Translocation Outcomes

for the Western Ringtail Possum

(*Pseudocheirus occidentalis*)

in the Presence of the Common Brushtail Possum

(*Trichosurus vulpecula*):

Health, Survivorship and Habitat Use

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Abstract

The western ringtail possum, *Pseudocheirus occidentalis*, is classified as threatened, both nationally and internationally. Land clearing for building development threatens the last major coastal population stronghold in and around the town of Busselton in the south-west of Western Australia (WA). Translocation of displaced *P. occidentalis* from this locality into nearby conservation estates commenced in 1991, in the presence of fox control, with the aim of re-establishing populations of the species within suitable habitat outside its current range. Initial successes (1991-1998) were followed by a major population decline at one site for unclear reasons. The aim of this project was to determine which factors presently limit translocation success for *P. occidentalis* and thereby provide direction for future management of the species.

Displaced and rehabilitated *P. occidentalis* were translocated into three sites, two of which were baited for fox control. Survival was monitored weekly, causes of mortality were ascertained and attributes of habitat use were mapped and analysed. Each individual *P. occidentalis* underwent comprehensive health and disease screening under isoflurane anaesthesia prior to translocation and whenever recaptured for re-collaring. Health, survivorship and habitat use of resident common brushtail possums, *Trichosurus vulpecula*, were similarly studied at each site. Pilot spotlight surveys using line transect methods were performed at the end of the study to provide provisional data on population densities.

Health screening revealed no evidence that infectious disease currently limits translocation success for *P. occidentalis*. Possums of both species were negative for toxoplasmosis, leptospirosis, salmonellosis and chlamydiosis. Cryptococcal antigen was detected in one individual *T. vulpecula* but was not of pathological significance. Endoparasite levels were negatively correlated with body condition. Differences between pre- and post-translocation haematological values were found, suggesting that habitat quality or nutrient intake were lower at the translocation sites than at the sites of origin.

Mortality rates of translocated *P. occidentalis* were high. The majority of *P. occidentalis* deaths were attributed to predation, with foxes, cats, pythons and raptors all implicated. Some *P. occidentalis* died in poor body condition from apparent hypothermia/hypoglycaemia, with moderate to heavy parasite burdens present at necropsy. Most *T. vulpecula* mortality was attributable to fox predation. Survivorship analyses were carried out using information-theoretic techniques to investigate which, if any, of a suite of hypothesised factors most influenced post-translocation survival of *P. occidentalis*. The most highly ranked models were those that included pre-release white blood cell counts and/or numbers of *T. vulpecula* at the release site. Survivorship of *P. occidentalis* was negatively correlated with each of these factors, and the two together acted in a synergistic fashion. Effects of fox control on *P. occidentalis* survivorship were equivocal. The average annual survival rate of established *P. occidentalis* was less than half that of resident *T. vulpecula*.

Post-translocation dispersal distances varied among individual *P. occidentalis*. Mean home range sizes of translocated *P. occidentalis* were larger than those reported for other coastal populations. Individual home ranges overlapped one another, both within and between possum species. Vegetation dominated by peppermint (*Agonis flexuosa*) was utilised by translocated *P. occidentalis* where available, and habitat partitioning between the two possum species was observed in some areas. A greater range of diurnal rest site types were utilised by *P. occidentalis* than *T. vulpecula*. Spotlight surveys revealed presence of low density *P. occidentalis* populations, including juveniles, at two sites but numbers remained negligible in the site at which the post-1998 decline had occurred.

Complex interactions involving health, predation, habitat quality and inter-specific competition influence the success or otherwise of wildlife translocation programs. The results of this project suggest that all these factors, particularly predation, affected translocation outcomes for *P. occidentalis* during the period of study. Complete exclusion of exotic predators (foxes and cats) from the translocation sites may be necessary in future, especially given the numbers of native predators (pythons and raptors) present. In addition to heavy predation pressure, the small size and apparently low carrying capacity of the translocation sites for *P. occidentalis*, along

with high numbers of resident *T. vulpecula*, currently appears to limit *P. occidentalis* survival and population growth.

While, in the short term, the most efficient use of funds and the best option for the species in its current coastal strongholds might be to put greater effort into conserving *P. occidentalis* in its natural environment, there could also be value in carrying out further experiments to determine whether or not translocation success can be improved through use of particular management actions. The principles of adaptive management apply both to management of *P. occidentalis* in its natural environment and to conduction of translocation programs. Possible experimental approaches are outlined and recommendations for further research proposed.

following declines is reliant on availability of sufficient suitable habitat, and may be severely inhibited by high predator numbers. Increasing aridity, ongoing habitat destruction and high fox and/or cat numbers probably limit the growth phase of the cycle of many present day possum populations throughout Australia (Kerle 2004, Maxwell et al. 1996).

1.5 THE CURRENT PROJECT

1.5.1 Context – Previous *P. occidentalis* translocations

Translocation has featured in the management of coastal populations of *P. occidentalis* since 1991, and arose out of an obligation to relocate individuals displaced by land clearing for urban development in the Busselton region, and the need to release rehabilitated *P. occidentalis* after recovery from injury or other mishap (Burbidge and de Tores 1998, de Tores et al. 1995, de Tores et al. 1998, de Tores et al. 2004). Although the preferred management option is to conserve *P. occidentalis* populations *in situ* (Burbidge and de Tores 1998, de Tores et al. 1995), translocations were considered warranted in the face of accelerating rates of land clearing and pressure from the proponents of development projects to incorporate translocation as a means of mitigating habitat loss (Burbidge and de Tores 1998, de Tores et al. 1995, de Tores et al. 2004). Translocation was also seen as a means of appropriately managing rehabilitated individuals (P. de Tores, personal communication).

A trial relocation of five radio-collared *P. occidentalis* was carried out in 1991 within the greater Busselton region (Locke Nature Reserve), and resulted in the death of four of the animals within six weeks (Jones 1991). The deaths were attributable to fox predation, and emphasised the need for predator control to be a component of any further translocation programs. It was also considered more appropriate to reintroduce *P. occidentalis* into unoccupied parts of its former range, on the proviso that i) large enough areas of suitable habitat could be found and ii) the numbers of foxes could be reduced. Leschenault Peninsula Conservation Park (1,071 ha, Fig. 1.2), hereafter referred to as Leschenault Peninsula, was chosen for initial trials, as it

contains large forested areas dominated by peppermint, the preferred habitat type for *P. occidentalis* in coastal regions of south-west WA (de Tores 2008a, Jones et al. 1994b, Jones 1995). Being a long narrow peninsula, the site was also well-suited for fox-baiting because opportunities for reinvasion by foxes were limited.

Following instigation of a monthly 1080-baiting program in September 1991, eight radio-collared rehabilitated *P. occidentalis* were translocated into Leschenault Peninsula. All survived their first three months, so further releases were carried out as animals became available (de Tores et al. 2005a, de Tores et al. 1998, de Tores et al. 2004). Translocations continued until 1995 by which time offspring of founder animals were reproducing. The translocation was deemed successful by 1998, as annual spotlight surveys indicated that the population was continuing to increase and other behavioural criteria for success had been met (de Tores et al. 1998, de Tores et al. 2004).

Two additional 1080-baited translocation sites were established within the 12,888 ha Yalgorup National Park at White Hills Road (551 ha) and Preston Beach Rd (573 ha) (Fig. 1.2) in 1995. These sites were deemed to contain suitable peppermint-dominated habitat and were within the species former range. Translocations were carried out during 1995-2001, whenever displaced *P. occidentalis* became available (de Tores et al. 2004, Lynch 1996). Intense post-translocation telemetry monitoring of radio-collared animals, followed by intermittent spotlight surveys, showed these populations remained extant until at least 2006 (de Tores 2008b, de Tores et al. 2004).

Pseudocheirus occidentalis were also translocated to a 1080-baited site in the northern jarrah forest, Lane Poole, during 1996-99 (de Tores et al. 2008a, de Tores 2005, Mawson 2004, Morris 2000). There was a high mortality of *P. occidentalis* at the latter site due to suspected chuditch predation, in addition to some predation by foxes (Mawson 2004). However, *P. occidentalis* have been observed at this site in subsequent surveys (de Tores et al. 2008a).

Translocations of smaller numbers of *P. occidentalis* to Karakamia Sanctuary (275 ha), a predator-free fenced enclosure east of Perth owned by the Australian Wildlife Conservancy (Fig. 1.1), were carried out in 1995-96 and 1998-02 (AWC 2006, de Tores

et al. 1998), and a low density population remains in existence there (AWC 2006, 2009). Numbers of *P. occidentalis* translocated to each of the sites between 1991 and 2001 are summarised in Table 1.5.

Table 1.5 Numbers of *P. occidentalis* translocated to each site during the two periods 1991 to 2001 and 2004 to January 2006.

Release Site	N translocated 1991-2001	N translocated 2004-2006
Leschenault Peninsula	122 (1991-97; mainly rehabilitated)	100 (mainly displaced)
White Hills Rd & Preston Beach Rd	140 (1995-2001; mainly displaced)	
Martin's Tank		55 (mainly displaced)
Lane Poole	133 (1996-99; mainly rehabilitated)	
Locke Nature Reserve	5 (1991, rehabilitated)	
Karakamia Sanctuary	42 (1995-2002; rehab & displaced)	
Total	**442**	**155**

AWC (2006), de Tores (unpublished data)

Although the translocated *P. occidentalis* populations in Yalgorup National Park have persisted until the present day (de Tores et al. 2008a), the population at Leschenault Peninsula suffered a major decline in numbers between 1998 and 2002 (de Tores et al. 2005a, de Tores et al. 2004, de Tores 2005). Limited monitoring during those four years prevented identification of the reason(s) for this decline. Various possible causes were mooted, including changes in the fox-baiting regime, predation by cats and/or pythons, competition with *T. vulpecula*, prey switching, drought, unsuitable habitat, and disease (de Tores et al. 2004, de Tores 2005). An increase in the level of fox predation as a result of changes in the 1080-baiting regime (lapses in effort, reduced bait numbers, a change to burying baits) was considered the most parsimonious explanation for the decline, but it may not have been the single causal factor (de Tores et al. 2004).

Translocations of *P. occidentalis* recommenced in 2004 with the aim of ascertaining the specific factors responsible for limiting translocation success at Leschenault Peninsula and other sites (de Tores et al. 2005b, de Tores 2005). *Pseudocheirus occidentalis* were translocated to two sites during 2004-05, one baited for fox control (Leschenault Peninsula) and the other an unbaited site (Martin's Tank, 516 ha, within Yalgorup National Park, Fig. 1.2). Monitoring was carried out with the aim of determining causes

of mortality and effects of 1080-baiting on survivorship. Evidence from reintroduction programs of burrowing bettongs and other small native mammals in arid areas of WA (Christensen and Burrows 1994, Risbey et al. 2000) has indicated that fox-control may result in increased predation by feral cats, and it was important to determine whether such mesopredator release effects were likely to be deleteriously affecting *P. occidentalis* survivorship in baited sites. Numbers of *P. occidentalis* translocated from 2004 to January 2006 are shown in Table 1.5.

The translocation project described in this thesis took place during 2006-08. In addition to monitoring survivorship of *P. occidentalis* and *T. vulpecula*, the health and disease status of possums was assessed at both the source locations (*P. occidentalis*) and the translocation sites (*P. occidentalis* and *T. vulpecula*). Inter-specific partitioning of habitat use and other interactions between the two possum species that might affect *P. occidentalis* translocation success were also investigated. The previous translocation work had not included comprehensive examinations of the health of individual *P. occidentalis*, nor surveys for infectious diseases in either possum species. Neither had the issue of competition with *T. vulpecula* been specifically addressed.

The possibility that disease could be limiting translocation success was highlighted by absence of any compelling evidence for other cause(s) of the rapid decline in *P. occidentalis* numbers at Leschenault Peninsula (de Tores et al. 2004, de Tores 2005), and the death of an individual *P. occidentalis* at one of the Yalgorup sites (White Hills Rd) due to toxoplasmosis (de Tores et al. 2008a). Although the latter was a one-off incident, it emphasised the current lack of knowledge about the prevalence of this disease, and others, among possums in south-west WA. The rapid decline of *P. occidentalis* at Leschenault Peninsula could plausibly have been due to a disease episode, despite lack of evidence after the event.

It has been previously hypothesised that competition between *T. vulpecula* and *P. occidentalis* may limit populations of the latter species (How and Hillcox 2000, Wayne 2005). This suggestion is based on anecdotal behavioural observations and the fact that both species rarely coexist in equal numbers within discrete vegetation communities in WA (de Tores et al. 2004, Jones and Hillcox 1995). There is strong

evidence that 1080-baiting for fox control directly benefits *T. vulpecula* at some sites in WA (Kinnear et al. 2002), and spotlighting data from Leschenault Peninsula during the years following commencement of 1080-baiting at that site suggest a similar effect (de Tores et al. 2004). Manipulative experiments, involving exclusion of *T. vulpecula*, are required to unequivocally demonstrate that these possums competitively limit *P. occidentalis* populations (Wayne 2005). Although manipulative experiments were beyond the scope of my study, it was possible to incorporate information on *T. vulpecula* numbers at the study sites into analyses of *P. occidentalis* survivorship and to investigate levels of inter-specific habitat partitioning through use of radio-telemetry and spotlight surveys.

1.5.2 Aims

The overall aim of my study was to investigate translocation outcomes for *P. occidentalis* in the presence of sympatric *T. vulpecula*, in the context of the health status of both species and in relation to 1080-baiting for fox control. Within this broad topic there were five specific aims:

1. To assess the current health and disease status of *P. occidentalis* and *T. vulpecula*, and investigate relationships between health and translocation success.
2. To determine proximate and ultimate causes of mortality of translocated *P. occidentalis* and resident *T. vulpecula*.
3. To model survivorship of radio-collared *P. occidentalis* and *T. vulpecula* in relation to individual animal characteristics, site-specific habitat attributes, 1080-baiting for fox control and climatic variables.
4. To examine habitat use by translocated *P. occidentalis* and resident *T. vulpecula*, investigate levels of habitat partitioning, and evaluate the evidence for inter-specific competition.
5. To ascertain current *P. occidentalis* and *T. vulpecula* population densities at the translocation sites using line transect survey methods.