

# BiblioRakali: the Australian water rat, *Hydromys chrysogaster* Geoffroy, 1804 (Muridae: Hydromyinae), a subject-specific bibliography

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## ABSTRACT

Eighty-six references relating to the Australian water rat or Rakali (*Hydromys chrysogaster* Geoffroy), have been collated to create this bibliography. References were taken from available written literature (published and unpublished, with or without peer review) to provide a comprehensive resource for researchers. Using these references we present a summary of the distribution, status and biology of the species. In addition, each reference has been sorted into the following groups: behaviour, conservation status, description, diet, distribution, ecology, evolution, general, genetics, species management, parasites, physiology, reproduction and threatening processes.

## DESCRIPTION

The Australian water rat, or Rakali, *Hydromys chrysogaster*, was described by Geoffroy (1804) and is part of the Family Muridae (Vernes 1998) within the order Rodentia (Olsen 1983). The Hydromyinae includes all the native Australian rodents in the Muridae, except for the genus *Rattus* (Hinds et al., 2002).

*Hydromys chrysogaster* is thought to have radiated from New Guinea to Australia (Vernes 1998), and is one of the few amphibious mammals found in Australia (Hinds et al. 2002). Water rats have effectively colonised a niche which few mammals have successfully colonised, and have evolved adaptations to live a semi-aquatic and semi-nocturnal lifestyle (McKenzie, 1998). Water rats have a flattened head with small ears and eyes, dorsally located nostrils on a blunt nose and a large number of whiskers (Australian Museum, 2003). Their hind feet are broad and partially webbed for efficient swimming (Olsen 1983). The fur of the water rat is waterproof and the colouring depends on where it is found in Australia. It varies from black to grey on the dorsal surface and white to orange on the ventral surface (Olsen, 1983). Its tail is covered by dark fur and usually terminates with a white tip (Olsen, 1983). In south-eastern Australia, adult males ranged in length (head and body) from 231 – 345 mm (mean 310 mm), with a weight range of 400 – 1275 g (mean 755 g), while adult females were on average slightly smaller with head and body lengths of 245–370 mm (mean 290 mm) and weights from 340–992 g (mean 606 g; Olsen 1983). Olsen (1983) also reported that mean tail lengths were very similar between males and females at 275 and 272 mm respectively.

## DISTRIBUTION

Water rats live near permanent water whether it is fresh, brackish or marine (Olsen 1983). Water rats can be found in wetlands, rivers, estuaries and along beaches and on islands. Natural areas are not the only places offering suitable habitat, as artificial water sources and even polluted urban water bodies can support water rat populations (Watts & Aslin 1981).

Water rats are found in suitable habitats throughout Australia, New Guinea and the offshore islands. In Australia, *H. chrysogaster* is a widespread species (Vernes 1998), and can be found in all states and territories (Olsen, 1983, 1995). In Western Australia, they can be found along water courses and in wetlands on the Swan Coastal Plain, and along rivers in the Darling Range (Kitchener, Chapman & Barron 1978). The abundance of water rats in suitable habitats within Australia ranges from sparse to common (Olsen 1983).

A specimen list originally constructed by Kitchener et al. (1978) and updated by the Western Australian Museum (Ric How pers. comm., 2005<sup>1</sup>) gives an indication of the distribution of water rats in Western Australia from the late 1800s to 2002. Specimens have been sent to the Western Australian Museum from various places such as Kununurra, Shark Bay, Balingup and Albany. The majority of specimens were from regional country towns with only 13 specimens from Perth (all collected prior to 1983). A specimen was recently recovered from Lake Goollelal in Perth (Mike Bamford pers. comm. 2005<sup>2</sup>). The distribution

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Figure 1. Distribution of *Hydromys chrysogaster* (records prior to 1850 indicated by ★, 1950–1999 by □ and 2000 onwards by ●) in Western Australia based on specimens located in Australian museums (adapted from BioMaps (<http://www.biomaps.net.au/biomaps/> Retrieved 20/6/07) and FaunaBase (<http://www.museum.wa.gov.au/faunabase/prod/index.htm> Retrieved 20/6/07)).

of water rats in Western Australia as compiled from national, state and territory Museum records (FaunaBase and BioMap Databases) is shown in Figure 1.

### Conservation Status

Along rivers, water rat populations appear to be sparsely distributed. However in Victorian irrigated areas and drainage swamps, water rat populations have been found to be quite dense (Olsen, 1983). In these areas water rats are said to be a pest by some as they profit on the easy availability of prey and their burrows are thought to cause damage to irrigation structures (McNally 1960). However, they prey upon the burrowing freshwater crayfish (*Cherax destructor*), which could cause more damage if not kept in check by the water rat (Olsen 1983).

In the past, particularly in south-eastern Australia, the water rat was hunted to almost extinction for its fur, as it

was highly prized for use in clothing manufacture (McKenzie 1998). It is now a protected species across Australia and this is believed to have led to a recovery in abundance.

The current range of the water rat in Australia is similar to that occupied prior to European settlement (Watts & Aslin 1981). However, this does not reflect localised losses associated with clearing, pollution and secondary salinisation (Lee 1995). Lee (1995) believed that degradation and salinisation of southwestern Australian waterways had resulted in a substantial decline in populations. Water rats are considered to be secure nationally, however little is known of abundance and health of Western Australian populations. Water rats are not listed as a threatened species in the 2000 IUCN Red List of Threatened Species, the *Wildlife Conservation Act 1950* (Western Australian Government), or the *Environmental Protection and Biodiversity Conservation Act 1999*

(Commonwealth Government). However in Western Australia, it is listed as a Priority 4 species (Department of Environment and Conservation), that is, one that is not threatened at this time, but is in need of monitoring.

Oral histories (Sanders 1991) suggest that in the wheatbelt of Western Australia water rats declined during the 1950s and then the species disappeared from wetlands. This may have come about through falling numbers of the prey species (fish, frogs and crustaceans), which resulted from the increased salinity in the region (Sanders 1991; Lee 1995; Scott & Grant 1997).

The natural predators of the water rat are birds of prey, snakes and large fish but they are also taken by feral cats and foxes (Scott & Grant 1997). The impact of feral predators and cane toads on water rats is poorly understood.

Barrett (1950) controversially described the Western Australian populations as a different species to the eastern populations. Olsen (1983) however stated that subspecies had been described but were unlikely to be valid. Genetic studies are required to determine the taxonomic relationships between the various Australian populations as this may affect the imperatives for conserving each of these populations.

Despite the broad distribution and abundance of the species in Australia, it has attracted comparatively little scientific interest with only 85 publications found compared to the 294 for Chuditch (Smith et al. 2004). The possibility of a subspecies in Western Australia and the few publications available on western populations suggests that more research on this species is needed in the west.

## DIET

Water rats are not completely nocturnal and are most active around sunrise and sunset but can also be seen foraging during the day. Occasionally they climb trees in search of food but mainly forage in the water (Olsen 1983). Water rats will take captured prey to consume at feeding middens to allow their bodies to warm up between hunts, especially when the water temperature is low, as they don't have insulated fur (Scott & Grant 1997). Water rats are opportunists and will feed on fish, aquatic insects, mussels, crustaceans, small waterbirds, small mammals, lizards, frogs and even household rubbish. They consume little plant material and will only do so if their preferred prey is unavailable (Olsen 1983).

## REPRODUCTION

Water rats have been recorded as breeding at anytime of the year but according to Olsen (1983) the most common times are spring and summer. Any regional differences in breeding times are unknown. Females can start breeding at four months of age but usually begin at eight months. Nests generally consist of tunnels dug into a river bank, or occasionally logs. The gestation period lasts for 34 days

and 3–4 young are born. Typically one or two litters are produced a year but more litters are possible if conditions are optimal. The young are suckled for approximately four weeks but stay with the mother for another four weeks gaining independence before dispersing (Olsen 1983). A single male water rat will keep a large home range which may contain several female home ranges within it (Scott & Grant 1997). Water rats are territorial animals and will fight in overcrowded areas often resulting in damaged tails (Olsen, 1983).

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## BIBLIORAKALI

This bibliography of information on the Rakali or Australian water rat, *Hydromys chrysogaster*, lists the majority of known and available references that focus solely on the water rat and relevant literature that contains some information on the water rat.

The bibliography was built using titles extracted from the Web of Science and Streamline Online Databases at Edith Cowan University and the Department of Environment and Conservation (Western Australia) library at Woodvale. Some references have been taken from the World Wide Web and although useful may not be completely reliable sources of information. The URLs have been included in the reference but may change over time.

The references have been listed in alphabetical order and given a number. These numbers have been placed under 14 broad subject groups in relation to the information given in each reference.

### BEHAVIOUR:

2, 3, 10, 14, 21, 26, 28, 35, 40, 41, 44, 48, 49, 51, 54, 55, 56, 57, 60, 71, 75, 76, 79, 80, 81, 86

### CONSERVATION STATUS:

5, 8, 10, 14, 18, 19, 30, 37, 38, 40, 44, 46, 58, 59, 62, 64, 70, 79, 80

### DESCRIPTION:

1, 2, 3, 5, 8, 10, 14, 15, 18, 24, 25, 26, 28, 31, 34, 40, 41, 42, 49, 50, 51, 54, 57, 60, 64, 70, 71, 74, 75, 79, 80, 81

### DIET:

3, 5, 6, 8, 10, 14, 19, 34, 41, 44, 50, 51, 54, 55, 56, 57, 60, 71, 74, 75, 79, 80, 81, 86

**DISTRIBUTION:**

1, 2, 3, 4, 5, 8, 9, 10, 11, 14, 16, 18, 22, 25, 26, 28, 29, 30, 34, 35, 36, 37, 39, 40, 41, 42, 43, 44, 45, 46, 48, 50, 51, 54, 56, 57, 58, 59, 60, 62, 64, 67, 68, 70, 71, 73, 74, 76, 79, 80, 81, 82, 83, 84, 85

**ECOLOGY:**

3, 26, 28, 50, 56, 70, 79, 81, 86

**EVOLUTION:**

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**GENERAL:**

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**GENETICS:**

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**MANAGEMENT:**

10, 19, 40, 60, 80, 81

**PARASITES:**

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**PHYSIOLOGY:**

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**REPRODUCTION:**

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**THREATENING PROCESSES:**

5, 8, 10, 24, 30, 37, 38, 40, 41, 44, 50, 51, 52, 59, 60, 71, 79, 80

1. Australian Museum (2002) *Mammals of Sydney Harbour: Water-rats, Hydromys chrysogaster*. Retrieved on 20/6/07 from <http://www.livingharbour.net/mammals/rats.htm>
2. Australian Museum (2003) *Water Rat*. Retrieved on 20/6/07 from [http://www.amonline.net.au/factsheets/water\\_rat.htm](http://www.amonline.net.au/factsheets/water_rat.htm)
3. Australian Platypus Conservancy (1996) *Our Other "Platypus"– The Australian Water-rat*. Retrieved on 25/1/06 from [http://www.totalretail.com/tr/tr\\_plat.nsf/232c11af696287994a2566de0015d2c7/ec8886e0043628c34a256719007734ac?OpenDocument](http://www.totalretail.com/tr/tr_plat.nsf/232c11af696287994a2566de0015d2c7/ec8886e0043628c34a256719007734ac?OpenDocument)
4. Bamford, MJ, Bamford, AR (1990) *Yellagonga Regional Park: A Preliminary Survey of Vertebrate Fauna*. Department of Conservation and Land Management, Perth.
5. Barrett C (1950) *Wildlife in Australia Illustrated*. Colorgravure Publications, Melbourne.
6. Barrow GJ (1964) *Hydromys chrysogaster*– some observations. *Queensland Naturalist* **17**: 43–44.
7. Beveridge I (1980) *Uncinaria hydromyidis* sp. N. (Nematoda: Ancylostomatidae) from the Australian water rat, *Hydromys chrysogaster*. *Journal of Parasitology* **66**: 1027–1031.
8. Burbidge A.A., McKenzie NL (1989) Patterns in the modern decline of Western Australia's vertebrate fauna: causes and conservation implications. *Biological Conservation* **50**: 143–198.
9. CALM, National Parks and Nature Conservation Authority and City of Canning (1997) *Canning River Regional Park Management Plan 1997–2007*. Department of Conservation and Environment, Perth.
10. CALM (2003) *Water Rat (Rakali) Hydromys chrysogaster (Geoffroy, 1804)*. Retrieved on 20/6/07 from [http://www.naturebase.net/component?option=com\\_docman/task,cat\\_view/Itemid,1288/gid,375/orderby,dmdatecounter/ascdesc,DESC/](http://www.naturebase.net/component?option=com_docman/task,cat_view/Itemid,1288/gid,375/orderby,dmdatecounter/ascdesc,DESC/)
11. CALM, City of Wanneroo and City of Joondalup (2003) *Yellagonga Regional Park Management Plan 2003–2013*. Department of Conservation and Environment, Perth.
12. Cribb TH (1991) Notocotylidae (Digenea) from the Australian water-rat *Hydromys chrysogaster*, Geoffroy, 1804 (Muridae). *Systematic Parasitology* **18**: 227–237.
13. Cribb TH, Pearson JC (1988) *Baiobolmins elegans* n. g., n. sp. (Digenea: Nanophyetidae) from the Australian water-rat *Hydromys chrysogaster*. *Systematic Parasitology* **12**: 117–121.
14. CSIRO (2004) *Taxon Attribute Profiles Hydromys chrysogaster, Water-rat*. Retrieved on 20/6/07 from <http://www.anbg.gov.au/cpbr/WfHC/Hydromys-chrysogaster/>
15. Dawson TJ, Fanning FD (1981) Thermal and energetic problems of semiaquatic mammals: a study of the Australian water rat, including comparisons with the platypus. *Physiological Zoology* **54**: 285–296.
16. Deece K (1998) 'Distribution and microsatellite DNA studies of the water rat, *Hydromys chrysogaster*, in the Sydney Harbour Basin'. Thesis (Hons), University of Western Sydney Macarthur.
17. Dehnhardt G, Hyvarinen H, Palviainen A, Klauer G (1999) Structure and innervation of the vibrissal follicle-sinus complex in the Australian Water Rat, *Hydromys chrysogaster*. *The Journal of Comparative Neurology* **411**: 550–62.
18. Dickman CR, Leung LKP, Van Dyck SM (2000) Status, ecological attributes and conservation of native rodents in Queensland. *Wildlife Research* **27**: 333–46.

19. Dickman CR, Lunney D, Matthews A (2000) Ecological attributes and conservation of native rodents in New South Wales. *Wildlife Research* **27**: 347–55.
20. Fannin FD, Dawson TJ (1980) Body temperature variability in the Australian Water Rat, *Hydromys chrysogaster*, in air and water. *Australian Journal of Zoology* **28**: 229–238.
21. Fish FE, Baudinette RV (1999) Energetics of locomotion by the Australian Water Rat (*Hydromys chrysogaster*): a comparison of swimming and running in a semi-aquatic mammal. *The Journal of Experimental Biology* **202**: 353–63.
22. Flannery TF (1995) *Mammals of New Guinea*. Reed Books, Sydney.
23. Fleay D (1948) *The shy, water-loving aristocrat*. Walkabout (Reprint in Wildlife Australia, Summer 1990, 12–16).
24. Fleay D (1964) The rat that mastered the waterways. *Wildlife Australia* **1**: 3–7.
25. Friend JA, Thomas ND (1990) The water-rat, *Hydromys chrysogaster* (Muridae) on Dorre Island, W.A. *Western Australian Naturalist* **18**: 92–93.
26. Gardner JL, Serena M (1995) Observations on activity patterns, population and den characteristics of the water rat *Hydromys chrysogaster* along Badger Creek, Victoria. *Australian Mammalogy* **18**: 71–75.
27. Geoffroy Saint-Hilaire, É (1804) Note sur un nouveau genre de mammifères, de l'ordre des rongeurs, sous le nom d'hydromys. *Bulletin de la Société Philomatique de Paris* **3**: 353–354
28. Harris WF (1978) *An ecological study of the Australian water rat (Hydromys chrysogaster: Geoffroy) in southeast Queensland*. M.Sc. Thesis, University of Queensland, Brisbane.
29. Hind FE, Close RL, Campbell MT, Spencer PBS (2002) Characterisation of polymorphic microsatellite markers in the water rat (*Hydromys chrysogaster*). *Molecular Ecology Notes* **2**: 42–4.
30. Hocking GJ, Driessen MM (2000) Status and conservation of the rodents of Tasmania. *Wildlife Research* **27**: 371–77.
31. John Hopkins University (1997) *Water Rats, or Beaver Rats*. Retrieved on 25/1/06 from [http://www.press.jhu.edu/books/walkers\\_mammals\\_of\\_the\\_world/rodentia/rodentia.muridae.hydromys.html](http://www.press.jhu.edu/books/walkers_mammals_of_the_world/rodentia/rodentia.muridae.hydromys.html)
32. Johnston TH (1948) *Microphallus minutes*, a new trematode from the Australian water rat. *Records of the South Australian Museum* **9**: 93–100.
33. Johnston TH, Angel LM (1951) The life-history of *Plagiorchis jaenschii*, a new trematode from the Australian water rat. *Transactions of the Royal Society of South Australia* **75**: 49–58.
34. Jone FW (1968) *The Mammals of South Australia: Parts I–III 1923–1925*. Government Printer, Adelaide.
35. Kerle JA, Burgman MA (1984) Some aspects of the ecology of the mammal fauna of the Jabiluka Area, Northern Territory. *Australian Wildlife Research* **11**: 207–22.
36. Kitchener DJ, Chapman A, Barron G (1978) *Faunal Studies of the Northern Swan Coastal Plain: a Consideration of Past and Future Changes*. Western Australian Museum, Perth.
37. Laurance WF (1994) Rainforest fragmentation and the structure of small mammal communities in tropical Queensland. *Biological Conservation* **69**: 23–32.
38. Lee AK (1995) The Action Plan for Australia's Rodents. In *Endangered Species Program Project Number 130*. Australian Nature Conservation Agency, Switzerland.
39. Loos T (2000) Water rats *Hydromys chrysogaster* seen in Fitzroy Gardens at Easter-time. *Victorian Naturalist* **117**: 188–189.
40. McKenzie LM (1998) *The Marvellous Rakali*. An Elmac Production, Melbourne.
41. McNally J (1960) The biology of the water rat *Hydromys chrysogaster* Geoffroy (Muridae: Hydromyinae) in Victoria. *Australian Journal of Zoology* **8**: 170–180.
42. Menkhorst P (2001) *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne.
43. Menkhorst KA, Woinarski JCZ (1992) Distribution of mammals in monsoon rainforests of the Northern Territory. *Wildlife Research* **19**: 295–316.
44. Menkhorst PW, Ed. (1995) *Mammals of Victoria: Distribution, Ecology and Conservation*. Oxford University Press, Melbourne.
45. Menzies JI, Dennis E (1979) *Handbook of New Guinea Rodents*. Wau Ecology Institute Handbook No.6.
46. Morris KD (2000) The status and conservation of native rodents in Western Australia. *Wildlife Research* **27**: 405–19.
47. Obendorf DL, Smale, LR (1985) The internal parasites and pathological findings in *Hydromys chrysogaster* (Muridae: Hydromyinae) from Tasmania. *Australian Journal of Zoology* **33**: 33–38.
48. Olsen PD (1980) Seasonal and maturational pelage changes, and injuries, in the eastern water rat, *Hydromys chrysogaster*, at Griffith, N.S.W. *Australian Wildlife Research* **7**: 217–33.
49. Olsen PD (1982) Reproductive biology and development of the water rat, *Hydromys chrysogaster*, in captivity. *Australian Wildlife Research* **9**: 39–53.

50. Olsen PD (1983). Water-rat *Hydromys chrysogaster* in *The Australian Museum's Complete Book of Australian Mammals*. (ed.) R. Strahan. Angus and Robertson, Sydney, 367–368.
51. Olsen PD (1995) Water-rat, *Hydromys chrysogaster*. In *The Mammals of Australia*. (ed.) R. Strahan. Reed Books, Chatswood, 628–629.
52. Olse P, Settle H (1979) Pesticide contamination of water rats in the Murrumbidgee Irrigation areas, New South Wales, Australia, 1970–72. *Pesticides Monitoring Journal* **12**: 185–188.
53. Peterson J (1965) Eastern water rat. *Victorian Naturalist* **82**: 206.
54. Petzold D (1997) *Eco-ethology of the Australian Water Rat (Hydromys chrysogaster)*. Retrieved on 20/6/07 from [http://www.dirk-petzold.de/sr\\_tiere\\_e.htm](http://www.dirk-petzold.de/sr_tiere_e.htm)
55. Petzold D, Trillmich F, Dehnhardt G (1997) The role of water depth and food types for foraging and diving behaviour in Australian water rats (*Hydromys chrysogaster*). *Advances in Ethology* **32**: 187.
56. Preston T (2004) *Rakali Observations: 2003–2004*. Retrieved on 20/6/07 from <http://home.vicnet.net.au/~earthcar/rakali200.htm>
57. Queensland Government (2004) *Water Rat: Hydromys chrysogaster*. Retrieved on 20/6/07 from [http://www.epa.qld.gov.au/nature\\_conservation/wildlife/native\\_animals/nocturnal\\_animals/mammals/water\\_rat/](http://www.epa.qld.gov.au/nature_conservation/wildlife/native_animals/nocturnal_animals/mammals/water_rat/)
58. Robinson AC, Kemper CM, Medlin .C., Watts CHS (2000) The rodents of South Australia. *Wildlife Research* **27**: 379–404.
59. Sanders A (1991) *Oral Histories Documenting Changes in Wheatbelt wetlands*. Department of Conservation and Land Management, Como, Western Australia.
60. Scott A, Grant . (1997) *Impacts of Water Management in the Murray-Darling Basin on the Platypus (Ornithorhynchus anatinus) and the Water Rat (Hydromys chrysogaster)*. Retrieved on 20/6/07 from <http://pandora.nla.gov.au/pan/13482/20020130/www.clw.csiro.au/publications/technical/tr23-97.pdf>
61. Seebeck J (2000) Wandering with water rats or, rambling with Rakali. *Victorian Naturalist* **117**: 229–231.
62. Seebeck J, Menkhorst P (2000) Status and conservation of rodents of Victoria. *Wildlife Research* **27**: 357–69.
63. Smales LR (1996) *Heterakis fieldingi* n.sp. (Nematoda: Heterakoidea) from the Australian water-rat, with a review of heterakids occurring in mammals. *Systematic Parasitology* **35**: 127–132.
64. Smales LR (1984) A survey of *Hydromys chrysogaster*, the Australian Water Rat, in Central Gippsland. *Victorian Naturalist* **101**: 115–118.
65. Smales LR (1991) A new species of *Antechiniella* Quentin & Beveridge, 1986 (Nematoda: Acuariidae) from the Australian water rat, *Hydromys chrysogaster* Geoffroy, 1804. *Transactions of the Royal Society of South Australia* **115**: 217–220.
66. Smales LR (1997) A review of the Helminth parasites of Australian rodents. *Australian Journal of Zoology* **45**: 505–21.
67. Smales LR, Cribb TH (1997) Helminth parasite communities of the Water-rat, *Hydromys chrysogaster*, from Queensland. *Wildlife Research* **24**: 445–57.
68. Smales LR, Obendorf D. (1996) Protozoan parasites and pathological findings in *Hydromys chrysogaster* (Muridae: Hydromyinae) from Queensland. *Journal of Wildlife Diseases* **32**: 344–347.
69. Smales LR, Obendorf DL, Miller AK (1990) Parasites of the water-rat *Hydromys chrysogaster* from Victoria and South Australia. *Australian Journal of Zoology* **37**: 657–663.
70. Smit M (1995) The Ecology of the Eastern Water rat (*Hydromys chrysogaster*) at Swan Bay, Queenscliff, Victoria. B. Sc. (Honours) Thesis – University of Ballarat.
71. Smith M (1999) *Rakali Watch 1999 Results*. Retrieved on 20/6/07 from <http://home.vicnet.net.au/~earthcar/rakali.htm>
72. Swann CA, Hope RM, Breed WG (2002) cDNA nucleotide sequence encoding the ZPC protein of Australian hydromyine rodents: a novel sequence of the putative sperm-combining site within the family Muridae. *Zygote* **10**: 291–299.
73. Tate GHH (1951) Results of the Archbold expeditions No.65– the rodents of Australia and New Guinea. *Bulletin of the American Museum of Natural History* **97**: 183–430.
74. Triggs B (1996) *Tracks, Scats and Other Traces: a Field Guide to Australian Mammals*. Oxford University Press, Melbourne.
75. Troughton E (1941) Australian water-rats: Their origin and habits. *Australian Museum Magazine* **7**: 377–381.
76. Vernes K (1998) Observation of a long-range overland movement event by an adult common water rat, *Hydromys chrysogaster*. *Australian Mammalogy* **20**: 409–410.
77. Waikagu J, Pearson JC (1989) *Heterophyes nocens* Onji & Nishio, 1916 (Digenea: Heterophyidae) from the water rat, *Hydromys chrysogaster* Geoffroy, 1804 in Australia. *Systematic Parasitology* **13**: 53–61.

78. Wallau BR, Schmitz A, Perry SF (2000) Lung morphology in rodents (Mammalia, Rodentia) and its implications for systematics. *Journal of Morphology* **246**: 228–248.
79. Watt C.H.S, Aslin HJ (1981) *The Rodents of Australia*. Angus & Robertson, Australia.
80. Weir A (1998) *A Survey of the Australian Water Rat (Hydromys chrysogaster) from Beaumaris to Brighton*. Bayside City Council, Melbourne.
81. Weir A (2004) *Australian Water Rat Management Report*. Bayside City Council, Melbourne.
82. Western Australian Museum (2003) *Hydromys chrysogaster*. Retrieved on 20/6/07 from <http://www.museum.wa.gov.au/faunabase/prod/>
83. Woinarski JCZ, Palmer C, Fishe, A, Southgate R, Masters P, Brennan K (1999) Distributional patterning of mammals on the Wessel and English Company Islands, Arnhem Land, Northern Territory, Australia. *Australian Journal of Zoology* **47**: 87–111.
84. Woinarski JCZ (2000) The conservation status of rodents in the monsoonal tropics of the Northern Territory. *Wildlife Research* **27**: 421–35.
85. Woinarski JCZ, Milne DJ, Wanganeen G (2001) Changes in mammal populations in relatively intact landscapes of Kakadu National Park, Northern Territory, Australia. *Austral Ecology* **26**: 360–70.
86. Woollard P, Vestjens WJM, MacLean L (1978) The ecology of the eastern water rat *Hydromys chrysogaster* at Griffith, N.S.W.: food and feeding habits. *Australian Wildlife Research* **5**: 59–74.

### Additional Reference cited

- Smith JA, Wright LJ, Morris KD (2004) BiblioChuditch: the chuditch, *Dasyurus geoffroii* (Gould 1841), a Wildlife Science Library subject-specific bibliography. *Conservation Science Western Australia* **5**(1) 6–19