# A case for *in situ* management of Western Ringtail Possums, *Pseudocheirus occidentalis*, in development areas

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## Abstract

The threatened Western Ringtail Possum (*Pseudocheirus occidentalis*) is relatively abundant in numerous locations on the coastal strip between Bunbury and Dunsborough, Western Australia. But this area is subject to rapid residential development and there is the inevitable conflict between protecting a threatened species and development. We recorded 306 dreys, mostly in Peppermint trees, in the Dunsborough town site. Areas with high concentrations of dreys did not necessarily coincide with where most possums were found foraging. Over six nights 118 *P. occidentalis* were seen in road side verges, 246 in remnant vegetation and 53 in residential areas, indicating that they are abundant in this highly disturbed habitat. We use these data to discuss potential management options (*i.e.*, no development, do nothing, translocate or *in-situ* management) for new development sites in the region.

**Keywords:** Western Ringtail Possum; *Pseudocheirus occidentalis*, threatened species, management, translocations, Western Australia

## Introduction

*Pseudocheirus occidentalis* is listed as a Schedule 1 species (*i.e.*, fauna that is rare or likely to become extinct) under the Western Australian Wildlife Conservation (Specially Protected Fauna) Notice 2008, and as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation* (EPBC) Act 1999. It is also listed as Vulnerable in the IUCN Red List of Threatened Species (http://www.iucnredlist.org/details/18492).

Under the EPBC Act any action that is likely to have a significant impact on a matter of national environmental significance requires assessment and approval by the Commonwealth Minister for the Environment before that action can proceed. General guidelines for what the commonwealth considers a significant impact on a species are available in a Department of the Environment and Heritage (2006) publication. In 2009, the Commonwealth Department of Environment, Water, Heritage and the Arts (2009a) released its policy guideline indicating what it considered as significant impact thresholds and actions that might impact on *P. occidentalis*.

As a consequence of legislative requirements and the Commonwealth government's signalled intent, most land developers along the coastal strip between Bunbury and Dunsborough in Western Australia are required to undertake a field survey to determine the presence of *P. occidentalis* in order to assess the potential impact of the proposed development on this possum.

Jones *et al.* (1994a), de Tores (2008) and the Department of Environment, Water Resources and Heritage (2009b) indicated that *P. occidentalis* is now most found along the coastal strip of vegetation between Bunbury and Dunsborough, but scattered populations are also present throughout the south-west as far east as Albany (Jones *et al.* 2007). *Pseudocheirus occidentalis* is nocturnal and usually shelters by day in a drey (bird-like nest) or tree hollow. Dreys are typically located in the crown of Peppermint trees, but may be constructed in other tree species, such as Melaleuca, Banksia, Marri, Tuart and Jarrah trees. Where the vegetation is not suitable to make a drey, tree hollows are utilised as retreats (Jones *et al.* 1994a). In this general area *P. occidentalis* will also make use of dense ground cover (*e.g.*, sword grass) for daytime refuge and also grass trees, reeds, sedges, blackberry thickets, fallen logs and disused rabbit warrens (Harewood 2008; de Tores 2008). *Pseudocheirus occidentalis* are territorial and have defined, overlapping home ranges of 0.5–1.5ha that extend about 60m from their drey tree (Jones *et al.* 1994b). An individual may have numerous dreys within its home range. In the coastal region, the leaves of Peppermint trees are a primary food source (Jones *et al.* 1994b), but individuals in residential areas may also feed on a variety of other tree foliage as well as domestic garden plants, fruit and vegetables. In Eucalypt dominated woodlands, with fewer Peppermint trees other vegetation will be eaten (Jones *et al.* 1994b, de Tores 2008).

The specific objective of this paper is to briefly describe the locations of *P. occidentalis* and their dreys

within a section of the Dunsborough town site and to discuss potential management options that arise from these data for developments in the south-west of Western Australia.

## Methods

### Survey Site

A section of the Dunsborough town site (Figures 1 and 2) was surveyed by four people between 25 and 31 March 2007. The surveyed area was divided into three zones; remnant vegetation (47.8ha); residential (57.4ha); and road side verges (21.7ha). The purpose of the survey was to record the location of all dreys within the area and to count the number of *P. occidentalis*. Both day and night searches were undertaken to accomplish this task.

### Day-time Searches

Dreys were located during the day by systematically searching the area on foot. All dreys were numbered and their location recorded using a hand-held GPS. Although we could find no data to suggest drey type was connected to usage or abundance, there is a variation in the construction of dreys that we consider may provide an index of use with further investigation (Lindenmayer *et al.* 2008). Therefore, dreys were classified into one of four categories:

Type 1 dense, well-made ball or slightly elongate form with a distinct entrance hole. In this type of drey the possum is completely enclosed;

Type 2 dense, well-made cup-shaped nest with some material over the top, but the possum is not fully enclosed;

Type 3 dense, well-made cup-shaped nest with an open top. The possum sits deep inside the cup of the drey and may not be visible from the ground;

Type 4 platform of twigs, often in a tree or branch fork, with no more than a shallow depression where the possum rests.

For each drey the following information was recorded: drey category, tree species, height of the tree (estimated), height of the drey above the ground (estimated), condition of the drey and the presence of a possum(s). Dreys were easily detected and therefore a near complete list can be provided for each of the tree habitat types.

### Night-time Searches

Night searches were used to locate *P. occidentalis*. This was done by searching for individuals using a head torch while walking through the area between 1930 and 0200hrs. Due to the size of the survey area it was not possible to cover all of the area every night. No area was searched on multiple occasions on a single night, but each area was searched on at least two occasions on non-consecutive evenings. A different combination of observers searched each area during the second search of the area.

### Weather

Skies were clear and suitable for spotlighting on five of the six evenings. On 27 March it rained and was windy. Although *P. occidentalis* were still observed, the evening search was stopped at 2300hrs when the weather deteriorated to avoid inconsistent observations due to inclement weather. Possums were observed to be retreating to sheltered areas (*e.g.*, tree hollows) and had stopped feeding when the rain began to get heavy.

### Limitations

We acknowledge that there were likely to be observer differences in detecting *P. occidentalis* using spotlights (Wayne *et al.* 2005), but this was not crucial to this study as no attempt was made to estimate densities or relative abundance, rather it was to indicate which habitat types were being utilised.

In addition, it was unlikely that all *P. occidentalis* were observed each evening in the areas searched, as possums will often turn their head or close their eyes when a light is shone nearby. These behavioural responses make spotlighting counts difficult given that eye-shine is the primary method for locating individuals in the tree canopy. Possums that inhabited residential dwellings and backyards that could not be accessed were not counted. The drey and possum counts for residential areas are therefore almost certainly an under-estimate.

Differences among estimates of drey height were not statistically examined as there was likely to be 'measurement' error in the estimates, limiting any quantitative analysis.

## Results

### Dreys

A total of 306 *P. occidentalis* dreys were recorded in the study area (Figure 1). The height and rating of each drey is summarised in Table 1. The average height of a drey above the ground level was 5.3m with a range of 1.5–25m. Dreys located in the residential area had the highest mean height (5.8m), while the dreys located in the roadside vegetation had the lowest mean drey height of 4.8m. The majority of dreys were either type 1 or 2 (69%),

**Table 1**

Height, rating and density of dreys

| Location | Drey abundance | Drey height (m) Mean ± 1 se | Range | Drey rating 1 | 2 | 3 | 4 | Drey density/ha |
|---|---|---|---|---|---|---|---|---|
| Roadside verges | 54 | 4.8 (0.341) | 1.8–12 | 22 | 16 | 9 | 7 | 4.56 |
| Remnant vegetation | 153 | 5.2 (0.237) | 1.5–25 | 52 | 50 | 33 | 18 | 1.13 |
| Developed areas | 99 | 5.8 (0.276) | 1.5–15 | 38 | 34 | 15 | 12 | 2.66 |
| TOTAL | 306 | 5.3 | 1.5–25 | 112 | 100 | 57 | 37 | 2.41 |


**Figure 1.** Locations of *Pseudocheirus occidentalis* dreys in the Dunsborough town site.

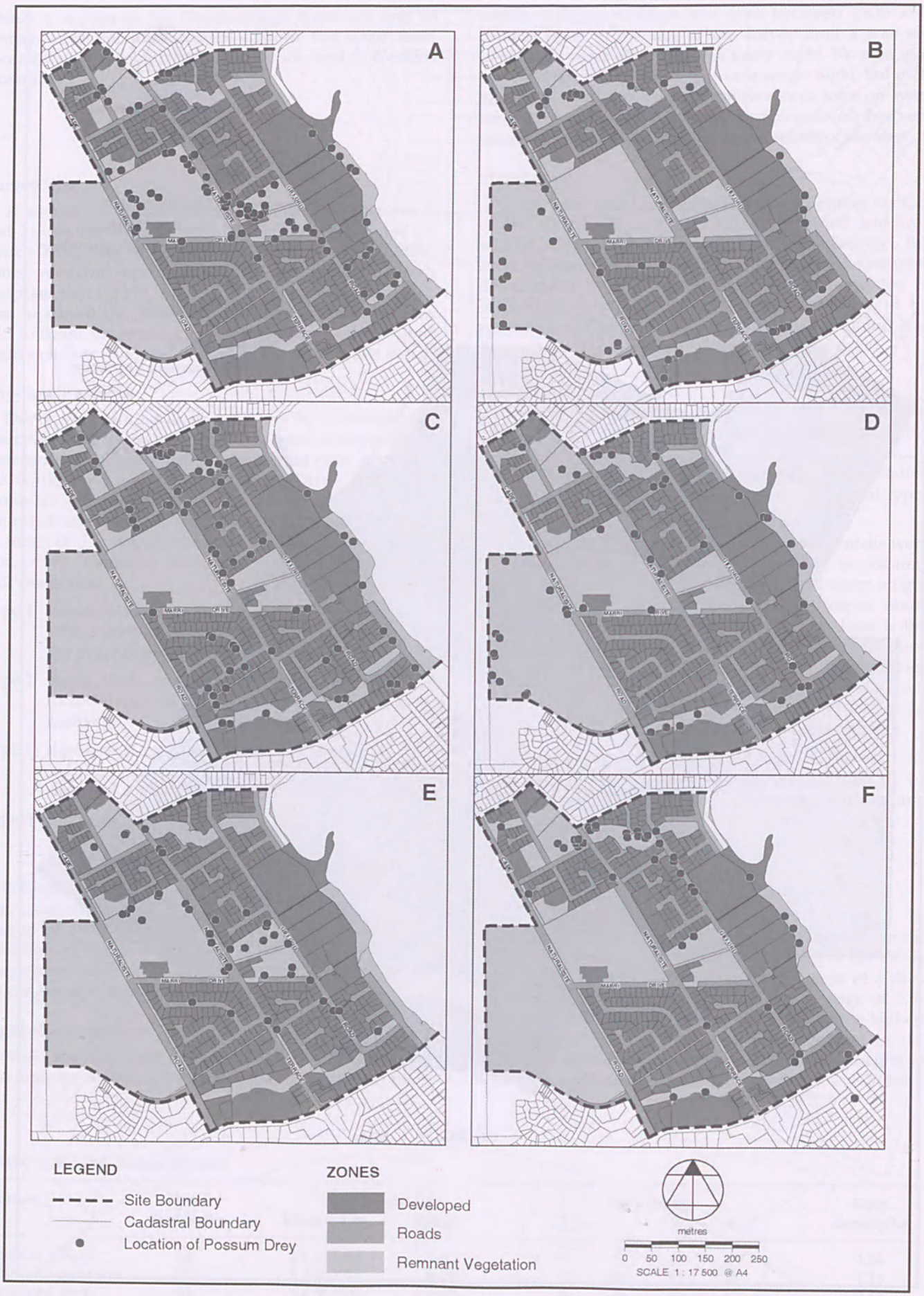


**Figure 2.** Locations of *Pseudocheirus occidentalis* in the Dunsborough town site on the six search occasions.

followed by type 3 and then type 4. The density of dreys was lowest in the remnant vegetation (1.13/ha) and highest in roadside vegetation (4.56/ha). The density of dreys across the survey area was 2.4/ha (Table 1). Dreys were recorded in a variety of trees, but most were in Peppermint trees (43.9%) with the next most common locations being Melaleuca, Banksia and Marri trees (19.6%, 12.7% and 12.4% respectively; Table 2).

*Pseudocheirus occidentalis*

One hundred and nine *P. occidentalis* were observed on 25 March; 55 on 26 March; 91 on 27 March; 63 on 28 March; 51 on 29 March; and 52 on 30 March. Overall 246 observations were made in remnant bushland, 118 in roadside verges and 53 in residential areas (Table 3). The majority of *P. occidentalis* were recorded in Peppermint trees (60%) followed by Marri trees (16%). In the

**Table 2**

Numbers of *P. occidentalis* dreys detected in different tree types in each of the sampled habitats in the Dunsborough town site.

| Tree type | Roadside verges | Remnant vegetation | Developed areas | TOTAL | % of Total |
|---|---|---|---|---|---|
| Peppermint | 31 | 46 | 57 | 134 | 43.8 |
| Melaleuca | 10 | 43 | 7 | 60 | 19.6 |
| Banksia | | 38 | 1 | 39 | 12.7 |
| Marri | 7 | 13 | 18 | 38 | 12.4 |
| Eucalypt | 2 | 1 | 2 | 5 | 1.6 |
| Acacia | 1 | | 3 | 4 | 1.3 |
| Bamboo/Pine | | | 4 | 4 | 1.3 |
| Allocasuarina | | 3 | | 3 | 1.0 |
| Bottlebrush | 1 | | 2 | 3 | 1.0 |
| Jarrah | | 2 | | 2 | 0.7 |
| Kunzea | | 2 | | 2 | 0.7 |
| Pine | | | 2 | 2 | 0.7 |
| Planted/introduced | 1 | | 1 | 2 | 0.7 |
| Bamboo | | 1 | | 1 | 0.3 |
| Chinese Pepper | | 1 | | 1 | 0.3 |
| Hakea | 1 | | | 1 | 0.3 |
| Hakea/Wisteria | | 1 | | 1 | 0.3 |
| Hibiscus | | | 1 | 1 | 0.3 |
| Pitossporum | | 1 | | 1 | 0.3 |
| Woody Pear | | 1 | | 1 | 0.3 |
| Yate | | | 1 | 1 | 0.3 |
| TOTAL | 54 | 153 | 99 | 306 | |

**Table 3**

*Pseudocheirus occidentalis* locations and use of tree species

| Tree type | Roadside verges | Remnant vegetation | Residential | TOTAL | % of Total |
|---|---|---|---|---|---|
| Peppermint | 59 | 159 | 32 | 250 | 59.95 |
| Marri | 29 | 35 | 3 | 67 | 16.07 |
| Banksia | 2 | 20 | | 23 | 5.52 |
| Melaleuca | 8 | 5 | 4 | 17 | 4.08 |
| Acacia | 2 | 8 | 1 | 11 | 2.64 |
| Eucalypt | 4 | 5 | 2 | 11 | 2.64 |
| Fence | 2 | 2 | 6 | 10 | 2.40 |
| On the ground | 1 | 3 | 1 | 5 | 1.20 |
| Tuart | | 4 | | 4 | 0.96 |
| Allocasuarina | 2 | 1 | | 3 | 0.72 |
| Bottlebrush | 2 | | 1 | 3 | 0.72 |
| Jarrah | | 2 | | 2 | 0.48 |
| Lilly Pilly | | | 2 | 2 | 0.48 |
| On the roof | 3 | | | 3 | 0.72 |
| Hakea/Wisteria | | 1 | | 1 | 0.24 |
| Lemon tree | 1 | | | 1 | 0.24 |
| Moptop | 1 | | | 1 | 0.24 |
| Planted/introduced tree | | 1 | 1 | 2 | 0.48 |
| Woody Pear | 1 | | | 1 | 0.24 |
| Other | | | | 4 | |
| TOTAL | 118 | 246 | 53 | 417 | |

residential areas, *P. occidentalis* were observed utilising roofs, fences and a variety of exotic shrubs and trees in addition to native vegetation.

## Discussion

It is apparent that *P. occidentalis* utilised residential areas, remnant vegetation and trees in roadside verges. Dreys were located in all habitat types; however, they were least abundant in the remnant vegetation. As possums will readily retreat to tree hollows, the lack of dreys in remnant vegetation might simply reflect a higher number of available tree hollows.

Jones *et al.* (1994b) recorded densities of *P. occidentalis* between 2.5 and 4.5 per hectare at the Abba River and the Locke Estate, Busselton, although elsewhere (*e.g.*, Geographe Bay and Emu Point) densities were less than 1.0 per hectare. Harewood (2008) reported average densities of *P. occidentalis* of 13.5 per hectare within urban reserves in Busselton. Jones *et al.* (2007) reported 30 *P. occidentalis* in 85 hectares of pastoral land, 170 in 50 hectares of a C class nature reserve, 200 in 35 hectares of beachside settlements and 270 in 35 hectares of beachside recreation reserve (A class) used for camping since 1955 in the Siesta-Kealy area south of Busselton. So although the species is listed as threatened under state and commonwealth legislation, it was relatively abundant in the highly disturbed Dunsborough town site and in reserves within the town of Busselton and was in much higher densities in the beachside Peppermint woodland south of Busselton.

Dreys ranged in height above the ground from 1.5–25m, with the developed areas having the highest and roadside verges having the lowest. This largely reflects the availability of trees in these areas, as the Pines, Chinese Peppers, etc in residential properties were generally taller than street trees which are mostly Peppermints.

The majority of *P. occidentalis* dreys recorded within the study area and in each of the habitat types were types 1 or 2. *Pseudocheirus occidentalis* were most often found in Peppermint trees, but as no assessment was made of the availability of tree types, this may reflect the abundance of these trees in the area rather than any selective preference. It is however, apparent that *P. occidentalis* forage and retreat to a variety of tree types, and will also utilise artificial structures (*e.g.*, compost heaps, houses, poles, power lines). Maps produced by Jones *et al.* (1994b) suggested the locations of dreys and possums were similar at their study site. However, possums foraging (Figure 1) at night in Dunsborough did not cluster in areas of higher drey density (Figure 2), which suggests that possums utilised a variety of trees in their home ranges in which to forage.

These data suggest that the Dunsborough town site is an important area for maintaining the population of *P. occidentalis* in the south-west of Western Australia. The Department of the Environment, Water, Heritage and the Arts (2009a) Policy Statement 3.10 on *P. occidentalis* does not include the Dunsborough town site as a 'core habitat' area, which is surprising given the number of possums in the town. We have also recorded *P. occidentalis* in other areas south of Dunsborough, which suggests there is a need for a more detailed and comprehensive assessment of their geographic distribution in the south-west of Western Australia. Without a detailed knowledge of their current geographic distribution in the area, it is difficult to assess the potential impacts of proposed developments in town sites on this species in the general area. The recent reports by Harewood (2008) and Jones *et al.* (2007) for the GeoCatch Council provide evidence of how little we know of the current spatial distribution and their relative abundance.

### Management implications

If *P. occidentalis* are present in a proposed development area, then there are potentially four management options: a) stop the development from proceeding, b) do nothing and ignore the presence of *P. occidentalis*, c) capture and translocate individuals to another suitable location, and d) manage the population *in situ*.

Stopping a development is an option that is likely to provide the highest level of protection. However, elsewhere in Western Australia the presence of rare and endangered species in a development area has usually not been sufficient to stop the development (*e.g.*, Barrow Island development potential impact on flatback turtles; EPA Bulletin 1221, 2006), so this may be an unrealistic option.

As developers can be prosecuted under the EPBC Act (1999) if a development significantly impacts on *P. occidentalis*, it is advisable to make a referral to the Commonwealth Environment Minister under the EPBC Act (1999) if they are on a development site. The Commonwealth Department of Environment, Water, Heritage and the Arts (2009) released a policy guideline for addressing the issue. This policy paper only addresses *P. occidentalis* within the coastal zone (~15km from the sea) between Bunbury and Dunsborough. This area has been divided into core habitat (*i.e.*, high densities of *P. occidentalis*), supporting habitat (*i.e.*, buffer zone and areas offering foraging, breeding and dispersal opportunities) and primary corridors (connections between core habitats). Thus, the option of doing nothing and ignoring the presence of *P. occidentalis* is not available to a developer in this area. Few recommendations are offered on managing *P. occidentalis* in development areas in the policy statement.

Capturing and translocating *P. occidentalis* has been attempted at numerous locations including into Leschenault Peninsula Conservation Park, Yalgorup National Park and Lane Poole Reserve (see review in de Tores *et al.* 2004, and also de Tores *et al.* 2005; 2008). The summary review by de Tores *et al.* (2004) suggested many individuals translocated into the Leschenault Peninsula Conservation Park died after translocation. Possible reasons for these deaths were competition from Brushtail Possums (*Trichosurus vulpecula*), predation by cats (*Felix catus*), foxes (*Vulpes vulpes*) or pythons (*Morelia spilota imbricata*), prey switching [rabbit (*Oryctolagus cuniculus*) numbers had been significantly reduced], effects of drought, disease and unsuitable habitat. The most likely reason was predation by foxes as the frequency of the 1080 baiting program had become erratic (de Tores *et al.* 2004). Augee *et al.* (1996) reported that hand-reared *Pseudocheirus peregrinus* released into the Ku-ring-gai Chase National Park in New South Wales

survived for an average of 101 days compared with wild ringtail possums and most died as a consequence of predation by foxes (52%) and cats (29%). Early data for translocations to Yalgorup National Park and Lane Poole Reserve suggested that small populations might have been established (de Tores *et al.* 2008), but long-term survival of these populations will only be known with future monitoring. de Tores *et al.* (2008) expressed the view that translocations have increasingly been used as a mitigation measure for many threatened species and suggested they have a major role to play in conserving *P. occidentalis*. The Commonwealth Government (Department of Environment, Water, Heritage and the Arts 2009b) background to the policy statement indicates that 'translocation does not reduce the impact of an action, and is not considered to be a mitigation or offset measure as it is unlikely to result in a positive conservation outcome for the species'. It is our view that the translocation of individuals into 'presumed suitable' habitat that is devoid of the species may doom translocated individuals to suffer the same fate as those in the Leschenault Peninsula Conservation Park. Understanding why *P. occidentalis* are not present in 'presumed suitable' habitat within their known geographic distribution is an important precursor to successful translocations, as it enables management strategies to be put in place to mitigate these threats. For example, if *P. occidentalis* have become locally extinct in an area due to fire or fox predation, then the management strategies would be entirely different to enhance the survival of translocated individuals.

Jones *et al.* (1994a) reported extant populations of *P. occidentalis* outside the urban area occurred in areas associated with water courses, drainage lines and swamps with habitat characterised by their near-coastal position and high continuity of canopy or mid-strata vegetation. More recently, Jones *et al.* (2007) have reported substantial populations in disturbed but non-urban areas between Busselton and Dunsborough and Harewood and our data demonstrate that *P. occidentalis* are also able to survive and maintain relatively high densities within urban areas. It therefore seems appropriate to maintain existing *P. occidentalis* populations *in situ* as the preferred management strategy in new development areas. Being arboreal, feeding in the tree canopy, being relatively slow and clumsy on the ground and preferring to move through the tree canopy rather than come to the ground provides a planning framework for ensuring their coexistence with human habitation (Jones *et al.* 1994a, b; pers. observation).

The tree canopy and connectivity of habitat are likely to be important for the survival of *P. occidentalis* whose home ranges have been affected by clearing. To reduce the number of individuals forced out of an area, developments should retain undisturbed habitat with an abundance of mature trees providing adequate foligae and hollows (Jones *et al.* 2007). Residential areas should be developed in stages over a number of years, retaining as many of the existing trees as possible and implementing a planting program of 'advanced' trees. A development restriction might, for example, only allow a proportion of the total development area to contain a prescribed density of immature trees. As trees grow and mature and thus become suitable habitat for *P. occidentalis*, new areas can be developed. Such an approval condition would provide an incentive for land developers to plant 'advanced' trees at a density that would sustain *P. occidentialis* in the new residential developments within a minimum timeframe.

Small residential blocks that are mostly covered with buildings offer limited space for growing large trees and obtaining the necessary connectivity among trees. Therefore, it might be important that these new residential developments have larger lots, controls on tree clearing, and are accompanied by active planting of trees on housing lots and roadside verges prior to the sale of the land. Developers might also be requried to construct physical linkages among trees (*e.g.*, wire cables, ropes) to provide improved connectivity. Local government can enhance *P. occidentalis* habitat by planting Peppermint trees sufficiently close together on the street verges and in public open space to provide connectivity corridors that enable possums to move between residential areas and public open space.

Given that cats could contribute to the decline in *P. occidentalis* (Augee *et al.* 1996; de Tores *et al.* 2008; Department of Environment, Water, Heritage and the Arts 2009b), caveats might also be placed on the land titles to either ban residents owning cats or compelling owners to keep their cats inside at night. Strategically locating public open space provisions to protect high quality *P. occidentalis* habitat and to offer strong connectivity among trees in roadside verges and residential properties might also be important.

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