



FAUNA *of* AUSTRALIA

36. BIOGEOGRAPHY AND PHYLOGENY OF EUTHERIA

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INTRODUCTION

In considering the biogeography and phylogeny of the eutherian mammals in Australia, a distinction must be made between those groups which invaded the continent prior to the 18th Century and those that have been deliberately or inadvertently introduced since then. For the latter group, the worldwide distribution and fossil history is essentially irrelevant except that many species have a long association with humans as either domesticated animals or commensals. In this chapter, we will address the more general questions of the origins and affinities of the native Australian eutherians. For details of the biogeography, fossil history and affinities of the introduced mammals, the reader should refer to the family accounts (Chapters 44–46, 54, 55, 58–62).

Any examination of the phylogeny of a group must consider two main lines of evidence: the fossil record and the study of living forms. Morphological studies can be made on both living and fossil forms and such studies, particularly of skeletal and dental characters, have traditionally formed the basis for phylogenetic reconstruction in the Mammalia. In recent years there has been an increase in biochemical and molecular studies on living species which, with a very few exceptions, cannot be compared to extinct species. To date, only a relatively few species of living mammals have been studied adequately using molecular techniques, but attempts are being made to reconcile the biochemical data with the traditional morphological studies (Shoshani 1986; McKenna 1987).

Within the Eutheria, with a few exceptions such as the rodents, the taxonomic arrangements and the inferred phylogenetic relationships of families within orders have remained relatively stable since Simpson's (1945) treatment. At the intrafamilial level, however, new techniques have led to frequent rearrangements based on the detection of substantial numbers of new biological species and a rearrangement of the content of many genera. At the supraordinal level, molecular data combined with some new anatomical studies has led to a number of changes in our understanding of the relationships between orders. We have attempted to follow the most recent revisions at the family level and below. At the supraordinal level, however, we prefer to follow the widely used classification of McKenna (1975).

FOSSIL HISTORY

Order Chiroptera

The earliest known fossil bats are found in Early to Middle Eocene deposits of Europe and western North America. Six genera belonging to three families and a further three of indeterminate affinity have been described (Hill & Smith 1984). The best known of these Eocene fossils, *Icaronycteris index* from Wyoming, has a number of distinctive microchiropteran characters, but has a claw on manual digit 2, a character which in living forms occurs only in the Megachiroptera. These Eocene bats, together with *Archaeopteropus* from the Oligocene of Europe which Hill & Smith (1984) considered a pteropodid, are grouped together into the superfamily Palaeochiropterygoidea within the suborder Eochiroptera (Hand 1984). According to Hand (1984), the dental characteristics of *Icaronycteris* are consistent with it being close to the ancestry of vespertilionoid microchiropterans, but the earliest known members of the other living microchiropteran superfamilies have specialised dentitions that indicate that modifications to the teeth may have preceded the early radiation of this suborder. Novacek (1987) described the advanced auditory specialisations

of *Icaronycteris* and *Palaeochiropteryx* and considered them to be true microchiropterans, thus placing the validity of the suborder Eochiroptera in doubt. Rhinolophoids and vespertilionoids are first found in the Middle Eocene and the earliest emballonuroid occurs in Late Eocene or Early Oligocene deposits, all of which are from Europe.

Following their earliest appearance in the Eocene, fossil microchiropterans of all three superfamilies appear sporadically in the Tertiary deposits of Europe and Africa with occasional appearances of some families in the Americas and Asia. Only the superfamily Rhinolophoidea is represented in the Tertiary of Australia (Hand 1984). *Macroderma godthelpi* and another unnamed magadermatid occur in Miocene deposits from the Riversleigh deposits of northern Queensland along with a hipposiderid (*Hipposideros* (*Brachhipposideros*) *nooraleebus* Sigé, Hand & Archer 1982) and an undescribed rhinolophid (Hand 1984, 1985).

The ancestry of the Megachiroptera is problematical. The only known Tertiary fossil is *Propotto leakeyi*, a pteropodid from the Early Miocene of Africa. Although most modern systematists have considered the Megachiroptera and Microchiroptera to be a monophyletic group sharing a common winged ancestor, there is considerable evidence to suggest a polyphyletic origin (Smith 1977; Pettigrew 1986; Pettigrew & Jamieson 1987).

Pleistocene bats from Australia, which were listed by Archer, Clayton & Hand (1984), are all referable to modern genera and species.

Order Primates

For a description of the fossil record of hominids in Australia the reader is referred to Chapter 44.

Order Rodentia

Although rodent fossils are known as early as the Paleocene genus *Paramys* of North America, the earliest fossil referable to the family Muridae is *Antemus* from the mid Miocene Siwalik deposits of Pakistan (Carleton & Musser 1984). The earliest known Australian murids are two undescribed forms from the early Pliocene Bluff Downs deposits in northern Queensland and the early to mid Pliocene Chinchilla deposit of south-eastern Queensland (Archer *et al.* 1984). The only other fossil murids in Australia are a large number of Pleistocene specimens all of which are referable to extant genera and species (Archer *et al.* 1984).

Order Carnivora

The oldest known pinniped fossil, *Enaliarctos* from the Early Miocene of western North America, was considered by King (1983b) to be ancestral to the Otariidae which first appear in the mid-Miocene. King (1983b) described a Pliocene to Pleistocene radiation of otariids which involves the migration of two ancestral stocks to the Southern Hemisphere. The Southern fur seals are all placed in the genus *Arctocephalus*, but there has been further radiation in the sea lions. The only Australian fossil is a Pleistocene record of the modern Australian sea lion, *Noephoca cinerea*, from Queenscliff, Victoria (Archer *et al.* 1984).

Phocid seals are considered to have evolved about the beginning of the Miocene in the North Atlantic rather than in the Pacific and to have radiated early into two lineages, the Phocinae and the Monachinae (King 1983b). Only the latter group invaded the southern oceans and, although the timing and the number of migrations involved is unknown, must have occurred early, as undescribed monachines are recorded from Late Miocene, Early Pliocene and early Pleistocene deposits in Victoria (Fordyce & Flannery 1983; Archer *et al.* 1984).

The Australian fossil record of the Dingo (Canidae) is described in Chapter 54.

Order Sirenia

The only purported Australian fossil sirenian reported in the literature appears to be indeterminate (Fordyce 1982b). There is no evidence for the time of appearance of sirenians in Australia.

Order Cetacea

The fossil history of whales in Australia has been reviewed by Fordyce (1982b, 1984, 1985). No Australian records exist of the suborder Archaeoceti, the primitive toothed whales first found in Middle Eocene Tethyan deposits. These earliest whales, which are placed in the family Protocetidae, appear not to have had a southern distribution. The second family of archaeocetes, the Basilosauridae, occurs in Late Eocene deposits on Seymour Island and New Zealand, but not in Australia.

The modern suborder Odontoceti appears first in the fossil record in the Late Oligocene and two early radiations (Squalodontidae and Rhabdosteidea) are represented in Australian deposits ranging from Late Oligocene to Middle Miocene. A further early family, the Kentriodontidae or ancestral dolphins, occurs in Late Oligocene New Zealand deposits. The first modern families to appear are the Ziphiidae and Physeteridae in Early Miocene South American deposits and are found later in the Miocene in Australia. Delphinidae occur in Late Miocene to Early Pliocene Australian deposits, but other modern families are not recorded from Australia.

Whales of the suborder Mysticeti appear first in Late Oligocene deposits. *Mammalodon* is a Late Oligocene toothed mysticete of uncertain affinities. Other early toothed mysticetes are grouped into the family Cetotheriidae which is found in Late Oligocene deposits in New Zealand, but do not occur in Australia until the early Miocene. The family Balaenidae, which first appears in the Early Miocene of South America, occurs in Late Miocene to Early Pliocene deposits in Australia along with the first representatives of the Balaenopteridae. As with the odontocetes, many of the specimens of fossil mysticetes from modern families are referable to living genera.

PHYLOGENY

Eutherian Origins

Eutherians and metatherians are presumed to have evolved from a common therian ancestral stock in the mid to Late Cretaceous with the earliest eutherian fossils found in both Asia and western North America (Keilan-Jaworowska, Brown & Lillegraven 1979). Both fossil evidence (Kemp 1982, 1983) and biochemical evidence (McKenna 1987) confirm that the Eutheria and Metatheria form a monophyletic group and that their sister group is the Monotremata. Early eutherian radiations occurred in North America, South America and Eurasia. By the Paleocene, some modern orders, including the Lagomorpha and Rodentia, had become established (Eisenberg 1981) and by the Eocene the remaining extant orders had appeared.

The phylogenetic relationships of the eutherian orders have been the subject of much debate since Simpson's (1945) division of the Eutheria into Cohorts. More recent analyses have tended to subdivide and rearrange Simpson's groupings (see for example McKenna 1975; Szalay 1977). The increasing availability of molecular data, particularly from protein sequencing, has allowed a further re-examination of relationships by comparing molecular and morphological

evidence which confirms some of the rearrangements, but proves others to be unwarranted (McKenna 1987). Some authors follow McKenna (1975) in naming the supraordinal taxa 'Grandorders', but others retain Simpson's (1945) category of Cohort. We follow this latter course in the interest of preserving stability. Only those groups which occur in Australia will be discussed further here.

Cohort Archonta

The Archonta incorporates the orders Scandentia, Dermoptera, Chiroptera and Primates (McKenna 1975; Szalay 1977) and forms part of Simpson's (1945) Cohort Unguiculata. This grouping was erected on morphological evidence (McKenna 1975). More recent studies on amino acid sequences of myoglobin, haemoglobin and alpha-crystallin suggest that the primates may not belong with the others, but may be closer to the Cohort Glires and that the remaining orders are allied to the Carnivora and Pholidota (Miyamoto & Goodman 1986; McKenna 1987). As the more recent molecular data are based on a relatively small sample of species, the intraordinal variation is poorly understood. We, therefore, prefer to follow McKenna's (1975) classification as we see the recent reclassification of Miyamoto & Goodman (1987) as premature. Within this cohort only the orders Chiroptera and Primates occur in Australia.

Order Primates. The relationships of the Hominidae are discussed by Groves (Chapter 44) and were reviewed in detail by Andrews (1987) who concluded that the conflict between those available morphological data supporting a *Pan/Gorilla* grouping and biochemical data supporting a *Pan/Homo* grouping do not permit a definitive phylogenetic interpretation of relationships within the Hominidae.

Order Chiroptera. The bats have long been considered to be a monophyletic group with the highly modified forelimbs being a shared derived character. The major differences in such characters as dentition, ear structure, echolocation mechanisms, placentation *etc.* have been explained as a result of an early divergence from a common flying ancestor. Studies of morphology of Megachiroptera (Pettigrew 1986; Pettigrew & Jamieson 1987) have indicated that this suborder may in fact be more closely allied to the Primates than to the Microchiroptera. Pettigrew & Jamieson (1987) analysed a number of characters which clearly cluster the Megachiroptera with the primates rather than with the Microchiroptera. The Megachiroptera and Primates also share the additional character of two upper and lower incisors as a primitive condition.

Microchiropteran relationships are discussed by Hall (1984), Hand (1984) and Hill & Smith (1984). All of these authors recognise four superfamilies, three of which are represented in Australia. All four superfamilies apparently are derived from a palaeochiropterygoid ancestor (Hand 1984) and have a long separate fossil history (see above). The relationships and taxonomic arrangements within the superfamilies have been stable for many years, with the exception that some authors combine the family Hipposideridae with the Rhinolophidae (Koopman 1984c). There have not been, to date, any recent biochemical studies of phylogenetic relationships within this suborder as a whole.

Cohort Glires

Glires, first used by Linnaeus as an Order, was used by Simpson (1945) to include the rodents and lagomorphs. In a number of subsequent studies the lagomorphs have been considered to have closer affinities to a number of other different orders and the concept of a cohort Glires was abandoned (Diersing 1984). More recent studies summarised by McKenna (1987) have indicated that

the Lagomorpha may well form a monophyletic group with the Rodentia. Whatever the eventual outcome of this debate, the two orders are representatives of one of the oldest of eutherian radiations (Eisenberg 1981).

Order Lagomorpha. The lagomorphs appear to have originated in Asia and diverged into two lineages, Ochotonidae and Leporidae in the Oligocene of Asia and North America, respectively (Diersing 1984). Relationships of the two leporids introduced into Australia are discussed in Chapter 45.

Order Rodentia. The relationships within the rodents has been the subject of much debate over the last four decades. As only a few genera from one large cosmopolitan family occur in Australia, the relationships of subordinal groupings are of minor interest. Carleton (1984) reviewed the relationships within the order and Carleton & Musser (1984) reviewed the family Muridae. Within the Australasian representatives of the Muridae, a number of attempts have been made to ascertain phylogenetic relationships (Tate 1951a; Simpson 1961; Lee, Baverstock & Watts 1981; Baverstock *et al.* 1981; Lidicker & Brylski 1987), but as Carleton & Musser (1984) pointed out such comparisons cannot reveal a definitive phylogeny until more is known of the rodents of the Philippines and the Indonesian archipelago. The biogeographic patterns in the Australasian region, however, are of interest and we deal with these below.

Order Carnivora

This order was included by Simpson (1945) in the Cohort Ferungulata along with the ungulate orders. McKenna (1975) removed them from this association and considered the living carnivores to be allied to the extinct Creodonta representing a separate lineage from the ungulates. Recent molecular data support this separation (McKenna 1987).

Within the carnivores, the seals and sea-lions have been considered variously as a separate suborder (Simpson 1945) or even a separate order (Stains 1967). In more recent years, fossil and biochemical evidence have indicated that they represent two separate lineages that are possibly allied to mustelids and ursids respectively (Stains 1984; McKenna 1987).

Cohort Ungulata

Originally part of Simpson's (1945) Cohort Ferungulata with the addition of his Cohort Mutica, the Ungulata generally is seen to form a monophyletic lineage (McKenna 1975). Two orders within this cohort occur naturally in Australia and are discussed briefly here. For discussion of the phylogeny of the introduced ungulates, the reader is referred to Chapters 58–62.

Order Cetacea. Whales, like carnivores, have been considered at times to represent two distinct orders (Rice 1967), but more recently analyses have confirmed that they form a monophyletic group and should be considered a single order (Rice 1984). The two living suborders Odontoceti and Mysticeti represent old parallel lineages (See Fossil History, above). Recent molecular and cytological data indicate that the Odontoceti may possibly be paraphyletic as the protein sequence data indicate a closer relationship between the Physeteridae and the Mysticeti than either has to the remaining odontocetes (McKenna 1987).

Order Sirenia. Sirenians, which are represented by two living families, are part of an old African radiation and have apparently close affinities with the Proboscidea and the extinct Desmostylia (Rathbun 1984).

BIOGEOGRAPHY

Introduction

One of the most striking differences between the eutherian and metatherian mammals is that the major centre of early radiation of Eutheria was Laurasia rather than Gondwana. With the exception of the Sirenia, all of the orders of eutherian mammals represented in Australia have their centre of origin in the Northern Hemisphere. The origins of some of the families are subject to some uncertainty and there is a possibility that at least two families of Microchiroptera and the Megachiroptera may have had their origin in the Southern Hemisphere. At the subfamilial level there has been considerable evolution in lineages such as murid rodents in Australasia and otariids and phocids since their entry to the southern oceans.

Order Chiroptera

Distributions of the bat genera found in Australia are summarised in Table 36.1. The major centres of radiation of four of the bat families represented in Australia are in the Old World tropics; the other three are the pantropical Emballonuridae and Molossidae and the virtually cosmopolitan Vespertilionidae

Family Pteropodidae. The family Pteropodidae is distributed widely in tropical and subtropical regions from Africa to the islands of the western Pacific Ocean (Koopman 1984c). The most widespread genus is *Pteropus* which ranges from Madagascar to the Cook Islands (Hall 1987). Within Australia this genus is widespread in the more mesic coastal regions from north-western Western Australia round the northern coastline and south to Victoria (Hall 1987). Of the other genera occurring in Australia, *Syconycteris* also occurs in New Guinea and *Dobsonia*, *Macroglossus* and *Nyctimene* are more widespread. Within Australia, *Dobsonia* and *Macroglossus* have restricted tropical distributions from Cape York to Cooktown and Mackay, respectively. *Macroglossus* is also found in northern and north-western Australia. *Nyctimene* occurs coastally from Cape York to the Tweed River and *Syconycteris* is found as far south as Coffs Harbour.

Family Emballonuridae. Two genera which occur in Australia are distributed from tropical Africa to the Solomon Islands. Within Australia the majority of species are tropical, with the exception of *Saccolaimus flaviventris* which occurs throughout the mainland, but is absent from Tasmania.

Family Megadermatidae. The genera in this family have a disjunct distribution with two genera endemic in Africa, one in Asia and the fourth (*Macroderma*) endemic to mainland Australia. The single Recent species occurs over a wide range in the tropics.

Family Rhinolophidae. This family is distributed widely in the Old World tropics and subtropics, but only two species extent to Australia. Of these, one (*Rhinolophus megaphyllus*) occurs elsewhere only in New Guinea, but the other (*R. philippinensis*) is more widespread. Within Australia, the first of these extends from Cape York to Victoria, but the second is more restricted and occurs only as far south as Townsville.

Family Hipposideridae. In this Old World tropical family, the genus *Hipposideros* is widespread, occurring throughout the family range. The other genus, *Rhinonycteris*, is endemic to Australia. Within the Australian *Hipposideros*, one species (*H. stenotis*) is endemic to the drier parts of the continent but the other four species extend to New Guinea and beyond.

Table 36.1 Distribution of bat genera found in Australia. Compiled from Hall (1984); Corbet & Hill (1986) and subsequent revisions.

FAMILY & GENUS	NUMBER OF SPECIES OCCURRING IN		
	AUSTRALIA ONLY	AUSTRALIA & NEW GUINEA	NEW GUINEA & ELSEWHERE
PTEROPODIDAE			
<i>Pteropus</i>	1	3	53
<i>Dobsonia</i>		1	9
<i>Nyctimene</i>	1		13
<i>Syconycteris</i>		1	2
<i>Macroglossus</i>		1	2
EMBALLONURIDAE			
<i>Saccolaimus</i>	1	2	2
<i>Taphozous</i>	3	1	7
MEGADERMATIDAE			
<i>Macroderma</i>	1		
RHINOLOPHIDAE			
<i>Rhinolophus</i>		2	66
HIPPOSIDERIDAE			
<i>Hipposideros</i>	1	4	46
<i>Rhinonycteris</i>	1		
VESPERTILIONIDAE			
<i>Myotis</i>		1	97
<i>Pipistrellus</i>	1	2	50
<i>Falsistrellus</i>	2		
<i>Eptesicus</i>	9		34
<i>Chalinolobus</i>	4	1	1
<i>Scotorepens</i>	2	2	
<i>Scoteanax</i>	1		
<i>Miniopterus</i>		2	9
<i>Phoniscus</i>		1	3
<i>Murina</i>		1	14
<i>Nyctophilus</i>	4	2	2
MOLOSSIDAE			
<i>Chaerephon</i>		1	14
<i>Mormopterus</i>	2	2	6
<i>Nyctinomus</i>	1		8

Family Vespertilionidae. This family is virtually cosmopolitan except in latitudes poleward of 60°, being absent only from some oceanic islands. Representatives occur all over mainland Australia, Tasmania and all offshore islands. Two genera (*Scoteanax* and *Falsistrellus*) are endemic to Australia. *Scotorepens*, *Nyctophilus* and *Chalinolobus* also occur in New Guinea. In *Chalinolobus*, the range of one species extends to New Caledonia and a single endemic species occurs in New Zealand. For further details of the distribution of this family refer to Hall & Woodside (Chapter 42).

Family Molossidae. The molossids are a widespread family occurring in most tropical to mid temperate regions. No genus is endemic to Australia and the three genera found here are widespread in the world. *Nyctinomus* is found on all continents, *Mormopterus* extends to Africa, South America and the Caribbean

and *Chaerephon* occurs from Australia to Africa. Within Australia, *Chaerephon* is restricted to the tropics. The other two occur widely, but are absent from Tasmania.

Order Primates

Following the first invasion approximately 40 000 years ago (Jones 1987; Smith 1987), hominids have been widespread in Australia. During the Pleistocene glaciations, the Tasmanians were probably the most southerly humans in the world.

Order Rodentia

Australia's native rodents are all members of the widespread family Muridae. As discussed above under Phylogeny, there is no universally accepted view of the relationships of the Australasian rodents. For the distribution of genera that occur in Australia see Table 36.2. Of the genera listed, *Rattus* and *Mus* occur throughout much of the Old World; the remainder are restricted to the Australasian region. The endemic Australasian rodent genera probably represent a number of independent lineages, some such as *Hydromys*, *Pogonomys*, *Uromys* and *Melomys* with their centres of origin in New Guinea and the remainder forming an Australian radiation.

Table 36.2 Distribution of genera of rodents occurring in Australia. Compiled from Watts & Aslin (1981), Carleton & Musser (1984) and unpublished information. *Number approximate pending revision of genus. Parentheses indicate number of species introduced.

GENUS	NUMBER OF SPECIES PRESENT IN		
	AUSTRALIA ONLY	AUSTRALIA & NEW GUINEA	NEW GUINEA ONLY
<i>Hydromys</i>		1	3
<i>Xeromys</i>	1		
<i>Pogonomys</i>	1		3
<i>Melomys</i>	5		13*
<i>Uromys</i>		1	6
<i>Notomys</i>	9		
<i>Mesembriomys</i>	2		
<i>Conilurus</i>	1	1	
<i>Zyzomys</i>	3		
<i>Leporillus</i>	2		
<i>Pseudomys</i>	24*		1
<i>Leggadina</i>	2		
<i>Mastacomys</i>	1		
<i>Rattus</i>	5	5(3)	9(2)
<i>Mus</i>		1(1)	

Within Australia, rodents occur in all climatic zones and display a number of adaptive types (Lee *et al.* 1981; see also Chapter 35 on Natural History). *Hydromys* occurs widely on both the mainland and Tasmania wherever suitable aquatic habitats exist. *Xeromys*, however, has a disjunct distribution and occurs only in three widely separated coastal areas. *Pogonomys* has been found only on the Atherton Tableland and Iron Range of north-eastern Queensland and *Uromys* is restricted to the tropical rainforest from Cape York to Townsville, but *Melomys* is more widespread in mesic coastal habitats from the Kimberley

region to central New Southern Wales. Of the two most numerous genera in Australia, *Notomys* is strictly limited to arid habitats, but *Pseudomys* occurs primarily in mesic areas with relatively few species in the arid zone. *Mesembriomys* and the only extant species of *Conilurus* occur in coastal and subcoastal areas. The extinct species of *Conilurus* occurred in the south-eastern mainland. Two of the three species of *Zyzomys* are distributed fairly widely in northern Australia, but the third (*Z. pedunculatus*) is found only in southern Northern Territory. Two species of *Leporillus* were formerly widespread across south-western Australia, but now the sole survivor (*L. conditor*) is found only on Franklin Island, South Australia. Of the two species of *Leggadina*, one is distributed widely in the arid centre and north-west and the other is restricted to a small area near Cooktown. *Mastacomys* has a restricted distribution and occurs only in a limited range of habitats in South-eastern New South Wales, Victoria and Tasmania.

Of the introduced rodents, *Mus* is found everywhere on the continent in all habitats, although it is scarce in wetter tropical areas. *Rattus norvegicus* is restricted to areas of human habitation and *R. rattus* occurs only in disturbed habitats, primarily in coastal areas.

Order Carnivora

The Dingo is absent from Tasmania, but otherwise occurred in all habitat types. In many areas of south-eastern Australia feral dogs of mixed breeds have replaced the Dingo. The introduced fox also occurs widely on the mainland except in the tropics and in rainforest habitats. As discussed in Chapter 37, there is some evidence for possible competitive exclusion of foxes by the Dingo in some areas. Feral cats occur virtually everywhere.

Among the marine carnivores, the fur seals represent a relatively old (Pliocene) radiation in the Southern Hemisphere (see section on fossil history, above). The single genus *Arctocephalus* has a circumpolar distribution with broad overlap between species. Two species have breeding colonies on islands off Australia and Tasmania. Three species occur on Macquarie Island and two are known to breed there. On the other hand, the Southern sea lions have a more discrete distribution with a single endemic genus in Australia. As discussed in the earlier section on fossil history the monachine seals represent an old Southern Hemisphere radiation. They occur primarily in Antarctic and sub-Antarctic waters and are only occasional wanderers to Australian waters.

Order Sirenia

The sirenians have a disjunct distribution in tropical waters with one extant family occurring in the Americas and West Africa and the other in the Indo-Pacific from the Red Sea to Morton Bay. The Indo-Pacific dugongs are restricted to the shallower continental shelf regions by their diet of marine grasses.

Order Cetacea

Most cetacean genera have virtually cosmopolitan distributions (Table 36.3). Some, such as *Hyperoodon*, *Lagenorhynchus*, *Orcinus* and *Phocoena*, occur in colder waters of both Northern and Southern Hemispheres while *Berardius* and *Caperea* are restricted to southern latitudes. Four genera, *Indopacetus*, *Sousa*, *Orcaella* and *Feresa*, are restricted to tropical waters. The rarest whale genus, *Indopacetus* is known only from two specimens.

Table 36.3 Distribution of cetacean genera which occur in Australian waters. Numbers after generic names indicate the number of species occurring in Australian waters. Data from Baker (1983) and Rice (1984); (1) except higher latitudes; (2) Tasmania to Argentina; (3) 2 specimens only from Queensland & E. Somalia; (4) tropical and warm temperate; (5) Africa to Australia; (6) India to Australia; (7) occasionally warm temperate; (8) Macquarie Is. only Australian record.

FAMILY & GENUS	NORTH		TROPICAL			SOUTH			NOTES
	Atl	Pac	Atl	Pac	Ind	Atl	Pac	Ind	
ZIPHIIDAE									
<i>Berardius</i> (1)						+	+	+	
<i>Ziphius</i> (1)	+	+	+	+	+	+	+	+	1
<i>Tasmacetus</i> (1)						+	+		2
<i>Indopacetus</i> (1)				+	+				3
<i>Hyperoodon</i> (1)	+					+	+	+	
<i>Mesoplodon</i> (6)	+	+	+	+	+	+	+	+	
PHYSETERIDAE									
<i>Physeter</i> (1)	+	+	+	+	+	+	+	+	1
<i>Kogia</i> (2)	+	+	+	+	+	+	+	+	4
DELPHINIDAE									
<i>Stenella</i> (2)	+	+	+	+	+	+	+	+	
<i>Tursiops</i> (2)	+	+	+	+	+	+	+	+	
<i>Globicephala</i> (2)	+	+	+	+	+	+	+	+	
<i>Grampus</i> (1)	+	+	+	+	+	+	+	+	
<i>Lagenodelphis</i> (1)	+	+	+	+	+	+	+	+	4
<i>Lagenorhynchus</i> (1)	+	+				+	+	+	
<i>Orcinus</i> (1)	+	+				+	+	+	
<i>Sousa</i> (1)				+	+				5
<i>Orcaella</i> (1)					+				6
<i>Delphinus</i> (1)	+	+	+	+	+	+	+	+	4
<i>Steno</i> (1)	+	+	+	+	+	+	+	+	4
<i>Feresa</i> (1)			+	+	+				7
<i>Lissodelphis</i> (1)		+				+	+	+	
<i>Peponocephala</i> (1)	+	+	+	+	+	+	+	+	4
<i>Pseudorca</i> (1)	+	+	+	+	+	+	+	+	4
PHOCOENIDAE									
<i>Phocoena</i> (1)	+	+				+	+	+	8
BALAENOPTERIDAE									
<i>Balaenoptera</i> (5)	+	+	+	+	+	+	+	+	
<i>Megaptera</i> (1)	+	+	+	+	+	+	+	+	
BALAENIDAE									
<i>Balaena</i> (1)	+	+	+	+	+	+	+	+	
<i>Caperea</i> (1)						+	+	+	

Order Lagomorpha

For a discussion of the worldwide distribution of lagomorphs see Chapter 45. Within Australia, the hare occurs throughout much of the eastern grassland and health habitats from Eyre Peninsula to Townsville. The rabbit now occurs everywhere except the far north where there appears to be the possibility of climate inhibiting sustained breeding.

Introduced Ungulates

For discussions of the worldwide and Australian distributions of the introduced ungulates see Chapters 58–62.

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