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(Muddy Lake)

A DESCRIPTION OF NATURAL VALUES OF THE SOUTH BUNBURY TO CAPEL COASTAL CORRIDOR

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Surviving quokka (*Setonix brachyurus*) population on the Swan Coastal Plain, Western Australia

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Abstract. A survey of the Muddy Lakes area on the Swan Coastal Plain was carried out to determine the presence of quokkas. Extensive on-ground searches found a carcass, juvenile skull, and fresh scats, which were identified as belonging to quokka, using DNA analyses. This is currently the only known population remaining on the coastal plain.

Prior to European settlement, the geographic range of the quokka (*Setonix brachyurus* (Quoy & Gaimard, 1830)) included the south-west corner of Western Australia between Moore River (31°21'S, 115°30'E) in the north and east to Bremer Bay (34°24'S, 119°23'E) (Fig. 1). Quokkas were common throughout their range including the Swan Coastal Plain (SCP), a narrow geographic feature that lies between the Darling Scarp and Indian Ocean. They have since undergone a significant contraction in range and abundance (summarised in De Tores *et al.* 2007).

The catastrophic collapse of mainland populations of many marsupial species in the 1930s, including *S. brachyurus* (Perry 1973), led scientists to believe that *S. brachyurus* was extinct on the mainland. However, they were rediscovered at Manjedal Swamp, 40 km south-east of Perth, in the 1950s (Barker *et al.* 1957), and small populations have subsequently been found throughout much of their former range, with the exception of the SCP (summarised in De Tores *et al.* 2007). All extant *S. brachyurus* populations north of Busselton are within the jarrah forest. Despite recent surveys at SCP locations near Gingin, Yalgorup National Park and Busselton, no evidence of *S. brachyurus* was found (see De Tores *et al.* 2007). There are no records of *S. brachyurus* ever being captured on the SCP between Bunbury and Busselton; in fact, very few records of their previous presence here exist at all (Table 1). Abbott (2008) outlined many of the threatening factors, including habitat loss and fragmentation, disease, poison baiting, high-intensity wildfires, logging, and predation by introduced European foxes (*Vulpes vulpes*), which has probably been the most persistent and widespread threat.

A survey of part of the Stratham Regional Fauna and Flora Reserve by Dell and Hyder-Griffiths (2002) reported that *S. brachyurus* may still be present on the SCP. *S. brachyurus* is a species of Commonwealth significance (listed as vulnerable

under IUCN Red List criteria: Maxwell *et al.* 1996), and so a follow-up survey of this area was initiated in early 2008 to confirm the observations of Dell and Hyder-Griffiths (2002) and to establish whether a *S. brachyurus* population was present on the SCP.

The survey area included the Muddy Lakes wetland and adjacent area, which was described as 'a regionally significant natural area of outstanding value' by the Environmental Protection Authority (EPA 2003). Historically, the Muddy Lakes area has been under private ownership and much of it continues to be so. The remaining wetland vegetation consists of extremely dense *Typha orientalis*/*Juncus pallidus* sedgeland (see Keighery *et al.* 2002), providing suitable habitat and refuge for small marsupials and birds from introduced predators. Dominant tree/shrub species include *Acacia saligna*, *Agonis flexuosa*, *Banksia littoralis*, *Melaleuca raphiophylla*, *Melaleuca viminea*, *Rhadinthamnus anceps* and *Rhagodia baccata*. The wetland areas contain many sedge species, including *Baumea articulata*, *Typha orientalis*, *T. domingensis*, *Juncus pallidus*, *Lepidosperma gladiatum*, *Carex appressa*, *C. fascicularis*, *C. tereticaulis* and *Gahnia trifida*. The broader area also includes a dampland at the interface between the Quindalup and Spearwood Dune systems, a unique habitat of which there is only one other area preserved, in the Rockingham area to the north (Keighery *et al.* 2002).

A combination of approaches was used to search for evidence of *S. brachyurus*. These included on-ground searches, live-trapping, sand pads and spot-lighting. On-ground searches were conducted during three separate visits between February and March 2008 to look for signs of *S. brachyurus* activity, including runways, scats, skeletal material and hair. European fox scats were also collected to determine whether *S. brachyurus* were being preyed upon.

Traplines were set at four sites where scats and runways were found, indicating *S. brachyurus* activity. A total of 12 traps, six

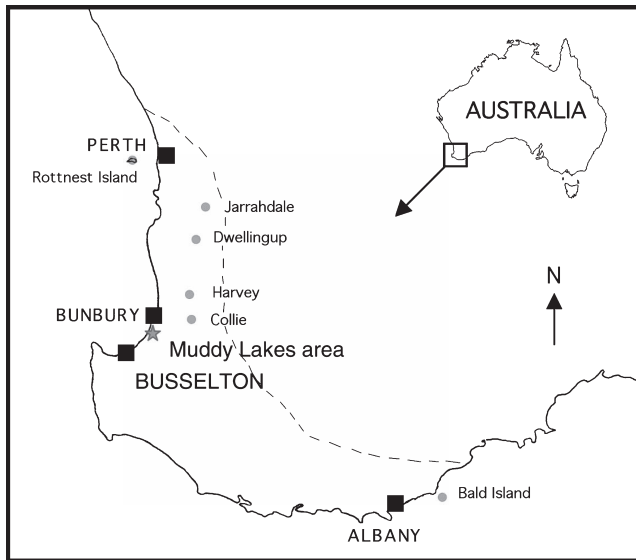


Fig. 1. Map showing the distribution of *S. brachyurus* in south-west Western Australia prior to European settlement (broken line) and the approximate location of the Muddy Lakes area on the Swan Coastal Plain (star). Grey circles indicate known *S. brachyurus* populations in the jarrah forest.

standard cat/possum traps (30 × 30 × 70 cm) and six collapsible hessian traps (30 × 45 × 80 cm), were positioned, covered with hessian, prebaited for five days, and monitored for a further five days (60 trap-nights). During the prebaiting period, traps were tied open and freshly baited each afternoon with apple and peanut butter, so that animals were free to move in and out of the traps. Apple juice was also used as an attractant and sprayed on the traps. Six Sheffield cage traps (22 × 22 × 55 cm) and four Elliott traps (9 × 10 × 33 cm) were baited and monitored for a total of 96 trap-nights to provide information on other mammal species using the wetland. Southern brown bandicoots (*Isodon obesulus*) were commonly trapped, as well as two introduced species: black rat (*Rattus rattus*) and house mouse (*Mus musculus*). No *S. brachyurus* were captured.

Four sand pads were established and monitored between 14 and 19 March 2008. Two small pads (~0.5 m × 0.5 m) were placed in the vicinity of two runway exits. Two larger sand pads (~2 m × 1 m) were monitored along the middle of a vehicle-access track. The sand pads were inspected each morning, tracks

were recorded, and the sand pad refreshed. No *S. brachyurus* tracks were observed on the sand pads. However, fresh *V. vulpes* tracks were observed on two occasions. *V. vulpes* tracks and scats were also observed within open wetland areas where the water level had dropped. Spotlighting was conducted on two evenings from dusk for 2–3 h. No *S. brachyurus* were observed.

On-ground searches yielded the most evidence for the presence of *S. brachyurus*. Extensive runways, often under the dense vegetation, were evident at all sites visited within the wetland area. Some runways contained weeds and/or old *S. brachyurus* scats, as determined by degree of decay and colouration, indicating that they were not currently in use. Fresh scat material (three pellets at a time, soft and greenish in colour) was collected on three occasions. These scats were compared with freshly collected scat of western grey kangaroos (*Macropus fuliginosus*), also present at the site. Species identification from scats can be complicated where multiple macropod species co-occur (see Hayward *et al.* 2005). While *M. fuliginosus* was common in the area, the older scats within enclosed runways provided good evidence for the presence of a smaller macropod, such as *S. brachyurus*. DNA analysis of freshly collected scats, using RT-PCR methods, was consistent with *S. brachyurus*, and sex-linked DNA markers indicate that there was at least one male and one female alive at the time of the survey (Sinclair *et al.* unpubl. data). One dead adult carcass and one subadult skull (based on size and minimal teeth wear) were also found through extensive on-ground searches. The carcass was determined to have been dead for 3–4 weeks, based on the absence of flesh and maggots (G. Porter, pers. comm. 2008), and the presence of late-instar beetle larvae (*Dermestes* spp.). A fox scat (containing *S. brachyurus* hair) was also found *in situ*. It was not possible to determine whether the fox had killed the animal, or had scavenged on the carcass. The skull and carcass have been lodged with the Western Australian Museum (Table 1).

The presence of fresh *S. brachyurus* scats and a recently dead individual provide unequivocal evidence for the presence of a small remnant population of *S. brachyurus* on the SCP. The three fresh scat samples were all collected in close proximity, suggesting that current activity may be restricted to part of the wetland. The presence of old *S. brachyurus* scats throughout the wetland indicates seasonal movement, depending on water levels, food availability, and predator access. The continued persistence of *S. brachyurus* in this area shows

Table 1. Summary of all known records of *S. brachyurus* from the Muddy Lakes area

Sample	Collection date	Collected by	Location	Publication
1 Skull	10.vi.1975	A. N. Start	WAM 19881	Kabay and Start (1976)
2 Old scats	1976	–	–	Hart <i>et al.</i> (1986)
3 Adult skull	~2000	E. Manea	Unknown	– (pers. comm.)
4 Carcass	~2000	E. Manea	Unknown	– (pers. comm.)
5 Old scats and runways	2002	–	–	Dell and Hyder-Griffiths (2002)
6 Adult skull	25.ix.2002	S. Reynolds	WAM 54123	HGM (2002)
7 Carcass	10.iii.2008	E. Sinclair and B. Hyder	WAMM60791	This paper
8 Subadult skull	12.iii.2008	E. Sinclair and B. Hyder	WAMM60790	This paper
9 Fresh scats	12–18.iii.2008	E. Sinclair and B. Hyder	–	This paper

remarkable resilience, and is perhaps a characteristic of the species, in which remnant populations are also genetically discrete (Sinclair 2001).

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