# Managing the Grey-headed Flying-fox *Pteropus poliocephalus* as a threatened species in NSW: adjusting to a long-term vision

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ABSTRACT

The effective management of the Grey-headed Flying-fox *Pteropus poliocephalus* as a threatened species in NSW will depend on our ability to develop and implement policies that focus on habitat conservation and enhancement. The aim is to preserve a continuous food supply for the species and an integrated network of camps as stopover habitat during migration as well as suitable roosting environments. Several ecological attributes of the Grey-headed Flying-fox make this a demanding task, in particular, its wide-ranging and nomadic habits. The long distances over which flying-foxes travel mean that there needs to be an integrated response between states, as well as a shift in thinking that encourages setting aside habitats on a broad landscape scale, irrespective of current land tenure. These conservation initiatives will have to address many hard issues being faced throughout Australia, including the need to make conservation equitable by providing incentives to encourage private landholders to retain habitat and participate more fully in conservation initiatives. In order to involve the whole community in conserving habitat for Grey-headed Flying-foxes, the community also needs to be made aware of the value of the species, including its crucial role in dispersing seeds and pollen for forest regeneration. Community education and participation will be essential to the recovery process for the species. Further, the information currently available to management is inadequate for the task, and ongoing, adaptive management will need to be underpinned by sustained research on a variety of fronts to achieve the successful transition of the Grey-headed Flying-fox from pest to threatened species and ultimately to recovery. It will take a shift in perception to adjust to adopting a long-term vision in the management of this magnificent Australian bat.

## Introduction

The effective management of the Grey-headed Flying-fox *Pteropus poliocephalus* as a threatened species in NSW will depend on our capacity to adapt to its changed conservation status and the acuity of our long-term vision. Flying-fox management in NSW has always been preoccupied with reducing immediate conflicts with farmers and neighbours of camps, as illustrated by most of the contributions in this book. The need to expand the management debates and to develop policies to include habitat conservation has been recognised in the determinations of the Scientific Committee under the NSW *Threatened Species Conservation Act 1995* and the Threatened Species Scientific Committee under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (see appendices in Dickman and Fleming 2002; Eby and Lunney 2002). The immediate challenge is to arrest the population decline in the Grey-headed Flying-fox by reversing the processes that threaten the species, particularly ongoing loss and degradation of foraging and roosting habitat (Tidemann *et al.* 1999). Several ecological attributes of the Grey-headed Flying-fox make this a demanding task and for the NSW National Parks and Wildlife Service (NPWS), and other agencies with a wildlife management role; there will be testing times ahead.

Pages 273-284 in *Managing the Grey-headed Flying-fox as a Threatened Species in New South Wales*, edited by Peggy Eby and Daniel Lunney, 2002. Royal Zoological Society of New South Wales, Mosman NSW.

The distribution of the Grey-headed Flying-fox coincides with the most densely populated part of Australia – the temperate east coast (Australian Bureau of Statistics 1996). It is also the area experiencing the most rapid growth in population size. In addition, south-eastern Australia supports intensive agricultural practices and forestry operations. Further, rates of forest clearing and degradation continue to be high (Barson *et al.* 2000; Wilson *et al.* in press). Three main sources of forest loss have been identified: broad-acre clearing for agriculture; incremental clearing for coastal development; and forestry practices (Australian State of Environment Committee 2001). All three impact on flying-foxes. Ratcliffe (1931) estimated that the pre-European flying-fox populations had, by the 1920s, been reduced by 50%, primarily due to habitat loss. The ongoing forest clearance and degradation have reduced the numbers and distribution of Grey-headed Flying-foxes (Tidemann *et al.* 1999) to the point of it becoming a threatened species.

Conservation strategies for Grey-headed Flying-foxes will be difficult to devise and even harder to implement due largely to their wide-ranging and nomadic habits (Eby 1991). Grey-headed Flying-foxes are suffering from the cumulative effects of incremental loss in habitat over a large area and the impact of many small decisions taken at a local level under a range of jurisdictions. Little remains of some vegetation communities that are key to the species' survival. The impact of the loss of the small remnant patches that remain is amplified by the absence of alternatives. The conservation of Grey-headed Flying-foxes cannot be based only on habitat preservation in conservation reserves (Eby 1991). This is why it is critical that private landholders be engaged in the process of management, whether it be for controlling the impact of Grey-headed Flying-foxes on crops, or for managing their conservation. These conservation initiatives must address many hard issues being faced throughout Australia, including the need to make conservation equitable by providing incentives to encourage private landholders to retain habitat and participate more fully in conservation initiatives.

In our opinion, any long-term vision focuses on habitat conservation. We argue that a strategic conservation program and the enhancement of feeding habitat should reduce impacts on crops by providing preferred alternatives. Further, we contend that community education and participation are essential to the recovery process. A recurring theme is that the information currently available to management is inadequate for the task, so ongoing, adaptive management will need to be underpinned by research to achieve the successful transition of the Grey-headed Flying-fox from pest to threatened species and ultimately to recovery.

## Habitat conservation by season, year and decade

Grey-headed Flying-foxes can roost undeterred amidst the activity and noise of a popular public botanical garden, navigate across highly disturbed city landscapes and feed in trees fringing railway lines or 24-hour industrial sites. However, they cannot escape the impact of a continuous reduction in foraging habitat. Recovery planning for Grey-headed Flying-foxes must be based on a strategic program of habitat conservation and enhancement. The aims should be to preserve a continuous food supply and an integrated network of camps to provide stopover habitat during migration and suitable roosting environments. It is also essential that there be sufficient camps suitable for reproduction, and that such camps remain undisturbed from September to April each year, so as to encompass the period of birthing rearing of young to independence, sexual bonding, and conception (Martin and McIlwee 2002). This will require protection of existing habitat and augmentation of key feeding and roosting sites (Pallin 2000; Law *et al.* 2002).

Arresting the loss of vital feeding habitat will be no mean task. Firstly, it is necessary to grasp a key element of flying-fox ecology – their movement patterns. Migratory animals depend on a progression of spatially distinct, often apparently unrelated habitats, to complete their annual cycles. For nomadic species like the Grey-headed Flying-fox, key habitat areas are difficult to define and are unlikely to be conserved incidentally within general programs of resource management (Woinarski *et al.* 1992; Pressey 1994). Specific initiatives are required.

The areas of habitat that offer foraging resources at any time are small and vary in location between years. This is due to the uneven distributions of the plants in the animal's diet and the variations that occur in the flowering patterns of individual plant species. The greatest diversity of diet plants in NSW occurs along the coast, particularly the north coast and the Sydney Basin

(Figure 1). This general pattern varies when seasonal flowering schedules are taken into account. Most tree species required by Grey-headed Flying-foxes have distinctive seasonal flowering patterns and the number and distribution of those that flower vary from month to month (Clemson 1985; Sommerville 1999; Law *et al.* 2000). For example, 33 of the 62 species in the diet of Grey-headed Flying-foxes flower in January and summer-flowering plants are distributed throughout their range. By contrast, there are relatively few resources in winter with only 11 of the 62 species flowering in July. Further, the winter-flowering plants are limited in distribution to the box woodlands of the western slopes and various lowland plant communities along the coast (Figure 1).

The actual locations of nectar flow at any time are further restricted because eucalypts do not flower every year (House 1997; Wilson and Bennett 1999; Sommerville 1999; Law *et al.* 2000). Several winter-flowering plants have

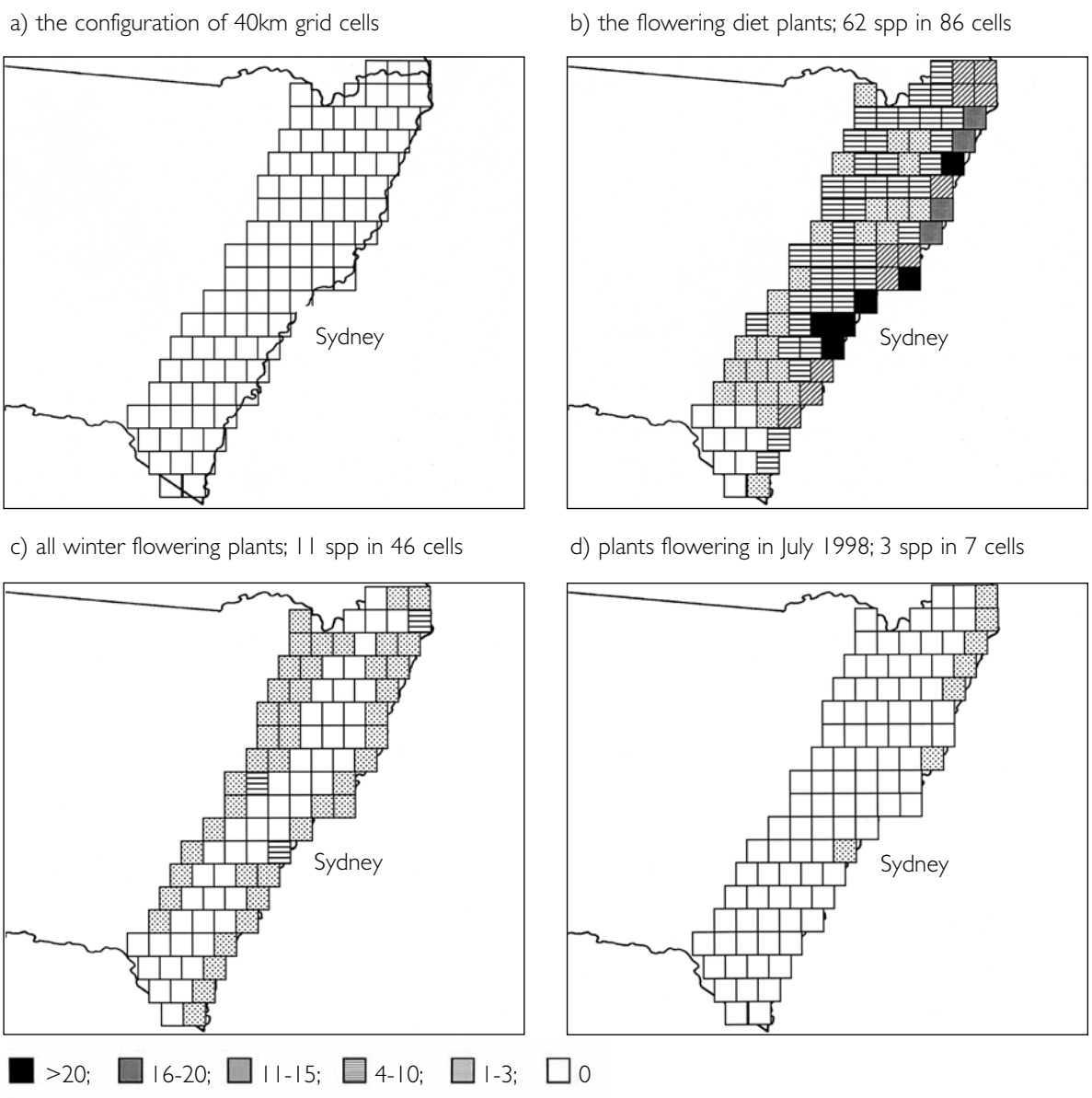


**Figure 1.** The impact on foraging resources for Grey-headed Flying-foxes of seasonal flowering phenologies, species distribution and annual variations in nectar secretion in diet plants. The NSW range of the Grey-headed Flying-fox has been overlaid with a 40 km x 40 km grid, positioned to align with the coast. Data are counts of the number of species in each grid cell. (a) the distribution of all species in the flower diet of Grey-headed Flying-fox. source: National Herbarium database (K. Hill unpublished), and vegetation data from NSW NPWS; (b) the distribution of species that flower during July. source: Clemson 1985; Sommerville 1999 (c) the distribution of floral resources available in July 1998. source: NSW Agriculture Apiary Officers, commercial apiarists; P. Eby personal observations. Introduced plants have been excluded from the data.

highly irregular flowering patterns and only occasionally contribute to the foraging options for Grey-headed Flying-foxes. For example, Spotted Gum *Corymbia maculata* flowers in July on the south coast of NSW about once every ten years (Pook *et al.* 1997). Woolybutt *E. longifolia* on the south coast and various ironbarks on the north-western slopes seldom flower (Sommerville 1999). Species that flower more regularly occur in lowland coastal habitats in northern NSW and southern Queensland. They include Forest Red Gum *E. tereticornis*, Swamp Mahogany *E. robusta*, Broad-leaved Paperbark *Melaleuca quinquenervia* and Coast Banksia *Banksia integrifolia* (Law 1994; Sommerville 1999). Grey-headed Flying-foxes closely track the nectar flow and in most winters they congregate on the coastal lowland areas.

This characteristic of the species has been documented in range-wide surveys taken over successive years (see Eby *et al.* 1999 for methods). Results from the winter of 1998 provide a good example. The primary winter (June to August) food in 1998 occurred in remnant woodlands dominated by Forest Red

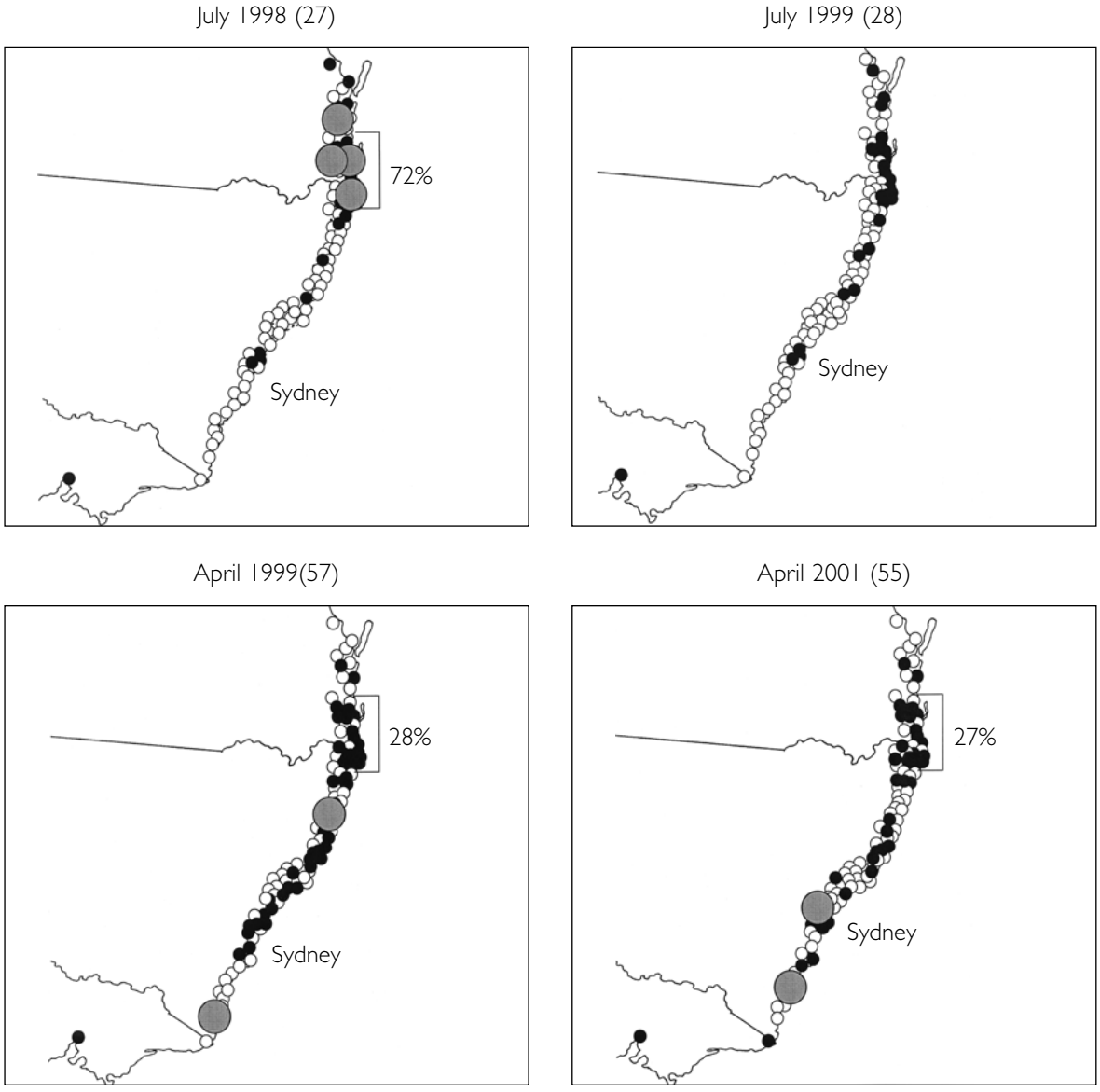


**Figure 2.** Seasonal and annual variations in the distribution of Grey-headed Flying-foxes assessed by the populations of communal roosts. These maps show the relative distribution of the species in autumn when it is generally restricted to coastal areas and wide spread, and winter when it generally concentrates in coastal lowland habitats in northern NSW and southern Qld. Data are results of national, synchronous surveys (Eby *et al.* 1999). Open circles are camps that were unoccupied, black circles are occupied camps, and large grey circles are camps of estimated population size >30,000. Total numbers of occupied camps are in parentheses. The percentage of the total estimated population that occupied the area between Maroochydore, Qld and Ballina, NSW is given. In July 1999, heavy rain prevented population estimates from being conducted in many areas and presence/absence data are presented.

Gum and these were located between Gympie, on the Queensland coast, and Woodburn on the north coast of NSW (Figure 1). The only other substantial nectar flow at that time within the range of the Grey-headed Flying-fox occurred in coastal areas near Yamba, Urunga and Taree on the north coast of NSW and in the streetscapes and gardens of Sydney (Eby *et al.* 1999). There was no substantial nectar flow from plants located inland from the coast or south of Sydney and the Coast Banksia was not in flower. Grey-headed Flying-foxes congregated onto the available resources. In July 1998, about 72% of the known population occupied 18 camps between Maroochydore in Qld and Ballina in NSW (Figure 2). The number and locations of occupied camps were similar in the following year.

In contrast to their winter habits, in autumn Grey-headed Flying-foxes occupy a greater number of camps distributed over a larger area (Figure 2). In April, large camps are likely to occur in the southern half of their range, but their locations vary widely from Pambula, on the far south coast, to western Sydney, then to Bellingen on the north coast (see also Lunney *et al.* 2002 for a picture of this seasonal flux). Again, this trend reflects the distribution of food.

The winter convergence of Grey-headed Flying-foxes on restricted coastal habitats exposes a high proportion of the population to the impacts of the increasing human population on the remnant vegetation in this 'sun-belt' area. Migratory animals are particularly vulnerable during the periods in which they concentrate (Brower and Malcolm 1991). High rates of mortality can result from loss of small areas of key habitat. The vegetation communities that contain winter-flowering Forest Red Gum, Swamp Mahogany and Melaleuca have been substantially cleared, are poorly represented in conservation reserves, occur primarily on privately owned land and continue to be cleared for coastal development (Catterall *et al.* 1997; Kingston 1999; Barson et al. 2000; Accad *et al.* 2001; Wilson *et al.* in press).

## Conservation status

Since the winter habitat is critical, its loss has a direct and adverse impact on Grey-headed Flying-foxes. This is compounded by ongoing reductions in nectar flow in all seasons throughout its range. In addition to forest clearance and degradation, nectar flow is adversely affected by such factors as some forestry practices, eucalypt dieback, drought, fire, and the vulnerability of eucalypt nectar flow to fluctuations in temperature and rainfall (Norton 1996, House 1997; Law *et al.* 2000). It is difficult to assess the impact of the loss of foraging habitat in seasons other than winter when Grey-headed Flying-foxes are more dispersed and the location of the nectar flow is less predictable. Food shortages do occur. They are most readily identified in spring when they are associated with episodes of extreme crop damage and either premature births or deaths of new-born young (Collins 1999; Eby 1999; Parry-Jones 2000; Martin and McIlwee 2002). As in winter, several key spring-flowering trees are primarily confined to relatively fertile, flat or undulating land. Such land has been extensively cleared and is poorly represented in conservation reserves, for example grassy box woodlands west of the escarpment that contain Yellow Box *E. melliodora* and alluvial flats in southern NSW that contain Forest Red Gum (Benson 1991; Prober 1996; Keith and Bedward 1999; Sattler and Williams 1999; Wilson *et al.* in press).

## Habitat conservation and conflict resolution

Flying-foxes belong to a small group of Australian native mammals that engender hostility in human communities, hostility which can lead to illegal actions involving camp disturbance and/ or killing of the animals. The incidence of conflict between Grey-headed Flying-foxes and orchardists and at camps is not declining in line with the decline in the population of Grey-headed Flying-foxes. Instead, conflict is apparently increasing (Biel 2002; Comensoli 2002; Rogers 2002; Tidemann 2002). Some interpret the increase in conflict as evidence that the population is in fact increasing and that listing the Grey-headed Flying-fox as vulnerable was misguided. There is a grimmer view of the matter. A more ecological interpretation is that the incidence of flying-fox damage in commercial orchards and the increasing presence at urban camps are not indicative of high numbers, but rather of altered use of the landscape driven by the decline in native forests and coastal vegetation communities.

The loss of native habitat has the potential to influence the use of refuges in urban and rural landscapes and of crop visitation. There is consistent evidence, although poorly documented as yet, that flying-foxes cause severe damage to commercial fruit crops only

when native food is in short supply (Ratcliffe 1931; McWilliam 1986; Eby 1990, Tidemann *et al.* 1999; Teagle 2002). If flying-foxes use crops when native food is limited, one would predict the fruit industry in eastern Australia will continue to experience difficulties with flying-foxes so long as these giant fruit bats experience periods of diminished food. Consequently, it is our opinion that improvements to the management of habitat for flying-foxes would enhance both conservation and crop management outcomes. Similarly, there is growing evidence that the increasing use of urban camps is a response to both an increase in the numbers of native trees in gardens and along streets in cities like Sydney and Melbourne and the decline in native forests (Birt *et al.* 1998; Hall and Richards 2000; Parry-Jones and Augee 2001).

This indeed is the nub of the matter. It is not that flying-foxes prefer to co-exist with humans, but that they depend on the native vegetation that is confined to the best agricultural lands and coastal lowlands. The status of vulnerable for the Grey-headed Flying-fox has now altered the rules for their co-existence with human settlements. The toughest decisions will be those that require allocating land valued by humans to Grey-headed Flying-foxes. If we fail to tackle it, the Grey-headed Flying-fox will slide into the endangered schedule.

## The need for a landscape approach

If the native vegetation required by Grey-headed Flying-foxes was constant in place and reliable in quantity and time, a minimum system of reserves to conserve feeding habitat for the species could be contemplated. However, the irregular nature of flowering and fruiting of eucalypts, melaleucas, banksias and rainforest trees makes this approach unrealistic. Habitat conservation for flying-foxes will need to incorporate land that has commercial value - both privately-owned land and publicly-owned land outside conservation reserves or State Forests. Further, the long distances over which flying-foxes travel mean that there needs to be an integrated response between states. Ultimately, there needs to be a shift in thinking that encourages setting aside habitat areas on a broad landscape scale irrespective of their current tenure.

The established farming communities of coastal NSW have been undergoing a demographic shift since the 1950s. There has been an ever-growing influx of the people from the cities and from the west. The rising human population puts great store by the proximity to the coast, land values rise accordingly and native vegetation may be cleared, or options for its regeneration closed off. These lands are greatly under-represented in the reserve system (Pressey *et al.* 1996). This example provides part of the case argued by Lunney *et al.* (1997) for a reconciliation between short-term economic imperatives and long-term ecological goals. One of the approaches will be to take a landscape approach to both development and conservation planning at a scale that has hitherto not been formally attempted because some of the land in question is privately owned, commercially valuable and apparently off-limits for conservation options.

Worked examples of planning initiatives that incorporate the conservation of a native mammal are scarce. Study of koalas in Coffs Harbour City shire provides one model of the type of broadscale conservation endeavour that will be needed for flying-fox conservation. Coffs Harbour City produced a statutory Koala Plan of Management (Lunney *et al.* 1999) under State Environmental Planning Policy number 44 (SEPP 44 Koala habitat) in conjunction with the revision of the Local Environmental Plan (LEP), an important statutory planning instrument. The adoption of the koala plan was materially assisted by an economic study, which demonstrated that conserving koalas in Coffs Harbour was worthwhile economically for the tourist trade (Hamilton *et al.* 2000).

In order to involve the whole community in conserving habitat for Grey-headed Flying-foxes, the community needs to be made aware of the value of the species and be prepared to compensate those who contribute to its conservation by forgoing alternative economic activity. One crucial value to the entire community is the role of Grey-headed Flying-foxes in dispersing seeds and pollen, which is a vital part of forest regeneration. In the language of the ecological economist, this is an environmental service. This term has yet to gain wide currency, but it will in time become part of the bottom line of all environmental accounting procedures. Grey-headed Flying-foxes currently provide this service free of charge, but if the service were to be measured in dollar terms, or some other trading currency, this would provide

a basis for negotiations with landholders and a framework for addressing issues of compensation. What we are suggesting is a significant paradigm shift that will require input from economists who understand the ecological trade-offs. It is an important component of our long-term vision. Society at large is just beginning to understand the principle of ecosystem services, and we have yet to see it incorporated into the national accounts.

## Public education and participation

Shifting the public perception of Grey-headed Flying-foxes as an overabundant pest to a declining native species that confers many benefits to forest ecosystems will be essential to its recovery. A major program of public education is now required. It will need to focus on providing the ecological information needed to enhance the public's understanding of these huge bats and the events that affect them (Ford 2002; Smith 2002). Surveys (Larsen *et al.* 2002; Lunney *et al.* 2002) also contribute to effective education by publishing information about public attitudes to specific wildlife and conservation issues.

The solutions to many seemingly intractable issues can be found in education (Ford 2002; Smith 2002). Yet a pressing call from an allegedly aggrieved party, or a minister's office, can overwhelm long-term education initiatives. This was seen in recent years in the public contest over the flying-fox camps at Maclean High School, as outlined by West (2002) and Tidemann (2002), and the Royal Botanical Gardens in Melbourne during 2001-2, as well as the tension surrounding the listing of the Grey-headed Flying-fox as a threatened species.

The NPWS Director-General announced at the forum on 28 July 2001 his intention to establish a NSW Flying-fox Consultative Committee (FFCC) to provide a forum for community involvement in flying-fox management in NSW (Gilligan 2002). This committee was established in August 2001. It comprises representatives from NPWS; NSW Agriculture; NSW Farmers' Association, with the additional appointment of two horticulturists; Banana Industry Committee; Nature Conservation Council of NSW; RSPCA; Local Government Shires Association of NSW; and the scientific community. (PE is a member of this committee in this capacity). The aim is to advise NPWS on conservation and management strategies for all three flying-fox species found in NSW. The Committee has had regular input into the NPWS policy on the mitigation of commercial crop damage by flying-foxes and has prepared a funding proposal to support the development of a conservation and management strategy. The committee and its work are indicative of the growing recognition that a cooperative effort is needed to tackle the difficulties of flying-fox management.

## Research

While heated arguments may be effective in influencing short-term political decisions, they do little to advance long-term solutions. Complex, vexatious management issues take time to research, to negotiate with all interested parties, and to integrate into broader strategies for the ethical management of species and the land. Recovery planning for the Grey-headed Flying-fox must, in our opinion, include a significant and sustained program of research. There is no escaping the fact that the difficult management issues outlined in this book cannot be resolved with the information currently at hand. The greatest impediment to managing Grey-headed Flying-foxes as a threatened species is a lack of quality information on the species and its habitats, economic data on its impacts, and field trials on control techniques appropriate to a threatened species. Inadequate research inhibits the development of effective management practices and tends to reduce the debate to claims and counter-claims.

Priorities for the research necessary to achieve a strategic approach to management have been identified in several documents (Eby 1995; Tidemann *et al.* 1999; Hall and Richards 2000; Threatened Species Scientific Committee 2001 in Eby and Lunney 2002, Appendix 1; Teagle 2002). (Also, the NSW Flying-fox Consultative Committee, NPWS files, unpublished 2002 *Submission to Treasury for a recurrent allocation for management of the Grey-headed Flying-fox* is a relevant document in this process). The fundamental projects and lines of enquiry suggested in these documents align closely with each other and with the research recommendations presented here. The recommendations have been divided into horticultural and ecological research. The immediately pressing issues are:

*Horticultural research:*

- field tests of non-lethal deterrents for flying-foxes on commercial fruit crops;
- assessments of levels of flying-fox damage to individual fruit growers and to the horticulture industry in NSW;
- the effectiveness of culling, including culling 'scouts', as a technique for mitigating flying-fox damage on fruit crops.

*Ecological research:*

- development of a method to reliably assess population trends;
- identification of habitat requirements, diet preferences and roost preferences;
- assessment of the methods used by flying-foxes to locate food;
- models of impacts of various threatening processes on the Grey-headed Flying-fox.

In addition, there is a profound need to undertake research that takes a broader longer-term view, and includes topics whose relevance to management may not be immediately apparent. There are many topics on the biology of flying-foxes that will yield ideas and information that will be essential in the long run to managing the species. In the 1986 symposium on flying-foxes (Hall and Hughes 1987), there were papers on taxonomy, hearing, vision, parasites, reproductive biology and an exploration of the question of whether flying-foxes are really primates. More recent applied research has focused on viruses, a vital public health matter (Field 2002). Also, taxonomic research has identified a new flying-fox species (Richards and Hall 2002) and some work has been published on vocal communications in Grey-headed Flying-foxes (Christesen and Nelson 2001). The list of new, curiosity-driven research is short and it needs to grow. Further, the apparently peripheral research into such matters as education, ecological history, value of flying-fox habitat to other species, and attitudes in society will become essential. The management relevance of such work has been illustrated in this book in the papers by West (2002), Larsen *et al.* 2002), Ford (2002), Hughes (2002) and Lunney *et al.* (2002). In addition, there is an ever-increasing case for an economic study of all aspects of the matter.

If a second national symposium on flying-foxes were to be convened, the range of topics would be greater than 1986, but the thin support for research nationally would become embarrassingly apparent. Here we join all other players in urging financial assistance for wide-ranging research, and for helping those with expertise to follow productive lines of enquiry, even though it might not be glaringly obvious to all that such research will confer any immediate practical benefit.

The recent federal court case in Brisbane concerning the Spectacled Flying-fox in the Wet Tropics World Heritage Area demonstrates the costly and divisive nature of disputes contested in the absence of a solid research base (McKinnon *et al.* 2002). The outcomes establish legal boundaries and guidance for the rangers in the field, but do not achieve a balance for the long term.

## Conclusion

The inclusion of the Grey-headed Flying-fox on the schedule of Vulnerable species both in NSW and nationally has identified the need for restorative management of this species. The recovery of the species will be inhibited if no resolution is found to the conflicts that surround Grey-headed Flying foxes on crops and in some camps. However, a cessation of culling and disruption to camps is not sufficient to arrest the decline of this species. Nectar-dependent birds and bats in Australia are exposed to food shortages from the incessant reduction and degradation of forests, particularly those in the fertile lowlands and coastal habitats. Without this difficult matter being addressed, Grey-headed Flying-foxes and other faunal icons of Australia's forests will continue to disappear. The challenge is immense and is not being considered by many planners, much less being met at a local level. The variability of the resource base from native trees, the scale of planning required to conserve the species and the need to incorporate private landholders in conservation strategies are substantial challenges to recovery planning.

The effective management of Grey-headed Flying-foxes will be a matter of public communication and negotiation. To be effective, management strategies will need to find a way to balance concerns. It will be necessary to devise programs that prevent significant losses to the horticulture industry, minimise nuisance problems and health concerns at urban camps, and at the same time arrest population decline by protecting and enhancing important habitat areas and phasing out culling - a formidable challenge indeed.

At the outset of the forum on 28 July 2001, the Director-General of the NSW National Parks and Wildlife Service, Brian Gilligan (2002), identified

his aspiration to find a balanced solution to managing the Grey-headed Flying-fox as a threatened species. In doing so, the Director-General acknowledged that the Service needs to exercise a fine judgment in heeding the aims of those whose focus is on conserving the species and those who experience it as a pest, whether on a crop or in an urban camp. He also announced a determination to restructure and substantially reduce licensed culling in commercial fruit crops over a three-year period. As any wildlife manager knows, three years is a tight time frame to accomplish such a change. It cannot be attained without a widespread acceptance both of the problems faced by all parties and of the need to change. This points to the need for good policy, good rural extension work and education program, and a sound research base with a mix of applied and longer-term projects (O'Brien and Fisher 2002).

The principle of a landscape approach to conservation, and the inclusion of the community in conservation endeavours, are recognised as key elements of the NSW Biodiversity Strategy (NPWS 1999) and are corporate goals of NPWS, but their application is only in its infancy at the scale of entire ecosystems. If flying-foxes were a species that lived and died within a valley, then local measures would suffice, but this migratory species flies long distances each year. It follows that a comprehensive, entire east coast view of the species and the protection of its habitat, irrespective of its land tenure, is essential. It also follows that actions taken in one location, such as habitat clearing and shooting, affect the whole population of Grey-headed Flying-foxes. The Murray-Darling River binds all those in that river basin in an ecological sense, and there is now a commission with responsibilities in that vast area. The migratory path of the Grey-headed Flying-fox provides that same unity. It is a question of perception. It will take a shift in perception to adjust to a long-term vision needed to manage of this magnificent Australian bat. This book forms part of the process of that essential shift in perception.

## Acknowledgements

We are indebted to many colleagues and friends for years of discussion on the biology and management of flying-foxes. We wish to thank Len Martin and Irina Dunn for their critical comments on a draft of this manuscript.

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