Supplementary information to

Revision of *'Balaena' belgica* reveals a new right whale species, the possible ancestry of the northern right whale, *Eubalaena glacialis*, and the ages of the divergence for the living right whale species

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INSTITUTIONAL ABBREVIATIONS

AMNH, American Museum of Natural History, New York, USA.
IZIKO, Iziko South Africa Museum of Natural History, Cape Town, South Africa.
MSNT, Museo di Storia Naturale e del Territorio dell'Università di Pisa, Calci, Italia.
MZUSN, Museo Zoologico dell'Università degli Studi di Napoli, Napoli, Italia.
NBC, Naturalis Biodiversity Center, Leiden, The Netherlands.
RBINS, Royal Belgian Institute of Natural Sciences, Brussels, Belgium.
USNM, National Museum of Natural History, Smithsonian Institution, Washington DC, USA.

LIST OF CHARACTER STATES USED IN PHYLOGENETIC ANALYSIS

Rostrum: Premaxilla, maxilla, nasal

1) Position of posterior end of premaxilla: (0) on the anterior border of supraorbital process of frontal; (1) located more posteriorly and covering part of the interorbital region of the frontal.
2) Transverse expansion of anterior portion of premaxilla: (0) present; (1) absent.
3) Mesorostral groove: (0) absent; (1) present.
4) Dental ontogeny: (0) polyophiodonty; (1) monophyodonty.
5) Baleen plates: (0) absent; (1) present.
6) Baleen plates: (0) short; (1) long.
7) Plate-like infraorbital process of the maxilla: (0) absent; (1) present.
8) Lateral process of maxilla: (0) absent; (1) present.
9) Lateral process of maxilla: (0) short (broad-nosed rostrum); (1) long (sharp-nosed rostrum).
10) Teeth: (0) present on maxilla and/or premaxilla and mandible; (1) absent from maxilla, premaxilla and mandible.
11) Rostrum shape in lateral view: (0) rostrum straight; (1) rostrum highly arched.
12) Transverse compression of maxilla: (0) present as superior surface facing laterally and dorsally; (1) absent as superior surface faces dorsally.
13) Ascending process of maxilla: (0) absent; (1) present.
14) Ascending process of the maxilla: (0) short and narrow; (1) long and narrow; (2) short and wide.
15) Ascending processes of maxillae meeting posteriorly to nasals along the longitudinal axis: (0) no; (1) yes.
16) Location of posterior end of maxilla: (0) as posterior as posterior end of premaxilla; (1) more posterior than posterior end of premaxilla; (2) more anterior than posterior end of premaxilla.
17) Location of posterior end of ascending process of maxilla: (0) anterior to supraorbital process of frontal; (1) posterior.
18) Lateral border of ascending process of maxilla and posterior border of maxilla: (0) forming a right angle; (1) forming an obtuse angle.
19) Lateral borders of maxilla: (0) thick; (1) thin.
20) Infraorbital foramen disintegrated into a series of foramina: (0) no; (1) yes.
21) Contact between maxilla and frontal: (0) sutured along whole posterior border of maxilla; (1) sutured only along ascending maxilla.
22) Antorbital notch: (0) absent; (1) present.
23) Antorbital groove: (0) absent; (1) present.
24) Position of nasofrontal suture: (0) at anterior border of infraorbital region of frontal; (1) located well within interorbital region of the frontal.
25) Nasals transversely compressed: (0) no; (1) yes.
26) Posterior end of nasals converging medially: (0) no; (1) yes.
27) Position of anterior border of nasal: (0) at anterior end of skull; (1) at mid-length of rostrum; (2) in posterior quarter; (3) in line with anterior border of supraorbital process of frontal; (4) posterior to anterior border of frontal.

Jugal

28) Jugal short and ventrally convex: (0) no; (1) yes.

Frontal

29) Transverse elongation of supraorbital process of the frontal: (0) short; (1) moderate; (2) long.
30) Supraorbital process of the frontal: (0) horizontal; (1) gently descending from the interorbital region of the frontal; (2) slightly depressed from interorbital region of the frontal; (3) abruptly depressed from interorbital region of frontal.

31) Supraorbital process of the frontal projecting anteriorly: (0) no; (1) yes.
32) Shape of supraorbital process of the frontal: (0) flat; (1) prismatic.
33) Elongation of medial emergence of supraorbital process of frontal: (0) as long as distal border; (1) longer than distal border.
34) Anterior border of supraorbital process of frontal projected posterolaterally: (0) no; (1) yes.
35) Position of orbitotemporal crest: (0) at posterodorsal edge of supraorbital process of frontal; (1) on dorsal surface of supraorbital process of frontal; (2) at anterior border of supraorbital process of frontal.
36) Orbitotemporal crest shape: (0) sharply edged; (1) rounded; (2) reduced to a line.
37) Exposure of interorbital region of frontal: (0) long; (1) short because parietal is superimposed onto it; (2) short because posteromedial elements of rostrum are superimposed onto it.

Parietal

38) Shape of temporal fossa: (0) long and wide; (1) anteroposterior length shorter than transverse width.
39) Temporal fossa partially covered by lateral edges of supraoccipital: (0) no; (1) yes.
40) Shape of coronal suture: (0) transverse with respect to longitudinal axis; (1) anteriorly convex; (2) anteriorly concave.
41) Coronal suture systematically interdigitated with posteromedial elements of the rostrum: (0) no; (1) yes.

Squamosal

42) Glenoid fossa of the squamosal wide and allowing broad movements of mandible: (0) no; (1) yes.
43) Zygomatic process of squamosal longitudinally twisted and arched dorsally: (0) no; (1) yes.
44) Zygomatic process of squamosal with parallel medial and lateral borders: (0) no; (1) yes.
45) Secondary squamosal fossa: (0) absent; (1) present.
46) Supramastoid crest: (0) absent; (1) present.
47) Squamosal dorsoventrally elongated: (0) no; (1) yes.
48) Squamosal bulge: (0) present; (1) absent.
49) Systematic presence of squamosal cleft: (0) no; (1) yes.
50) V-shaped squamosal cleft: (0) absent; (1) present.

Occipital

51. Supraoccipital extending onto parietal posteriorly: (0) no; (1) yes.
52. Location of anterior end of supraoccipital: (0) posterior to anterior end of zygomatic process of squamosal; (1) anterior to anterior end of zygomatic process of squamosal.
53. Location of anterior end of supraoccipital: (0) posterior to or at level of orbit; (1) anterior to orbit.
54. Superimposition of supraoccipital on parietal: (0) short; (1) moderate as most of parietal is exposed in dorsal view; (2) moderate as only a subtle stripe of parietal is exposed in dorsal view; (3) massive as the parietal is not exposed in dorsal view because it is completely hidden by the supraoccipital; (4) the supraoccipital generates an anterior appendix that subdivides the parietal into two halves; (5) the supraoccipital subdivides the parietal into two halves by itself or by the interparietal bone.
55. Superimposition of supraoccipital on interorbital region of frontal: (0) absent; (1) present.
56. Shape of anterior border of supraoccipital: (0) broadly round; (1) triangular and pointed; (2) broadly squared; (3) narrowly squared.
57. Neck of occipital condyle: (0) well developed; (1) reduced.
58. Sites for attachment of neck muscles on supraoccipital: (0) moderately developed; (1) strongly developed.

59. Position of posterolateral corner of exoccipital in ventral view: (0) close to postglenoid process of squamosal; (1) posterolateral corner protruded posteriorly and medially reaching a point more posterior than the postglenoid process of squamosal; (2) posterolateral corner protruded posteriorly and laterally reaching a point more posterior than the postglenoid process of the squamosal; (3) posterolateral corner not protruded and reaching a point more anterior than the postglenoid process of the squamosal.

Basicranium

60. Palatal sulci and nutrient foramina: (0) absent; (1) present.
61. Foramen pseudovale: (0) absent; (1) present.
62. Hypoglossal foramen: (0) present; (1) absent.
63. Palatal maxillary sulci open into a long, alveolar groove: (0) absent; (1) present.
64. Massive elongation of palatine posteriorly: (0) absent; (1) present..
65. Pterygoid located towards posterior end of skull: (0) no; (1) yes.
66. Presence of median keel on palate: (0) no; (1) yes.

Petrosal

67. Shape of anterior process of petrosal: (0) broadly squared; (1) narrowly squared; (2) broadly round; (3) triangular.
68. Shape of lateral process of anterior process of petrosal: (0) tubercle-like; (1) triangular.
69. Crista transversa: (0) recessed in internal acoustic meatus; (1) not recessed and separating foramen for facial nerve from internal acoustic meatus at least in a phase of the ontogenetic process.
70. Transverse elongation of pars cochlearis of petrosal: (0) absent; (1) present.
71. Longitudinal elongation of pars cochlearis of petrosal: (0) absent; (1) present.
72. Median promontorial groove: (0) present; (1) absent.
73. Tegmen tympani: (0) relieved; (1) highly relieved; (2) low.
74. Roof of stylomastoid fossa: (0) crest-like; (1) no roof at all; (2) long and thick; (3) long and low.
75. Exposure of posterior process of petroympanics on skull in lateral view: (0) absent; (1) present.
76. Shape of posterior process of petrotympanics: (0) prismatic; (1) flat.
77. Anterior and posterior processes of petrosal fused to tympanic bulla: (0) no; (1) yes.

Tympanic bulla

78. Elliptical foramen: (0) present; (1) absent.
79. Distinct ventromedial ridge developed on tympanic bulla: (0) no; (1) yes.
80. Inner posterior prominence of tympanic bulla does not project posteriorly (therefore, interprominential notch of tympanic bulla is absent): (0) no, it projects; (1) yes.
81. Dorsoventral height of tympanic cavity: (0) high; (1) low.
82. Tympanic bulla dorsoventrally compressed: (0) no; (1) yes.
83. Epitympanic hiatus enlarged because of reduction of conical process in the tympanic bulla: (0) no; (1) yes.
84. Anterolateral lobe: (0) absent (pear-shaped bulla); (1) long; (2) short.
85. Ventral margin of sigmoid process of tympanic bulla: (0) present; (1) absent.

Mandible

86. Sharp myloyoidal groove: (0) absent; (1) present.
87. Distance between coronoid process and condyle: (0) short; (1) long.
88. Height of coronoid process of mandible: (0) high; (1) very short-to-absent; (2) middle sized.
89. Presence of postcoronoid crest and fossa in mandible: (0) no; (1) yes.

90. Postcoronoid crest and fossa well developed in mandible: (0) no; (1) yes.
91. Satellite process in mandible: (0) absent; (1) present.
92. Exposure of articular surface of mandibular condyle: (0) posterodorsal; (1) posterior; (2) dorsal.
93. Angular process of mandible projected posteriorly: (0) no; (1) yes.
94. Height and shape of angular process: (0) high; (1) middle sized; (2) low and rounded; (2) low and squared.
95. Dorsal bowing of dentary: (0) absent; (1) present and limited to anterior portion; (2) present along whole length.
96. Gingival foramina: (0) absent; (1) present.
97. Anterior torsion of dentary: (0) absent; (1) moderate; (2) strong.
98. Mental symphysis: (0) fused; (1) not fused.
99. Groove for mental ligament: (0) absent; (1) present.

Postcranial

100. Shortened cervical vertebrae: (0) no; (1) yes.
101. Cervical vertebrae fused (bodies and neural processes): (0) no; (1) yes.
102. Sacral vertebrae disintegrated: (0) no; (1) yes.
103. One pair of ribs articulated with sternum: (0) no; (1) yes.
104. Medial tuberculum of humerus absent: (0) no; (1) yes.
105. Articulation between humerus and radius+ulna: (0) rotational; (1) non rotational.
106. Radius+ulna and carpals: (0) in tight articulation; (1) not in tight articulation.
107. Anterior border of scapula projection: (0) dorsal; (1) anterior.
108. Posterior border of scapula projection: (0) dorsal; (1) posterior.
109. Hyperphalangy: (0) absent; (1) present.
110. Trapezium: (0) present; (1) absent.
111. Hindlimbs: (0) well developed; (1) strongly reduced.
112. Sternum: (0) formed by several sternebra; (1) formed by a single element.

Balaenidae module

113. Supraoccipital highly elongated: (0) no; (1) yes.
114. Sagittal crest on supraoccipital: (0) yes; (1) no: it is flat; (2) not it shows a sagittal concavity.
115. Dome on supraoccipital: (0) absent; (1) present.
116. Transverse compression of supraoccipital: (0) present; (1) absent.
117. Squared anterior border of supraoccipital: (0) no; (1) yes.
118. Transverse diameter of anterior border of supraoccipital: (0) short; (1) intermediate; (2) large.
119. Reduced zygomatic process of squamosal: (0) no; (1) yes.
120. Zygomatic process of squamosal projection: (0) anterolateral; (1) lateral.
121. Pterygoid present in temporal fossa: (0) no; (1) yes.
122. Foramen ovale with incomplete infundibulum: (0) no; (1) yes.
123. Orientation of supraorbital process of frontal: (0) posterior; (1) transverse.
124. Shape of orbitotemporal crest: (0) very low-to-absent; (1) sharp.
125. Shape of frontal-parietal suture: (0) straight; (1) with distinctive anteroventral corner.
126. Orientation of dorsoventrally elongated squamosal: (0) anterior; (1) posterior; (2) vertical.
127. Shape of exoccipital in lateral view: (0) round; (1) squared.
128. Height of ventral border or exoccipital in lateral view: (0) at orbit level; (1) higher than orbit.
129. Rostral curvature: (0) rostrum uniformly curved; (1) posterior part of rostrum horizontal and anterior part curved.
130. Concavity on anterior border of nasal: (0) absent; (1) present.
131. Short nasals: (0) no; (1) yes.
132. Crest at parietal-squamosal-supraoccipital interface: (0) absent; (1) present.

133. Parietal spreads onto emergence of supraorbital process of frontal: (0) no; (1) yes.
134. Shape of parietal-squamosal suture: (0) straight; (1) anteriorly protruded.
135. Shape of posterior process of petrosal in ventral view: (0) triangular; (1) squared; (2) prismatic.
136. Lateral process of anterior process of petrosal triangular: (0) no; (1) yes.
137. Size of lateral process of anterior process of petrosal: (0) narrow; (1) wide.
138. Transversely elongated pars cochlearis: (0) no; (1) yes.
139. Crista transversa within internal acoustic meatus: (0) yes; (1) no.
140. Vascular groove in posterior part of pars cochlearis: (0) yes; (1) no.
141. Pyramidal process evident posteriorly to perilymphatic foramen of petrosal: (0) present; (1) absent.
142. Size of endolymphatic foramen: (0) small; (1) large.
143. Height of transverse process of atlas: (0) short; (1) long.
144. Neural process on atlas neural arch: (0) present; (1) absent.
145. Shape of neural arch: (0) triangular; (1) round.
146. Anterior and posterior borders of humerus: (0) straight and parallel; (1) highly concave.
147. Humeral head: (0) small-sized; (1) globular and large-sized.
148. Deltopectoral crest location on humerus: (0) close to head; (1) located more distally.
149. Posterior expansion of distal end of ulna: (0) absent; (1) present.
150. Superior corner of olecranon: (0) present; (1) absent.
151. Coracoid process in scapula: (0) well developed; (1) reduced-to-absent.
152. Orientation of tyrohyoidal process: (0) posterior; (1) transverse.
153. Dorsoventral compression of anterior end of dentary: (0) moderate; (1) strong.

TAXON X CHARACTER MATRIX USED IN PHYLOGENETIC ANALYSIS

Protocetus atavus
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Georgiacetus vogtlensis
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0000000??? 00???00000 0000000000- 0000000000 010????????0? ---------
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Dorudon atrox
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00000000-0 0000?00000 0000000000- 0000000000 010000000010 ---------
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Mammalodon colliveri
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Janjucetus hunderi
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Uranocetus gramensis
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‘Aglaocetus’ patulus

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Piscobalaena nana

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Herpetocetus morrowi

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Herenthalia nigra

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Tranatocetus argillarius

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Mixocetus elysius

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Table S1.

Stratigraphic ages of the taxa used in phylogenetic analysis

taxon	Geological age	age (Ma)	Stratigraphic character state	Reference
Protocetus atavus	Lutetian (Early Eocene)	48.6-40.4	0	Paleobiology Database
Dorudon atrox	Priabonian (Late Eocene)	37.2-33.9	1	Paleobiology Database
Georgiacetus vogtlensis	Lutetian (Middle Eocene)	40.4-37.2	0	Paleobiology Database
Mammalodon colliveri	Chattian (Late Oligocene)	28.4-23.03	2	Paleobiology Database
Janjucetus hunderi	Chattian (Late Oligocene)	28.4-23.03	2	Paleobiology Database
Aetiocetus weltoni	Chattian (Late Oligocene)	28.4-23.03	2	Paleobiology Database
Eomysticetus whitmorei	Chattian (Late Oligocene)	28.4-23.03	2	Paleobiology Database
Tokarahia kauaeroa	Chattian (Late Oligocene)	27-25	2	Boessenecker & Fordyce 2015
Yamatocetus canaliculatus	Chattian (Late Oligocene)	28.4-23.03	2	Paleobiology Database
Morenocetus parvus	Burdigalian (Lower Miocene)	20.43-15.97	3	Paleobiology Database
Caperea marginata	Recent (Holocene)	0.012-0.0	8	Paleobiology Database
Miocaperea pulchra	Tortonian (Lower Miocene)	11.608-7.246	5	Bisconti (2012)
Balaena mysticetus	Recent (Holocene)	0.012-0.0	8	Paleobiology Database
Balaena ricei	Zanclean (Early Pliocene)	5.332-3.6	6	Paleobiology Database
Balaena montalionis	Zanclean (Early Pliocene)	5.332-4.0	6	Bisconti (2000)
Balaenella brachyrhynus	Zanclean (Early Pliocene)	5.332-3.6	6	Bisconti (2005)
Balaenula astensis	Piacenzian (Late Pliocene)	3.8-3.4	7	Bisconti (2000)
Eubalaena shinshuensis	Messinian (Upper Miocene)	7.246-5.332	5	Paleobiology Database
Eubalaena sp. (Tuscany)	Piacenzian (Late Pliocene)	3.8-3.6	7	Bisconti (2002)
Eubalaena japonica	Recent (Holocene)	0.012-0.0	8	Paleobiology Database
Eubalaena australis	Recent (Holocene)	0.012-0.0	8	Paleobiology Database
Eubalaena ianitrix	Piacenzian (Upper Pliocene)	3.2-2.8	7	This work
Eubalaena glacialis	Recent (Holocene)	0.012-0.0	8	Paleobiology Database
Eschrichtioides gastaldii	Zanclean-Piacenzian	5.332-2.588	6	Bisconti (2008)
Eschrichtius robustus	Recent (Pleistocene-Holocene)	2.5-0.0	8	Paleobiology Database
Archaebalaenoptera castriarquati	Piacenzian (Late Pliocene)	3.8-2.588	7	Paleobiology Database
Megaptera novaeangliae	Recent (Pleistocene-Holocene)	0.781-0.0	8	Paleobiology Database
Balaenoptera physalus	Recent (Holocene)	0.012-0.0	8	Paleobiology Database
Titanocetus sammarinensis	Langhian (Middle Miocene)	15.97-13.65	4	Paleobiology Database
Mixocetus elysius	Tortonian (Upper Miocene)	11.608-7.246	5	Paleobiology Database
Tranatocetus argillarius	Tortonian (Upper Miocene)	11.608-7.246	5	Paleobiology Database
Herentalia nigra	Tortonian (Upper Miocene)	11.608-7.246	5	Bisconti (2015)
Herpetocetus morrowi	Piacenzian (Late Pliocene)	3.8-2.588	7	Paleobiology Database
Piscobalaena nana	Messinian (Late Miocene)	7.246-5.332	5	Paleobiology Database
Cophocetus oregonensis	Burdigalian (Lower Miocene)	20.43-15.97	3	Paleobiology Database
Aglaocetus moreni	Burdigalian (Lower Miocene)	20.43-15.97	3	Paleobiology Database
Parietobalaena palmeri	Langhian (Middle Miocene)	15.97-13.65	4	Paleobiology Database
Isanacetus laticephalus	Burdigalian (Lower Miocene)	20.43-15.97	3	Paleobiology Database
'Aglaocetus' patulus	Langhian (Middle Miocene)	15.97-13.65	4	Paleobiology Database
Uranocetus gramensis	Tortonian (Upper Miocene)	11.608-7.246	5	Paleobiology Database
Pelocetus calvertensis	Langhian (Middle Miocene)	15.97-13.65	4	Paleobiology Database

CALCULATION OF BODY LENGTH IN EXTANT AND FOSSIL BALAENOID SPECIES

Data on body length of extant Balaenidae and Neobalaenidae species are reported in literature (Omura, 1958; Tomilin, 1967). Data on skull length and body length of extinct Balaenidae and Neobalaenidae were inferred based on the known skull/body proportions (from 1:3 to1:4) and on the relationship between supraoccipital length and skull length (Bisconti, 2002).
The body length of *Morenocetus parvus* was inferred based on a supraoccipital length of 1.6 m as provided by Buono (2013). The total body length was inferred from this value and ranged from 4.8 and 6.2 m.
The body length of *Miocaperea pulchra* was reconstructed based on skull/body proportions that in Neobalaenidae are approximately 1:4. The skull length of *M. pulchra* is *c.* 1.1 m (Bisconti, 2012) thus the total body length is *c.* 4.4 m.
The body length of *Balaena ricei* was estimated based on the supraoccipital length/skull length relationship. Being the supraoccipital length 0.67 m (Westgate & Whitmore, 2002), the total skull length is *c.* 1.6 m; the inferred total body length ranges from *c.* 4.8 and *c.* 6.4 m.
The body length of *Balaenella brachyrhynus* is inferred ranging from *c.* 3.3 to 4.4 m based on the total skull length (Bisconti, 2005).
The body length of *Balaena montalionis* ranged from *c.* 7.5 to *c.* 10 m based on a total skull length of *c.* 2.5 m (Bisconti, 2000).
The body length of *Balaenula astensis* ranged from *c.* 4.8 and *c.* 6.4 m based on an inferred skull length of 1.6 m (Bisconti, 2000).
The body length of *Eubalaena shinshuensis* ranged from *c.* 9.6 and *c.* 12.8 m based on a measured skull length of 3.2 m (Kimura, 2009).
The body length of the *Eubalaena* sp. from Tuscany ranged from *c.* 12.6 to *c.* 16.8 m based on an inferred skull length of 4.2 m (Bisconti, 2002).

Table S2

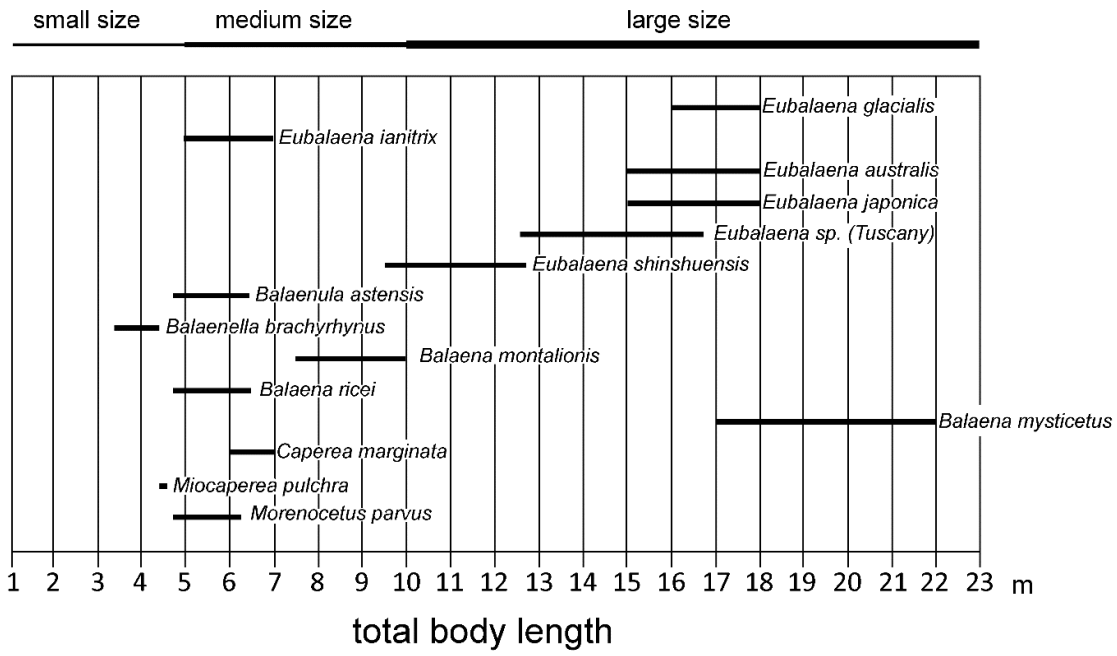
Raw data, methods of inference and range of total body length at adulthood for the balaenoid species cited in the text.

Taxon	Raw data[1] and references	Equation used	Body length range
Morenocetus parvus	SocL = 0.32 m (Buono, 2013)	Eq. (4) provides a skull length of 1.60 m[2]	*c.* 4.8-6.2 m
Miocaperea pulchra	SkL = 1.1 m (Bisconti, 2012)	Skull/body ratio[2]	*c.* 4.4 m
Caperea marginata	Data from literature (Baker, 1985)		*c.* 6-7 m
Balaenella brachyrhynus	SkL = 1.1 m (Bisconti, 2005)	Skull/body ratio[2]	*c.* 3.3-4.4 m
Balaena mysticetus	Data from literature (Tomilin, 1967; Reeves & Leatherwood, 1985)		16-22 m
Balaena ricei	SocL = 0.67 m (Westgate & Whitmore, 2002)	Eq. (4) provides a skull length of *c.* 1.6 m[2]	*c.* 4.8-6.4 m
Balaena montalionis	Data from literature (Bisconti, 2000)		*c.* 7.5-10.0 m
Balaenula astensis	Data from literature (Bisconti, 2000)		*c.* 4.8-6.4 m
Eubalaena shinshuensis	SkL = 3.2 m (Kimura, 2009)	Skull/body ratio[2]	*c.* 9.6-12.8 m
Eubalaena sp. (Tuscany)	Data from literature (Bisconti, 2002)		*c.* 12.6-16.8 m
Eubalaena japonica	Data from literature (Omura, 1958; Cummings, 1985)		*c.*15-18 m
Eubalaena australis	Data from literature (Omura, 1958)		*c.* 15-18 m
Eubalaena ianitrix	Present work		*c.* 5-7 m
Eubalaena glacialis	Data from literature (Omura, 1958; Cummings, 1985)		*c.* 16-18 m

[1]Explanation of acronyms: SkL, skull length (condylobasal length); SocL, supraoccipital length (from dorsal edge of foramen magnum to anterior end of supraoccipital). Data in meters.
[2]This work.

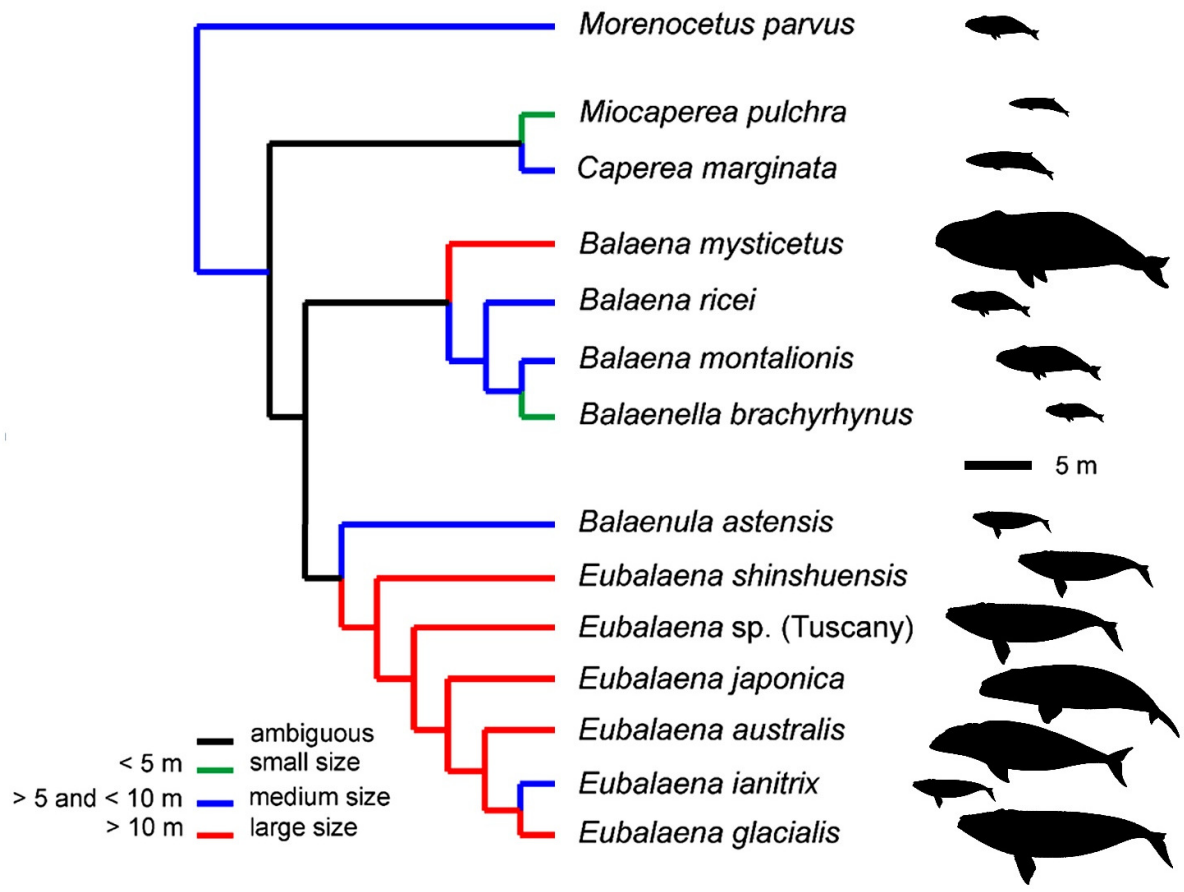
Supplementary Figure S1

Range of body lengths at adulthood across Balaenoidea based on Table S2.
Note that definitions of small, medium and large size are as follows: the size is small if total body length < 5 m; the size is medium if total body length is between 5 and 10 m; the size is large if total body length is > 10 m.



Supplementary Figure S2

Character reconstruction at internal nodes of Balaenoidea based on Fitch's (1971) parsimony. As calculated, ancestral body size for Balaenoidea is medium; the evolution of large size is observed independently in *Balaena mysticetus* and the *Eubalaena* species with the exception of *E. ianitrix*. Small size is a derived character in *Balaenella brachyrhynus*, but it is unclear whether it is a derived character also in *Miocaperea pulchra*. On the right side, silhouettes are shown to visually illustrate the differences in the reconstructed body sizes among Balaenidae.



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