MAMMALIAN SPECIES 831:1–11

Cercartetus concinnus (Diprotodontia: Burramyidae)

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Abstract: *Cercartetus concinnus* (Gould, 1845) is a burramyid commonly called the western pygmy-possum. It is 1 of 4 species in the genus *Cercartetus*, which together with *Burramys parvus* form the marsupial family Burramyidae. *C. concinnus* is endemic to southern mainland Australia. Its habitat is heathlands, shrublands, and dry forests in semiarid zone areas and it feeds on a range of foods, particularly nectar and pollen. This species is notable for short-term hibernation and its role as a pollinator of plants. It is considered secure throughout most of its range except for southwestern New South Wales, where it is classified as endangered. DOI: 10.1644/831.1.

Key words: Australia, Burramyidae, hibernator, marsupial, pollinator, western pygmy-possum

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Cercartetus Gloger, 1841

Cercartetus Gloger, 1841:85. Type species *Phalangista nana* Desmarest, 1817, by monotypy.
Dromicia Gray, 1841:401. Type species *Phalangista nana* Desmarest, 1817, by monotypy.
Burramys Broom, 1896:563. Type species *Burramys parvus* Broom, 1896, by monotypy.
Eudromicia Mjöberg, 1916:13. Type species *Eudromicia macrura* Mjöberg, 1916, by subsequent designation (Matschie 1916:260).
Dromiciola Matschie, 1916:260. Type species *Dromicia lepida* Thomas, 1888, by original designation.
Dromiciella Matschie, 1916:260. Type species *Dromicia concinna* Gould, 1845, by original designation.

CONTEXT AND CONTENT. Order Diprotodontia, suborder Phalangeriformes, superfamily Phalangeroidea, family Burramyidae (Kirsch 1968). The family Burramyidae consists of 2 genera: *Burramys* and *Cercartetus*. Members of *Cercartetus* are *C. caudatus*, *C. concinnus*, *C. lepidus*, and *C. nanus* (Harris 2008; van Dyck and Strahan 2008).

A rudimentary key to the extant burramyids adapted from descriptions in Flannery (1994) follows:

1. Ventral fur pure white ..... *C. concinnus*
   Ventral fur more gray than white 2
2. Adult body weight ≤9 g ..... *C. lepidus*
   Adult body weight substantially >9 g 3
3. Tail about the same length as body and <100 mm ..... *C. nanus*
   Tail >1.2 times length of body and >140 mm 4
4. P3 longer than each molar, grooved and serrated ..... *B. parvus*
   P3 smaller than molars, not grooved or serrated ..... *C. caudatus*

Cercartetus concinnus (Gould, 1845)
Western Pygmy-possum

Dromicia concinna Gould, 1845:2. Type locality "Western Australia;" restricted to "Swan River" by Thomas (1922:127).

Fig. 1.—An adult *Cercartetus concinnus* from Nepean Bay Conservation Park, Kangaroo Island, South Australia. Used with permission of the photographer A. C. Robinson.

Phalangista (*Dromicia*) *concinna*: Waterhouse, 1846:314. Name combination.

Phalangista (*Dromicia*) *neillii* Waterhouse, 1846:315. Type locality "King George's Sound, Western Australia."

Dromicia (*Dromiciella*) *concinna*: Glauert, 1933:24. Name combination.

Cercartetus concinnus: Iredale and Troughton, 1934:22. First use of current name combination and correction for gender.

CONTEXT AND CONTENT. Context as for genus. Two subspecies (listed below) have been previously recognized (Flannery 1994; McKay 1988). However, as discussed in the Nomenclatural Notes, this is unwarranted, and accordingly I do not recognize them as valid.

C. concinnus concinnus Gould, 1845:2. See above.

C. concinnus minor Wakefield, 1963:100. Type locality "Nurcong [approximately 16 km] northwest of Natimuk," Victoria.

NOMENCLATURAL NOTES. The genus name *Dromicia* (Gray 1841) was used in the 1st description of the subject species (Gould 1845). An alternate genus, *Dromiciella* (Matschie 1916), was later proposed for *D. concinna*, although this was largely ignored. Iredale and Troughton (1934) noted that *Cercartetus* (Gloger 1841) antedated *Dromicia* by several months. They advanced *Cercartetus concinnus* to supersede *D. concinna* and this included a slight change in the epithet to accord with the new genus.

Two subspecies of *C. concinnus* were originally proposed based on slight differences in size and coloration but principally because of an apparent disjunct distribution: *C. c. concinnus* in southwestern Western Australia and *C. c. minor* in South Australia, western Victoria, and western New South Wales (Wakefield 1963). However, the subspecific arrangement was later questioned (Wakefield 1970) because of both modern and fossil records from approximately the middle of the distributional gap (Bolam 1923; Lundelius 1957), and lack of significant differences in body and skull measurements (Ryan 1963). Consequently, for some years the status of the 2 subspecies was a matter of debate (Flannery 1994; McKay 1988; Smith 1995), but recent genetic studies provide reasonably convincing evidence that there are in fact no subspecies (Osborne and Christidis 2002; Pestell et al. 2008).

It has occasionally been presumed that *Cercaertus* (Burmeister 1837) was a misspelling or synonym of *Cercartetus* (e.g., Cook 1963; Grzimek 1975; Ryan 1963; Sharman 1963; Simpson 1945). However, *Cercaertus* is a junior synonym of *Trichosurus* (brushtail possums) and not of *Cercartetus* (Harris 2006; Wakefield 1963). *Cercartetus* is a reference to the prehensile tail (from the Greek *kerkos*) and *concinnus* is derived from the Latin word for elegant or neat (Flannery 1994; Strahan 1981).

Vernacular names used include "beautiful pigmy-phalanger" (Waterhouse 1846), "Neill's phalanger" (Gerrard 1862; Waterhouse 1846), "beautiful Dromicia" (Gould 1863), "King George's Sound Dromicia" (Krefft 1871), "lesser dormouse-phalanger" (Thomas 1888), "western dormouse-opossum" (Ogilby 1892), "western dormouse-phalanger" (Lydekker 1896), "elegant dormouse possum" (Wood Jones 1924), "western pigmy possum" (Iredale and Troughton 1934), and "thin-tailed dormouse possum" or "southwestern pygmy phalanger" (Grzimek 1975). Aboriginal names for *C. concinnus* include "Man-dur-da" (Gould 1863; Whittell 1954) or "Mundarda" (Brooker 1988; Wakefield 1963), "Jāā-jat" (Waterhouse 1846), "Nyeranit" (Abbott 2001; Shortridge 1909), and "Wirappi" (Tunbridge 1991).

DIAGNOSIS

Cercartetus concinnus (Fig. 1) is distinguished from other pygmy-possums by its size, coloration, length of tail, and dentition. This species has pure white underparts (including chin and lower jaw), and the line of demarcation from the bright cinnamon-gray dorsal fur is sharply marked. All other pygmy-possum species have gray-based belly fur.

GENERAL CHARACTERS

Cercartetus concinnus has a delicate skull with short, pointed rostrum, slender zygomatic arch, and broad squamosals (Fig. 2; Rosenberg and Richardson 1995; Turner and McKay 1989). The dentition is diprotodont and the 3 molars present have simplified crowns. It possesses long vibrissae, large, black, forward-directed eyes, and a dark patch in front of the eyes, but this is indistinct compared with that of some other pygmy-possum species. The ears are large, oval-shaped, thin, and membranous (Fig. 1). The tail is finely scaled, long, slender, prehensile, and cylindrical, except for the base, which is occasionally incrassated (Casanova 1958). On the digits of the forefeet and hind feet they have expanded apical pads (Fig. 3; Wood Jones 1924) that have eccrine sweat glands (Green 1963; Rosenberg and Rose 1999). The 2nd and 3rd digits on the hind feet are syndactylous, and the hallux is opposable and clawless.

The sexes are very similar in size and color (Gould 1863). Adult body weight is 8–21 g ($\bar{X}$ = 13 g—Carthew et al. 2008). Ranges and means (mm) for standard external measurements from 4 male specimens in the Australian Museum are: length of head and body (57–72; 66); length of tail (77–87; 81); length of hind foot (11.0–13.0; 11.5); length of ear (13.0–15.0; 14.5—Flannery 1994). Further data of this type are available elsewhere (Carthew et al. 2008; Thomas 1888; Wakefield 1963; Waterhouse 1846; Wood Jones 1924, 1925).

DISTRIBUTION

Cercartetus concinnus (Fig. 4) occurs in southwestern Western Australia (Dell and How 1985; Glauert 1933; How

Fig. 2.—Dorsal, ventral, and lateral views of cranium and lateral view of mandible of an adult female *Cercartetus concinnus*, from Little Desert, Victoria, collected 30 March 1970 (Museum Victoria reg. no. C22691). Greatest length of cranium is 20 mm. Used with permission of Museum Victoria.

et al. 1987, 1988; Kitchener and Vicker 1981; McKenzie and Rolfe 1995; McKenzie et al. 1983; Pearson et al. 1999), southern South Australia (Carthew 2004; Harris 2005; Paton 1999; Stewart et al. 1998), including Kangaroo Island (Robinson and Armstrong 1999; Waite and Wood Jones 1927), northwestern Victoria (Anonymous 1914; Bennett and Lumsden 1995; Cockburn et al. 1979; van der Ree et al. 2004; Wakefield 1963, 1966, 1971), and southwestern New South Wales (Kavanagh 2004; New South Wales National Parks and Wildlife Service 2001; Ryan 1963). The modern distribution is suggested to be spatially disjunct between Western Australia and South Australia, with a broad stretch of saltbush on the Nullarbor Plain forming an apparent barrier (Pestell et al. 2008; Wakefield 1963). However, there is a record known from Fisher (Bolam 1923), which is approximately at the middle of the distributional gap in the Nullarbor Plain. This specimen could have been accidentally transported to Fisher in farm machinery; the mulga-saltbush vegetation at this locality was considered to probably not be suitable habitat (Wakefield 1970). Attention also is drawn to a recent record from Yellabina on the southeastern edge of the Nullarbor (Sinclair Knight Merz 2006) and an unverified record from Balladonia (see Richards and Short 1996). In any event, *C. concinnus* was not recorded in a comprehensive biological survey of the Nullarbor region in 1984 (McKenzie and Robinson 1987). However, within the distributional gap are a few fossil sites of recent geological age that have produced *C. concinnus* (e.g., Murraelellevan Cave—Lundelius 1957; see also Fossil Record below).

An unknown number of *C. concinnus*, of unknown origin, were released on Wilsons Promontory, in southeastern Victoria, in March 1934 (Seebeck and Mansergh 1998; Wescott 1998). This location is considerably outside the natural range of the species, and probably because the translocated animals were not well suited to the mesic climate and vegetation in this area they did not become established.

FOSSIL RECORD

In Western Australia, *Cercartetus concinnus* is known from Murraelellevan Cave (Baynes 1987; Lundelius 1957, 1963; Partridge 1967), Strongs' Cave (Cook 1963; Merrilees 1968), Wedges Cave (Lundelius 1960), Harley's Cave (Merrilees 1968), Devil's Lair (Balme et al. 1978; Baynes et al. 1975; Dortch and Merrilees 1971; Merrilees 1984), Skull Cave (Porter 1979; Merrilees 1984), Madura Cave (Lundelius and Turnbull 1982, 1989), Thylacine Hole (Lowry and Merrilees 1969), Turner Brook (Merrilees 1984), Horseshoe Cave (Archer 1974), Au25 near Augusta (Archer and Baynes 1972), Kestrel Cavern, Twin Level Cave, Fox Cave, and also unnamed caves or sinkholes near Balladonia, Hampton Tableland, Mount Andrew, Wylie Scarp, Peak Charles, and Mount Arid (Baynes 1987).

On Kangaroo Island, fossil remains have been recorded from Emu Four Hole (Pledge 1974; Williams 1980). On mainland South Australia, fossils of *C. concinnus* are known from Dark Peake and South Block Range (Baynes 1987; Watts and Ling 1985); Black's Point Sinkhole (McDowell 1997); Bat Cave, Roberston Cave, and Wet Cave in the Naracoorte World Heritage Area (McDowell 2001; Reed and Bourne 2000; Tidemann 1967); and Shell Beach (Innes National Park) and Warbla Cave (Pestell et al. 2008). All

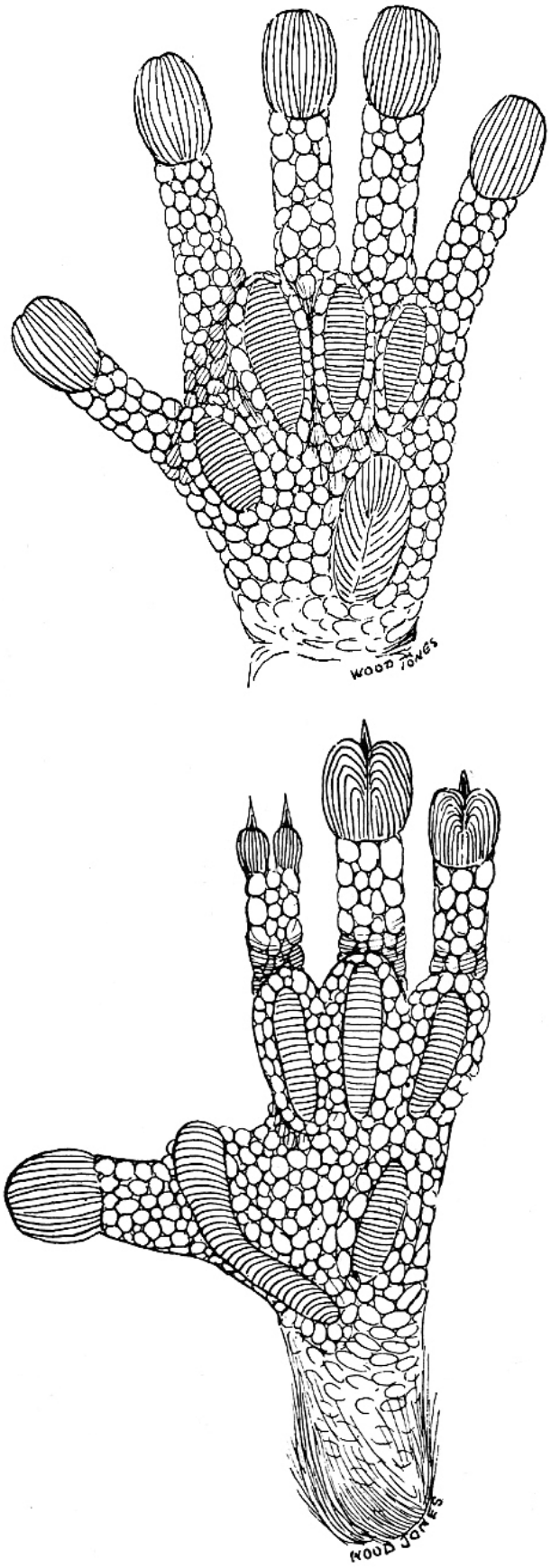

Fig. 3.—Palmar surface of the manus and pes of *Cercartetus concinnus*. Reproduced from Wood Jones (1924).

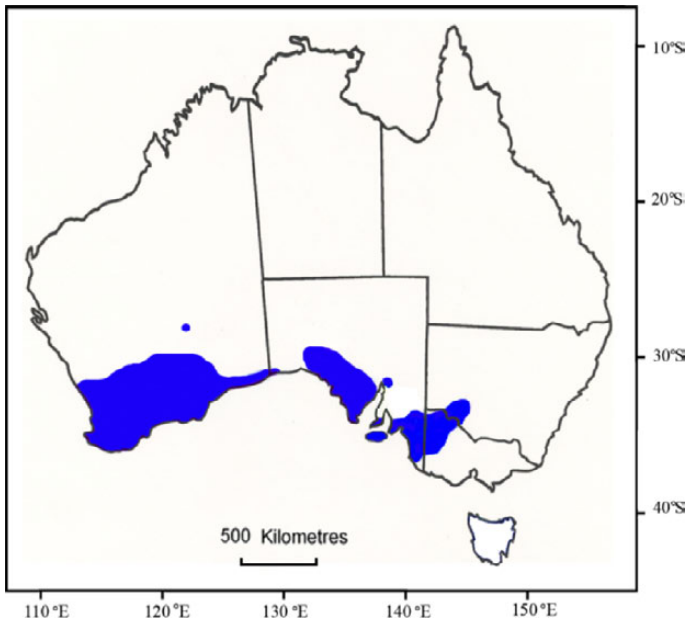

Fig. 4.—Geographic distribution of *Cercartetus concinnus*. Adapted from van Dyck and Strahan (2008) and Pearson et al. (1999).

these sites are late Pleistocene to Holocene (see Lundelius 1983).

FORM AND FUNCTION

Dental formula is i 3/2, c 1/0, p 3/3, m 3/3, total 36. Technical descriptions and measurements of the dentition, skull, and face musculature are available in the literature (Osborne and Christidis 2002; Rosenberg and Richardson 1995; Ryan 1963; Thomas 1888; Wakefield 1963; Waterhouse 1846). The tongue is broad, long (10–12 mm), tapers to a blunt point, and the rostral half reportedly lacks a brushlike structure (Rosenberg and Richardson 1995). All burramyids have a simple gut structure and a well-developed cecum (Turner and McKay 1989). The kidneys of *Cercartetus concinnus* have a high maximal urinary concentrating capacity (6102 mOsm/kg H_2O—Slaven and Richardson 1988).

The female's pouch is well developed and typical of diprotodont marsupials (type 5—Russell 1982). It opens anteriorly and contains 6 teats. Males have a nonpendulous scrotum (Smith 1984) and carrot-shaped prostrate (Ward 1990). Measurements of testis length (4.3–4.5 mm) and width (3.2–3.7 mm) are available from museum specimens (n = 2—Woolley and Vanderveen 2002). Both male and female *C. concinnus* possess paracloacal glands (Green 1963; Smith 1984)

and have reproductive tracts that are similar to those of other species of *Cercartetus* (Turner and McKay 1989; Ward 1990).

All burramyids investigated in some detail have the ability to hibernate (i.e., undergo prolonged bouts of torpor—Geiser 1985, 1987). In *C. concinnus*, the longest torpor bout recorded is 11 days (Wakefield 1970). Observations under laboratory conditions were 4 days at an ambient temperature of 12°C and 8 days at an ambient temperature of 8°C (Geiser 1987). Mean body temperature at normothermia was 34.4°C ± 0.5°C *SD*; during torpor body temperature dropped to as low as 4.7°C (Geiser 1987; see also Zosky and Larcombe 2003). Oxygen consumption (a measure of metabolic rate) of torpid individuals was 0.046 L kg^{-1} h^{-1} ± 0.02 *SD* and increased about 200-fold during normal activity (Geiser 1987; see also Zosky and Larcombe 2003). Torpid individuals may have periods of apnea lasting for about 5 min at an ambient temperature of 10°C (Geiser 1987). Average heart rate of *C. concinnus* is 18.0 beats/min ± 1.1 *SD* during torpor and 20.1 ± 2.1 beats/min during eupnea (Zosky and Larcombe 2003). Arousal rates are rapid (over a 10-min period these averaged 0.79°C/min—Geiser 1987). Functionally, torpor allows *C. concinnus* to reduce overall energy expenditure and increase fasting endurance during poor weather, lower temperatures, and during periods of food shortage (Fig. 5; Bennett and Lumsden 1995; Pearson et al. 1999; Turner and McKay 1989; Wakefield 1970).

Fig. 5.—Torpid *Cercartetus concinnus*. Note that torpid individuals usually sit on their tails with their backs exposed upward and curled as seen in the photograph. However, the photograph displays a possum on its side for ease of visualization. Used with permission of the photographer J. Turner.

ONTOGENY AND REPRODUCTION

It has been implied that embryonic diapause (or delayed implantation) occurs in *Cercartetus concinnus* (Kean 1967; Marshall 1967; Renfree 1981, 1993; Renfree and Calaby 1981; Sharman 1963; Ward 1990). This is based on anecdotal observations of captive females that produced a 2nd litter in the absence of a male (see Bowley 1939; Casanova 1958; Hartman 1940). Further investigations of this phenomenon found that the blastocysts continued to grow during lactation (Clark 1967). Although knowledge of reproduction in *C. concinnus* is incomplete, examination of available data suggests that diapause, sensu stricto, does not actually occur (see also Renfree 1978; Turner and McKay 1989; Tyndale-Biscoe 1973; Ward 1990). However, only about 2 days are needed between the weaning of one litter and commencement of suckling of the next; in that short period the mammary section changes from milk to colostrum and the enlarged teats regress to a size small enough to be taken into the mouth of a neonate (Clark 1967; Flannery 1994; Smith 1995).

Females are thought to reach sexual maturity at 12–15 months (Tyndale-Biscoe and Renfree 1987). The reproductive rate is high because breeding may occur throughout the year and females can rear 2 or 3 litters in close succession (Clark 1967; New South Wales National Parks and Wildlife Service 2001; Ward 1990). Records of lactating females and juveniles are concentrated in the spring months and few in the winter months (Ward 1990). Females typically ovulate more eggs and carry more embryos than there are teats, so number of teats limits litter size to 6 (Ward 1990, 1998). There are a number of observations of 6 young (Bowley 1939; Casanova 1958; Glauert 1950) and some records of only 4 young (Jones 1954; Pearson et al. 1999; Ryan 1963). In one field study, the mean number of pouch young was 4.6 ± 1.0 *SD* (n = 21 litters—Ward 1990, 1998).

Newborns have a head length of about 2.9 mm (Clark 1967). The young leave the pouch at around 25 days before the eyes open (Bowley 1939; Clark 1967) but remain in a nest (Bowley 1939; Casanova 1958). At this stage, the young are only sparsely furred and are dependent on the mother. The young are suckled until they reach about 50 days (Clark 1967).

ECOLOGY

Population characteristics.—There is some evidence to indicate that populations fluctuate widely in numbers, depending on climatic conditions and the availability of resources (Carthew 2004; Paton 1999; Pearson et al. 1999; Pestell and Petit 2007b; Rose 1995). At Queen Victoria Springs, Western Australia, lack of recaptures between trapping sessions suggested that *Cercartetus concinnus* is a transient in its habitat, either dispersing through it in search of preferred habitat or visiting the area on a nomadic basis in search of food resources or mates (Pearson et al. 1999). To

Fig. 6.—Habitat of *Cercartetus concinnus* in Newland Head Conservation Park, South Australia. This site is coastal mallee heath dominated by *Banksia marginata*, *B. ornata*, *Callistemon rugolusus*, and a mix of eucalypt species, including *Eucalyptus baxteri*, *E. cosmophylla*, and *E. diversifolia*. Used with permission of the photographer S. Carthew.

maximize capture success, surveys of *C. concinnus* (using pitfall traps or nest boxes) should be planned to coincide with flowering of proteaceous and myrtaceous understory species and avoid periods of inclement weather when the species is likely to be torpid (New South Wales National Parks and Wildlife Service 2001).

Space use.—*Cercartetus concinnus* occurs in areas with high temperatures and low rainfall (Ryan 1963) and is essentially a semiarid-zone species (Brown 1974). Its habitat is generally stated to be mallee woodlands, heathlands, shrublands, and dry forests with a heathy or structurally dense understory of callistemons and melaleucas (family Myrtaceae) and banksias, grevilleas, and hakeas (family Proteaceae—Fig. 6; Bennett and Lumsden 1995; Carthew et al. 2008; Flannery 1994; Kemp and Carthew 2004; Menkhorst and Beardsell 1982; Misso 1997; Wakefield 1963; Ward 1992). At Mallee Cliffs National Park, New South Wales, *C. concinnus* was trapped in unusual habitat—a belah (*Casuarina pauper*) patch in a mixed woodland with an understory of cottony saltbush (*Chenopodium curvispicatum*), bitter saltbush (*Atriplex stipitata*), ruby saltbush (*Enchylaena tomentosa*), and Mueller's daisy bush (*Olearia muelleri*—Fig. 7; New South Wales National Parks and Wildlife Service 2001). Also in New South Wales, at Boree Plains Station, the species was recorded from mallee spinifex shrubland with an understory of *Leptospermum coriaceum* (see New South Wales National Parks and Wildlife Service 2001).

Cercartetus concinnus shelters in a variety of locations, including tree hollows, under loose pieces of bark, in cavities excavated by fire, under the fronds of *Xanthorrhoea*, between dead *Banksia* inflorescences, in abandoned birds' nests (e.g., grey-crowned babbler [*Pomatostomus temporalis*] and Zebra Finch [*Taeniopygia guttata*]), among leaves on the ground, at the base of trees, and in hollow stumps (Aitken 1954; Casanova 1958; Flannery 1994; Gould 1863; Kemp and Carthew 2004; Lydekker 1896; Misso 1997; Pestell and Petit 2007a, 2007b; Ryan 1963; Shortridge 1909; Tulloch 2004; Wakefield 1963; Waterhouse 1846; Wood Jones 1924). Different types of shelter sites may be used for different purposes, such as breeding and avoidance of predators (Misso 1997; Tulloch 2004).

Fig. 7.—Habitat of *Cercartetus concinnus* in Mallee Cliffs National Park, New South Wales. Used with permission of the photographer J. Smith.

Little information exists on the movements and size and spacing of home ranges of this species. However, in southeastern South Australia, the mean distance moved by individuals between captures ranged from 24 m to 60 m, and the maximum distance recorded between captures was 195 m (Horner 1994; not seen, cited in New South Wales National Parks and Wildlife Service 2001). Males tended to move further than females. In the Middleback Ranges in South Australia, mean distances travelled were 56 m for males and 50 m for females and the maximum recorded distance was 195 m (S. Carthew, in litt.).

Diet.—*Cercartetus concinnus* feeds on a range of foods including nectar, pollen, and insects (Cadzow and Carthew 2004; Glauert 1950; Horner 1994; Pestell and Petit 2007b; Wakefield 1963; Waterhouse 1846; Whittell 1954). Nectar and pollen are probably the primary dietary components, and sources include species in the genera *Banksia*, *Eucalyptus*, and *Melaleuca* (Cadzow and Carthew 2004; Pestell and Petit 2007b). *C. concinnus* is a regular and nondestructive flower visitor and may play an important part in the pollination of its food plants (Carthew et al. 2008; Pestell and Petit 2007b; Turner 1982; Turner and McKay 1989). In captivity, *C. concinnus* may accept soft fruit, apples, cakes, rose leaves, jam, honey, cow's milk, baby food, honey–water mixture, custard, freshly collected *Banksia* pollen, and mealworms (*Tenebrio molitor*—Casanova 1958; Geiser 1987; Glauert 1950; Landwehr et al. 1990; Wakefield 1970; Wood Jones 1924; Wooller

et al. 1999; Zosky and Larcombe 2003). A laboratory study of sugar preferences in *C. concinnus* found no clear preference for any one particular sugar type (Landwehr et al. 1990). Another laboratory study determined daily nitrogen requirements to be about 0.146 g $N/kg^{0.75} \pm 0.086$ *SD* (Wooller et al. 1999).

Diseases and parasites.—Fleas recorded as parasitic on *Cercartetus concinnus* include *Acanthopsylla scintilla scintilla* and *A. scintilla tasmanica* (Dunnet and Mardon 1974; Holland 1971). Astigmatic mite records are for *Listrophoroides queenslandicus* and *Murichirus notomys* (Domrow 1992). Hepatoma (a type of cancer originating in the liver) is known from captive *C. concinnus*, although the etiology of the condition remains unknown and it is unclear whether this is a common cause of death in this species (Canfield et al. 1990; Hopkins et al. 1984; Turner and McKay 1989).

Interspecific interactions.—The domestic cat (*Felis catus*) is a known predator of *Cercartetus concinnus* (Loaring 1960; Wood Jones 1924). In addition, the introduced red fox (*Vulpes vulpes*) and a range of native Australian carnivorous marsupials (e.g., quolls [*Dasyurus*]), snakes, and owls probably prey regularly on *C. concinnus*. Sympatry with *C. lepidus* occurs in a number of areas including Ngarkat Conservation Park in South Australia (Paton 1999); the Big Desert, Victoria (Bennett et al. 1989; Robertson et al. 1989; Ward 1992); and Jilpanger Flora and Fauna Reserve, Victoria (Conole 1996). It is not yet clear how these ecologically similar congeners partition the habitat and other resources such as food and nesting sites (Bennett et al. 1989; Cadzow and Carthew 2004; Robertson et al. 1989).

Miscellaneous.—The species can be maintained readily in captivity (Aitken 1954; Brooker 1988; Casanova 1958; Fairfax 1982; Geiser 1987; Glauert 1950; Hopkins et al. 1984; Landwehr et al. 1990; Wakefield 1970; Waterhouse 1846; Wood Jones 1924; Wooller et al. 1999; Zosky and Larcombe 2003). However, individuals have a tendency to overeat and become obese (Fairfax 1982; Geiser 1987; George 1990; Landwehr et al. 1990; Wakefield 1970). Although breeding is known to have occurred at Perth Zoo, such instances have been irregular (George 1990). The author also is aware that about 20 years ago, a captive breeding population was maintained at Murdoch University in Perth, Western Australia, although this no longer exists.

BEHAVIOR

Cercartetus concinnus is scansorial, nocturnally active, and usually agile but individuals may be placid when handled (Carthew et al. 2008; Casanova 1958; Smith 1995; Wood Jones 1924). The forepaws are used to hold food or to hold open floral parts for better access to nectar and pollen (Casanova 1958; Turner and McKay 1989; Wood Jones 1924). The prehensile tail is used to cling to branches or grasp objects such as nesting materials (Bolam 1923; Casanova 1958). During torpor, *C. concinnus* typically coils tightly into a ball with the ears folded over the eyes and the tail spiraled upon the stomach (Fig. 5; Bolam 1923; Casanova 1958; Pearson et al. 1999; Wakefield 1970). In hot weather, *C. concinnus* has been observed panting (Casanova 1958). Extensive self-grooming is undertaken after feeding bouts (Casanova 1958). Its vocalization is described as a rapid chattering "chi-chi-chi" (Casanova 1958).

Antipredator behavior in burramyids is thought to include anachoresis (avoidance by concealment in a retreat, such as a burrow, that precludes an attack), specific activity patterns (such as adjustment of foraging activity to minimize predation risk), vigilance (a general wariness), withdrawal (retreat to hollow or mother's pouch when alarmed), retaliation (biting or intimidatory displays including hissing), and flight (fleeing from the predator—Coulson 1996).

GENETICS

Cercartetus concinnus has XY/XX sex determination and a diploid number (2n) of 14 chromosomes (Martin and Hayman 1967; McKay 1984; Rofe and Hayman 1985). It has been suggested that the population of *C. concinnus* in New South Wales may be genetically distinct from nearby Victorian populations (New South Wales National Parks and Wildlife Service 2001). However, a number of recent molecular analyses (mitochondrial DNA [mtDNA] *ND2* gene [Osborne and Christidis 2002] and mtDNA *ND4* gene [Pestell et al. 2008]) found <1% sequence divergence among samples from widely distributed populations. This casts doubt on any special genetic significance of the New South Wales population, and also that *C. concinnus* represents a single monophyletic group across its range (see also subspecific dichotomy in Nomenclatural Notes above). *C. concinnus* has a sister relationship with *C. nanus* (Osborne and Christidis 2002), and probably diverged in the late Miocene about 8 million years before present (Pestell et al. 2008).

CONSERVATION

The species is listed as "Least concern, Lower risk" by the International Union for the Conservation of Nature and Natural Resources (2006), and is not listed as a threatened species federally in Australia or in state-based legislation in Western Australia, South Australia, or Victoria (Tulloch 2004). However, in New South Wales, *Cercartetus concinnus* is listed as endangered (Kavanagh 2004; New South Wales National Parks and Wildlife Service 2001; New South Wales Scientific Committee 1997). In this state, *C. concinnus* is threatened by vegetation clearing, the reduction of food sources by livestock overgrazing, inappropriate fire regimes, and introduced predators (i.e., feral cats and foxes—New South Wales National Parks and Wildlife Service 2001; New South Wales Scientific Committee 1997; Rose 1995; Tulloch

2004). Potentially, the harvesting of nectar and pollen by commercial honeybees also could have a detrimental impact on populations of *C. concinnus*, although this has been little studied (Paton 1999).

A few informal assessments of its conservation status in specific areas are available in the literature, and for its range in Western Australia these include that it is "common" (Baynes 1970; Glauert 1933) or "stable" (Burbidge and McKenzie 1989). However, in the Western Australian wheat-belt *C. concinnus* is reportedly "rare" (Kitchener et al. 1980). In most of its South Australian range, *C. concinnus* is considered "common" (Aitken 1983; Carthew 2004; Robinson and Armstrong 1999; Watts 1990; Watts and Ling 1985), except for Brookfield Conservation Park where it is "rare" (Goonan et al. 1993). In the mallee of northwestern Victoria, *C. concinnus* is "common" to "uncommon" (Bennett and Lumsden 1995; Bennett et al. 1989; Robertson et al. 1989; van der Ree et al. 2004). However, a southward contraction at the northern end of its geographic range in Victoria has been noted (Bennett and Lumsden 1995).

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