Problems with keeping native Australian mammals as companion animals

Karen L. Viggers[1] and David B. Lindenmayer[2]

[1]Research School of Biological Sciences, The Australian National University, PO Box 475, Canberra, ACT, 2601

[2]Centre for Resource and Environmental Studies and Department of Geography, The Australian National University, Canberra, ACT, 0200.

ABSTRACT

Keeping native animals as pets has recently been proposed as a new strategy to enhance the conservation of wildlife in Australia. In this paper we critically examine the arguments put by the proponents of a native animal pet industry, discuss potential problems associated with it and cover a range of important related issues. The primary argument for a native animal pet industry is that it will generate major benefits for the conservation of Australia's biodiversity. However, the use of native animals as pets (and associated captive-breeding and re-introduction programs) will only ever focus on a small subset of species, will be unable to address larger biodiversity conservation issues, and will be unlikely to make more than a very limited contribution to nature conservation in Australia. Other approaches such as setting aside reserves and off-reserve conservation strategies such as landscape restoration will be far more important for nature conservation. Yet, a native animal pet industry has the potential to divert funds from these important activities, and may possibly even reduce public appreciation of the critical need for them.

We provide a range of reasons why native animals are unlikely to replace domestic animals as pets. We also raise concerns about animal welfare and other issues that could flow from keeping native animals as pets. These include (among others):- potential for a significant incidence of stress-related and husbandry-related diseases, problems with access to appropriate husbandry and veterinary care, and the potential for inappropriate breeding to select particular anatomical traits. Keeping native animals as pets also has the potential to:- transmit disease to wild populations of the same species, transmit disease to other species in close contact, and spread disease from animals to humans (zoonoses). These problems have major negative implications not only for wild populations of Australian native animals, but also for human health in this country. It is essential these issues are fully addressed prior to the further development and promotion of the concept of a native animal pet industry. Indeed, for the establishment of such an industry to be justified, there must be substantial positive conservation outcomes for wild populations. It must also be demonstrated that any new industry would not have any negative effect on the status of wild populations.

Introduction

Habitat loss is the key process underpinning the decline and extinction of biodiversity worldwide (Groombridge 1992; Haila 1999). Several other factors can contribute to population decline including stochastic events, over-hunting and disease (Sim-berloff 1988). In Australia, predation by introduced feral animals also has a major negative impact on native fauna (e.g. Short *et al.* 1992). In an attempt to address these threatening processes and limit risks of population decline and extinction, *in-situ* conservation of species usually requires strategic approaches including (among others):- limiting habitat loss (Caughley and Gunn 1995), habitat restoration (Saunders *et al.*

Pages 130 - 151 in *A Zoological Revolution. Using native fauna to assist in its own survival.* Edited by Daniel Lunney and Chris Dickman, 2002. Royal Zoological Society of New South Wales, Mosman 2088 and Australian Museum.

1993), reserve establishment (Margules *et al.* 1995), feral predator control (Kuchling *et al.* 1992), and recovering populations by re-introduction (Serena 1995). Of these strategies, the primary focus of conservation must remain on habitat retention and restoration, because habitat loss is the main cause of extinction and population decline.

Recently, a new strategy for native wildlife conservation has been proposed - keeping native mammals as companion animals (Archer 2000). In this paper, we critically examine ways in which the proponents of keeping native animal pets suggest this strategy might contribute to wildlife conservation. We also discuss several potential problems associated with this strategy that have had negative impacts on wildlife populations overseas and in Australia. Given Australia's history of ill-conceived animal introductions for sporting and biological control purposes (Rolls 1969; Burgman and Lindenmayer 1998), this country cannot afford any more major errors of human judgement that may lead to further pressure on the nation's biodiversity. Therefore, whatever model for a native animal pet industry is proposed, it must be shown that:-

1 it will have no negative effects on wild populations, and,

2 there actually will be a significant conservation benefit.

Effectiveness of current *in-situ* conservation strategies

A key argument from proponents of a native animal pet industry is that existing *in-situ* conservation strategies are failing, and a new approach is needed to conserve biodiversity (that is, the use of native animals as pets). A number of strategies are needed to conserve remaining biodiversity and limit further losses (Caughley and Gunn 1995). The establishment of reserve systems is critical. Although the present reserve system is not representative of the range of environments, plant communities and wildlife species in Australia (Burgman and Lindenmayer 1998), networks of protected areas in Australia nevertheless **will** make a significant positive contribution to *in-situ* conservation (Margules and Pressey 2000).

It is increasingly recognised that off-reserve conservation strategies are also extremely important for *in-situ* nature conservation (Hale and Lamb 1997; Hunter 1999; Lindenmayer and Franklin, 1999). For example, the conservation of remnant vegetation and habitat restoration on private land will be extremely important (e.g. Saunders *et al.* 1993). Many investigations are now highlighting the important conservation value of even small areas of remnant native vegetation (e.g. Semlitsch and Bodie 1998; Lindenmayer *et al.* 1999; Schwartz, 1999). These are areas in which more conservation effort needs to be focussed.

Biodiversity encompasses genes, individuals, demes, metapopulations, populations, species, communities, ecosystems and the interactions between these entities. Hence, the maintenance of biodiversity requires consideration of factors at many spatial and management scales. However, the use of native animals as pets and associated captive-breeding and reintroduction programs can only ever focus on a limited number of individual species and cannot address larger biodiversity conservation issues.

The key point is that even though current strategies such as reserve and off-reserve conservation have some limitations, they are nevertheless central to addressing the major factor threatening species decline and extinction – the loss of habitat. The fact they have not been 100% successful does not mean it is valid to supplement them with unproven approaches like a native animal pet industry. If such alternative or supplementary approaches are to be trialed on the grounds of a potential conservation benefit, it is essential that projected positive conservation outcomes are clearly defined and likely to be realised, without risk to *in-situ* wildlife populations. Rather, given the central importance of reserve and off-reserve conservation, we believe that even further effort needs to be placed on stimulating habitat conservation and vegetation restoration. We are concerned that the recent proposal to allow keeping native animals as pets has the potential to distract attention from the urgent and critical need to conserve wildlife populations *in-situ*. Archer (2000) and Hopwood (2001) argue that the pets issue draws public attention to the need for *in-situ* conservation. However, there is little evidence that pet ownership translates into awareness or action on species conservation issues (see below). Moreover, extreme caution is required not to generate the impression that the survival of select species as pets in urban homes equates with conservation or that it guarantees a future for free-ranging populations.

A native animal pet industry

Proponents of a native animal pet industry have suggested that keeping Australian animals as pets will assist the conservation of wild populations of both common and endangered native species. They (e.g. Archer 2000; Hopwood 2001) contend a native animal pet industry would contribute to conservation by:-

1 increasing public awareness of wildlife conservation issues.

2 replacing current domestic companion animals.

3 generating funds for the conservation of wild populations.

4 providing captive breeding colonies for reintroduction programs for endangered species.

5 providing a supply of individuals to restore species that become extinct in the wild.

We examine each of these proposed outcomes and evaluate the likelihood that positive benefits will occur. We do this by outlining and discussing a list of questions that must be addressed to ensure that native wildlife populations are not put at risk by the advent of a native animal pet industry.

Questions to be addessed

The following questions must be adequately addressed if a native pet industry is to proceed:-

1 How would a native animal pet industry contribute to the conservation of wild populations? Are any of the perceived goals and benefits for free-ranging wildlife deliverable and realistic?

2 How would the native animal pet industry contribute to halting habitat loss – the key factor threatening populations of native animals in the wild?

3 Would community attitudes to conservation change significantly as a result of a native pet industry?

4 Does it logically follow that the conservation status of wild populations will improve once a native animal pet industry has been established?

5 Would native animals replace current domestic and companion animals?

6 Can animal welfare issues be adequately addressed? Issues of concern include:-

- **a** provision of suitable housing and behavioural stimuli for animals,
- **b** diet-related diseases,
- **c** husbandry-related diseases,
- **d** stress-related diseases,
- **e** dumping of unwanted animals,
- **f** conflict with current domestic pets (i.e. dog and cat attack on native pets), and,
- **g** social requirements for colonial species of native animals.

7 Is there sufficient biological and veterinary knowledge to proficiently establish and service a native animal pet industry?

8 Is there sufficient knowledge about disease in captive and wild populations to prevent serious disease risk in other wild populations and in humans through movements of animals and close contact in the domestic environment?

9 How would movements of animals between States and regions be restricted and controlled to limit potential problems such as the spread of disease and the hybridisation of naturally isolated gene pools?

10 What would be the source of native animals to support breeding programs?

11 What would prevent poaching and population depletion of wild stocks of native animals?

12 How would captive breeding populations be managed to maintain genetic variability and original wild types?

13 How would inappropriate breeding and inbreeding be prevented?

14 What would be the sources of funding for industry establishment, regulation and monitoring?

We explore some of these questions in detail in the following sections.

Conservation through captive breeding and reintroduction programs

One of the major perceived conservation benefits of a native animal pet industry is the establishment and further development of captive breeding colonies of endangered species for reintroduction programs. However, difficulties in genetic management cannot be taken lightly and several reviews have shown that captive breeding and reintroduction programs are high-

cost and high-risk approaches to conservation that often fail (see Fischer and Lindenmayer 2000). Reintroduction programs are a major undertaking, requiring detailed planning (Lindburg 1992), considerable expense (Kleiman 1989; Woodford and Kock 1991) and substantial resources for many years for implementation, monitoring and disease surveillance (Woodford and Kock 1991). It is doubtful that the proposed native pet industry could generate sufficient funds to contribute to conservation in this way.

Successful breeding of animals in captivity is often far from straight-forward and there are major unresolved issues to be addressed such as husbandry, genetics, negative selection, and disease. Appropriate captive-breeding protocols have yet to be determined for many Australian animals (George 1990). Captive breeding programs must be underpinned by detailed management plans, including recommendations on minimum population sizes, prevention of inbreeding and outbreeding depression, suitable selection and propogation procedures, maintenance of heteozygosity, minimisation of loss of genetic variation, and the conservation of important alleles (George 1990). It is also important to avoid selection for captivity or selection for deleterious genes (George 1990). It cannot be expected that all of this could be managed by state government fauna authorities, such as National Parks and Wildlife Services (or equivalent) or zoos, which are all generally experiencing ongoing reduction in resources rather than a substantial increase as such further duties and management strategies would require.

More importantly, in cases where animals can be successfully raised in captivity, breeding them for reintroduction programs is futile unless there is both:-

1 conservation and/or restoration of suitable habitat to release captive bred animals, and,

2 the causes contributing to the decline of the original wild population are addressed (Kleiman 1989; Fischer and Lindenmayer 2000). Such strategies have not been outlined in current native pets proposals (Hopwood 2001). Producing large numbers of animals for reintroduction programs without attempting to address these issues indicates a poor understanding of ecological processes and population management (Caughley and Gunn 1995; Fischer and Lindenmayer 2000).

Captive breeding of native animals will result in the selection of individuals that survive and reproduce best in a captive environment (Frankham 1986; 1995), such as those that are quieter, unafraid of humans, and unafraid of predators. McLean *et al.* (1995) showed that captive native animals do not recognise predators, and in the case of the Rufous Hair Wallaby, a predator recognition program had to be developed to increase survival prospects during reintroduction. Thus, captive breeding and pet ownership will select **away** from those characteristics which promote animal survival in the wild (Frankham 1986; 1995). On this basis, we question the legitimacy of the argument that a native pet industry would produce animals that could be released into the wild.

If a native animal pet industry hopes to contribute to conservation by breeding animals for reintroduction, it will be necessary to maintain at least two separate breeding colonies; one that attempts to maintain the characteristics of wild animals, and a second to provide animals for the pet market. Maintenance of captive breeding colonies is expensive (Bradley *et al.* 1999) and resources are unlikely to be available for both. Kleiman (1989) discusses some of the many complexities of the genetic management of captive breeding programs and selection of individuals suitable for reintroduction.

Hopwood (2001) outlines an approach to captive breeding and reintroduction of native species that, in our opinion, fails to recognise the difficulties faced by these programs (see also Spielman 1999). Such issues include: the maintenance of wild-type genetic characteristics, inbreeding and outbreeding depression within the breeding colony, potential negative impacts on endemic animals through introduced disease, the consequences of hybridisation of genetic stock from different regions, identification of the size and composition of groups to be released, the importance of mating systems, maintaining social organisation, and spatial relationships of populations in the wild (Kleiman 1989). Indeed, reintroducing captive-bred animals without prior preparation and ongoing monitoring could be inhumane, and jeopardise wild populations (Kleiman 1989).

Improved community attitudes to conservation

The supporters of a native animal pet industry claim that pet ownership will foster positive community attitudes towards conservation with benefits for wild populations of endangered species (Oakwood and Hopwood 1999; Hopwood 2001). The underlying assumption is that, through owning a pet, people will develop empathy and concern for a given species (or another closely-related species), as well as an awareness of their conservation status. Evidence supporting this assumption is limited both in Australia and overseas (see Spielman 1999) Domestic dogs are probably the most widely kept companion animal worldwide. However, ownership of dogs has not contributed to the conservation of wild populations of species such as the wolf or the African Wild Dog (Spielman 1999). Similarly, domestic cat ownership has not improved the conservation status of large cats such as the cougar, tiger, cheetah or ocelot (Spielman 1999). Indeed, there continues to be active persecution of several species of wild cats and wild dogs in some countries. For example, wild cats are still actively hunted and some species are the focus of now illegal Chinese medicine trade. In another example, the budgerigar is one of the world's most widely kept cage birds, but few owners are aware that it is native to Australia, or that it occurs in large flocks in desert regions of this country. This shows that even with common and widely known domestic species, ownership does not necessarily translate into awareness, let alone into conservation action. Moreover, it is possible that keeping native animals as pets will actually **reduce** public concern for nature conservation. This is because the public may perceive there is no need to protect habitats and pursue *in-situ* conservation because a given species can be maintained in suburban homes.

Another very real problem with the issue of native animals as pets is that, by focusing on keeping individual animals, or singling out particular species for a captive existence as pets, there could be a focus **away** from the critical need for habitat management and ecosystem conservation. Serious attempts to conserve free-ranging populations of wildlife need to be underpinned by *in-situ* habitat conservation (Bradley *et al.* 1999; see below). The framework for the proposed native animal pet industry (Hopwood 2001) fails to maintain this important focus. As such, it is difficult to see where the conservation benefits for wild populations will be achieved. Therefore, it is difficult to rationalise keeping of native animals as pets, other than for the luxury of human entertainment and enjoyment. This is not a sufficient reason to move a new group of animals that are not adapted to domestication into urban homes (see below).

The keeping of some native animals as pets, especially endangered species, may actually **increase** pressure on wild populations due to poaching. For example, the international pet trade for chimpanzees and orang-utans has lead to poaching and depletion of wild populations (Goodall 1999). Therefore, hoping that awareness of conservation issues will increase by owning native animals is not a sound justification for developing an entirely new industry which may have negative effects on free-ranging wildlife populations. Issues associated with the depletion of wild populations are examined below.

A more effective way to increase awareness and appreciation of wildlife and conservation issues might be to encourage more members of the community to be trained in the care and rehabilitation of injured and orphaned wildlife through the existing wildlife care networks (see Tribe and Brown 1999). This would bring people in contact with native animals, while avoiding many of the problems associated with pet trade and pet ownership. It is noted, however, that many care groups have limited knowledge of the conservation status of most species (K. Viggers, personal observation). This is further evidence that even those people keen to keep or care for wild animals are mostly uninformed of the conservation status of the species for which they are caring. These groups need to be encouraged to become better informed about conservation issues and also to increase the scope of their activities to include habitat restoration. Examples of this occurring are uncommon, but provide some cause for optimism, eg. with icon species such as the koala on the north coast of NSW (Lunney *et al.* 2000).

Replacement of current companion animals

Some authors have suggested that owning a native animal pet will make people less inclined to keep dogs and cats. However, most Australian native species will be far less interactive than dogs and cats – species which have undergone many years of breeding and selection to make them suited to domestication (Diamond 1997). Owners of companion animals usually desire social and emotional interactions with their pets, which most Australian native mammals are unlikely to provide (Spielman 1999). Diamond (1997) provides an extensive set of arguments demonstrating why so few of all animal species have become domesticated and how the limited pool of potentially suitable candidates is now already domesticated. Thus, while some individual Australian native animals that are hand-reared may imprint on humans, most individuals from the vast majority of species will not have a suitable temperament to make good pets. This is demonstrated by the experiences of wildlife carers who rehabilitate injured and orphaned Australian animals. They often report that Australian animals which are quiet and docile when young (such as the Eastern Grey Kangaroo, *Macropus giganteus* and Common Wombat, *Vombatus ursinus*), develop aggressive patterns of behaviour as they mature. Triggs (1988) discusses such behavioural changes in the Common Wombat.

In summary, limited interactive behaviour with humans and lack of domestication (including behavioural problems) mean that few if any of Australia's native mammals are likely to provide viable substitutes for domestic dogs and cats – animals which are well established in the Australian public psyche of keeping animals.

Multi-pet households

Rather than a substitution of domestic pets for native animals, we consider it more likely that pet owners would keep both domestic and native animals in the same household. Native animals are unaccustomed to living in close confines with potential predators such as dogs and cats. This has animal welfare implications because multi-pet households are likely to create increased stress among native animals, which could further result in immuno-suppression and increased susceptibility to disease (Woodford and Rossiter 1993). In addition, new diseases may emerge when a species is placed in a new situation (Thrusfield 1986), such as within suburban homes. This may result in transfer of disease from resident animals (i.e. current companion animals) to the newly introduced ones (i.e. native pets) (Thrusfield 1986) or vice versa or to humans (see below).

Multi-pet households also could lead to physical injury among native pets because of attacks by domestic pets. Attacks on native animals by dogs or cats are common (Vogelnest 1992), and have been observed in Australian States where it is currently legal to keep some native mammals as pets. Finally, in cases where native animals become habituated to domestic pets, if they are subsequently released or escape into the wild, they may be particularly susceptible to attack and/or predation by dogs and cats.

Prevention of extinction

Proponents of a native animal pet industry argue that if a species becomes extinct in the wild, it will continue to persist as pets in suburban households. Pet populations could then act as a source to re-establish animals in their former range including urban environments (e.g. the case of extinction of Eastern Quoll, *D. viverrinus*, in the Sydney suburb of Vaucluse: Oakwood and Hopwood 1999; Hopwood 2002). This is theoretically possible. However, urban and peri-urban environments will rarely provide suitable habitat for the vast majority of threatened native animals. In fact, such loss of habitat is one of the primary reasons why these native species have disappeared from such places. Programs to reintroduce animals to areas lacking suitable habitat will almost certainly fail (Serena 1995; Fischer and Lindenmayer 2000). In addition, re-introduction programs are unlikely to be successful (and are arguably unethical) unless the original cause of decline is removed (Kleiman 1989; Caughley and Gunn 1995; Fischer and Lindenmayer 2000) – which is unlikely to occur in urban environments. Finally, the problems that were outlined earlier that are associated with the release of maladapted captive-bred animals still apply.

Animal welfare issues

Stress and Stress-related diseases

Animals kept in a captive environment to which they are unsuited and/or unaccustomed often develop stress-related diseases (Woodford and Rossiter 1993; Bellamy 1994; Woods 1999; Spielman 1999). This occurs often despite concerted efforts by experienced carers to minimise stressful conditions (see Walraven 1990; Bellamy 1994; Woods 1999). Stressed animals are often also immunosuppressed, and this may affect an animal's ability to respond to the presence of an infectious agent (Thrusfield 1986). Endogenous pathogens in healthy animals may cause disease when an animal is stressed, and such opportunistic infections are most likely to occur when an animal's resistance is lowered (Thrusfield 1986; Spielman 1999).

Veterinarians and wildlife carers who have been closely involved with rearing, treating and handling native wildlife are well aware that such animals can be very susceptible to stress (Walraven 1994; Spielman 1994; Bellamy 1994; Woods 1999). Stress can be difficult to recognise in unfamiliar species (Schuppli and Fraser 2000). It can be caused by many factors, and most people would be unaware of these. Such factors include:- inexpert or rough handling, loud or unusual noises, the presence of predators, inappropriate diet and food presentation, overfeeding, separation from colonial members, inappropriate ambient temperatures, close contact with humans and exposure to unfamiliar humans (Walraven 1994; Woods 1999). Stress is often difficult to detect or measure and may only be recognised through symptoms such as diarrhoea, alopecia (hair loss), impaired growth, nervousness, ringworm and displacement behaviour (such as overgrooming and sucking lesions) (Bellamy 1994). These types of conditions are common among hand-reared animals, including those handled by experienced humans from a very young age (Speare 1988; Bellamy 1994; Woods 1999).

Nervousness or aggression usually emerges in most animals as they mature, even in cases where there is initially a close relationship with a wildlife carer (K. Viggers, personal observation; eg. Eastern Grey Kangaroo, *M. giganteus*; Common Wombat, *V. ursinus*; Common Brushtail Possum, *Trichosurus vulpecula*; Agile Wallaby, *Macropus agilis*; Sugar Glider, *Petaurus breviceps*; koala, *Phascolarctos cinereus*; swamp wallaby, *Wallabia bicolor*; red-necked wallaby, *Macropus rufogriseus)*. Indeed, there are few examples of individuals which remain suitable to a domestic existence over time. With inexperienced handlers (ie. the majority of people likely to become native pet owners), stress-related illnesses are likely to be extremely common. New pet owners can be trained, but this is time-consuming and requires a significant degree of interest and compliance to be successful. Hence, if a native animal pet industry were to be set up on a large-scale commercial basis, many animals would suffer significant stress while the appropriate expertise was being developed. If any native species were considered to be potential candidates as pets, the particular species and individuals would need to be carefully trialed and screened to minimise welfare issues related to animal stress.

Keeping requirements

Many species of Australian wildlife have very specific requirements for housing, feeding and husbandry in captivity (see Evans 1982; Booth 1994 a,b; Smith 1995). Zoos and sanctuaries are still developing knowledge and protocols of how to best care for native wildlife. Yet, they have significantly better expertise, facilities and funds for caring for animals than the average suburban home where native animal pets would be kept. We believe that the introduction to the pet industry of new taxa with species-specific requirements will result in the frequent mis-handling and suffering of many animals, as well as the potential for husbandry-related diseases (Thrusfield 1986). For example, it is legal to keep tortoises as pets in some Australian States. However, a common presentation of pet tortoises to veterinarians is for diet-related diseases, such as shell rot (a problem resulting from a calcium-deficient diet) (McCracken 1994; Rose 1999). Tortoises are generally purchased from pet outlets from which new owners obtain information on how to care for their new pets. This example demonstrates that either: (1) sufficient information may not always be provided by pet outlets for the correct keeping of unusual pets, or, (2) pet owners will be unable or unlikely to provide adequate care and suitable living conditions for native animals, even ones with quite well known and well documented requirements such as tortoises. Hopwood's (2001) proposal identifies pet shops as the likely outlet and source of information for new owners of native mammal pets. We believe that this would provide no guarantee of appropriate dissemination and uptake of knowledge on care of unusual pets.

Dumping

Dumping of dogs and cats is common and occurs for many reasons including:- owners shifting homes, or the development of unfavourable patterns of behaviour (such as aggression, inappropriate urination, destruction of property, excessive vocalisation). Dumping occurs despite the existence of the Royal Society of Prevention of Cruelty to Animals (RSPCA), and its facility for finding new homes for unwanted animals. Dumping of native animal pets is also highly likely to occur. Given that native animals occur naturally in Australia, many people will perceive that unwanted native pets should be able to survive in the wild and dump them. "Buy back" or "re-collection" clauses in pet purchase plans would not prevent dumping. For example, some people have strange attitudes to pet ownership and do not wish an animal to have a second owner and will release the animal into the wild (K. Viggers, personal observation, as a veterinarian in practice).

The release or escape of native animal pets into the wild has welfare implications. This is because translocated animals are often unable to forage or find shelter when returned to the wild and can die from predation or starvation. Studies of Common Brushtail Possums, *Trichosurus vulpecula,* translocated from an urban environment to a bush reserve near Melbourne showed that 88% of animals were dead within one week of being released as a result of predation, stress or lack of food (Pietsch 1995).

In cases where released or escaped native pets do survive, other problems may arise such as:-

1 aggression towards humans (this has occurred on several occasions with hand-reared and released male kangaroos; R. Booth, wildlife veterinarian, personal communication),

2 the establishment of animals outside of their normal range with potential for genetic mixing and hybridisation with formerly isolated but closely related populations (see below), and,

3 impacts on local animal populations, such as disease transmission (see below).

Social requirements

Animal welfare must include considerations beyond the absence of disease (WHO 1983), such as behavioural deprivation (Ewbank 1986; Schuppli and Fraser 2000). Stress can be associated with an inability to carry out normal forms of behaviour and such stress may be difficult to assess in unfamiliar species by inexperienced people (Schuppli and Fraser 2000). Some native species initially considered as potentially suitable for a pet industry have complex social requirements (eg. Sugar Glider, *Petaurus breviceps*, and Feathertail Glider, *Acrobates pygmaeus* [Suckling 1984; Ward 1990]). Keeping isolated individuals of species that are colonial will create significant animal stress, with corresponding welfare considerations.

Biological knowledge

Knowledge of the biology of the vast majority of Australian native mammals is relatively limited (see Strahan 1995). There is a paucity of information on the habitat requirements, diet, and social behaviour of many species. Proponents of a native animal pet industry have suggested that only those species whose biology is well known should be considered. On this basis, very few candidates could be targeted in a native animal pet industry. All of them will be relatively common and well-studied species (eg. the common brushtail possum, *Trichosurus vulpecula*), so the flow-on benefits for *in-situ* conservation are likely to be limited or non-existent because these species are abundant and their populations relatively stable or increasing in the wild.

Veterinary knowledge

The presently limited veterinary knowledge base for the treatment and handling of native wildlife resides largely within the zoo system. There are some wildlife veterinarians in academia, but there are few in general practice with experience in wildlife veterinary medicine. Currently, the only locations where an adequate case load can be encountered to obtain the required experience is within zoos, or in those few veterinary practices where the principals provide heavily subsidised care and treatment of native animals for wildlife care and rehabilitation groups. This means that access to appropriate veterinary care is likely to be limited, at least initially.

Veterinary understanding of native wildlife medicine is slowly increasing, but the knowledge base for many species is still very limited and largely restricted to those diseases seen in

captive or donated wild animals. Efforts have been made by the Post-Graduate Foundation in Veterinary Science to expand the number of veterinarians with wildlife knowledge by running courses in Wildlife Medicine and Healthcare (Post-Graduate Foundation in Veterinary Science 1994, 1999). However, the last conference in July 1999 was poorly attended (80 attendees, of which 24 were students; Post Graduate Foundation in Veterinary Science, personal communication). With little financial incentive to develop expertise in native animals and so few veterinarians with specialist training in wildlife medicine, there is little chance of rapidly expanding the veterinary knowledge base to properly service native mammal pets. Further education of veterinarians will take place, but given that native pets would only ever be likely to occupy a small niche in the companion animal market, incentives to expand facilities and learning in this area will be limited. Therefore, uptake of new knowledge is also likely to be slow. This has been the case in most veterinary practices for alternative pet species such as birds, rabbits, rats, mice, lizards, tortoises and ferrets (see also Schuppli and Fraser 2000).

Disease in wild populations

Little is known of the disease status of free-ranging wildlife populations (Office International des Epizooties 1988; Viggers *et al.* 1993; Cunningham 1996; Viggers 1997). This becomes a major issue when considering the development of a new pet industry which will bring into urban homes animals that are not usually in close contact with people or domestic pets. Funds for research on wildlife disease are difficult to obtain, except where there is a major, visible disease outbreak (eg. kangaroo blindness, Reddacliff *et al.* 1999; Hooper *et al.* 1999a; pilchard die-off, Whittington *et al.* 1997), or where there are human health implications (e.g. Hendra virus, Williamson *et al.* 1998). Detailed health surveys of free-ranging populations of common and threatened species of wildlife are required to enable an improved understanding of the prevalence and importance of disease. These surveys should be completed prior to considering an individual species for pet suitability status. Such surveys should encompass bacteriology, virology, toxicology, fungal diseases, nutritional diseases and genetic and metabolic problems (Karesh and Cook 1995).

The paucity of knowledge of wildlife disease in native animals, particularly in free-ranging populations, means there is a limited understanding of the potential for disease transmission between species which do not normally interact (Woodford and Kock 1991; Field 1999) but which may be held in close confines within people's homes. The behaviour of disease agents when they switch species is unpredictable and hence the potential consequences of this for other species is unknown (see Field 1999). Differences between species in susceptibility to disease can mean that pathogens carried and tolerated well by one species may result in serious infections in another species (Woodford and Kock 1991). Consequently, an apparently harmless pathogen that is translocated with an animal can become virulent in an unexposed host in a new environment (Woodford and Rossiter 1993). Close contact between humans and captive species may facilitate the transmission of such pathogens between species (Woodford and Kock 1991).

Disease transmission to humans

A native animal pet industry could elevate the risks of zoonotic disease (disease transmitted from animals to humans; see Rose 1999; Tribe and Brown 1999; Schuppli and Fraser 2000). The risk of zoonotic disease means that research on diseases in both captive and wild populations needs to be completed prior to placing native animals in people's homes. The importance of zoonoses is emphasised by the recent emergence of new viral diseases (see Field 1999) such as Australian Bat Lyssavirus (similar to rabies; Fraser *et al.* 1996; Hooper *et al.* 1999b) and Hendra virus (Williamson *et al.* 1998). Only after human deaths occurred from these viruses was it discovered that some species of native bats function as wildlife reservoirs for these disease agents (Williamson *et al.* 1998; Hooper *et al.* 1999b). This serves to demonstrate the limited existing knowledge about disease in free-ranging wildlife populations.

Occurrence of zoonoses may actually have negative consequences for conservation because public persecution of a species may occur if it is discovered to be a carrier of a disease harmful to humans.

The production of specific pathogen free (SPF) animals from a breeding colony would not preclude the transmission of diseases between native pets, current domestic pets and humans. This is because our limited knowledge of disease in native animals means that we do not know what to test for and eliminate other than presently known agents of disease (see also Spielman 1999). In addition, native animals may carry agents of disease to which they are resistant, but which may cause disease when the animal is stressed and immunosuppressed, or cause diseases in other species (see above; Thrusfield 1986). Some potentially serious agents of disease, such as *Salmonella* species, can be difficult to detect in asymptomatic carriers and hence can be almost impossible to eliminate (see Spielman 2000).

Introduction of disease to wild populations

Movements of animals among Australian States and regions presents a seriously problematic scenario which could result in disease transmission to previously uninfected populations with negative impacts (Woodford and Kock 1991; Viggers *et al.* 1993; Cunningham 1996). Introductions of disease

1 from pet animals to wild populations, and,

2 by movements of domestic and non-domestic animals, have occurred both in Australia (see Spielman 2000) and overseas (Jacobsen *et al.* 1991), with consequences which have been both expensive and disastrous for wildlife populations (Woodford and Kock 1991).

Introduction of disease to wild populations from escaped pets

Escape or release of captive individuals held as pets or from breeding colonies could introduce diseases from the captive environment to naive wild populations. In Australia, inclusion body disease, which is a potentially fatal disease of pythons, has probably been introduced to wild Australian pythons from imported and then escaped captive animals held by herpetologists (Carlisle-Nowak *et al.* 1998). Psittacine beak and feather disease known from populations of Australian psittacine birds such as the Sulphur-crested Cockatoo, *Cacatua galerita,* and the Budgerigar, *Melopsittacus undulatus,* has been introduced to parrot populations overseas via the illegal bird trade (Garnett 1998). This has had substantial negative impacts on some species including the Norfolk Island Green Parrot (Garnett 1998). In another example, a fatal upper respiratory tract disease acquired by Mojave desert tortoises in pet shops was introduced to wild populations of the species when unwanted ill pets were released by owners into the desert (Jacobsen *et al.* 1991). These examples illustrate the fact that the potential for captive animals to transmit diseases to wild populations cannot be taken lightly, and may have unforseen negative implications for conservation of some species.

Introduction of disease through movements or translocations of animals

The distribution of many diseases and parasites is highly localised (Woodford and Rossiter 1993). Therefore moving or translocating animals from one area to another can result in unexpected disease problems (Woodford and Rossiter 1993). For example, a fungal skin disease has been recently reported in association with morbidity and mortality of platypus, *Ornithorhynchus anatinus*, in Tasmania. This disease is not seen in mainland platypus and is thought to have been introduced to Tasmania with escaped or released green tree frogs (*Litoria caerulea)* imported with bananas from Queensland (N. Stewart, personal communication). In another example, translocations of raccoons (*Procyon lotor*) within the USA to augment stock for hunting purposes, concurrently translocated parvoviral enteritis (Allen 1986) and rabies (Anon 1990) into areas where these diseases did not previously occur in local raccoon populations. These examples illustrate the potential for seemingly harmless movements of unrelated animals to impact on local wildlife populations through unforseen transmission of disease (see Viggers *et al.* 1993; Cunningham 1996).

Other examples of introduced disease impacting local wild populations overseas include:- **(1)** massive decline of Hawaiian native bird populations due to introduced diseases (van Riper *et al.* 1986), **(2)** canine distemper virus in the Black-footed Ferret (*Mustela nigripes*) (Thorne and Williams 1988), and, **(3)** rinderpest virus in Wildebeest and African buffalo (Plowright 1982). Examples from overseas and from within Australia should serve as cautionary notices as to possible human health and disease risks associated with a native animal pet industry.

The source of animals for breeding programs and genetic management

The establishment and maintenance of breeding programs, both for provision of pets and for captive breeding and reintroduction programs, requires a source of animals. Presumably animals would come from captive colonies, from the wild, or both. Captive animal stocks within the zoo system are generally small and have restricted gene pools, especially in the case of endangered species (e.g. Maquire and Lacy 1990). Therefore, it may be necessary to obtain animals from wild populations to maintain sufficient genetic variability to prevent inbreeding and to maintain "wild types" for reintroduction (Bradley *et al.* 1999). This may deplete wild populations (Rabinowitz 1987). Moreover, there may be an ongoing requirement for wild-sourced animals to maintain genetic variability in captive stocks and limit problems of inbreeding depression (see Robinson *et al.* 1990; Bradley *et al.* 1999). The maintenance of genetic variability is important - inbred animals have reduced survival and reproductive performance when reintroduced to the wild (Jiminez *et al.* 1994; Miller 1994; Frankham 1995). Inbreeding depression can significantly lower fertility and increase mortality (see Ralls *et al.* 1988; Robinson *et al.* 1989). In addition, reduced genetic variability can render animals more susceptible to disease (Lacy 1993). Therefore, if a native animal pet industry intends to contribute to conservation by developing breeding colonies for reintroduction programs, then:-

1 genetic variability must be maintained,

2 breeding colonies must be housed under conditions as similar as possible to their known habitat requirements (Frankham 1995; Bradley *et al.* 1999), and,

3 species to be reintroduced should be held in captivity for as few generations as possible to minimise genetic adaptation to the captive environment (Frankham 1986; 1995). All of these requirements would add considerably to the complexity and cost of the central animal breeding facility which is at the core of the proposed native animal pet industry (see Hopwood 2001).

Management of endangered species in captivity to maintain genetic diversity requires strict adherence to breeding protocols (see Maquire and Lacy 1990; George 1990; Bradley *et al.* 1999; Spielman 1999). If the general public is allowed to breed and sell native animals, proper protocols are unlikely to be followed. Moreover, breeding of native animals for the pet trade by the public would make the central breeding facility proposed by Hopwood (2001) obsolete, particularly if animal owners can make a profit from breeding and selling pets.

Selection of inappropriate animal traits by unscrupulous breeding

It is probable that there would be inappropriate breeding by private owners to enhance certain anatomical characteristics of native animal pets. Evidence comes from many existing breeds of dogs and cats. Animal breeders often select for particular physical characteristics, even though they lead to recurrent problems requiring ongoing veterinary treatment. Examples include (among many others): excessive skin folds in some dog breeds (e.g. Sharpeis) leading to chronic dermatitis, lip shape in spaniels leading to dribbling and secondary lip fold dermatitis and infection, eye and lip shape in Bassett hounds leading to chronic eye and skin problems (see Thrusfield 1986; Barteges 1999) (see also Spielman 2000). Elective mating of problem dog and cat breeds and also of individuals which cannot give birth naturally is common (K. Viggers, personal observation), as is inbreeding and inherited diseases (Barteges 1999). These types of issues are also likely to arise if breeding of native mammals by lay people is allowed. Moreover, inappropriate breeding of native animal pets will significantly alter wild genotypes and phenotypes – a situation with negative implications if escapees breed with wild individuals. These problems could be circumvented if native animals are desexed prior to sale. However, the costs of desexing would have to be added to the price of native animal pets, and any factors which increase the cost of native pets would increase the incentives for illegal trading (such as poaching and breeding from wild stocks, see below).

Control of animal movements

One of the major potential problems of a native animal pet industry is that it would be almost impossible to control movements of animals between States and regions. Pet owners usually take their animals with them when they move. Movements of animals into different regions could result in mixing of separate genetic pools and subspecies (Woodford and Kock 1991). Escaped or released animals may breed and hybridise with previously isolated populations which may have negative consequences for some species (e.g. outbreeding depression in collared lizards that moved small distances in the Ozark Mountains, USA; Templeton 1994). The potential consequences of introducing diseases with translocated animals have been already discussed (see above).

Funding for regulation and control

Proponents of native mammals as pets argue that surplus funds generated by the industry would be channeled into programs for the conservation of wild populations (see Hopwood 2001). However, substantial funds would be required to develop, establish and regulate the industry. A case exists for the completion of a detailed independent economic analysis of the native pet industry proposed by Hopwood (2001). We believe that the proposed industry framework:-

1 is unlikely to be self-funding through sales of animals, unless animal prices are high to cover costs (i.e. for industry establishment, regulation and conservation contributions).

2 would generate little, if any, surplus money to support *in-situ* conservation, and

3 would almost certainly need to be subsidised by governments.

Budget constraints mean that government money is unlikely to be forthcoming. Furthermore, the need for a subsidy has the potential to divert scarce conservation dollars from *in-situ* programs – an outcome which would have major negative implications for conservation.

Poaching and depletion of wild populations

A native animal pet industry could have the opposite effect to which it is intended – it could **increase** pressure on wild populations through poaching and population depletion. If the cost of pets is high, the incentives for poaching also will be high due to potential financial returns from illegal sales. Poaching could be particularly problematic for small populations of endangered species. Prevention of poaching would be difficult. Uniquely identifying individuals by microchipping and molecular genetic techniques could help distinguish legitimate pets from illegally poached animals. Microchipping is relatively inexpensive, but to be a successful safeguard, it would require an extensive nationwide database of all native animals held in Australia. This is possible, however enforcement would require random checking of premises to ensure that only legally obtained animals are held. This would be a major task. It may be argued that this is within the scope of what State organisations do now, but we believe that it could not be properly policed and that there is substantial potential for the establishment of a significant black market in the trade of native mammal pets. Establishing a genetic library for each species is expensive and time-consuming. Collecting and processing genetic samples to verify the identity of animals from people's homes also would be very expensive and is unlikely to happen. Therefore, controls to limit illegally obtained animals would be almost impossible to enforce.

The potential problem of poaching and the depletion of wild populations of animals could be overcome if native pets were inexpensive to buy. However, insufficient funds would then be available to maintain, police and control a native animal pet industry, let alone generate funds for conservation purposes (see above).

The proposed model for a native animal pet industry

Hopwood (2001) presents a model for a native animal pet industry in New South Wales in which the National Parks and Wildlife Service would be the controlling and enforcing body and pet shops would be the local distribution agents. Prospective new owners pay for a "package deal", which includes licence fees, educational videos and books, the supply and installation of cages, animal runs and ancillary equipment, pet food, pet delivery and re-collection if the owner no longer wants the pet. This approach fails to recognise the difficulties of breeding and keeping native mammals in captivity. In addition, it underestimates the role which knowledge and experience plays in caring for and handling native animals. Many required skills cannot be learned from books and videos

(see Spielman 2000). It also does not take account of owner ignorance and indifference, which has contributed to the suffering of countless companion animals (Spielman 2000). Native mammal pets are even more likely to suffer in the hands of inexperienced owners, despite good intentions. Unfortunately, once animals leave the commercial breeding colony, control of their care and fates will be limited. A re-collection clause in no way ensures the return of unwanted animals, just as substantial de-sexing discounts does not ensure de-sexing of companion animals purchased from the RSPCA. The purchase of cages and other ancillary equipment does not guarantee the conditions and standards of hygiene under which animals will be kept. Finally, the infrastructure for the proposed model would be very expensive to establish, leaving limited surplus funds for conservation.

Hopwood provides a list of potential native mammal pets (2000). The inclusion of animals such as the eastern barred bandicoot, *Perameles gunnii*, indicates that little consideration has been given to temperament and suitability for captivity in the establishment of this list. Although the eastern barred bandicoot breeds well in captivity, the species is generally flighty and nervous, even when hand-reared and handled frequently, and is commonly subject to injury and self-trauma in a captive environment (K. Viggers, personal observation as locum veterinarian Healesville Sanctuary).

Answer to questions

The preceding discussion has raised some of the many issues associated with a native animal pet industry. We believe that it is essential these issues are fully addressed prior to its further development and promotion. To justify the establishment of such an industry, there must be genuine positive conservation outcomes for wild populations. It must also be demonstrated there would be no negative outcomes (such as legal or illegal depletion of wild populations, the introduction or transmission of diseases between individuals, species and regions, hybridisation of genetically separate populations etc.). If (and only if), after adequately addressing the issues raised in this paper, it is deemed that some animals could be trialled as pets, the following matters should be examined for each proposed pet species:-

1 Natural range of proposed species

Would the animal be retained within its present or former known range? It is important that animals are not introduced into new areas, as if they should escape and establish in new ranges, their potential impact on local wildlife is unknown. Possible negative outcomes may include:

(a) unforseen introduction of diseases (eg. *M. amphibiorum*, green tree frogs and platypus);

(b) competition with related local species,

(c) establishment as pest species.

2 Biology

What is the current knowledge of the biology of the species? On the basis of this information, is it possible to provide suitable housing, diet, and social and behavioural requirements for that species to minimise stress and other diseases? Are the housing and dietary requirements easy and relatively cheap to provide in captivity?

3 Disease information

What is the current knowledge of the health and disease status of the species in captivity and in wild populations? Is there knowledge or evidence of any zoonotic diseases? Are illnesses treatable or avoidable? What further research on captive and wild populations should be completed to minimise risks of zoonotic disease and the transmission of disease between species?

4 Behavioural attributes

What are the behavioural attributes of the species at different stages of its life? Is the species likely to remain a suitable pet throughout its life? The factors that need to be taken into account include aggression, anti-social behaviour, destructive behaviour, nervousness, consequences of imprinting, susceptibility to stress-related diseases, and social requirements.

5 Genetics

What is the genetic structure of populations of this species around Australia and what might be the consequences of genetic mixing?

Hopwood (2001) provides a list of questions relating to the ease of keeping and handling native animal pets. We believe that the issues listed above need to be added to those outlined by Hopwood - but only after the issues we canvassed earlier in this paper have been fully addressed.

Conclusions

Australia has a poor wildlife conservation record (Short and Smith 1994), in part because of some serious errors of judgement such as:-

1 the introduction of feral predators like the fox, and

2 the introduction of biological control agents, such as the cane toad, which has affected populations of many native taxa (Freeland 1986).

Given the appalling record of mammal extinctions and other losses of biodiversity in this country, it is important to limit further management errors which may increase pressure on wildlife populations – particularly errors that could have easily been avoided in the first place. On this basis, we believe the proposed native animal pet industry should be considered "guilty until proven innocent". Notably, it has been increasingly advocated by conservation scientists that the burden of proof to demonstrate that all reasonable precautions have been taken against negative environmental impacts lies with the proponents of a new activity, industry or developer (eg. Peterman 1990; Garcia 1994). On this basis, we believe the onus must be on the proponents of a native animal pet industry to show that:-

(1) negative outcomes seen overseas would not occur in Australia, and,

(2) there would be clear and positive conservation benefits to free-ranging populations of wildlife.

We believe that if this cannot be demonstrated, then there is no credible scientific, conservation or ethical basis for a native animal pet industry. Indeed, on the basis of the arguments outlined in this paper, we question the legitimacy of a native pet industry because:-

1 it may lead to conservation problems such as elevated wildlife disease risks and human health problems,

2 it will create significant animal welfare problems,

3 it may not produce native animals suitable for release into the wild,

4 it will not produce animals that are viable substitutes for existing domestic pets, and,

5 it is unlikely to be cost-effective and generate significant resources for *in-situ* conservation.

In summary, we believe the proposal for a native animal pet industry is presently ill-conceived and does not adequately address the full range of ecological, conservation and welfare issues. To date the proponents of the native animal pet industry have justified their proposal with limited anecdotal and unscientific assertions (Archer 2000; Hopwood 2001). However, such a proposal needs to be carefully assessed with rigorous science and critical thinking. Otherwise the industry could have unintended and unanticipated negative consequences for conservation - problems that could be expensive or even impossible to rectify.

Acknowledgments

KLV would like to thank a wide range of friends and colleagues from wildlife care groups in the Canberra/Queanbeyan region of southern N.S.W. for their thoughts and insights into the care of native animals over the past eight years. The authors would like to thank Dan Lunney for his encouragement and support with this work.

References

Allen, T. J., 1986. Evaluation of movements, harvest rate, vulnerability and survival of translocated raccoons in south western Virginia. *Transactions of the North-Eastern Section of the Wildlife Society* **43:** 64.

Anonymous, 1990. A bridge too far. *The Economist* **12 May:** 48-49.

Archer, M., 2000. Monstrous moggies or charming chuditches. *Nature Australia* **26/8:** 70-71.

Barteges, J. W., 1999. Common congenital diseases of dogs. Pp. 257-65 in *Reproduction and Paediatrics 99.* Post Graduate Committee in Veterinary Science: Sydney.

Bellamy, T., 1994. Handrearing native animals – marsupials. Pp 7-22 in *Wildlife* Proceedings 233, Post Graduate Committee in Veterinary Science: Sydney.

Booth, R., 1994a. Medicine and husbandry: monotremes, wombats and bandicoots. Pp 395-422 in *Wildlife* Proceedings 233, Post Graduate Committee in Veterinary Science: Sydney.

Booth, R., 1994b. Medicine and husbandry: dasyurids, possums and bats. Pp 423-442 in *Wildlife* Proceedings 233, Post Graduate Committee in Veterinary Science: Sydney.

Bradley, M.,P., Lambert, C., Power, V., Mills, H., Gaikhorst, G. and Lawrence, C., 1999. Reproduction and captive breeding as a tool for mammal conservation: the role of modern zoos. *Australian Mammalogy* **21:** 47-54.

Burgman, M. A. and Lindenmayer, D. B., 1998. *Conservation Biology for the Australian Environment*. Surrey Beatty and Sons, Chipping Norton: Sydney.

Carlisle-Nowak, M. S., Sullivan, N., Carrigan, M., Knight, C., Ryan, C. and Jacobson, E. R., 1998. Inclusion body disease in two captive Australian pythons (*Morelia spilota variega*ta and *Morelia spilota spilota*). *Australian Veterinary Journal* **76:** 98-100.

Caughley, G. C. and Gunn, A., 1995. *Conservation Biology in Theory and Practice.* Blackwell Science, Cambridge: Massachusetts.

Cunningham, A. A., 1996. Disease risks of wildlife translocations. *Conservation Biology* **10:** 249-53.

Diamond, J., 1997. *Guns, germs, and steel. The fates of human societies.* W.W. Norton and Company: New York.

Evans, D. D., 1982. *The Management of Australian Mammals in Captivity*. Zoological Board of Victoria: Melbourne.

Ewbank, R., 1986. Animal welfare – is an epidemiological approach possible? Pp 92-6 in *Society for Veterinary Epidemiology and Preventive Medicine*, Proceedings, Edinburgh, 2-4 April 1986 ed. by M.V. Thrusfield.

Field, H., 1999. Emerging viral diseases of bats. Pp 501-13 in *Wildlife in Australia, Healthcare and Management* Proceedings 327, Post Graduate Committee in Veterinary Science: Sydney.

Fischer, J. and Lindenmayer, D.B., 2000. An assessment of the published results of animal relocations. *Biological Conservation* **96:** 1-11.

Frankham, R., 1986. Selection in captive populations. *Zoo Biology* **5**: 127-38.

Frankham, R., 1995. Conservation Genetics. *Annual Review Genetics* **29**: 305-27.

Fraser, G. C., Hooper, P. T. and Lunt, R. A., 1996. Encephalitis caused by a lyssavirus in fruit bats in Australia. *Emerging Infectious Diseases* **2:** 327-331.

Freeland, W. J., 1986. Invasion north: successful conquest by the Cane Toad. *Australian Natural History* **22:** 69-73.

Garcia, S., 1994. The precautionary principle: its implications in captive fisheries management. *Ocean and Coastal Management* **22:** 99-125.

Garnett, S., 1998. Caught on the wing. *Wingspan* **9 (3):** 14-19.

George, G. G., 1990. Monotreme and marsupial breeding programs in Australian zoos. *Australian Journal of Zoology* **37:** 181-205.

Goodall, J., 1999. *Reason for Hope.* Warner Books: New York.

Groombridge, B. (ed). 1992. *IUCN Red List of Threatened Animals*. Gland: Switzerland.

Haila, Y., 1999. Islands. Pp 234-264 in *Maintaining Biodiversity in Forest Ecosystems* ed by M.L. Hunter. Cambridge University Press: Cambridge.

Hale, P., and Lamb, D., (editors). 1997. *Conservation outside reserves.* Centre for Conservation Biology, University of Queensland, Brisbane: Australia.

Hooper, P. T., Lune, R. A., Gould, A. R., Hyatt, A. D., Russell, G. M., Kattenbelt, J. A., Blacksell, S. D., Reddacliff, L. A., Kirkland, P. D., Davis, R. J., Durham, P. J. K, Bishop, A. L. and Waddington, J., 1999a. Epidemic of blindness in kangaroos – evidence of a viral aetiology. *Australian Veterinary Journal* **77:** 529-36.

Hooper, P. T., Fraser, G. C., Foster, R. A. and Storie, G. J., 1999b. Histopathology and immuno-histochemistry of bats infected by Australian bat lyssavirus. *Australian. Veterinary Journal* **77:** 595-99.

Hopwood, P., 2000. The case for allowing Australian native mammals to be kept as pets. *Australian Association of Conservation Biologists Newsletter* **19**: 5-8. (web site: http://www.zip.com.au/~brittonp/aavcb/)

Hopwood, P. 2001. Pp xx-x *A Zoological Revolution* ed by D. Lunney and C. R. Dickman. Royal Zoological Society of NSW Mosman.

Hunter, M. L., (ed). 1999. *Maintaining Biodiversity in Forest Ecosystems*. Cambridge University Press: London.

Jacobsen, E. R., Gaskin, J. M, Brown, M. B., Harris, R. K., Gardiner, C. H., LaPointe, J. L., Adams, H. P. and Reggardo, C., 1991. Chronic upper respiratory tract disease of free-ranging desert tortoises (*Xerobates agassizii*). *Journal of Wildlife Diseases* **27:** 296-316.

Jiminez, J. A., Hughes, K. A., Alaks, G., Graham, L. and Lacy, R.C., 1994. An experimental study of inbreeding depression in natural habitat. *Science* **265:** 271-73.

Karesh, W. B. and Cook, R. A., 1995. Applications of veterinary medicine to *in situ* conservation efforts. *Oryx* 29: 244-52.

Kleiman, D. G., 1989. Reintroduction of captive mammals for conservation. *Bioscience* **39**: 152-61.

Kuchling, G., Dejose, J. P., Burbidge, A. A., and Bradshaw, S. D., 1992. Beyond captive breeding: the Western Swamp Tortoise *Pseudemydura umbrina* recovery programme. *International Zoo Yearbook* **31**: 37-41.

Lacy, R.C., 1993. Impacts of inbreeding in natural and captive populations of vertebrates: implications for conservation. *Perspectives in Biology and Medicine*, **36**: 480-496.

Lindburg, D. G. 1992. Are wildlife reintroductions worth the cost? *Zoo Biology* **11**: 1-2.

Lindenmayer, D. B. and Franklin, J. F., 1999. Managing unreserved forest for biodiversity conservation: The importance of matrix. Pp 13-25 in *Nature Conservation in Production Environments: Managing the Matrix.* ed by J. Craig, N. Mitchell, and D. A. Saunders. Surrey Beatty & Sons: Sydney (in press).

Lindenmayer, D. B., Cunningham, R. B., Pope, M., and Donnelly, C. F., 1999. The Tumut fragmentation experiment in south-eastern Australia: the effects of landscape context and fragmentation of arboreal marsupials. *Ecological Applications*, **9**: 594-611.

Lunney, D., Matthews. A., Moon,C. and Ferrier, S., 2000. Incorporating habitat mapping into practical koala conservation on private lands. *Conservation Biology* **14**: 669-80.

McCracken, H., 1994. Husbandry and diseases of captive reptiles. Pp 461-546 in *Wildlife* Proceedings 233, Post Graduate Committee in Veterinary Science: Sydney.

McLean, I. G., Lundie-Jenkins, G. and Jarman, P. J., 1995. Training captive rufous hare-wallabies to recognize predators. Pp. 177-182 in *Reintroduction Biology of Australian and New Zealand Fauna* ed by M. Serena. Surrey Beatty & Sons: Chipping Norton.

Maguire, L. A. and Lacy, R. C., 1990. Allocating scarce resources for conservation of endangered subspecies: partitioning zoo space for tigers. *Conservation Biology* **4:** 157-166.

Margules, C. R., Redhead, T. D., Hutchinson, M. F., and Faith, D. P., 1995. *BioRap. Guidelines for Using the BioRap Methodology and Tools*. CSIRO: Canberra.

Margules, C. R. and Pressey, R. L., 2000. Systematic conservation planning. *Nature* **405**: 243-53.

Miller, P. S., 1994. Is inbreeding depression more severe in a stressful environment? *Zoo Biology* **13:** 195-208.

Oakwood, M. and Hopwood, P., 1999. A survey of the attributes and requirements of quolls that may affect their suitability as household pets. *Australian Zoologist* **31**: 365-75.

Office International des Epizooties., 1988. Resolution No. IX of the OIE International Committee 56th general session, 16-20th May 1988. Diseases of wild animals transmissible to domestic animals. *Revue scientifique et technique de l'Office International Epizooties* **7** (4): 1016.

Peterman, R. M., 1990. Statistical power analysis can improve fisheries research and management. *Canadian Journal of Fisheries and Aquatic Sciences* **47**: 2-15.

Pietsch, R. S., 1995. The fate of urban common brushtail possums translocated to sclerophyll forest. Pp. 239-46 in *Reintroduction Biology of Australian and New Zealand Fauna* ed by M. Serena. Surrey Beatty & Sons: Chipping Norton.

Plowright, W., 1982. The effects of rinderpest and rinderpest control on wildlife in Africa. *Symposia of the zoological Society of London* **50**: 1-28.

Ralls, K., J. D. Ballou, and A. R. Templeton, 1988. Estimates of lethal equivalents and the cost of inbreeding in mammals. *Conservation Biology* **2**: 185-93.

Rabinowitz, A., 1995. Helping a species go extinct: The Sumatran Rhino in Borneo. *Conservation Biology* **9**: 482-488.

Reddacliff, L., Kirkland, P., Philbey, A., Davis, R., Vogelnest, L., Hulst, F., Blyde, D., Deykin, A., Smithe, J., Hooper, P., Gould, A. and Hyatt, A., 1999. Experimental reproduction of viral chorioretinitis in kangaroos. *Australian Veterinary Journal* **77**: 522-28.

Riper, C. van III, Riper, S. G. van, Goff, M. L. and Laird, M., 1986. The epizootiology and ecological significance of malaria in Hawaiian land birds. *Ecological Monographs* **56**:327-44.

Robinson, N. A., Sherwin, W. B., Murray, N. D. and Graves, A. M., 1990. Applications of conservation genetics to the eastern barred bandicoot, *Perameles gunnii*. Pp 109-29 in *Management and Conservation of Small Populations* ed by T.W. Clark and J.H. Seebeck). Chicago Zoological Society :Illinois.

Rolls, E., 1969. *They all ran wild*. Angus and Robertson: Sydney.

Rose, K., 1999. Common diseases of urban wildlife. Pp 365-427 in *Wildlife in Australia, Healthcare and Management* Proceedings 327, Post Graduate Committee in Veterinary Science: Sydney.

Saunders, D. A., Hobbs, R. J. & Ehrlich, P. R., (eds). 1993. *Nature Conservation 3. The reconstruction of fragmented ecosystems.* Surrey Beaty & Sons, Chipping Norton,:Australia.

Schuppli, C. A. and Fraser, D., 2000. A framework for assessing the suitability of different species as companion animals. *Animal Welfare* **9**: 359-372.

Schwartz, M. W., 1999. Choosing the appropriate scale of reserves for conservation. *Annual Review of Ecology and Systematics* **30**: 83-108.

Semlitsch, R. D. and Bodie, J. R., 1998. Are small, isolated wetlands expendable? *Conservation Biology* **12**: 1129-1133.

Serena, M., (ed). 1995. Pp 1-6 in *Reintroduction Biology of Australasian Fauna*. Surrey Beatty and Sons, Chipping Norton: Australia.

Short, J., Bradshaw, S. D., Giles, J., Prince, R. I. and Wilson, G. R., 1992. Reintroductions of macropods (Marsupialia: Macropodoidea), in Australia – a review. *Biological Conservation* **62**: 189-204.

Short, J. and Smith, A. P., 1994. Mammal decline and recovery in Australia. *Journal of Mammalogy* **75**: 288-97.

Simberloff, D. A., 1988. The contribution of population and community biology to conservation science. *Annual Review of Ecology and Systematics*, **19**: 473-511.

Smith, B., 1995. *Caring For Possums*. Kangaroo Press, Kenthurst: NSW.

Speare, R., 1988. Clinical assessment and management of the orphaned joey. Pp 211-96 in *Australian Wildlife*. Proceedings 104. Post Graduate Committee in Veterinary Science: Sydney.

Spielman, D., 1994. First aid and emergency care for Australian native mammals. Pp 339-70 in *Wildlife* Proceedings 233, Post Graduate Committee in Veterinary Science: Sydney.

Spielman, D., 1999. Arguments against keeping Australian native animals as pets. *Australian Association of Conservation Biologists Newsletter* **17**: 6-8. (web site: http://www.zip.com.au/~brittonp/aavcb/)

Spielman, D., 2000. A case against allowing Australian native mammals to be kept as pets. *Australian Association of Conservation Biologists Newsletter* **19**: 8-13. (web site: http://www.zip.com.au/~brittonp/aavcb/)

State of the Environment Australia 1996. State of the Environment Advisory Council. CSIRO, Melbourne: Australia.

Strahan, R., (ed) 1995. *The Mammals of Australia*. Reeds Books, Chatswood, New South Wales.

Suckling, G.C., 1984. Ecology of the sugar glider, *Petaurus breviceps*, in a system of fragmented habitats. *Australian Wildlife Research* **11**: 49-75.

Templeton, A.R., 1994. Translocation in conservation. Pp 315-25 in *Biodiversity in Managed Landscapes; Theory and Practice* ed by Szare, R.C. and Johnson, D.W. Oxford University Press: New York.

Thorne, E. T. and Williams, E. S., 1988. Disease and endangered species: the black-footed ferret as a recent example. *Conservation Biology* **2**: 66-75.

Thrusfield, M., 1986. *Veterinary Epidemiology*. Second Edn. Blackwell Science: Oxford.

Tribe, A. and Brown, P. R., 1999. The rehabilitation and relocation of Australian fauna. Pp 515-24 in *Wildlife in Australia, Healthcare and Management* Proceedings 327, Post Graduate Committee in Veterinary Science: Sydney.

Triggs, B., 1988. *The Wombat: Common Wombats in Australia*. University of New South Wales Press, Kensington: New South Wales.

Viggers, K. L, Lindenmayer, D. B. and Spratt, D. M., 1993. The importance of disease in reintroduction programmes. *Wildlife Research* **20**: 687-98.

Viggers, K. L. 1997. Assessment of health, condition and the effects of parasites in the Mountain Brushtail Possum. PhD thesis. The Australian National University: Canberra. 264 pp (plus appendices).

Vogelnest, L.,1992. Birds and reptiles. Pp. 1-37 in *Urban Wildlife*. Proceedings 204. Post Graduate Committee in Veterinary Science: Sydney.

Walraven, E., 1990. *Guide to the Care of Urban Wildlife*. 157 pp. Allen and Unwin: Sydney, Australia.

Walraven, E., 1994. Rehabilitation and reintroduction of native fauna. Pp 191-216 in *Wildlife* Proceedings 233, Post Graduate Committee in Veterinary Science: Sydney.

Ward, S.J., 1990. Life history of the Feathertail Glider, *Acrobates pygmaeus* (Acrobatidae: Marsupialia), in south-eastern Australia. *Australian Journal of Zoology* **30**: 503-10.

Williamson, M. M., Hooper, P. T., Selleck, P. W., Gleeson, L. J., Daniels, P. W., Westbury, H. A. and Murray, P. K., 1998. Transmission studies of Hendra virus (equine morbillivirus) in fruit bats, horses and cats. *Australian Veterinary Journal* **76**: 813-818.

Whittington, R. J., Jones, J. B., Hine, P. M. and Hyatt, A. D., 1997. Epizootic mortality in the pilchard *Sardinops sagax neopilchardus* in Australia and New Zealand in 1995. I. Pathology and epizootiology. *Diseases of Aquatic Organisms* **28**: 1-16.

WHO. 1983. *Basic Documents, 35th Edn*. World Health Organisation: Geneva.

Woodford, M. H. and Kock, R. A., 1991. Veterinary considerations in re-introduction and translocation projects. *Symposia of the zoological Society of London* **62**: 101-10.

Woodford, M. H. and Rossiter, P. B., 1993. Disease risks associated with wildlife translocation projects. *Revue scientifique et technique de l'Office International Epizooties* **12**: 115-35.

Woods, R., 1999. Prevention of disease in hand reared native wildlife. Pp 457-89 in *Wildlife in Australia, Healthcare and Management* Proceedings 327, Post Graduate Committee in Veterinary Science: Sydney.

QUESTIONS & ANSWERS

PAUL HOPWOOD: Karen, with the presentation that you gave you alluded to one or two problems, and everyone realises that there are problems in any activity. However, do you feel it's fair to list a long stream of problems that have been documented over a vast range of species and then imply that all these problems may be or need to be confronted with any one particular species? That's the first question.

The second question is this: of all the problems that you mentioned it seemed to me that the most serious potential problem was the disease problem, therefore, I'd like to tell a little story and then ask a question. In the US, 300,000 people became seriously ill as a result of pet keeping. What happened was that kids were buying tortoises and it isn't known whether they were sucking on the tortoises' legs or not washing their hands after they'd handled the tortoises or whatnot, and they came down with a very nasty gut infection as a result of that. So that was what you'd call a fairly serious disease transmission problem.

But the answer to that was simply to sell tortoises that were specific pathogen free and not to stop kids from having the pleasure of keeping tortoises. Are you seriously indicating that there is a problem that is of such magnitude that it can't be controlled by very basic and very simple techniques, whether they be vaccination, specific pathogen free breeding, or whatever? Likewise, with the lesser problems that you raised, are you seriously proposing that those problems can't be directly answered? Thank you.

KAREN VIGGERS: Although not all of the issues I raised will necessarily apply to each animal, I do believe it is very important that all of those questions can be convincingly answered before we launch into considering even a couple of species as part of a native animal pet industry because of the potential for negative impacts on wildlife populations. Impacts on human health are also a real risk. Because we have a limited knowledge of disease in native wildlife we have very little idea of what agents of disease to test for in native animals. This has two major implications. First, it is very difficult to generate specific pathogen free colonies if you don't know what pathogens to test for, and you can't just test for everything. Secondly, we really don't understand just what implications there might be for human health. The case of Salmonellosis that you just described caused very serious illness in many people. Other diseases may result in deaths. This issue cannot be taken lightly. As far as vaccinating for diseases goes, unfortunately vaccinations don't exist for most of the diseases known to be potentially problematic in our wildlife, let alone the diseases we don't know about.

Another point is, I think it's really important that we can be convinced that there's a positive conservation benefit of having a native animal pet industry. It appears that the major thrust of the argument for a native animal pet industry is that we want to try and conserve our native species. If they end up only existing as pets then they're actually functionally extinct in the wild. There is this very great concern that we're shifting the focus away from that very important need for habitat and the prevention of habitat loss.

So what I am saying is that we must closely examine the motivation for a new pet industry and look realistically at the likely outcomes for native wildlife and conservation. I am also saying that, yes the problem of disease is a major one that cannot be treated lightly, and yes, I do think that for each proposed species all of these issues must be examined carefully each time.

PAUL HOPWOOD: Native animal pet keeping already occurs in several Australian States. Quite simply it works OK. So, let's get to the real question, which is what native animals are best to promote as pets and what guidelines are required to ensure best practice?

KAREN VIGGERS: Paul, just because something is already happening does not mean it is OK. Crime happens too, and that is not OK. I think it is really fundamental that in examining this issue we look deeply into what it is expected to achieve, and then realistically assess whether it is likely to achieve its goals. Keeping a handful of species as pets is not conservation. Nor is it likely to translate into conservation benefits for those species in the wild, let alone others. I am also very concerned at how lightly you treat some of the serious disease and conservation issues I have raised. These are real issues. They have been shown to be problematic both in Australia and overseas. It is important that we address these issues carefully and not bulldoze on regardless.

PAUL HOPWOOD: Another question on specifics. Could you explain why the introduction of Mitchell's Hopping Mouse into urban Sydney is a bad thing? Specifically and exactly what damage will it do? Why can hopping mice be kept successfully in South Australia and not New South Wales? As spinifex hopping mice are already kept under licence in NSW why would there be a problem in keeping the rare and endangered Mitchell's Hopping Mouse?

KAREN VIGGERS: Well Paul, there are a number of issues there to discuss. Firstly, a very important principle that should be adhered to is not to introduce animals to areas outside their current or historical ranges (and I'm not talking about during the Pleistocene). It might be OK to keep Mitchell's Hopping Mouse within it's previous range, but there is no knowing what impact it could possibly have on other locally native rodents if it were introduced into new environments in which it has never previously occurred. The case of disease introduced to platypus in Tasmania by accidentally translocated green tree frogs illustrates the type of unexpected disease issues that can arise with potentially serious consequences. Secondly, given that responsible pet ownership does not occur with current companion animals, there are no guarantees that extending pet ownership to include other species would result in their safe keeping, without escape, outside their normal ranges, no matter what the licensing system. Finally, the hopping mouse serves as a very useful example. But unfortunately it certainly cannot be used as grounds to reject all of the issues I have raised in relation to all other native species.

DAVID LINDENMAYER: I was very enthused by Mike Archer's talk this morning as it related to the need for landscape reconstruction. This is because I think that is where a lot of the real issues reside; and I know that because I have to spend a lot of time out in the field. Unfortunately, I think the concept of native animal pet industry has really deflected the issue to one that has really divided the people here. I think we should be working together to try to solve the problem. I think that one of the things that has disappointed me most is that this issue [of native animals as pets] is a furphy.

I hate to say it, but I think that this is a divisive issue and I don't think it's really going to help us a lot with conservation in the wild, habitat loss, helping rural and regional Australia make a transition to more sustainability or any of those really fundamental and important issues. I think this issue of native animals as pets has got a whole lot of other things associated with it that tend to divide people rather than bring them together.

MICHAEL VARDON: Wildlife Management International. We know that what is going on now is unsustainable, categorically unsustainable. What we've got suggested here is a series of things that might be sustainable. If you have to jump over all these hurdles every time, each species, by the time we get around to doing all of this we're going to have lost the opportunity to save animals. It's going to be 200 years by the time we get around to doing something. I think

the main problem we have now is that you're looking at trying to rebuild ecosystems - in eastern Australia that's certainly the case. In the Northern Territory we're looking at trying to maintain them, to avoid the mistakes of what's going on down here. So what are the sustainable alternatives? Rather than knock over the trees, have rice, have cattle grazing, have all of that, do we have to go through and prove every time that not doing that is going to be more sustainable?

KAREN VIGGERS: I'm afraid that I don't have the answers for large scale landscape conservation. If there was a simple solution it would have been done by now. But on the issue of keeping native animal pets, I do think that the issues depend very much on the species that you're talking about. However there is a lot of common ground that needs to be assessed for each species. As far as sustainability goes, if you're talking about endangered species, where there's very little leeway for mistakes in the wild, I think it is essential to look at all of those issues very, very carefully.

KATHY DAVIS: Kathy Davis, Newcastle University. Thank you very much for your talk. I found it very informative and I would have to actually agree with you being a wildlife carer that also rehabilitates animals. There are many, many homes that I have visited where there's in fact schedule 12 animals being kept with cats and the dogs. A lot of rehabilitaters do a lot of good, I'm one of them; but there are a lot of them that have not learnt very much about their animals and who do not participate in conservation at any level.

KAREN VIGGERS: Thank you. Your point helps to illustrate that contact with native animals does not necessarily foster awareness, let alone conservation action.

MIKE ARCHER: Thanks, Karen. There are certainly a lot of things to think about. I'd like to think that we ourselves have been across all of those issues and realised they all have to be considered very carefully. I was saying thanks to Karen for putting so many of the issues together like that, that's great. We have thought of the vast majority of those; you've popped up a few that we hadn't actually considered.

I would like to think that we can go forward carefully. As you say, we don't want to make any more mistakes. We don't want any more of the mistakes of losing species and that's pretty important. So these alternative strategies are things we want to consider and not be stopped by the fact that there may be a lot of thought and care that has to go into each of these decisions.

One thing sticks in my mind, as a guy who has kept quolls and sugar gliders and a whole range of things: that you think these animals would not be as affectionate as cats or dogs. I can only tell you from personal experience it's a conclusion you'd want to revisit, because I can't think I've ever had more affectionate and bonding animals than some of the marsupials that I've kept as companions.

So I think there's room for discussion about a lot of these things based on experience. I guess where we want to go with this one is to say, "Yes, there are problems; yes, there are challenges; but let's take it one at a time, let's trial one in which we look at all of those sorts of issues and make sure we minimise any risks, but just try it," because current strategies have been miserably failing; that's the problem.

KAREN VIGGERS: I must say that you were really lucky that you had a really tractable quoll because they're not all like that. I remember at the Australian Veterinary Association meeting last year Meri Oakwood talked about keeping quolls as pets. I specifically remember that she said they were much less interactive on the whole. She said they were interested in you but they were less interactive.

I know Meri is here today so she can speak further. I was commenting on this from the perspective of actually replacing cats with quolls as pets.

MERI OAKWOOD: I'll agree with what you said, Karen, in that the quolls I had were not as interactive as a pet dog; but then the difference is I'd only had them for about two months whereas Mike had his for quite a long period of time and he had his in his house with him all the time, sleeping in his drawers and all that. The ones I had weren't that close to me in that they had their own bedroom, it wasn't my bedroom; they lived in that room, and I lived in this one. So I didn't allow them as close to me as Mike allowed his as close to him.

KAREN VIGGERS: I think that it's interesting to hear about Mike's experience but we have to remember it's a sample size of one. But I think that if we're going to go ahead with this, and we think that there is a positive conservation benefit for wild populations, and that it's not going to negatively impact on our wildlife, then trials should performed and they should be done under a strict list of questions.

JENNIFER SCHWARTZ: I just wondered, nobody has commented on the number of people who in fact do keep native animals as de facto pets, who hand-feed magpies, lizards, possums. How does that fit into these problems?

KAREN VIGGERS: I think that encouraging wild free-ranging animals to co-habit with you in your backyard, so long as you're feeding them appropriate foods, is definitely to be encouraged, and that's a good way of having animals living in suburbia and I'm certainly not against that. Unfortunately I don't think we have the knowledge and capacity to manage a native pet industry appropriately at the moment and I can't see that day forthcoming in the near future.

HELENA THOMPSON: Australians for Wildlife. Thank you very much and congratulations on an impartial point of view spoken from the side of the animal as well as the human. We look at it purely from the animal welfare aspect, and I'd like to just tell you a little anecdote that Michael told us about a year ago which was that he did have a native animal pet which imprinted on him to such an extent that when he had to go to the UK for a matter of months on some business, and the animal was being fed and looked after by somebody else, it pined and died. Now, he learnt a lesson from that and we're afraid that that is what is going to happen to many other native animals if they are allowed to be kept as pets. A lot of people - should we keep native wildlife - will learn their lessons too late, at the expense of the animal. Apart from that, the ethical consideration of taking, say, for instance, a sugar glider from the treetops and keeping it in your pocket - like a pocketknife or a pocket handkerchief - is simply not to be.

MIKE ARCHER: I come back to the issue of the bonds that native marsupials develop with us. There's nothing inefficient or deficient about them in the way in which they do bond to us as individuals. And it was a loving - okay, here I am in the soft and squashy zone again - but that was a loving relationship, and it was a very mutually-responsive relationship. It would, you know, come up and lick me and kiss me and cuddle up under my neck at night. So I have no doubt about the fact that it bonded quite strongly.

Yes, that situation that was described, it's exactly what happened; it's my interpretation about what happened. I think the mistake I made there was encouraging a friend of mine to come in each day to feed it. What I didn't replace was the constant companionship that you would with a cat or a dog, and that was a mistake on my part, and I learned a big lesson. That was a very, very long time ago, I never did that again; but it certainly left me with a full understanding of how deeply our native animals can bond to us as individuals,

like any cat or dog - I mean, this was a far closer bond than you would ever expect out of a cat, I can tell you that.

I used to be the curator of mammals in the Queensland Museum and people were constantly bringing me these animals. Many of them came to me damaged by cats, so I took them home and, as best I could, rehabilitated them. Now, many of those which I received as adult animals, including many of the gliders, began doing that bonding behaviour that Charles Westrum, for example, describes exhaustively in his study of sugar gliders. I'd get this head rubbing and the exchange of scents that signalled that they were regarding me to be, you know, a sociable member of a group to which they belonged.

KAREN VIGGERS: This illustrates one of the problems for species like the sugar glider, which is a colonial animal and is used to living in a colony with a complex social structure. It sounds like in losing that colonial existence, the animal bonded with whatever was available to it, because isolating these animals and keeping them as individuals is potentially very stressful. I know there is a very big sugar glider industry in the US, and I think there's something like 56,000 of them kept over there. David Lindenmayer worked on Leadbeater's possum for his PhD and is quite well-known for his work on that species. He has a Web site, and he gets 50 inquiries a week asking how to deal with behavioural problems of aggression and other similar problems in sugar gliders. So some individuals might be suited, some might not be.

This is the problem with tamed versus domesticated. When you're talking about animals like dogs and cats that have been selected for many, many years to be domesticated, it doesn't happen suddenly overnight that we get domesticated native animals. And those that are "tamed" don't necessarily give rise to offspring that are similarly "tame". The other issue is, once we domesticate them, they're not the sort of animals that are suitable to release to the wild. Even if we have captive breeding colonies, as Paul suggested, they have to be completely differently selected; obviously, because in selecting pets you'd be selecting away from nervousness, fear of predators, etcetera, which are traits they need to survive.

Perhaps a better way for people to get involved with wildlife and learn about them is through wildlife care groups, with rehabilitation and release as the end goal, with a focus also that they need to have somewhere to release these animals, and that might help us with habitat conservation. If such groups can be better educated on the wild status of the species they assist, this could be a much better approach to educating members of the general public than having pets which are isolated out of their natural environment and which are destined for a life in captivity.

MIKE ARCHER: Whenever I've had native animals and I've been given them as younger animals which I hand-reared so those bonds were much stronger.

KAREN VIGGERS: Hand rearing requires specific skills and you would have to carefully train people if they're going to get animals at that age. It's not straightforward.

MIKE ARCHER: But there is a learning curve, and I found a great deal of assistance with a few vets who were familiar with native animals and had generic suggestions about how best to go about it, and I would encourage what you said, that the veterinary students today should just keep one eye forward on the possibility that there will be growth in the veterinary industry focused on native animals. Whether these are animals being rehabilitated from wild situations or not, there's going to be an increasingly greater need to be able to effectively deal with native animals.