GLOBAL INVASIVE SPECIES DATABASE

FULL ACCOUNT FOR: ***Rattus exulans***

Rattus exulans 正體中文

System: Terrestrial

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Mammalia	Rodentia	Muridae

Common name Kleine Pazifikratte (German), kiore (Maori), Maori rat (English), Pacific rat (English), Polynesian rat (English), tikus Polynesia (English, Indonesia)

Synonym *Mus exulans* , Peale, 1848
Mus maorium , Hutton, 1877, 1879

Similar species *Rattus norvegicus*

Summary The Pacific rat is the smallest of the three rats closely associated with humans. The fur is brown and its tail length is only slightly longer or shorter than the combined head and body length. Rattus exulans is recognised as a predator of native insects, lizards and birds, a browser of native flora and an agricultural pest. There appears to be no island groups reached by the Polynesians that did not receive Rattus exulans, although not all islands in a group were necessarily colonised.

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Species Description
The Pacific rat (*Rattus exulans*) is the smallest of the three rats (*Rattus rattus*, *R. norvegicus* and *R. exulans*) closely associated with humans. *R. exulans* has a slender body, pointed snout, large ears, and relatively small, delicate feet. A ruddy brown back contrasts with a whitish belly. Mature individuals are 4.5 to 6 inches long (11.5 to 15.0cm) from the tip of the nose to the base of the tail and weigh 1.5 to 3 ounces (40 to 80 g). The tail has prominent fine scaly rings and is about the same length as the head and body. Female *R. exulans* have 8 nipples, compared to 10 and 12 nipples normally found on *R. rattus* and *R. norvegicus*, respectively (Tobin 1994). Morphology (skull size) of *R. exulans* has been shown to vary with latitude (Bergman's rule: geographic races of species with smaller body size are found in warmer parts and larger body size in colder parts of the species range) and island size. This effect is most pronounced in the tropics (Atkinson and Towns 2001).
A useful feature distinguishing them from other rats is the dark outer edge of the upper side of the hind foot near the ankle, the remainder of the foot being pale.

Notes
The larger species of *Rattus rattus* and *Rattus norvegicus* are known to displace the Pacific rat (*Rattus exulans*) from its environmental niche (Spennemann, 1997).
The Polynesian rat is thought to have originated from the Malayan region, and to have been deliberately introduced to many islands by Polynesians who considered it a valuable food source (Spennemann, 1997).

Lifecycle Stages
In New Zealand: Gestation 19-21 days. Weaning 2-4 weeks. Sexual maturity 8-12 months, though maturity can be achieved during the same season as birth (Atkinson and Moller 1990). In captivity: Gestation minimum 23 days. Weaning 2-3 weeks. Sexual maturity 60-70 days (Tobin 1994). Total life is estimated between 12 - 15 months. Pacific rats have been observed to mature earlier and survive better, with some adults surviving to a second breeding season, where high quality food and year-round shelter were available (Atkinson and Towns, 2001). Strong seasonal fluctuations occur in the density of kiore populations on New Zealand's northern offshore islands. Breeding is restricted to spring and summer, so densities reach a peak in autumn, then decline to low levels in spring (Campbell *et al*., 1984).

Habitat Description
Pacific rats can live in a wide range of habitats including grassland, scrub and forest, however they do require adequate food supplies and shelter (especially in temperate latitudes). They are able to climb trees easily where at least some of their feeding is done, but are not good swimmers. Snap trap success results have shown annual cycles in the abundance of *R. exulans* on Tiritiri Island in New Zealand. *R. exulans* are predominantly nocturnal, but become active just before dark during times of high density.
Husking stations have been found amongst tree roots, within wide fissures in tree trunks at ground level, amongst rock piles, under the enlarged bases of fronds shed from nikau palms, and occasionally up trees – all characteristically dry places (Campbell *et al*., 1984). *Rattus exulans* is considered to be a fairly sedentary animal with a limited home range (Spennemann, 1997).

Reproduction
Placental, sexual. Females are polyestrous and ovulate spontaneously. Breeding largely determined by food availability. Litter size normally 6 - 11, gestation is 21-24 days, young weaned at about 28 days. Females can be sexually active in the season of their birth, and can have up to six litters a year (Wittenberg, R. (ed.) 2005). In New Zealand, the Norway rat has been observed breeding throughout the year (Innes, 2001).

Nutrition
The Pacific rat eats a wide range of foods including earthworms, centipedes, larvae of some butterflies and moths, ants, beetles, weevils, cicadas, snails, spiders, lizards and birds. They also eat fleshy fruit and other seeds, flowers, stems, leaves, roots and other plant parts.
Campbell *et al*. (1984) found that Pacific rats feed on: invertebrates (eg. ants, wetas, moths - eggs, larvae and pupae but especially large insects over 12mm in length), amphipods, and chicks, and plant material such as seeds, leaves, shoots, bark, flowers and roots. They will strip bark and eat plant stems, particularly in winter. Pacific rats may not consume all edible parts of fruits in one sitting. They eat a wide range of plant and animal items of varying sizes and stages of development, living in habitats ranging from treetops to underground. A study on Lady Alice Island, New Zealand, (Newman and McFadden, 1990) found that Pacific rats eat 78% plant material together with a wide range of animal food, including weevils, scarab beetles, moth larvae, weta, seabird chicks and skinks (Atkinson and Towns, 2001). Pacific rats have been observed to carry food to "husking stations" to feed, where they are sheltered from predators, competitors and rain (Campbell *et al*., 1984).

General Impacts
Atkinson and Towns (2001) report numerous species of New Zealand flora and fauna that are vulnerable to Pacific rats (*Rattus exulans*). Most vulnerable amongst invertebrates are large, flightless species; especially those that need to descend to ground level for part of their life-cycle. Lizard populations have also been shown to increase following the removal of *Rattus exulans*. In Hawai'i and New Zealand there are examples of detrimental effects on both burrowing petrels and on red-tailed tropicbirds. In the Leeward Islands of Hawai'i, it has been shown that predation on seabirds only becomes significant after storms have reduced the fruiting of food plants. Fatal attacks by *R. exulans* on adult Laysan albatrosses appear likely to be associated with the same factor. *R. exulans* is also known to browse native flora (including trees, shrubs, fungi, sedges, grasses, orchids and other herbaceous plants and lianes), although the magnitude of such effects has been difficult to determine (Atkinson and Atkinson, 2000).
R. exulans is a major agricultural pest throughout Southeast Asia and the Pacific region. Crops damaged by this species include rice, maize, sugarcane, coconut, cacao, pineapple, and root crops.

Management Info
Preventative measures: Research has shown that it can often be difficult to eradicate rats from islands in the early stages of invasion, hence it is better to prevent rodents arriving on islands in the first place. Eliminating a single invading rat can be disproportionately difficult because of atypical behaviour by the rat in the absence of conspecifics, and because bait can be less effective in the absence of competition for food (Russell *et al.* 2005). Weihong *et al.* (1999) provide useful information regarding the detection of rodent species using different trapping methods and bait, Dilks and Towns (2002) published by New Zealand's Department of Conservation discusses how to detect and respond to rodent invasions on islands.
Physical: Control on mainland sites predominantly consists of snap-trapping.
Chemical: Over the last fifteen years, Pacific rats (*Rattus exulans*) have been eradicated from increasingly larger New Zealand offshore islands. To date, the largest eradication has been from Raoul Island (2938 ha), although confirmation of eradication from the larger Little Barrier Island (3083 ha) is due this year. Eradication of *R. exulans* populations on islands is achieved using chemical poisons. In New Zealand compound 1080 has not proved effective against *R. exulans*, but they are susceptible to anticoagulant poisons such as brodifacoum and bromadialone. Recent successful eradication campaigns have all sown Talon 20 P baits aerially by helicopter. Talon 20 P is a cereal-based (pollard) pellet of approximately 0.8 g containing the anticoagulant toxin brodifacoum at 20 ppm. Currently this is applied at 15kg/ha at a cost of ~$75US/ha (Atkinson and Towns 2001). Fisher *et al*. (2004) suggest that diphacinone especially, and also coumatetralyl and warfarin, should be evaluated in field studies as alternative rodenticides in New Zealand. Brodifacoum, the most widely used rodenticide in New Zealand currently, can acquire persistent residues in non-target wildlife. Mineau *et al.* (2004) presented a risk assessment of second generation rodenticides at the 2nd National Invasive Rodent Summit. O'Connor and Eason (2000) discusses the variety of baits which are available for use on offshore islands in New Zealand.
Biological: Monitor lizards and mongooses were introduced to Pacific islands in early attempts to control *R. exulans*.
Contraceptive methods of control are currently experimental, but the potential for effective control using contraceptive methods is promising. National Wildlife Research Center (USA) scientists are working on several possible formulations that may make effective oral immunisation possible (Nash and Miller, 2004).
Guidelines for the Eradication of Rats From Islands Within the Falklands Group offers guidelines for the eradication of rats from islands, based on the experiences in eradicating rats from the Falklands group.

Pathway
Rattus exulans is thought to have been deliberately introduced to many islands by Polynesians who considered it a valuable food source (Spennemann, 1997).

Principal source:

Compiler: IUCN SSC Invasive Species Specialist Group
Updates with support from the Overseas Territories Environmental Programme (OTEP) project XOT603, a joint project with the Cayman Islands Government - Department of Environment

Review:

Pubblication date: 2010-10-04

ALIEN RANGE

[6] AMERICAN SAMOA
[1] CHILE
[19] FIJI
[1] GUAM
[5] INDONESIA
[27] KIRIBATI
[33] MARSHALL ISLANDS
[1] MYANMAR
[5] NEW CALEDONIA
[68] NEW ZEALAND
[4] NORTHERN MARIANA ISLANDS
[28] PAPUA NEW GUINEA
[5] PITCAIRN
[18] SOLOMON ISLANDS
[3] TOKELAU
[4] TUVALU
[2] UNITED STATES MINOR OUTLYING ISLANDS
[3] WALLIS AND FUTUNA
[2] AUSTRALIA
[15] COOK ISLANDS
[34] FRENCH POLYNESIA
[1] INDIA
[1] JAPAN
[1] MALAYSIA
[14] MICRONESIA, FEDERATED STATES OF
[1] NAURU
[1] NEW GUINEA
[1] NIUE
[3] PALAU
[1] PHILIPPINES
[4] SAMOA
[1] TAIWAN
[5] TONGA
[15] UNITED STATES
[8] VANUATU

Red List assessed species 54: EX = 3; EW = 1; CR = 11; EN = 12; VU = 17; NT = 8; LC = 2;

Acrocephalus kerearako **NT**
Acrocephalus taiti **VU**
Anas laysanensis **CR**
Branta sandvicensis **VU**
Corvus hawaiiensis **EW**
Cyanoramphus novaezelandiae **VU**
Gallicolumba erythroptera **CR**
Megalurulus mariei **LC**
Mystacina robusta **CR**
Nesofregetta fuliginosa **EN**
Oceanites maorianus **CR**
Oreomystis bairdi **CR**
Palmeria dolei **CR**
Phoebastria immutabilis **NT**
Platymantis vitianus **EN**
Pomarea mendozae **EN**
Pomarea nigra **CR**
Procellaria parkinsoni **VU**
Pseudobulweria macgillivrayi **CR**
Pterodroma atrata **EN**
Pterodroma cookii **VU**
Pterodroma magentae **CR**
Pterodroma sandwichensis **VU**
Acrocephalus rimatarae **VU**
Acrocephalus vaughani **EN**
Apteryx owenii **NT**
Coenocorypha aucklandica **NT**
Cyanoramphus auriceps **NT**
Eunymphicus cornutus **VU**
Gallirallus australis **VU**
Melamprosops phaeosoma **CR**
Myzomela chermesina **VU**
Numenius tahitiensis **VU**
Oligosoma suteri **LC**
Pachycephala jacquinoti **NT**
Philesturnus carunculatus **NT**
Phoebastria nigripes **EN**
Pomarea fluxa **EX**
Pomarea mira **EX**
Porzana atra **VU**
Prosobonia cancellata **EN**
Pterodroma alba **EN**
Pterodroma cervicalis **VU**
Pterodroma incerta **EN**
Pterodroma pycrofti **VU**
Pterodroma ultima **NT**

Ptilinopus huttoni **VU**
Puffinus newelli **EN**
Sceloglaux albifacies **EX**
Vini kuhlii **EN**
Puffinus auricularis **CR**
Rattus simalurensis **EN**
Todiramphus ruficollaris **VU**
Vini stepheni **VU**

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Summary: This report reviews available information on the adverse effects of 14 alien vertebrates considered to be ﷽significant invasive species on islands of the South Pacific and Hawaii, supplementing the authors﷽ experience with that of other workers.

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Brooke, M. de L. 1995. The breeding biology of the gadfly petrels *Pterodroma* spp. of the Pitcairn Islands: characteristics, population sizes and controls. Biological Journal of the Linnean Society 56: 213-231.

Summary: This reference by Mike Brooke describes the total loss of all chicks of Kermedaec petrels on Henderson Island to Pacific rat predation.

Cromarty, P. L.; K. G Broome, A. Cox, R. A. Empson, W. M. Hutchinson, and I. McFadden., 2002. Eradication planning for invasive alien animal species on islands- the approach developed by the New Zealand Department of Conservation. In *Turning the tide: the eradication of invasive species*: 85-91. Veitch, C.R. and Clout, M.N.(eds). IUCN SSC Invasive Species Specialist Group. IUCN. Gland. Switzerland and Cambridge. UK.

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Cunningham, D.M. and Moors, P.J., 1993. Guide To The Identification And Collection Of New Zealand Rodents. Department of Conservation, NZ.

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Dilks, P and Towns, D., 2002. Developing tools to detect and respond to rodent invasions of islands: workshop report and recommendations. DOC SCIENCE INTERNAL SERIES 59

Summary: Available from: http://www.doc.govt.nz/upload/documents/science-and-technical/DSIS59.pdf [Accessed 19 February 2008]

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IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4.

Summary: The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable). The IUCN Red List also includes information on taxa that are categorized as Extinct or Extinct in the Wild; on taxa that cannot be evaluated because of insufficient information (i.e. are Data Deficient); and on taxa that are either close to meeting the threatened thresholds or that would be threatened were it not for an ongoing taxon-specific conservation programme (i.e. are Near Threatened).

Available from: http://www.iucnredlist.org/ [Accessed 25 May 2011]

IUCN/SSC Invasive Species Specialist Group (ISSG)., 2010. A Compilation of Information Sources for Conservation Managers.

Summary: This compilation of information sources can be sorted on keywords for example: Baits & Lures, Non Target Species, Eradication, Monitoring, Risk Assessment, Weeds, Herbicides etc. This compilation is at present in Excel format, this will be web-enabled as a searchable database shortly. This version of the database has been developed by the IUCN SSC ISSG as part of an Overseas Territories Environmental Programme funded project XOT603 in partnership with the Cayman Islands Government - Department of Environment. The compilation is a work under progress, the ISSG will manage, maintain and enhance the database with current and newly published information, reports, journal articles etc.

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ITIS (Integrated Taxonomic Information System), 2005. Online Database *Rattus exulans*

Summary: An online database that provides taxonomic information, common names, synonyms and geographical jurisdiction of a species. In addition links are provided to retrieve biological records and collection information from the Global Biodiversity Information Facility (GBIF) Data Portal and bioscience articles from BioOne journals.

Available from:
http://www.cbif.gc.ca/pls/itisca/taxastep?king=every&p_action=containing&taxa=Rattus+exulans&p_format=&p_ifx=plglt&p_lang= [Accessed March 2005]

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