Epiphyseal fusion in grey, harp and ringed seals

As in other aquatic mammals the skeletal growth is slow in seals with epiphyseals fusing to the bones late in life. Archaeozoological seal material are thus often dominated by unfused elements. This manual presents descriptions of how length measurements can be taken also on bones with both ends unfused. Lengths for elements with only one of the epihyses fused can be derived from the other descriptions. In Table 1 the relative order of epiphyseal fusion in each skeletal element is presented.

Table 1. Relative order of epiphyseal fusion within selected skeletal elements of the genera *Phoca* and *Halichoerus*.

Skeletal element	Proximal end	Distal end
Humerus	Last	First
Radius	First	Last
Ulna	First (crista olecranon)	Last
Femur	First	Last
Os cruris (tibia and fibula)	First	Last
Metacarpus I / Metatarsus I	Last	First
Metacarpi II-V / Metatarsi II-V	First (*in utero*)	Last
Phalanges 1 and 2 anterior	Last	First (*in utero*)
Phalanges 1 and 2 posterior	Last	First

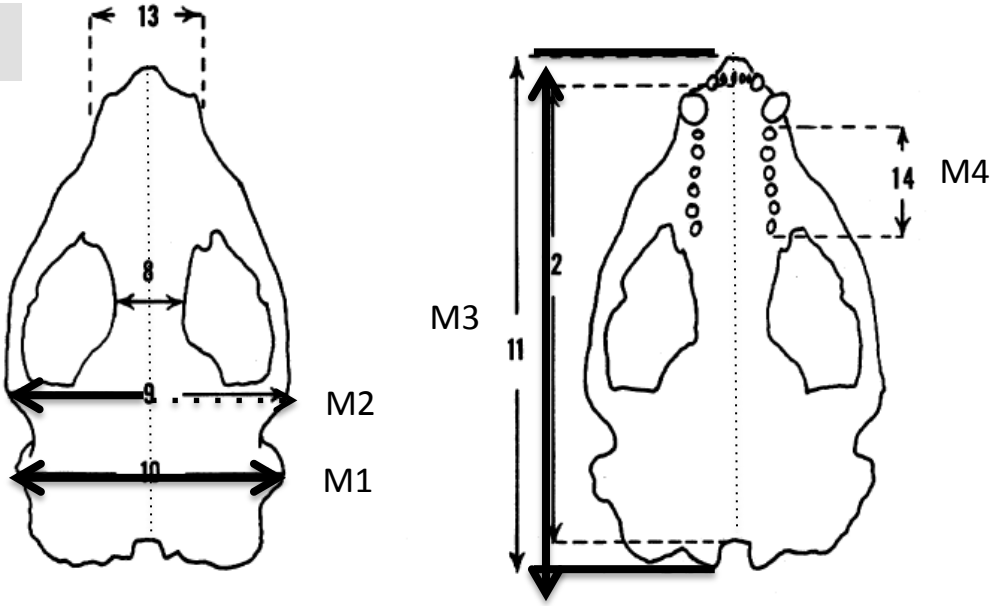
* Data from Ericson & Storå (1999)

The epiphyses have been grouped in four age groups (AG1-AG4), which were defined on the basis of epiphyseal fusion schedules in modern seal skeletons (Table 1). The age groups closely relate to life history stages: yearling, juvenile, young adult and old adult. The fusion stages of the epiphyses were divided into two basic categories, unfused and fused. Elements with a line of fusion still visible between the diaphysis and epiphysis were grouped with the fused elements. (from Storå 2002: 52)

Table 1. Sequence of epiphyseal fusion in seals. Age group division with the corresponding life history stage (Storå, in press)

Age group	Life history stage	Epiphyses
AG 1	Yearling	Metatarsal I distal Innominate — acetabulum Supraglenoid tubercle (Tub. Scap.)
AG 2	Juvenile	Femur proximal Radius proximal Humerus distal
AG 3	Young adult	Femur distal Humerus proximal Ulna proximal Tibia proximal.
AG 4	Old adult	Ulna distal Metatarsus I proximal Radius distal Tibia (and fibula) distal.

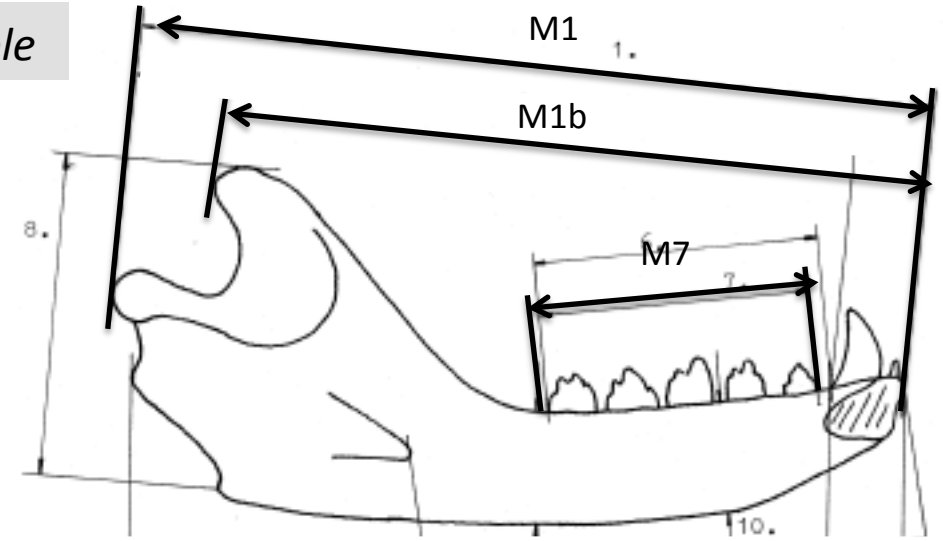
Cranium



M1: cranial breadth – from mastoid process – or to suture only (10)
M2: cranial breadth – from zygomatic – or to suture only (9)
M3: skull length – from condyle to nasal tip (11)
M4: length of tooth row (from P^1 to M^1 alveolus) *calipers*

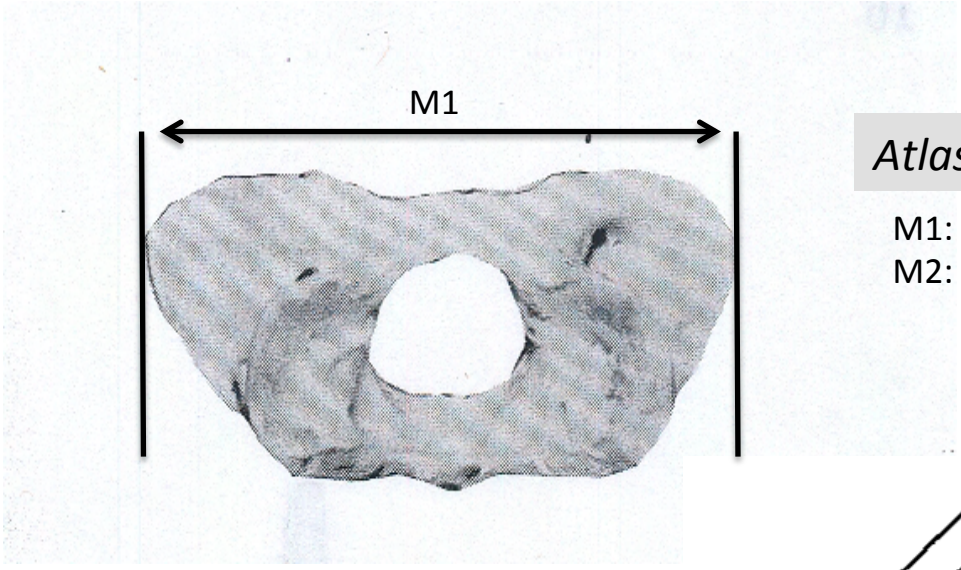
* Measurement numbers from Scheffer (1967)

Mandible



M1: greatest length – from condyle to incisor
M1b: greatest length – from coracoid to incisor
M7: length of tooth row (from M_1 to P_1 alveolus) *calipers*

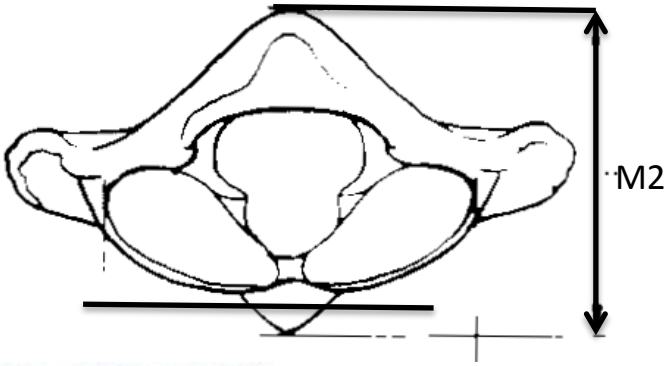
* Measurements from Ericson & Storå (1999) except M1b

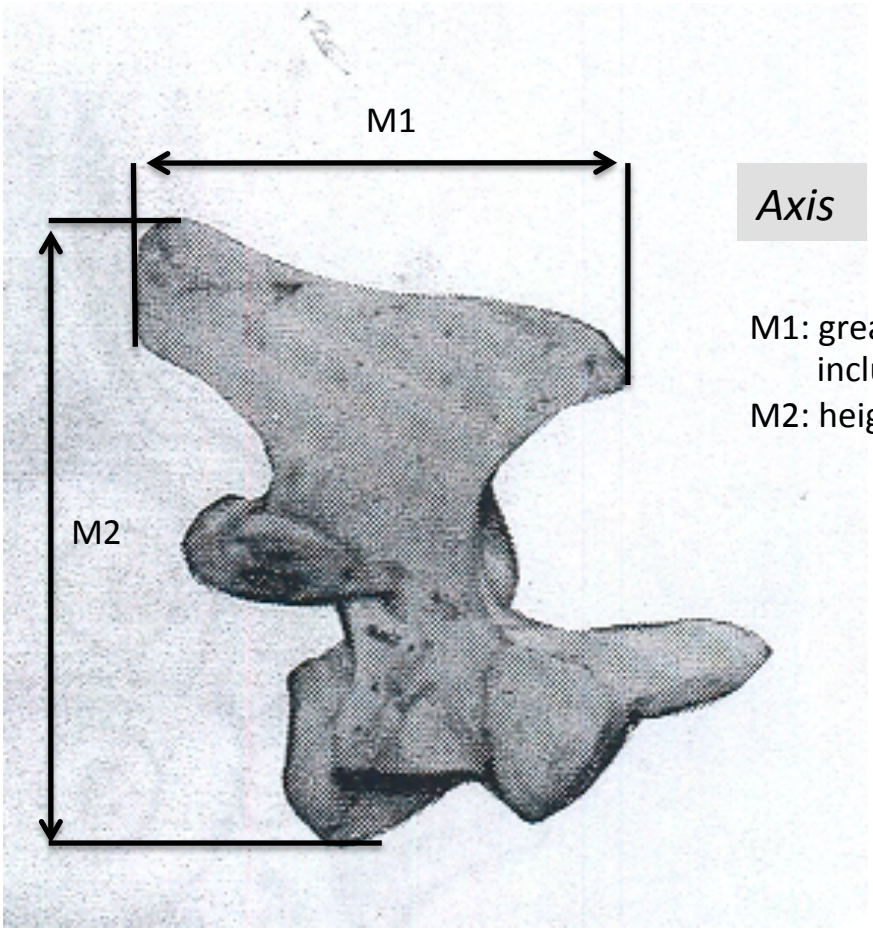


Atlas

M1: greatest breadth (GB)
M2: height (H)

** These can be done with calipers or tape measure**





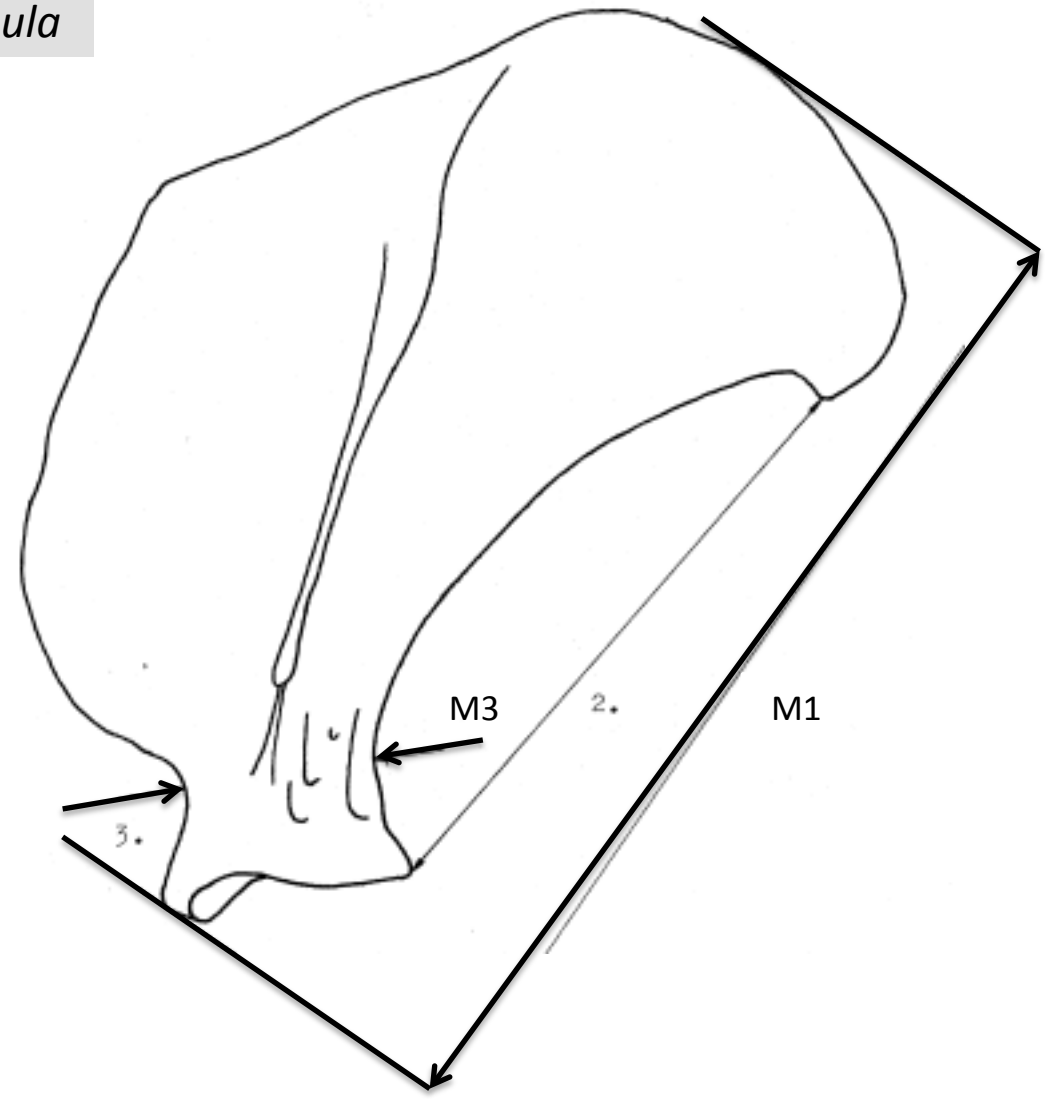
Axis

M1: greatest length of arch including processes (LAPa)
M2: height (H)

[1] Measurements for atlas and axis follow von den Driesch (1976). Acronyms in parentheses are also from von den Driesch.

[2] Photo images of harbour seal from Kasper (1980) and b/w illustration from von den Driesch (1976).

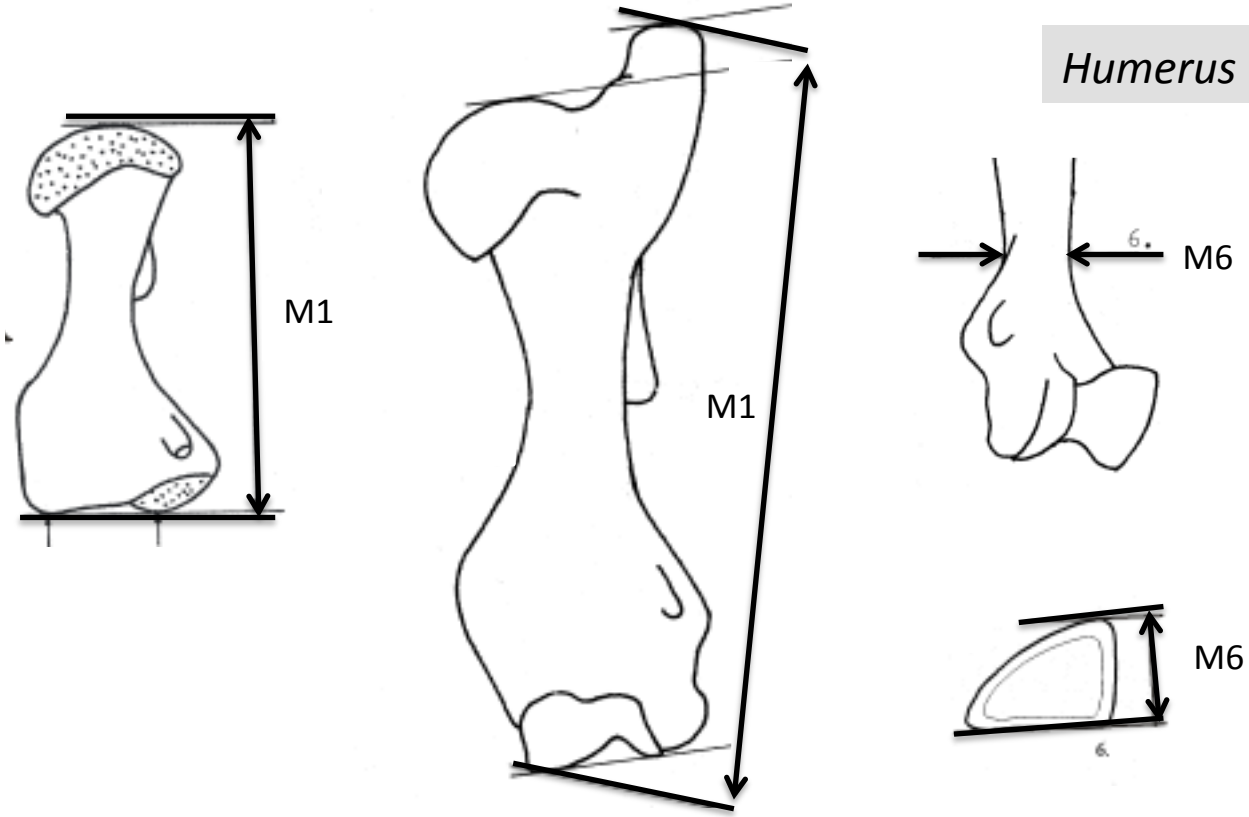
Scapula



M1: greatest length
M3: smallest length of collum scapulae *calipers*

* Measurements from Ericson & Storå (1999)

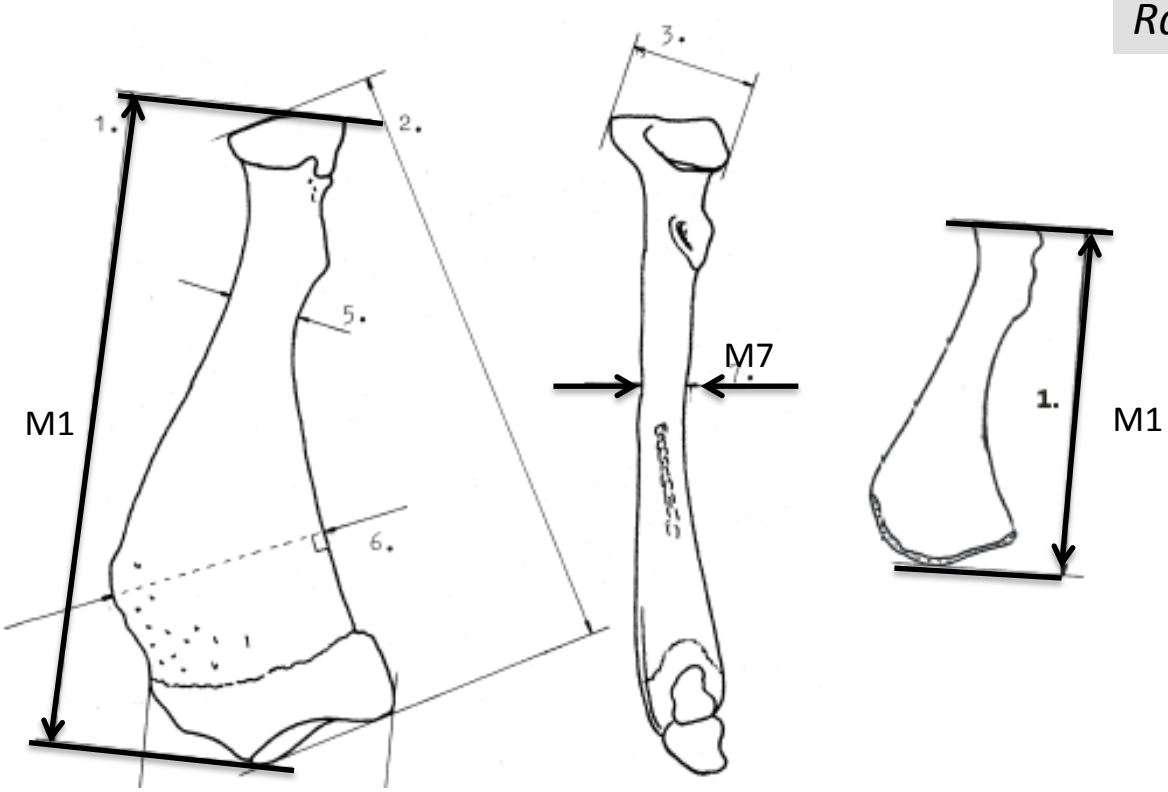
Humerus



M1: greatest length (on fused and unfused humeri)
M6: smallest diagonal breadth of diaphysis *calipers*

* Measurements from Ericson & Storå (1999)

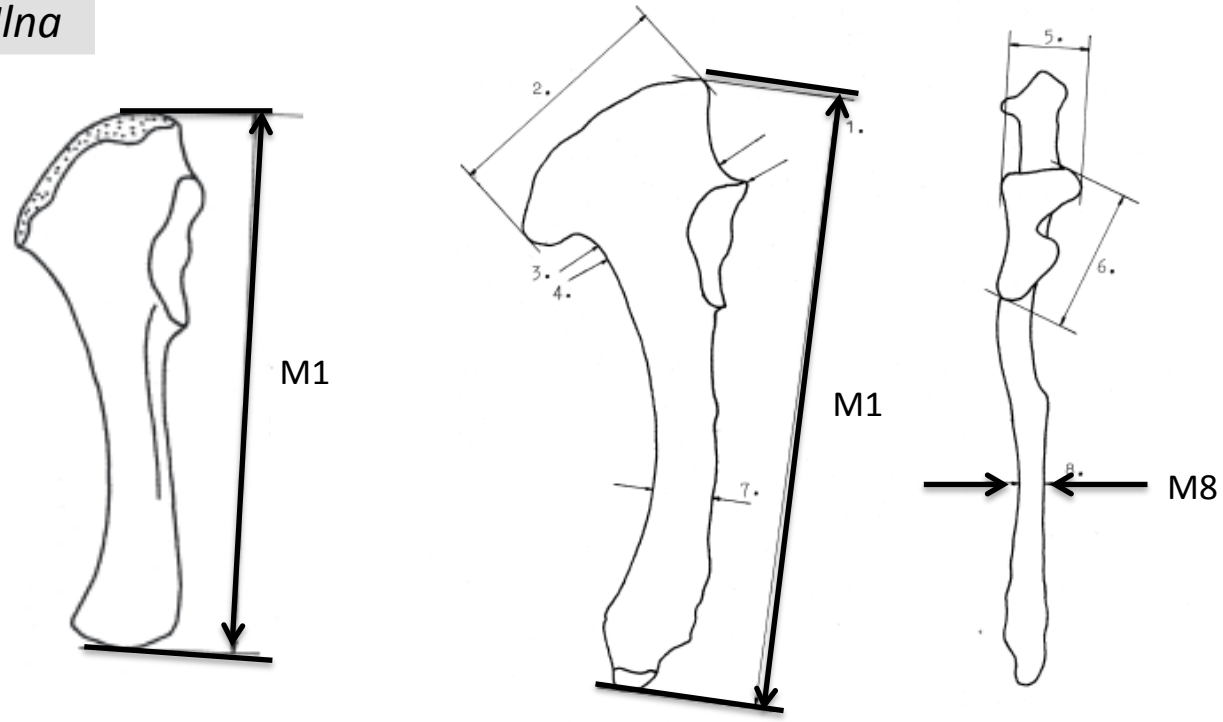
Radius



M1: greatest length (on fused and unfused radii)
M7: smallest breadth of diaphysis *calipers*

* Measurements from Ericson & Storå (1999)

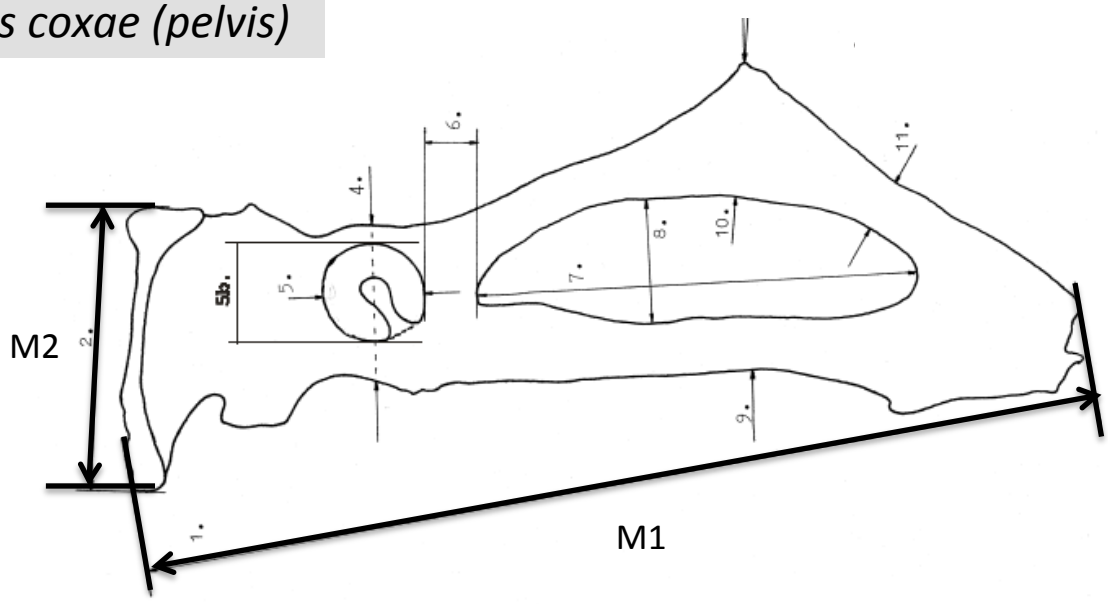
Ulna



M1: greatest length (on fused and unfused ulnae)
M8: smallest breadth of lower part of diaphysis *calipers*

* Measurements from Ericson & Storå (1999)

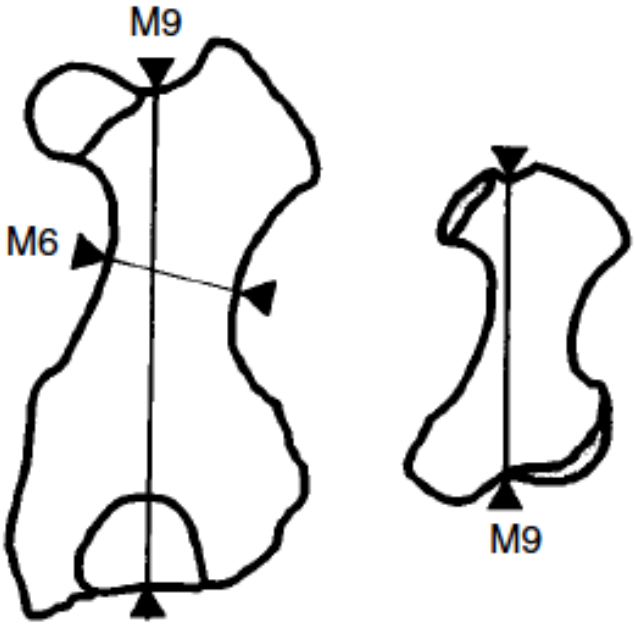
Os coxae (pelvis)



M1: greatest length (on fused or unfused os coxae)
M2: greatest breadth of crista ilium

* Measurements from Ericson & Storå (1999)

Femur

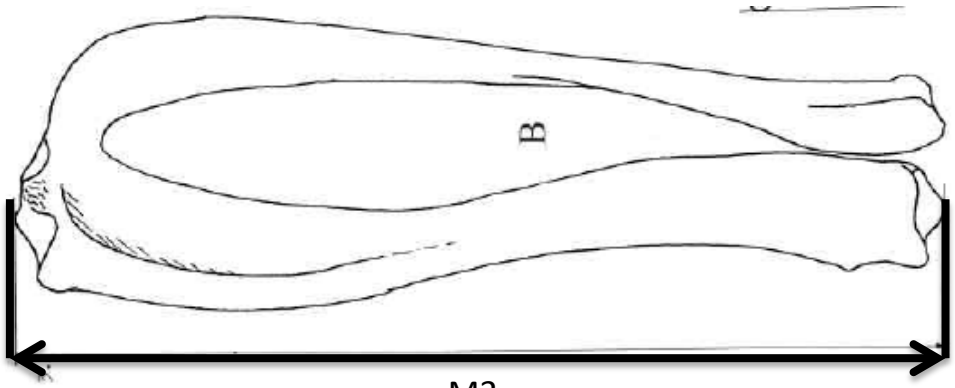


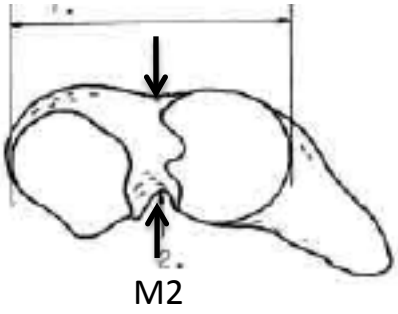
Cranial view

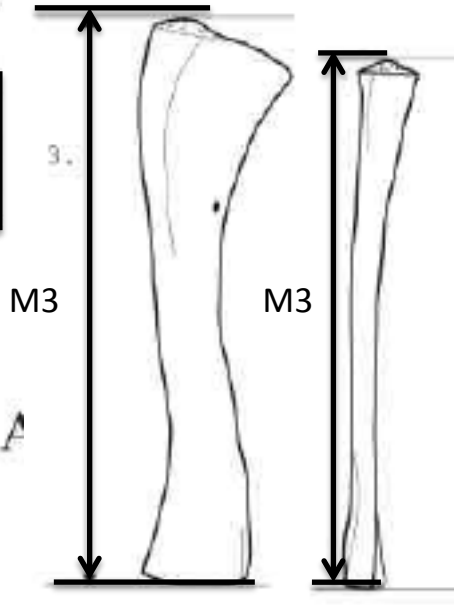
M9: smallest length of corpus (unfused and fused)
M6: smallest breadth of diaphysis *calipers*

* Measurements from Ericson & Storå (1999)

Tibia/fibula







M2: smallest depth between proximal articular surfaces of tibia *calipers*
M3: greatest length

* Measurements from Ericson & Storå (1999)

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Table 1. Osteometric data for Ross Sea seals from USNM (Smithsonian).

	cranium				mandible			atlas		axis	
(in millimeters)	M1	M2	M3	M4	M1	M2	M7	M1	M7	M1	M2
Hydrurga (Leopard)											
- female (n=3)	100-105	180-215	330-410	85-100	240-320	210-275	85-100				
- male (n=1)	115	210	370	100	290-300	270	100				
- unknown (n=0)											
- juvenile (n=0)											
Leptonychotes (Weddell)											
- female (n=2)	76-95	150-175	260-270	52-57	157-185	140-170	50-55				
- male (n=4)	85-95	175-185	250-270	55-60	170-185	160-175	56-58				
- unknown (n=6)	85-96	160-185	250-285	54-64	185-188	171	54-60				
- juvenile (n=6)	65-70	130-140	180-195	45-52	115-130	110-120	40-48				
Lobodon (Crabeater)											
- female (n=4)	65-80	135-145	225-250	65-70	150-160	133-150	65-70				
- male (n=1)	70	135	225	x	150-155	135-155	67				
- unknown (n=1)	70	140	245	66	160	140	66	107	39	41	70
- juvenile (n=0)											
Ommatophoca (Ross)											
- female (n=3)	80-85	160-170	220-252	37-44	155-165	134-150		110-114	44-54	21	65
- male (n=1)	90	185	245	53	180	147		115	40	26	65
- juvenile (n=1)			230		37-60	55-63					

Table 1 (continued). Osteometric data for Ross Sea seals from USNM (Smithsonian).

	scapula		humerus		radius		ulna		pelvis		femur		tib/fib	
(in millimeters)	M1	M3	M1	M6	M1	M7	M1	M2	M1	M2	M9	M6	M3	M2
Hydrurga (Leopard)														
- female (n=3)	185	51	183	36	185	x	220	19			100	30	220	30
- male (n=1)			186	35	188	20	225	15						
Leptonychotes (Weddell)														
- female (n=1)					155	11								
- male (n=0)														
- unknown (n=3)	212	47	146-153	25-29	166-184	13	196-211	15	268	82	105-111	36	284	35
- juvenile (n=2)	78-82	11	66-75	11-17	76-86	7-9	82-97	10			50-52	20	114-126	17-20
Lobodon (Crabeater)														
- female (n=1)			80	20	100	11	117	10						
- male (n=1)			110	22	124	11	130	12						
- unknown (n=1)	129	30							186	60	78	31	200	30
Ommatophoca (Ross)														
- female (n=2)	136-157	35	107	20	98	12	110	11	172-175	56	73-77	27-35	175-210	27-30
- male (n=1)	186	36	114	23	103	15	127	13	183	65	85	38	235	32
- juvenile (n=1)	166	38	85	20	97	15	112	14			61	37	180	22

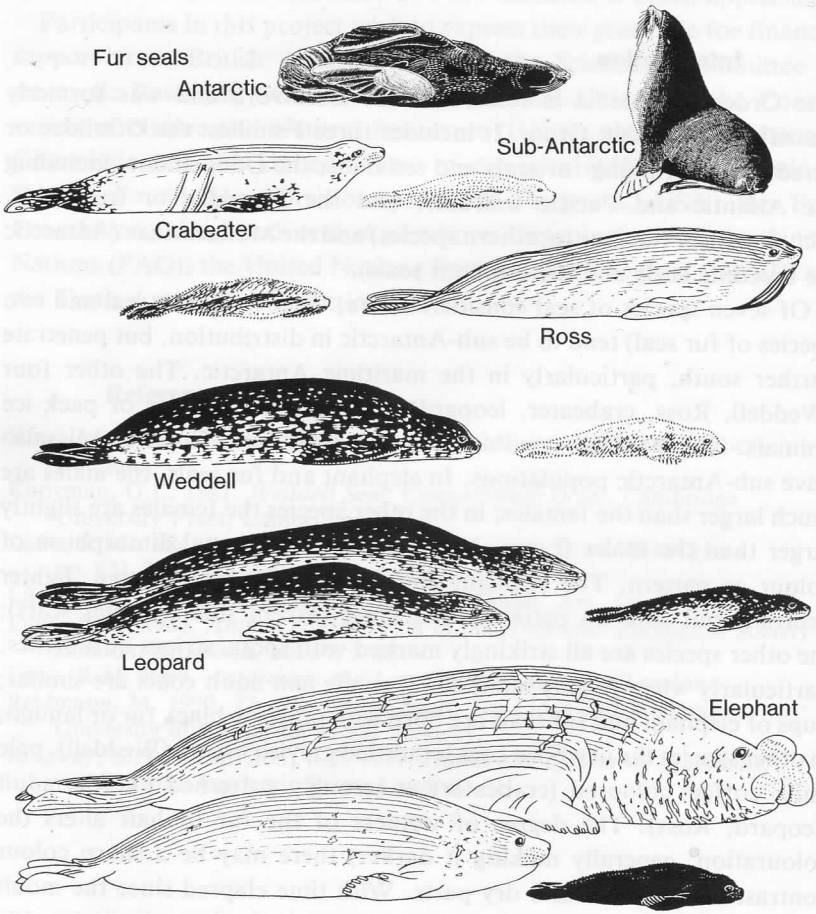

Fig. 1.1 Antarctic seals drawn to same scale for comparison of size, form and colour patterns.