and m	M	3.26	0.00832	Idem
		c	Kongsfjorden, Svalbard	Recomputed from kilograms	F	3	0.0257	Krafft *et al.* (2007; Tab. 2)
		d	Kongsfjorden, Svalbard	Recomputed from kilograms	male	3	0.0350	Idem
43	*Pusa sibirica* (Baikal seal)	a	Lake Baikal	a from mean cf	F	3	0.0248	Ikemoto *et al.* (2004; Tab. 1)
		b	Lake Baikal	a from mean cf	M	3	0.021	Idem
		c	Lake Baikal	a from mean cf	mixed	3	0.023	Idem
44	*Stenella frontalis* (Atlantic spotted dolphin)	a	Not specified	a from cf	F	3	0.00562	Trites & Pauly (1998; Tab. 4)
		b	Not specified	a from cf	M	3	0.00567	Idem
45	*Steno bredanensis* (rough-toothed dolphin)	a	Not specified	a from cf	F	3	0.00529	Idem
		b	Not specified	a from cf	M	3	0.00518	Idem
46	*Tursiops truncates* (bottlenose dolphin)	a	Not specified	a from cf	F	3	0.00348	Trites & Pauly (1998; Tab. 2)
		b	Not specified	a from cf	M	3	0.00367	Idem
47	*Ursus maritimus* (polar bear)	a	Svalbard	a from cf	F	3	0.0253	Derocher & Wiig (2002; Tab. 1)
		b	Svalbard	a from cf	M	3	0.0342	Idem
48	*Arctocephalus pusillus* (South African fur seal)	a	Not specified	a from cf	F	3	0.0101	Trites & Pauly (1998; Tab. 4)
		b	Not specified	a from cf	M	3	0.00444	Idem
49	*Arctocephalus townsendi* (Guadalupe fur seal)	a	Guadalupe, Mexico	a from mean cf	F	3	0.0151	Gallo-Reynoso *et al.* (1996; Table 1)

Table A1. Continued.

Spec. No.	Species	Stock	Locality	Method	Sex	*b*	*a*	Source
50	*Balaenoptera borealis* (sei whale)	a	Japan	a from mean cf	F	3	0.00559	Lockyer (1976; p. 271)
		b	Japan	a from mean cf	M	3	0.00617	Lockyer (1976; p. 270)
		c	Japan	Recomputed from t and m	mixed	2.43	0.356	Lockyer (1976; Tab. 1)
		d	Japan	Recomputed from t and m	unsexed	2.43	0.334	Lockyer (1976; Tab. 2)
		e	Natal, South Africa	a from cf	F	3	0.00856	Lockyer (1976; p. 271)
		f	Unspecified, Antarctic	a from cf	M	3	0.00639	Idem
51	*Balaenoptera brydei* (Bryde's whale)	a	Japan	a from mean cf	F	3	0.00622	Idem
		b	Japan	a from mean cf	M	3	0.00623	Idem
		c	Japan	Recomputed from t and m	mixed	2.74	0.0429	Lockyer (1976; Tab. 1)
		d	Japan	Recomputed from t and m	unsexed	2.74	0.0404	Lockyer (1976; Tab. 2)
52	*Balaenoptera musculus* (blue whale)	a	Unspecified, Antarctic	a from mean cf	F	3	0.00612	Lockyer (1976; p. 269)
		b	Unspecified, Antarctic	a from mean cf	M	3	0.00636	Lockyer (1976; p. 268-269)
		c	Unspecified, Antarctic	Recomputed from t and m	mixed	3.09	0.00304	Lockyer (1976; Tab. 2)
		d	Unspecified, Antarctic	a from mean cf	unsexed	3	0.00593	Lockyer (1976; p. 269)
		e	Not specified	Recomputed from t and m	mixed	3.25	0.000917	Lockyer (1976; Tab. 1)
		f	Newfoundland, Canada	a from cf	unsexed	3	0.00473	Lockyer (1976; p. 269)
53	*Balaenoptera physalus* (fin whale)	a	Unspecified, Antarctic	a from mean cf	F	3	0.00554	Lockyer (1976; p. 270)
		b	Unspecified, Antarctic	a from mean cf	M	3	0.0056	Lockyer (1976; p. 270)
		c	Unspecified, Antarctic	Recomputed from t and m	unsexed	2.53	0.207	Lockyer (1976; Tab. 2)
		d	California, USA	a from cf	F	3	0.00581	Lockyer (1976; p. 270)
		e	Korf Bay, Kamchatka, Russia	a from cf	F	3	0.00598	Idem
		f	Natal'ya Bay, Russia	a from cf	F	3	0.00617	Idem
		g	Far East	a from cf	F	3	0.00619	Idem
		h	Far East	a from cf	M	3	0.00583	Lockyer (1976; p. 269)
		i	Iceland	a from mean cf	M	3	0.00573	Idem
		j	Commander Island, Russia	a from cf	M	3	0.00504	Idem
		k	Not specified	Recomputed from t and m	mixed	2.9	0.0127	Lockyer (1976; Tab. 1)
54	*Berardius bairdii* (Baird's beaked whale)	a	Japan		mixed	3.08	0.00634	Hunter (2005; Tab. A.8)

Table A1. Continued.

Spec. No.	Species	Stock	Locality	Method	Sex	*b*	*a*	Source
55	*Cephalorhynchus hectori* (Hector's dolphin)	a	Not specified		mixed	2.53	0.1689	Idem
56	*Delphinapterus leucas* (white whale)	a	St. Lawrence, Canada		mixed	2.61	0.156	Idem
		b	Hudson Bay, Canada		mixed	2.56	0.182	Idem
		c	Hudson Bay, Canada		mixed	2.54	0.452	Idem
57	*Globicephala melas* (long-finned pilot whale)	a	Faeroe Island (postnatal)		mixed	2.5	0.23	Idem
58	*Pseudorca crassidens* (false killer whale)	a	Not specified		mixed	2.44	0.216	Idem
59	*Stenella attenuate* (Pantropical spotted dolphin)	a	Not specified		F	2.61	0.0696	Idem
		b	Not specified		M	2.87	0.0193	Idem
		c	Not specified		mixed	2.93	0.0126	Idem
60	*Stenella coeruleoalba* (striped dolphin)	a	Not specified (postnatal)		F	2.91	0.0183	Idem
		b	Not specified (postnatal)		M	2.98	0.0139	Idem
		c	Not specified		mixed	2.93	0.0171	Idem
61	*Stenella longirostris* (long-snouted spinner dolphin)	a	Not specified		F	2.61	0.0696	Idem
		b	Not specified		M	2.87	0.0193	Idem

Table A2. Summary of 179 populations of 47 marine mammal species for which von Bertalanffy growth parameters were found.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
1	*Arctocephalus australis* (South American fur seal)	a	Isla de Lobos, Uruguay	253	F	118	72	0.30	-0.67	Length-at-age; 0-28.5 years. Average W_∞ from Tab. 1 (1a, 1c). Lima & Paez (1995; Fig. 1).
2	*Arctocephalus gazelle* (Antarctic fur seal)	a	Not specified	-	F	220	87	0.44	-0.68	From generalized VBGF. W_∞ from Tab. 1(2b). McLaren (1993; Tab. 1).
		b	Idem	-	M	331	143	0.13	-0.66	Idem
3	*Arctocephalus forsteri* (New Zealand fur seal)	a	New Zealand	57	F	119	32	0.41	-	W_∞ from Tab. 1 (3a). Dickie & Dawson (2003; Tab. 1).
		b	Kangaroo Island, South Australia	-	F	137	50	0.33	-1.55	W_∞ from Tab. 1(3a). McKenzie *et al*. (2007; Tab. 2).
		c	Idem	-	M	184	135	0.17	-8.18	W_∞ from Tab. 1 (3b). McKenzie *et al*. (2007; Tab. 2).
4	*Arctocephalus pusillus doriferus* (Australian fur seal)	a	Seal Rocks, Bass Strait, Australia	163	F	163	84	0.36	-1.91	W_∞ from Tab. 1 (4a). Arnould & Warneke (2002; Tab. 1)
		b	Idem	69	M	600	7072	0.30	-0.88	From logistic curve. W_∞ from Tab. 1(4b). Arnould & Warneke (2002, Abstract); Hunter (2005; Tab. A.8).
5	*Arctocephalus tropicalis (Subantarctic fur seal)*	a	Amsterdam Island, southern Indian Ocean	108	F	139	23	0.62	-	From Gompertz equation. W_∞ from Tab. 1 (5a). Dabin *et al*. (2004; p. 1045).
6	*Balaena mysticetus* (bowhead whale)	a	Alaska	-	unsexed	1602	16000	0.032	-22.2	Average W_∞ from Tab. 1 (6a, 6b). George *et al*. (1999; p. 575)
7	*Balaenoptera acutorostrata* (minke whale)	a	Not specified	-	M	833	7688	0.17	-4.30	W_∞ from Tab. 1 (7c). Hunter (2005, Tab. A.8).
8	*Balaenoptera bonaerensis* (Antarctic minke whale)	a	Idem	-	F	907	8581	0.14	-4.30	W_∞ from Tab. 1 (8a). Hunter (2005, Tab. A.8).
		b	Idem	-	♂	833	6647	0.17	-4.30	W_∞ from Tab. 1(8b). Hunter (2005, Tab. A.8).
9	*Balaenoptera musculus brevicauda* (pygmy blue whale)	a	Idem	170	F	2190	70000	0.08	-16.2	From m to cm. W_∞ from Tab. 1 (9a). Branch (2008, Tab. 3).
		b	Idem	218	M	2110	60500	0.09	-15.5	From m to cm. W_∞ from Tab. 1 (9b). Branch (2008, Tab. 3).
10	*Callorhinus ursinus (northern fur seal)*	a	Eastern Bering Sea, California	6493	F	128	36	0.31	-2.06	Length at age; non-pregnant females; 0-15 years.Average W_∞ from Tab. 1 (10a, 10d-e). Trites & Bigg (1996; Tab. 1).
		b	Idem	9630	F	130	42	0.19	-7.32	Length at age; pregnant females; 4-23 years. Average W_∞ from Tab. 1 (10a, 10d-e). Trites & Bigg (1996; Tab. 1).

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
10	*Callorhinus ursinus* (northern fur seal)	c	Idem	2008	M	266	303	0.08	-3.69	Length at age; 0-16 years. W_∞ from Tab. (10b, 10f). Trites & Bigg (1996; Tab. 1).
		d	Pribilof Island, Alaska	137	F	127	39	0.38	-1.83	Length at age; 0-10 years. Average W_∞ from Tab. 1 (10a, 10d-e). Scheffer & Wilke (1953; Tabs. 1-2).
		e	Idem	306	M	308	818	0.08	-3.13	Length at age; 0-10 years. Average W_∞ from Tab. 1 (10b, 10f). Scheffer & Wilke (1953; Tabs. 1-2).
		f	Not specified	-	F	198	124	0.26	-0.67	From generalized VBGF. Average W_∞ from Tab. 1 (10d-e). McLaren (1993; Tab. 1).
		g	Idem	-	M	396	942	0.03	-0.42	From generalized VBGF. W_∞ from Tab. 1 (10f). McLaren (1993; Tab. 1)
11	*Cystophora cristata* (hooded seal)	a	Idem	-	F	280	252	0.20	-0.62	From generalized VBGF. W_∞ from Tab. 1 (11a). McLaren (1993; Tab. 1).
		b	Idem	-	M	311	141	0.16	-0.61	From generalized VBGF. W_∞ from Tab. 1 (11b). McLaren (1993; Tab. 1).
12	*Delphinus delphis* (common dolphin)	a	Hawke Bay, North Island, New Zealand	4	F	196	93	0.20	-6.99	Length at age; 2-27 years. W_∞ from Tab. 1 (12a). Kastelein *et al.* (2000; Fig. 3).
13	*Enhydra lutris* (sea otter)	a	Not specified	-	F	148	39	0.20	-	L_∞ from L_{max}; K from theta of female pups (13c). W_∞ from Tab. 1 (13a). Jefferson *et al.* (1993).
		b	Idem	-	M	148	48	0.22	-	L_∞ from maximum length; K from theta of female pups (13c). W_∞ from Tab. 1 (13b). Jefferson *et al.* (1993).
		c	Western Aleutian Islands, Alaska	102	F	118	20	2.49	-0.22	Length at age; female pups; 0-3 years. W_∞ from Tab. 1 (13a). Schneider (1973; Tab. 3).
		d	Idem	90	M	117	24	2.63	-0.21	Length at age; male pups; 0-3 years. W_∞ from Tab. 1 (13b). Schneider (1973; Tab. 3).
		e	Aleutian Islands, Alaska	-	F	110	16	0.53	-2.35	W_∞ from Tab. 1 (13a). Laidre *et al.* (2006; Tab. 2).
		f	Idem	-	F	123	22	0.82	-1.55	Idem
		g	Idem	-	M	119	25	0.38	-2.51	W_∞ from Tab. 1 (13b). Laidre *et al.* (2006; Tab. 2).
		h	Idem	-	M	132	33	0.61	-2.05	Idem
		i	California, USA	-	F	128	25	-	-	W_∞ from Tab. 1 (13a). Laidre *et al.* (2006; p. 985).
		j	Idem	-	F	127	24	-	-	Idem

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
13	*Enhydra lutris* (sea otter)	k	Idem	-	M	119	25	-	-	W_∞ from Tab. 1 (13b). Laidre *et al.* (2006; p. 985).
		l	Idem	-	M	118	24	-	-	Idem
14	*Erignathus barbatus* (bearded seal)	a	Barents Sea	-	mixed	306	338	0.21	-0.70	From generalized VBGF. Average W_∞ from Tab. 1 (14a-b). McLaren (1993; Tab. 1).
		b	Sea of Okhotsk	-	mixed	271	233	0.29	-0.74	Idem
		c	Bering-Chukchi Sea	-	mixed	300	319	0.25	-0.71	Idem
		d	Eastern Canada	-	mixed	326	516	0.18	-0.73	Idem
15	*Eschrichtius robustus* (gray whale)	a	California and Washington, USA	-	F	1297	23346	0.25	-2.84	W_∞ from Tab. 1 (15a). Kastelle *et al.* (2003; p. 26).
16	*Eumetopias jubatus* (steller sea lion)	a	Gulf of Alaska	-	F	360	913	0.34	-0.65	From generalized VBGF. Average W_∞ from Tab. 1 (16b-c). McLaren (1993; Tab. 1).
		b	Idem	-	M	486	2137	0.17	-0.65	Idem
		c	Shelikof Alaska	-	F	304	567	0.20	-0.66	Idem
		d	Idem	-	M	454	1766	0.17	-0.64	Idem
		e	Alaska	201	F	230	255	0.54	-1.05	Length at age; 0-24 years. Average W_∞ from Tab. 1 (16b-c). Winship *et al.* (2001; Tab. 3).
		f	Idem	235	M	307	579	0.26	-1.50	Length at age; 0-18 years. Average W_∞ from Tab. 1 (16b-c). Winship *et al.* (2001; Tab. 3).
17	*Grampus griseus* (Risso's dolphin)	a	Taiji, Japan	-	F	271	298	0.49	-2.09	Average W_∞ from Tab. 1 (17a-c). Amano & Miyazaki (2004; Fig. 2).
		b	Idem	-	M	273	305	0.57	-1.62	Idem
18	*Halichoerus grypus* (grey seal)	a	Eastern Canada	-	F	271	475	0.18	-0.60	From generalized VBGF. W_∞ from Tab. 1 (18a). McLaren (1993; Tab. 1).
		b	Idem	-	M	328	821	0.14	-0.58	Idem
		c	Farne Islands, England	-	F	241	338	0.18	-0.53	Idem
		d	Idem	-	M	290	573	0.16	-0.54	Idem
19	*Histriophoca fasciata* (ribbon seal)	a	Sea of Okhotsk	-	F	245	153	0.47	-0.62	From generalized VBGF. W_∞ from Tab. 1 (19a). McLaren (1993; Tab. 1).
		b	Idem	-	M	261	185	0.57	-0.62	Idem
		c	Idem	-	mixed	254	17	0.52	-0.64	From generalized VBGF. Average W_∞ from Tab. 1 (19a-b). McLaren (1993; Tab. 1).
		d	Bering Sea	-	F	242	148	0.37	-0.63	From generalized VBGF. W_∞ from Tab. 1 (19a). McLaren (1993; Tab. 1).
		e	Idem	-	M	262	187	0.46	-0.64	From generalized VBGF. W_∞ from Tab. 1 (19b). McLaren (1993; Tab. 1).

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
19	*Histriophoca fasciata* (ribbon seal)	f	Idem	-	mixed	253	168	0.42	-0.63	From generalized VBGF. Average W_∞ from Tab. 1 (19a-b). McLaren (1993; Tab. 1).
20	*Hydrurga leptonyx* (leopard seal)	a	Antarctic	-	F	539	221	0.36	-0.69	From generalized VBGF. W_∞ from Tab. 1 (20a). McLaren (1993; Tab. 1).
		b	Idem	-	M	497	1434	0.47	-0.69	From generalized VBGF. W_∞ from Tab. 1 (20b). McLaren (1993; Tab. 1).
21	*Lagenodelphis hosei* (Fraser's dolphin)	a	Southeast Brazil	11	mixed	236	69	0.48	-1.05	Length at age; 0-19 years. W_∞ from Tab. 1 (21a). Siciliano *et al.* (2007; Tab. 6).
22	*Lagenorhynchus obliquidens* (Pacific white-sided dolphin)	a	North Pacific	-	F	186	88	0.71	-1.29	W_∞ from Tab. 1 (22a). Heise (1997; Tab. 2).
		b	Idem	-	M	195	100	0.38	-2.06	Idem
		c	Idem	-	mixed	191	95	0.46	-1.75	W_∞ from Tab. 1 (22a). Hunter (2005; Tab. A8).
23	*Leptonychotes weddellii* (Weddell seal)	a	South Orkney Island	-	F	558	1795	0.62	-0.73	From generalized VBGF. W_∞ from Tab. 1 (23a). McLaren (1993; Tab. 1).
		b	McMurdo Sound, Antarctica	-	F	399	770	0.37	-0.73	Idem
		c	Idem	-	F	394	743	0.21	-0.74	Idem
		d	Idem	-	M	410	824	0.46	-0.73	Idem
		e	Idem	-	M	382	687	0.30	-0.73	Idem
		f	Idem	-	mixed	396	756	0.38	-0.72	Idem
		g	Idem	-	mixed	383	692	0.27	-0.74	Idem
24	*Lobodon carcinophaga* (crabeater seal)	a	Not specified	-	F	393	747	0.66	-0.73	From generalized VBGF. W_∞ from Tab. 1 (24a). McLaren (1993; Tab. 1).
		b	Idem	-	M	389	659	0.61	-0.74	From generalized VBGF. W_∞ from Tab. 1 (24b). McLaren (1993; Tab. 1).
		c	Idem	-	mixed	391	702	0.64	-0.72	From generalized VBGF. Average W_∞ from Tab. 1 (24a-b). McLaren (1993; Tab. 1).
25	*Megaptera novaeangliae* (humpback whale)	a	Northwest Atlantic	-	mixed	1050	51000	1.96	-0.26	From generalized VBGF. W_∞ from Tab. 1 (25g). Stevick (1999; Fig. 4).
		b	Idem	-	mixed	1145	65410	0.98	-0.46	Idem
		c	Northern Atlantic	11	F	1394	33000	0.25	-3.18	Length at age; not a good fit. Average W_∞ from Tab. 1 (25a, 25f). Stevick (1999; Tab. 1).
		d	Idem	12	M	1124	18327	0.84	-1.00	Length at age; not a good fit. W_∞ from Tab. 1 (25f). Stevick (1999; Tab. 1).
26	*Mirounga angustirostris* (northern elephant seal)	a	Not specified	-	F	492	3851	0.15	-0.67	From generalized VBGF. W_∞ from Tab. 1 (26a). McLaren (1993; Tab. 1).
		b	Idem	-	M	911	250000	0.16	-0.68	Idem

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
27	*Mirounga leonine* (southern elephant seal)	a	Macquarie Island	-	F	410	802	0.18	-0.68	From generalized VBGF. W_∞ from Tab. 1 (27a). McLaren (1993; Tab. 1).
		b	South Georgia	-	F	471	12147	0.27	-0.67	Idem
		c	Idem	-	M	1444	14000	0.17	-0.68	From generalized VBGF. W_∞ from Tab. 1 (27b). McLaren (1993; Tab. 1).
28	*Monachus schauinslandi* (Hawaiian monk seal)	a	Not specified	-	mixed	354	497	0.15	-0.73	From generalized VBGF. Average W_∞ from Tab. 1 (28a-b). McLaren (1993; Tab. 1).
29	*Monodon monoceros* (narwhal)	a	West Greenland	24	F	396	1000	-	-	W_∞ from Tab. 1 (29a). Garde *et al.* (2007; p. 52).
		b	Idem	38	M	457	1603	-	-	W_∞ from Tab. 1 (29b). Garde *et al.* (2007; p. 52).
30	*Neophocaena phocaenoides* (finless porpoise)	a	Kyushu, Japan	46	F	148	51	0.74	-1.00	Length at age. W_∞ from Tab. 1 (30a). Shirakihara *et al.* (1993; Tab. 1).
		b	Idem	51	M	150	48	0.71	-1.00	Length at age. W_∞ from Tab. 1 (30b). Shirakihara *et al.* (1993; Tab. 1).
31	*Odobenus rosmarus* (walrus)	a	Foxe Basin, Northwest Territories, Canada	90	F	275	364	0.31	-1.86	W_∞ from Tab. 1 (31a). Garlich-Miller & Stewart (1998; Tab. 1).
		b	Idem	103	M	312	433	0.20	-2.71	W_∞ from Tab. 1 (31b). Garlich-Miller & Stewart (1998; Tab. 1).
		c	Foxe Basin, Nunavut, Canada	-	M	576	2735	0.25	-0.86	From generalized VBGF. W_∞ from Tab. 1 (31b). McLaren (1993; Tab. 1).
		d	Hudson Bay, Canada	-	F	402	1137	0.26	-0.87	From generalized VBGF. W_∞ from Tab. 1 (31a). McLaren (1993; Tab. 1).
		e	Idem	-	M	432	1153	0.12	-0.87	From generalized VBGF. W_∞ from Tab. 1 (31b). McLaren (1993; Tab. 1).
		f	Unspecified, Alaska	-	F	422	1311	0.22	-0.87	From generalized VBGF. W_∞ from Tab. 1 (31a). McLaren (1993; Tab. 1).
		g	Idem	-	M	470	1481	0.10	-0.87	From generalized VBGF. W_∞ from Tab. 1 (31b). McLaren (1993; Tab. 1).
		h	Unspecified, Russia	-	F	475	1879	0.16	-0.88	From generalized VBGF. W_∞ from Tab. 1 (31a). McLaren (1993; Tab. 1).
		i	Idem	-	M	552	2411	0.10	-0.87	From generalized VBGF. W_∞ from Tab. 1 (31b). McLaren (1993; Tab. 1).
31	*Odobenus rosmarus* (walrus)	j	Northwest Greenland	34	F	269	341	-	-	W_∞ from Tab. 1 (31a). Knutsen & Born (1994).
		k	Idem	54	M	314	443	-	-	W_∞ from Tab. 1 (31b). Knutsen & Born (1994).
32	*Orcinus orca* (killer whale)	a	Norway, coastal waters	173	F	564	3196	0.17	-4.17	Length at age. Average W_∞ from Tab. 1 (32a-b). Christensen (1984; Fig. 4).
		b	Idem	143	M	650	4854	0.10	-5.81	Idem

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
32	*Orcinus orca* (killer whale)	c	British Columbia and Washington	27	F	618	4180	0.15	-	L_∞ from Powell-Wetherall Plot; K from theta (32e). Z/K=0.628. Average W_∞ from Tab. 1 (32a-b). Bigg & Wolman (1975).
		d	Idem	29	M	704	6151	0.12	-	L_∞ from Powell-Wetherall Plot; K from theta (32e). Z/K=1.05. Average W_∞ from Tab. 1 (32a-b). Bigg & Wolman (1975).
		e	Holland, Netherlands	1	F	618	4180	0.15	-	Growth increments; Gulland and Holt Plot; 1-12 years. Average W_∞ from Tab. 1 (32a-b). Kastelein & Vaughan (1989; Tab. 1).
33	*Otaria flavescens* (South American sea lion)	a	Southern Brazil	32	F	194	83	0.31	-2.00	W_∞ from Tab. 1 (33a). Rosas *et al.* (1993; p. 141, 143).
		b	Idem	94	M	254	77	0.30	-1.60	W_∞ from Tab. 1 (33b). Rosas *et al.* (1993; p. 141, 143).
34	*Pagophilus groenlandicus* (harp seal)	a	Not specified	-	mixed	240	315	0.31	-0.57	From generalized VBGF. W_∞ from Tab. 1 (34a). McLaren (1993; Tab. 1).
35	*Phoca largha* (larga seal)	a	Bering-Okhotsk Sea	-	F	225	109	0.36	-0.56	From generalized VBGF. W_∞ from Tab. 1 (35a). McLaren (1993; Tab. 1).
35	*Phoca largha* (larga seal)	b	Idem	-	M	246	152	0.44	-0.53	From generalized VBGF. W_∞ from Tab. 1 (35b). McLaren (1993; Tab. 1).
		c	Hokkaido, Japan	-	F	209	87	0.19	-0.57	From generalized VBGF. W_∞ from Tab. 1 (35a). McLaren (1993; Tab. 1).
		d	Idem	-	M	216	103	0.16	-0.55	From generalized VBGF. W_∞ from Tab. 1 (35b). McLaren (1993; Tab. 1).
36	*Phoca vitulina* (Harbour seal)	a	Commander, Aleutian and Pribilof Islands	-	F	167	107	0.20	-4.49	From generalized VBGF. W_∞ from Tab. 1 (36a). McLaren (1993; Fig. 40).
		b	Idem	-	M	175	123	0.23	-3.80	Idem
		c	Norway	-	F	210	207	0.24	-0.63	Idem
		d	Idem		M	226	256	0.22	-0.65	Idem
		e	Gulf of Alaska	-	F	203	189	0.22	-0.64	From generalized VBGF. W_∞ from Tab. 1 (36a). McLaren (1993; Fig. 39).
		f	Idem	-	F	150	78	0.31	-3.03	Idem
		g	Idem	-	M	162	98	0.30	-2.76	Idem
		h	Idem	-	M	226	257	0.22	-0.62	Idem
		i	Aleutian, Alaska	-	F	218	231	0.09	-0.66	Idem
		j	Idem	-	M	245	323	0.17	-0.65	Idem
		k	Denmark/Sweden	-	F	207	200	0.26	-0.62	Idem
		l	Idem	-	M	228	263	0.26	-0.63	Idem
		m	Nova Scotia, Canada	-	F	223	247	0.36	-0.63	Idem
		n	Idem	-	M	249	340	0.40	-0.63	Idem

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
36	*Phoca vitulina* (Harbour seal)	o	British Columbia	-	F	217	227	0.23	-0.64	From generalized VBGF. W_∞ from Tab. 1 (36a). McLaren (1993; Fig. 38).
		p	Idem	-	F	236	292	0.12	-0.65	Idem
		q	Idem	-	F	151	79	0.37	-2.52	Idem
		r	Idem	-	M	167	108	0.24	-3.69	Idem
		s	Hokkaido, Japan	-	F	224	249	0.22	-0.62	Idem
		t	Idem	-	M	250	345	0.16	-0.64	Idem
37	*Phocoena phocoena* (Harbour porpoise)	a	Sea of Azov	45	F	145	39	0.76	-	W_∞ from Tab. 1(37a). Gol'din (2004; Tab. 1).
		b	Idem	53	M	132	32	0.91	-	W_∞ from Tab. 1(37b). Gol'din (2004; Tab. 1).
		c	Black Sea	41	F	132	32	0.71	-	W_∞ from Tab. 1(37a). Gol'din (2004; Tab. 1).
		d	Idem	48	M	123	26	1.21	-	W_∞ from Tab. 1(37b). Gol'din (2004; Tab. 1).
		e	Western Greenland	-	F	155	46	0.48	-	W_∞ from Tab. 1(37a). Lockyer *et al.* (2001; Tab. 3).
		f	Idem	-	M	143	40	0.46	-	W_∞ from Tab. 1(37b). Lockyer *et al.* (2001; Tab. 3).
38	*Phocoenoides dalli* (Dall's porpoise)	a	Western Aleutian Islands	-	F	186	37	0.58	-1.39	Length-at-age. W_∞ from Tab. 1 (38a). Ferrero & Walker (1999; Figs. 8-9).
		b	Idem	-	F	188	38	0.40	-2.78	Idem
		c	Idem	-	M	192	41	0.50	-1.60	Idem
39	*Physeter macrocephalus* (Sperm whale)	a	Tasmania, Australia	-	F	1082	15100	0.16	-2.58	Average W_∞ from Tab. 1 (39d-e). Evans *et al.* (2004; p. 248).
		b	Western Australia	-	mixed	1052	14300	0.12	-4.12	Average W_∞ from Tab. 1 (39d-e). Bannister (1969).
		c	Not specified	-	M	1858	65100	0.05	-5.37	Length-at-age. Average W_∞ from Tab. 1 (39a-n). Lockyer (1981; Abstract).
40	*Pontoporia blainvillei* (Franciscana dolphin)	a	Paraná and Sao Paulo (25°00' - 25°58'S), Brazil	18	F	129	13	0.33	-3.07	W_∞ from Tab. 1 (40a). Barreto & Rosas (2006; Tab. 3).
		b	Idem	23	M	113	9	1.00	-0.90	W_∞ from Tab. 1 (40b). Barreto & Rosas (2006; Tab. 3).
		c	Rio Grande do Sul (29°20' - 33°45'S), Brazil	48	F	146	20	0.57	-1.71	W_∞ from Tab. 1 (40a). Barreto & Rosas (2006; Tab. 3).
		d	Idem	59	M	130	14	1.14	-0.71	W_∞ from Tab. 1 (40b). Barreto & Rosas (2006; Tab. 3).
41	*Pusa caspica (Caspian seal)*	a	Not specified		F	185	202	0.25	-0.61	From generalized VBGF. Average W_∞ from Tab. 1 (41a, 41d-f). McLaren (1993; Tab. 1).

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
42	*Pusa hispida (ringed seal)*	a	Sea of Okhotsk		F	161	118	0.11	-0.62	From generalized VBGF. Average W_∞ from Tab. 1 (42a, 42c). McLaren (1993; Tab. 1).
		aa	High Canada, Arctic		mixed	181	184	0.1	-0.61	From generalized VBGF. Average W_∞ from Tab. 1 (42a-d). McLaren (1993; Tab. 1).
		b	Sea of Okhotsk		M	164	146	0.15	-0.61	From generalized VBGF. Average W_∞ from Tab. 1 (42b, 42d). McLaren (1993; Tab. 1).
		c	Idem		mixed	162	130	0.12	-0.63	From generalized VBGF. Average W_∞ from Tab. 1 (42a-d). McLaren (1993; Tab. 1).
		d	Chukchi Sea		F	172	144	0.27	-0.58	From generalized VBGF. Average W_∞ from Tab. 1 (42a, 42c). McLaren (1993; Tab. 1)
		e	Idem		M	167	154	0.21	-0.6	From generalized VBGF. Average W_∞ from Tab. 1 (42b, 42d). McLaren (1993; Tab. 1)
		f	Idem		mixed	169	149	0.24	-0.61	From generalized VBGF. Average W_∞ from Tab. 1 (42a-d). McLaren (1993; Tab. 1)
		g	Baltic Sea		F	198	222	0.23	-0.63	From generalized VBGF. Average W_∞ from Tab. 1 (42a, 42c). McLaren (1993; Tab. 1)
		h	Baltic Sea		M	205	294	0.23	-0.62	From generalized VBGF. Average W_∞ from Tab. 1 (42b, 42d). McLaren (1993; Tab. 1).
		i	Idem		mixed	204	265	0.25	-0.61	From generalized VBGF. Average W_∞ from Tab. 1 (42a-d). McLaren (1993; Tab. 1).
		j	Barents Sea		F	178	160	0.22	-0.62	From generalized VBGF. Average W_∞ from Tab. 1 (42a, 42c). McLaren (1993; Tab. 1)
		k	Idem		M	186	215	0.29	-0.61	From generalized VBGF. Average W_∞ from Tab. 1 (42b, 42d). McLaren (1993; Tab. 1).
		l	Idem		mixed	181	185	0.26	-0.63	From generalized VBGF. Average W_∞ from Tab. 1 (42a-d). McLaren (1993; Tab. 1).
		m	Bering Sea		F	180	167	0.17	-0.6	From generalized VBGF. Average W_∞ from Tab. 1 (42a, 42c). McLaren (1993; Tab. 1)

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
42	*Pusa hispida (ringed seal)*	n	Idem		M	184	210	0.08	-0.61	From generalized VBGF. Average W_∞ from Tab. 1 (42b, 42d). McLaren (1993; Tab. 1).
		o	Idem		mixed	180	183	0.11	-0.56	From generalized VBGF. Average W_∞ from Tab. 1 (42a-d). McLaren (1993; Tab. 1).
		p	Svalbard		F	166	129	0.15	-0.58	From generalized VBGF. Average W_∞ from Tab. 1 (42a, 42c). McLaren (1993; Tab. 1)
		q	Idem	144	F	130	61	0.17		Average W_∞ from Tab. 1 (42a, 42c). Krafft *et al.* (2006; Tab 1).
		r	Idem	102	F	128	58	0.18		Idem
		s	Idem	131	M	130	70	0.34		Average W_∞ from Tab. 1 (42b, 42d). Krafft *et al.* (2006; Tab 1).
		t	Idem	170	M	128	67	0.43		Idem
		u	Idem		M	186	216	0.31	-0.62	From generalized VBGF. Average W_∞ from Tab. 1 (42b, 42d). McLaren (1993; Tab. 1).
		v	Idem		mixed	172	157	0.22	-0.6	From generalized VBGF. Average W_∞ from Tab. 1 (42a-d). McLaren (1993; Tab. 1).
		w	Western Canada, Arctic		F	160	116	0.14	-0.65	From generalized VBGF. Average W_∞ from Tab. 1 (42a, 42c). McLaren (1993; Tab. 1)
		x	Western Canada, Arctic		M	169	161	0.13	-0.67	From generalized VBGF. Average W_∞ from Tab. 1 (42b, 42d). McLaren (1993; Tab. 1).
		y	Idem		mixed	164	136	0.15	-0.68	From generalized VBGF. Average W_∞ from Tab. 1 (42a-d). McLaren (1993; Tab. 1).
		z	Southeast Canada, Arctic		mixed	154	112	0.1	-0.59	Idem
43	*Pusa sibirica* (Baikal seal)	a	Not specified		F	178	140	0.42	-0.62	From generalized VBGF. Average W_∞ from Tab. 1 (43a). McLaren (1993; Tab. 1).
44	*Stenella frontalis* (Atlantic spotted dolphin)	a	Southeast Brazil	27	mixed	225	64	0.14	-5.56	Length at age; 0-23 years. Average W_∞ from Tab. 1 (44a-b). Siciliano *et al.* (2007; Tab. 1).
45	*Steno bredanensis* (rough-toothed dolphin)	a	Idem	13	mixed	259	91	0.32	-2.97	Length at age; 0.5-24 years. Average W_∞ from Tab. 1 (45a-b). Siciliano *et al.* (2007; Tab. 5).

Table A2. Continued.

Spec. No.	Species	Stock	Locality	N	Sex	L_∞ (cm)	W_∞ (kg)	K (year^{-1})	t_o (year)	Comments/Source
46	*Tursiops truncates* (bottlenose dolphin)	a	Idem	21	mixed	305	101	0.14	-6.24	Length at age; 0-26 years. Average W_∞ from Tab. 1 (46a-b). Siciliano *et al.* (2007; Tab. 3).
		b	North-Central Gulf of Mexico		F	242	49	0.48	-1.19	From Gompertz curve; <1-30 years. W_∞ from Tab. 1 (46a). Mattson *et al.* (2006; Fig. 6).
		c	Idem		M	253	59	0.36	-1.77	From Gompertz curve; <1-30 years. W_∞ from Tab. 1 (46b). Mattson *et al.* (2006; Fig. 6).
		d	Indian River Lagoon, Florida, USA	72	F	114	5	0.45		From Gompertz equation. W_∞ from Tab. 1 (46a). Stolen *et al.* (2002; Tab. 1).
		e	Idem	118	M	124	7	0.36	-0.01	From Gompertz equation. W_∞ from Tab. 1 (46b). Stolen *et al.* (2002; Tab. 1).
47	*Ursus maritimus* (polar bear)	a	Svalbard		F	194	185	0.75	-0.27	W_∞ from Tab. 1 (47a). Hunter (2005; Tab. A.8).
		b	Idem		M	225	390	0.537	-0.4	W_∞ from Tab. 1 (47b). Hunter (2005; Tab. A.8)