FAUNA *of* AUSTRALIA

52. BALAENOPTERIDAE

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DEFINITION AND GENERAL DESCRIPTION

The Balaenopteridae (rorquals and Humpback Whales) comprises baleen whales with relatively short triangular baleen plates, in contrast to the very long and narrow baleen of the other mysticete family, the Balaenidae (right whales). Balaenopterids are almost all fast-swimming animals, generally undertake long migrations between breeding and feeding grounds and include the Blue Whale (*Balaenoptera musculus*), the largest animal ever known.

By comparison with the balaenids, balaenopterids have a relatively long and unarched upper jaw, an outwardly bowed mandible with a coronoid process and usually free cervical vertebrae (Fig. 52.1). The head is less than a quarter of the body length, numerous ventral grooves are present (the name rorqual is said to come from the Norse 'whale with pleats in its throat') and there is a dorsal fin, often rather small.

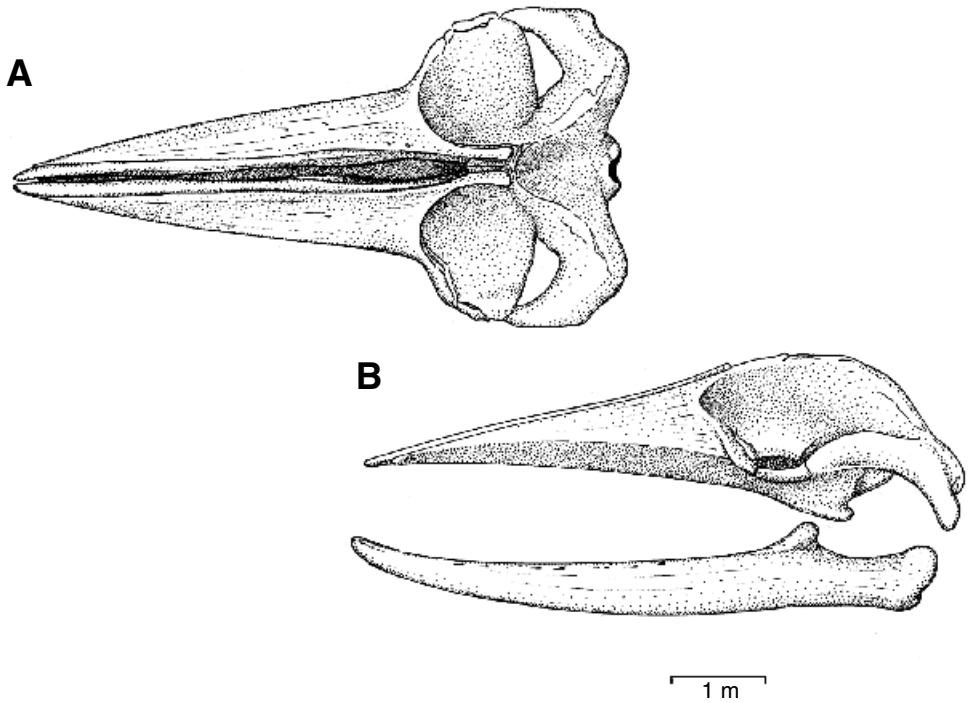

Figure 52.1 The skull of the Fin Whale, *Balaenoptera physalus*. **A**, dorsal view; **B**, lateral views. (© ABRS) [M. Thompson]

HISTORY OF DISCOVERY

There are only two genera, *Balaenoptera* Lacépède and *Megaptera* Gray. Balaenoptera comprises five species: the Minke Whale (*B. acutorostrata* Lacépède 1804); the Sei Whale (*B. borealis* Lesson 1828); Bryde's Whale (*B. edeni* Anderson 1878); the Blue Whale (*B. musculus* Linnaeus 1758); and the Fin Whale (*B. physalus* Linnaeus 1758). *Megaptera* is monotypic containing only the Humpback Whale (*M. novaeangliae*). The generic distinction is based externally on differences in overall appearance (the Humpback Whale is generally short and relatively fat), length and shape of flipper (very long with Humpback Whales, up to one-third of the body length and knobbed anteriorly, quite unlike any other balaenopterid) and number and width of ventral grooves (wider and generally fewer with Humpback Whales).

Within *Balaenoptera*, numerous species and subspecies have been described, but there is now general agreement on the validity of the five species listed above. At least one subspecies has been recognised, the Pygmy Blue Whale (*Balaenoptera musculus brevicauda*). There also may be at least one subspecies of *B. acutorostrata* (Minke Whale), *B. a. bonaerensis*. Several morphological forms of Bryde's Whale exist, perhaps also reflecting subspecific rank.

MORPHOLOGY AND PHYSIOLOGY

The short triangular baleen plates, up to 480 hanging down on each side of the upper jaw, the long slim body, short flippers and large number of ventral grooves extending from the chin back towards the navel, distinguish whales in the genus Balaenoptera from all other cetaceans (Fig. 52.2). Blue Whales, reaching more than 30 m in length and more than 160 tonnes weight in the adult, are the largest animals known, living or extinct. The other balaenopterids are still relatively huge by terrestrial standards; even the smallest, the Minke Whale, reaches 10 m and 10 tonnes. As in other mysticetes (in which they differ distinctly from the odontocetes), adult female balaenopterids are generally slightly larger than males; for example, an adult female Fin Whale at its maximum length of 27 m is 2 m longer than the largest adult male.

The major external distinguishing feature of Humpbacks—very long, anteriorly knobbed flippers—is accompanied by rather few (up to 36) wide ventral grooves and flukes which are characteristically serrated on their hind margin (Fig. 52.3). Humpbacks also carry more ectoparasites than other balaenopterids, possibly because of their relatively slow swimming speed. Most common are whale lice (cyamid amphipods) and barnacles, *Conchoderma* and *Coronula* species.

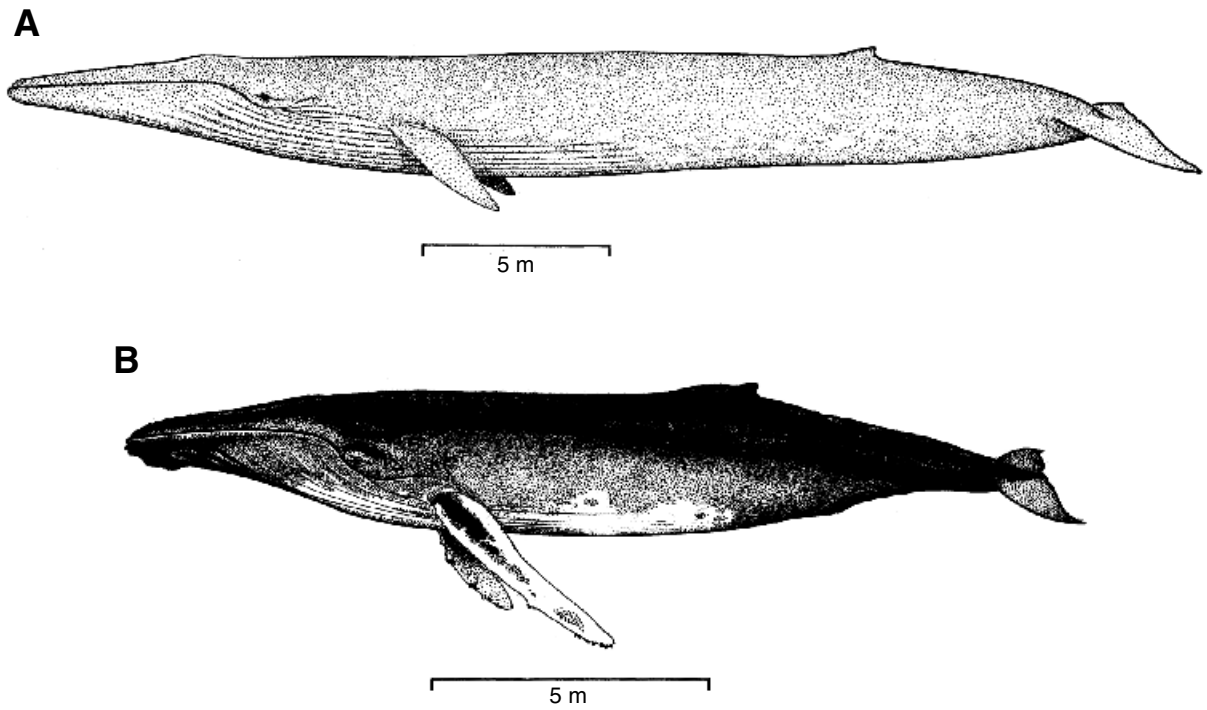

Figure 52.2 lateral view of **A**, Blue Whale, *Balaenoptera musculus*; **B**, Humpback Whale, *Megaptera novaeangliae*. (© ABRS) [M. Thompson]

Balaenopterids retain a few sparse hairs on the head. Blue and Fin Whales have them on the chin, along each side of the lower jaw and on the top of the head. They are best developed in younger animals, particularly the foetus. Humpbacks have each hair contained in a rounded dermal tubercle, protruding from the surface as a knob.

Most balaenopterids are darker dorsally than ventrally. Blue and Sei Whales are an overall dark blue/grey. Often the ventral surface of the former species is covered by a yellowish film of diatoms—hence the early whalers' name of ‘sulphur bottom’—and Sei Whales often have a white patch on the ventral grooves. Both Fin and Minke Whales are white ventrally. Northern Hemisphere Minke Whales bear a dorsal white patch on the flipper, but this character is variable in the Southern Hemisphere. The Fin Whale is unique in the extraordinary asymmetry of its head colour. The left side of the head is an even grey-blue, but the front of the lower jaw on the right is white, and this is shared by the first 20–30% of baleen plates on that side. Humpbacks vary from animals that may be almost all black, to black with white markings on the throat, belly and sides. The underside colour pattern of the flukes is individually distinct.

As in all cetaceans, balaenopterids possess a very thin epidermis and dermis overlying a much thicker layer of hypodermis or blubber. Blubber acts both as a foodstore and insulator and it varies in thickness over the body. It is responsible for the overall shape and streamlining of the animal and can account for more than 20% of body weight. The blubber is well vascularised and the thickness varies according to the animal's body size, reproductive state and whether it is feeding or migrating. It is relatively thickest in pregnant females and calves. Humpback Whales have the greatest relative blubber thickness of any balaenopterid, with a maximum depth of 190 mm.

However, the blubber layer may not be totally adequate as an insulator and whales may have to move continuously to generate sufficient body heat. This probably applies particularly to rorquals by comparison, for example, with the much slower swimming and fatter Humpback and Right Whales. The appendages are also well vascularised and play an important part in heat regulation. Out of water, where heat transfer is much less efficient, cetaceans rapidly become overheated, which can contribute considerably to their suffering when stranded alive.

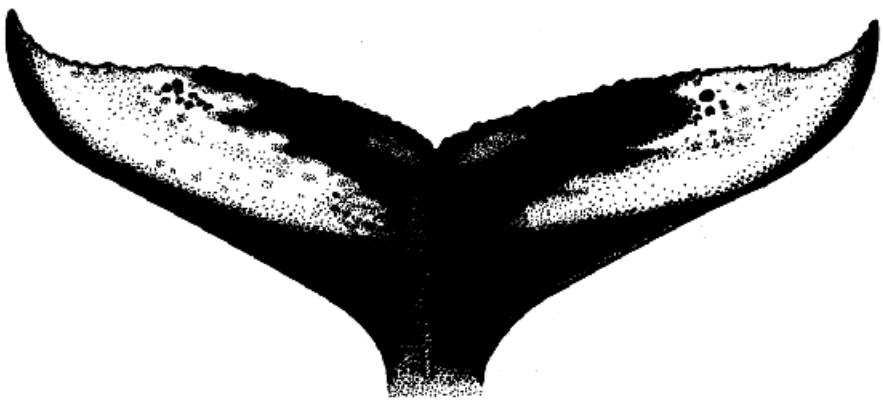

Figure 52.3 Ventral view of the tail flukes of the Humpback Whale, *Megaptera novaeangliae*. The width of the flukes is approximately 4 m. (© ABRS) [M. Thompson]

A most distinctive feature of mysticete (balaenopterid and balaenid) skulls is the long narrow palate, formed mainly by the maxillae, for support of the baleen plate feeding apparatus. Another is the rounded, outwardly arched mandibles. The latter meet at an angle in front and are held together by strong fibrous tissue; they lack the opposed flattened surface found in odontocetes.

NATURAL HISTORY

Because of their commercial importance, much effort has been expended in trying to determine the ages of individual balaenopterids, their growth and mortality rates, breeding rates and other aspects of their biology.

Capture data from Australia's eastern and western coasts (summarised in Chittleborough, 1965) demonstrate that there are two quite reproductively isolated breeding populations of Humpbacks in Australian waters, one wintering off the western coast, the other off the eastern coast. Both migrate to the Antarctic in summer to feed and, while there may be some mixing on the feeding grounds, there is little permanent exchange between the populations. The suggestion is that individuals are likely to return to the locality where they are born. Similar isolated breeding populations occur off the eastern and western coasts of the other southern continents. Subsidiary units of the Australian eastern coast populations winter near south-western Pacific islands, Tonga for example. Recent summer sightings of Humpbacks in the Murray Island area near the northern tip of the Great Barrier Reef (at about 10°S) (Simmons & Marsh 1986) suggest that some part of the population, perhaps younger animals, may not regularly migrate south each year.

From analysis of growth layers in the 'earplug' of Humpback Whales (a keratinised core occupying the inner end of the external auditory meatus), Chittleborough (1965) records animals up to 48 years of age. Both sexes reach puberty at 4–5 years; the birth rate is around 0.37 (young per reproductively mature female). Gestation lasts 11.5 months, with conception early in August and parturition around the end of the following July, when a single young is generally produced. Twins occur in 0.28% of pregnancies. Length at birth is about 4.3 metres. Lactation lasts 10.5–11 months, weaning occurring as the whales reach temperate latitudes on the return migration (Chittleborough 1965). Sharks and killer whales probably cause mortality among calves. Adult natural mortality has been calculated at around 9%.

Chittleborough (1965) assumed two growth layers were formed each year in Humpback earplugs; for other balaenopterids one layer per year seems more probable. While the general life history patterns of *Megaptera* and *Balaenoptera* are similar (conception, parturition and lactation are geared to the pattern of winter breeding in warm water and summer feeding in cold waters), there are differences in ages at puberty; for example, around 10 years for each sex of Sei and Fin Whales. The picture is further complicated by the proposition that in heavily exploited populations, an animal's age (but not size) at puberty will be less than in an unexploited population (see for example, Gambell 1985). This has been reported for both Sei and Fin Whales, despite recent suggestions that it may be an artefact of the analysis or due to systematic counting errors (Cooke 1985).

Southern Hemisphere balaenopterids feed largely on krill (*Euphausia superba*) in the Antarctic, although from the structure of the baleen (where the inner fringing bristles, forming the straining mat, vary from stiff and coarse in Blue Whales to silky and fine in Sei Whales), different components or species may be preferred at times. Sei Whales in particular, which do not penetrate as far south as the others, prefer copepods. Baleen whales have been arranged into three groups according to their feeding behaviour. 'Swallowers' (Blue, Fin, Bryde's and Humpback Whales) generally feed by taking in a large body of seawater

containing a mass of prey, discharging the water through the baleen mat and swallowing the strained food. 'Skimmers', with very fine baleen fringes, take advantage of more scattered plankton or scattered patches; Sei Whales are partly included in this category (along with all balaenids). The Sei Whale is however, more usually considered in a third, intermediate group—'swallowers/skimmers'—since it can adopt either behaviour, depending on the food species present (Nemoto 1970). Interestingly, balaenopterids seem to be more catholic in their feeding habits in the Northern Hemisphere than in the south, frequently feeding on shoaling fish and even squid. In this they are mirrored by Bryde's Whale which is restricted to temperate and tropical waters and has very coarsely fringed baleen plates. Not only can it feed almost entirely on shoaling fish, but also on euphausiids.

Balaenopterids tend to occur in larger concentrations on their feeding grounds than elsewhere. In migration, they tend to move singly, in pairs or in small groups. The exact breeding locations of Blue, Fin and Sei Whales are unknown. There is argument over whether animals are likely to be concentrated or scattered in small groups or pairs at that time. Most species, particularly Sei and Minke Whales, show segregation by sex and age, both on migration and on the feeding grounds. In the Antarctic, there is a well-defined sequence of arrival and departure, both by species (Blue Whales arriving and departing first, followed by Fin and Sei Whales) and by age and sex. For example, larger and older Fin Whales seem to travel further south and more female than male Minke Whales occur in these waters. Pregnant Blue, Fin and Sei Whales are among the first animals to arrive and leave. In Humpbacks, on the other hand, young animals and females nearing the end of lactation are in the vanguard of the northward migration, with pregnant females in the rear (Chittleborough 1965).

Baleen whales are known to vocalise, but not apparently for echolocation. Humpback 'songs' have been well recorded, particularly those of males on breeding grounds. Recent work off eastern Australia has shown that, at least in those waters, 'songs' may be produced on migration (Dawbin 1983). The pattern differs from that recorded off the western coast of Australia at much the same time in the same year. Noises recorded from other balaenopterids include low frequency grunts, moans and rumbles, buzzes, rasps and rachets, pings and clicks, screeches, whistles and downward sweeps. All are apparently for communication.

Records of balaenopterid strandings, as for mysticetes generally, are relatively much fewer than for toothed whales. In a study of 46 strandings (of 497 animals) on the Tasmanian coast between February 1978 and May 1983, McManus *et al*. (1984) record only 10 individual mysticete strandings, of which only three were balaenopterids (one each of Sei, Minke and Humpback Whales). Two remarkable strandings of live Blue Whales occurred in May 1973 and April 1974 at Albany, Western Australia. Both strandings were in much the same place (a blind inlet near the exit to Princess Royal Harbour), suggesting that in each case the animal had literally lost its way trying to get out of the harbour. Both were Pygmy Blue Whales (see below).

Balaenopterids generally dive rather shallowly. Blue Whales may make 10 to 20 shallow dives at 12–20 second intervals (blowing eight to 15 times between dives) followed by a deep dive of 10–30 minutes, as deep as 230 m. The 'blow' is tall, up to 6 m in height. A similar pattern is followed in the other species, although Bryde's Whale is said to blow only four to five times before diving. Most are fast swimmers, with Sei Whales probably the swiftest. The Blue Whale has been timed at up to 48 km / hour when chased. On migration, the Fin Whale has been recorded as covering up to 140 km / day. Humpbacks, generally slower than the rorquals, has been shown to travel at a mean of 4.3 knots off Western

Australia in undisturbed migration. One animal averaged at least 2.8 knots over 1350 nautical miles in 20 days between Cook Strait, New Zealand and Moreton Island, Queensland (Chittleborough 1965).

The Humpback is the most acrobatic balaenopterid; it breaches, spyhops (lifts its head vertically out of water), lobtails (slaps its tail on the water), slaps the water with one flipper and frequently throws its flukes out of the water before a long dive. Fin Whales may also breach and Blue Whales may occasionally show their flukes on diving.

Economic Significance

All the balaenopterids have been commercially important, but only to any major extent since 1864 when the advent of the explosive harpoon, combined with a steam catching vessel, allowed them to be hunted successfully. Modern whaling began in the North Atlantic and spread to the Southern Ocean in the early 1900s.

The Humpback was the first whale to be taken in any numbers, in the Antarctic in summer and from land stations in winter (for example, on the tropical coasts of Africa and Western Australia). Up to 12 000 were taken in one year (1912), resulting in rapid stock depletion. Attention soon turned to other species, particularly Blue and Fin Whales, with a maximum catch in 1931 of over 40 000 animals. From the end of World War II until 1965, around 30 000 animals a year were taken, not only Blue and Fin Whales (the latter being the mainstay of the industry by then) but also the smaller Sei Whale. With depletion of stocks and more stringent conservation measures, catches then fell very rapidly to between 10 000 and 15 000 per year in the late 1970s. Minke Whales, the smallest balaenopterid, were ignored until the early 1970s, but catches of between 5000 and 7000 per year were taken thereafter. Today, it remains the only Antarctic species exploited, with almost 5000 taken in the Antarctic in 1985-86 with most caught south of the eastern Indian Ocean.

Only the Humpback has featured prominently in balaenopterid catches off Australia, particularly off the western coast. There, four phases of hunting have occurred: in 1912-1916; 1925-1928; 1936-1938; and 1949-1963. Very few were taken from the same population in the Antarctic before 1934. Thereafter hunting was undertaken at both ends of its migration. The stock was severely depleted following killing of more than 12 000 animals between 1934 and 1939. Of this catch, 7244 were taken off Western Australia and the remainder in the Antarctic. The stock seemed to recover by 1949, but between then and 1963, removal of more than 18 000 (over 12 000 off Western Australia) again reduced the population, this time very severely. Chittleborough (1965) calculated that from an unfished state of 12–17 000 animals, the stock would have numbered about 10 000 in 1949 and not more than 800 in 1962.

Off eastern Australia, humpback whaling was initially much less intense, with very few taken by ‘modern’ whalers until 1949. At Eden, New South Wales, a few humpbacks were taken in an open boat, shore based industry before 1930. But, between 1950 and 1962 nearly 12 500 animals were caught from the eastern coast stock, over 7000 off the Australian coast, the rest in the Antarctic. From an unfished population of about 10 000 in 1949, the stock had been reduced in 1962 to less than 500. For several years on both coasts Humpback sightings were scarce, but more now are being reported. During aerial surveys in the most recent whaling area, off Carnarvon W.A., sightings in 1982 were double those recorded during whaling operations in 1963. A repeat survey in 1986 has provided further evidence of increase. The Humpback now is seen more frequently off the eastern coast also, particularly in Great Barrier Reef waters (Simmons & Marsh 1986).

The major commercial product from all balaenopterids was oil, mainly as a source of edible fats (for margarine) or for soap manufacture, with a lesser market for meat meal or meat extract. Recently, there has been a substantial Japanese market for Minke Whale meat.

BIOGEOGRAPHY AND PHYLOGENY

Distribution

Apart from Bryde's Whale, balaenopterids are generally worldwide in distribution, but undertake very long migrations between cold water feeding grounds and warmer water breeding grounds. Humpbacks seem to follow the most well-defined migration routes, generally following coastlines in warmer waters. Apart from Humpbacks, however, the other balaenopterids have not been recorded from Australian waters in any great numbers; a few Blue and Bryde's Whales were caught by whalers operating from Australian land stations while concentrating on catching Humpbacks. The exact identity of the few Bryde's taken has been in doubt. The animals are in some ways intermediate between typical Bryde's and Sei Whales (Chittleborough 1959), particularly in the shape of the baleen plates and the position of the ventral grooves relative to the navel. In a typical Bryde's Whale, these end at or close to the navel, but in three Western Australian specimens and two from the eastern coast they ended between 0.71 and 1.06 m anterior to it, much as in a Sei Whale.

The three Bryde's Whales taken in 1958 off Carnarvon, Western Australia, had been feeding on anchovies. In other parts of the world, two forms of Bryde's Whale have been described, an inshore and an offshore form (Best 1977). The latter feeds mainly on euphausiids and seems to occur well out to sea off north-western Western Australia (Kawamura 1980). In the late 1970s, a high proportion of animals captured in the latter region by the Japanese were feeding on euphausiids.

Bryde's Whale has also been recorded at least once from Victoria and South Australia. The latter specimen was identified from skeletal features (Aitken 1971b), but in the length of its ventral groves, which reached the navel, the Victorian animal (Dixon 1970) was more like the usual Bryde's Whale. The same was noted in an animal caught in moorings in the Houtman Abrolhos Islands, Western Australia, in 1973.

Blue Whales have been recorded infrequently from most Australian states. At least some may have been Pygmy Blue Whales. From their size, maturity and relative shortness of the tail region as described for *B. m. brevicaud*a by Ichihara (1966), the two animals stranded in successive years at Albany, Western Australia were apparently of this subspecies. Similarly, specimens of Minke Whale from off the eastern (Best 1985) and the western coast of Australia are referable to *B. acutorostrata bonaerensis*, particularly from the presence of white pigmentation on the upperside of their flippers. This subspecies' colour phase is smaller than the most usual acutorostrata and these animals do not seem to migrate to higher latitudes of the Antarctic.

Fossil Record

Fossil balaenopterids are known from the Late Miocene onwards and closely resemble living forms (Fordyce1982a). Examples have been reported from Australia, including earbones and fragments of skull from the Miocene and Pliocene referable to *Megaptera* and *Balaenoptera* (Fordyce 1984).

KEY TO AUSTRALIAN BALAENOPTERID SPECIES, EXTERNAL CHARACTERS

1 Whales with baleen plates present in the mouth; blowhole double . . . . . Mysticetes 3

2 Whales with teeth present, sometimes rudimentary or absent, but no baleen plates; blowhole single . . . . . Odontocetes

3 Mysticetes with long oar-like flippers, up to 1/3 bodylength, with knobs on leading edge; tail flukes scalloped on hind border; baleen plates generally all dark; ventral grooves few (less than 40) and wide; body robust; adult length to 16 m . . . . . *Megaptera novaeangliae*

4 Mysticetes with short flippers, up to 12 percent of body length; tail fluke hind border not scalloped; ventral grooves many (usually forty plus) and narrow; body streamlined, less robust than *Megaptera*; adult length 9 to 30 m . . . . . *Balaenoptera* 5, 6

5 Ventral grooves end well anterior to navel; adults 9 to 21 m 7, 8

6 Ventral grooves reach navel*; adults 12 to 30 m 9-11

7 Baleen plates almost all black, with silky white fringes; flukes and flippers dark underneath; body generally dark grey with lighter region on the belly; often heavily scarred; adults to 21 m . . . . . *B. borealis*

8 Baleen plates white-dark grey, frequently grey with white inner edges; flippers white underneath, may possess whitish patch or band above; body black-dark grey above, belly white; head very narrow and pointed; adults to 8 m . . . . . *B. acutorostrata*

9 Baleen plates slate-grey, with distinctly coarse lighter-coloured bristles; head frequently with three prominent ridges, one medial; body generally dark grey but chin and belly often white; adults to 14 m . . . . . *B. edeni**

* See text for possible variations in *B. edeni* in Australian waters

10 Baleen plates striped yellowish white and blue/grey except on right, where anterior 20 to 30% are yellowish white; head colour asymmetrical, dark grey/brownish black except on right side where lower lip (and sometimes upper) is white, matching baleen; body dark above, white below, including undersides of flippers and flukes; back behind dorsal fin distinctly ridged; adults to 27 m . . . . . *B. physalus*

11 Baleen plates all black with stiff rather coarse fringes; body colour blue-grey overall, often mottled; dorsal fin a small 'nub'; body very broad, head wide and flat above with a single median ridge; adults huge, to 30 m *B. musculus*

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