Aesthetics, Economics and Conservation of the Endangered Orange-Bellied Parrot

Harry Clarke

The Orange-bellied Parrot (*N. chrysogaster*), or OBP, is an exceedingly rare Australian parrot and, indeed, one of the world's rarest birds. The genus *Neophema* to which it belongs comprise small, graceful grass parrots in the family *Psittacidae* that include both parrots and lorikeets. They are ground dwelling and southern-based Australian parrots. Apart from the OBP, members include the Turquoise Parrot (*N. pulchella*), the Scarlet-chested Parrot (*N. splendida*), the Blue-winged Parrot (*N. chrysostoma*), the Elegant Parrot (*N. elegans*) and the Rock Parrot (*N. petrophila*). Members of this genus are described by Trounson (1996:54) as 'among the most beautiful of birds'. All are endemic to Australia and none, except the Blue-winged Parrot, are common with the OBP being by far the most rare. Bourke's Parrot (*N. bourkii*) formerly classified with this genus, is now placed in a different genus (Christidis and Boles, 1994).

The OBP breeds in summer on the south-west coast of Tasmania in hollow-bearing eucalypts which grow adjacent to the buttongrass plains where it feeds. On completion of its breeding season, the population migrates north across Bass Strait via King Island during March-April. Most OBPs then reside in the south-east region of Australia between Gippsland, eastern Victoria and The Coorong in south-eastern South Australia. Particular concentrations of OBPs are found in the saltmarshes of Port Phillip Bay (Forshaw (1989:284) claims up to 70 per cent live in this habitat) where they feed on salt-resistant plants restricted to this habitat (Loyn *et al*, 1986).

The population of OBPs in the wild has been variously estimated at between 150-500 birds (Blakers, Davies and Reilly, 1984; Schodde and Tidemann, 1993). Garnett (1993), in an authoritative survey on rare and extinct birds, estimates total numbers at 150+ while the Higgins (1999:561) survey estimates numbers at less than 200 with a breeding population of about 100 birds. Using International Union for the Conservation of Nature (IUCN) criteria the species is classified as 'endangered' rather than 'critically endangered' since although the population numbers are very low they have been stable in recent years and there is no evidence of continuing habitat decline (Garnett, 1993:90-92; Collar, Crosby and Stattersfield, 1994:103; Clarke, 2000).

Uncertainty about numbers is compounded by the possibility that during its non-breeding season, the OBP may be making a change in its use of habitats, from traditional saltmarsh country toward more open countryside (Starks, 1997:9).

During the breeding season human access to all potential breeding sites in Tasmania is limited so monitoring of population size is difficult. The population seems to have been stable in recent years but, as it is small, the species remains sensitive to catastrophes such as disease, bushfires and storms that can occur during migrations. The small population also raises the prospect of reduced 'safety in numbers' during migrations and reduced genetic variability although this is offset by the fact that large flocks of OBPs are seldom observed—the birds migrate in small groups. Some conservation biologists advance a '50/500 rule': animal populations, it is argued, need to have a genetically effective population of at least 50 members to conserve genetic diversity in the short-term (several generations) and numbers of 500 or more in the longer term to avoid serious 'genetic drift'. (Genetic drift refers to the loss of genetic variability when, by chance, certain characteristics are not be sampled in the next generation when the current generation is small). These figures, the genetic drift argument and the validity of the '50/500 rule' are disputed (Meffe et al, 1997:194).

The OBP was one of the first birds described by the white colonisers of Australia. It was first collected in 1773 or 1774 during Captain Cook's second or third voyage (Silva, 1989:67). At the turn of the century, and even as late as the 1960s, the species was considerably more numerous than at present and occupied a larger, less fragmented range. In earlier times, during the winter months, the OBP was claimed to occur as far north as the western suburbs of Sydney and around Sydney Harbour (Cayley, 1968; Crome and Shields, 1992; Silva, 1989). It was also more widely dispersed, during the summer months, in Tasmania. Numbers in the early nineteenth century are uncertain but references were made to 'thousands' (Morgan, 1918). While this is only a rough guide, the OBP seems never to have been common. The reasons for its decline in numbers and restriction/fragmentation in range include destruction and alteration of vegetation, competition from other species (particularly introduced seed-eating birds), predation by feral animals (cats and foxes) and trapping for aviculture, particularly in South Australia (Garnett, 1993:90-2).

Choice of the OBP for specific analysis here is partly a symbol for more general species conservation concerns and partly because the OBP recovery effort is the longest-running national individual species recovery effort in Australian history. The OBP Recovery Plan was the first of its kind for an endangered Australian species. It began in 1984 (Stephenson, 1991). Longstanding interest in the OBP makes it an intrinsically interesting case study in individual species conservation economics.

Conservation Prospects

OBPs live a specialised lifestyle in terms of food requirements and the annual migrations undertaken. Following legislative protection in 1960, it has become difficult (and illegal) for the caged-bird trade to persecute OBPs, so the main issue governing survival is habitat conservation. An additional survival factor

comprises the financial (and intellectual) resources going into programs to ensure the protection of the OBP, including captive breeding programs.

In economic terms the main cost of conserving the OBP is the opportunity cost of using the land the OBP now utilises for feeding and reproduction for its next best purpose as well as the cost of resources specifically directed towards OBP conservation.

A captive breeding program has been conducted by the Tasmania Parks and Wildlife Service in Hobart since 1985. In 1994, a second colony of OBP was founded at Healesville Sanctuary (near Melbourne) with breeding stock from Hobart. During 1997-98 breeding in the captive groups resulted in the successful fledging of 34 juveniles although survival of nestlings has been poor. A third colony has now been established in Melbourne. A total of over 50 young were reared in 1998-99. Mortality in adult captive birds has been high due to disease. From 1985-86 to 1997-98 a total of 318 OBP have been bred in captivity of which 68 have been released into the wild. The breeding stocks at the end of 1998 were about 40 in Hobart and about 29 in Healesville (Smales et al, 1999).

Land utilised for breeding in western Tasmania is entirely protected national parkland. Most areas utilised by the OBP on the mainland are reserved for conservation or subject to cooperative conservation agreements with landowners. The main conservation difficulties however still occur in Australian mainland areas where the OBP spends the winter. Here, because of the close proximity of habitat to concentrated urban areas, there have been repeated threats from development over the years. In the Port Phillip Bay area, these have included expansion of the Avalon Airfield and construction of a new port at Point Lillias (Brown and Wilson, 1984; Menkhorst, Loyn and Brown, 1990, Edgar and Menkhorst, 1993).

Recently, Point Lillias was proposed as an alternative to the Coode Island chemical storage facility. This would have been a marginal intrusion on OBP habitat but could have had a strategic significance of initiating conservation problems by opening the door to further 'marginal' developments and thereby, eventually, promoting 'death by one thousand cuts' of the species. The Point Lillias proposal was eventually shelved by the then Victorian State Government. The leader of this Government, The Hon. Jeffrey Kennett, in debunking proposals to forego development of Point Lillias to preserve the OBP, gave the bird a memorable common name — the 'Trumped-up Corella'. This puts the OBP into the wrong family of *Psittaciformes* namely the *Cacatuidae*, which include the cockatoos and corellas. Mr. Kennett subsequently abandoned these development plans though his reasons for doing this — valuable information for conservationists — remain private.

Conservation Arguments

In recent years substantial effort has gone into preventing extinction of the OBP. The World Wildlife Fund has sponsored an intensive survey of the species and a Recovery Plan has been adopted. The OBP Recovery Team has representatives from Federal and three State Governments as well as bird conservation organisations and universities. It has operated since 1984 with expenditures averaging something less than \$100,000 annually.

Over the seven years 1984 to 1990, the Recovery Program cost \$589,000 — an average of \$84,140 per annum. This included staff salaries, travel and material costs of land management and protection (\$300,000), maintenance of captive bred birds (\$44,000), recovery team meetings (\$22,000), winter survey costs (\$44,000), the captive breeding facility (\$80,000) and research and recovery plan costs (\$78,000) (Rounsevell, 1990). Since 1991, the Federal Government has provided \$496,000. The current proposed plan is costed at \$1.5m over five years (Menkhorst, 1998, personal communication). To the various costs mentioned are also often added 'in kind' costs. In 1995 'in kind' costs of \$22,275 were estimated for labour and transport services provided by volunteers (Starks, 1997).

What rationale (economic or other) can be given for this effort? We consider arguments that motivate conservation effort from six (not independent) viewpoints that describe various species conservation concerns.

Aesthetic

These are probably the strongest arguments but they are often poorly articulated. Defining 'aesthetic' narrowly to mean 'visually colorful and attractive' to human beings, the OBP is definitely handsome but probably not more so than its close relatives — particularly the spectacular Scarlet-chested and Turquoise Parrots. The OBP is visually similar to the Blue-winged and Elegant Parrots, which are genetically related and more common (Christidis *et al*, 1991). The OBP is of interest, in terms of broader aesthetic criteria that account for its peculiar and difficult migratory life cycle. However, the OBP is not unique in this respect. The Blue-winged Parrot which it closely resembles, also migrates seasonally across Bass Strait and is one of several *Neophema* genetically similar to, though more abundant than, the OBP. Also the Swift Parrot, *Lathamus discolor*, follows a similar migration pattern and is exceptionally attractive, although genetically and phenotypically very different from the OBP.

Commercial

Bird observers attach a high value to observing rare birds. Valuation of rare species by those with an interest in birds will be high simply because the birds are

rare.¹ There are problems for private firms in recovering such value because viewing birds is a non-rival and often nonexcludable public good (see Clarke, 1999). Ignoring congestion, birdwatching is a non-rival activity with high transaction costs of enforcing excludability.

With excludability — so access to OBP locations can be priced — and in the absence of congestion, social efficiency is achieved by levying a zero access charge. Costs of conservation at such sites can then be recovered by managing them as *club goods*. Under such an institutional arrangement a fixed licence fee is charged and, upon payment of this fee, unlimited access permitted. This is the charge system used at the important Western Treatment Plant site for observing the OBP and other birds. A fixed biannual fee of \$20 is charged and thereafter entry is free.

Without excludability there is an argument for public provision of birdwatching access because of its high implicit value and because interest in avifauna is substantial. In the US, there are 61 million birdwatchers of which 300,000 are considered serious in the sense that they can identify more than 100 species. Total US expenditure on birdwatching in 1990 was more than \$20 billion US. The Canadians and British are more ardent than this (Gill, 1995). Information on Australia is patchy but major birdwatching organisations (the Bird Observers Club of Australia (BOCA) and Birds Australia) have significant and growing memberships: BOCA has about 4,000 'family member' units and Birds Australia about 5,250 members.

Apart from specific birdwatching interest, the tourism values of the OBP are low on mainland Australia although there is growing inter-state and international recreational birding tourism. Furthermore, the OBP does not occupy mainland habitats regarded as having high tourism values. Sewerage farms and saltmarsh are distinctive environments for various flora and fauna but do not have mass appeal to humans.

There are more tourism values associated with the OBP in Tasmania. At its main breeding location in Tasmania (Melaleuca in the south west) an exceptional bird observatory (hide) is provided for observing OBP. This includes live video footage of activities inside a nest box used by a wild pair of OBP. Two small airlines (Tasair and Par Avion) run charter flights to Melaleuca several times per day throughout the summer and OBP viewing is an advertised highlight of these trips.² The Melaleuca area has high tourism value — thousands of people travel to it each year spending large amounts of money to do so.

Finally, the possibility of using the OBP as an avicultural output by farming it can be considered. The OBP's rarity means it has high value in avicultural markets. A political economy argument raised against such sales is that the

¹ As an observant referee notes, increasing the numbers of rare species might reduce their scarcity value to those bird observers who value rarity. We assume here that such losses will be outweighed by the gains other sections of society enjoy from knowing that the survival of a species is more assured.

² I thank Peter Menkhurst for these observations.

prospect of successfully selling the OBP might reduce incentives to continue public conservation effort. This could be damaging if private breeding programs failed. In addition, it is currently illegal to own privately an OBP so marketing OBP requires a change in law. Moreover, making birds marketable provides incentives for poaching from the wild, which offset arguments for marketing.

Ignoring poaching, the case for privatisation is based on the theory that private agents will act to maximise OBP survival (in captivity) to maximise profits. However, if property rights are ineffectively enforced on wild birds — so poaching is possible — privatisation may encourage a self-interested annihilation of the species in the wild by poachers. This is undesirable if conservation in the wild is an objective. In addition, private purchasers will underbid for legally-supplied OBP if illegally supplied birds are available at low cost.

Some have suggested building up a large OBP stock via captive breeding to 'flood the market' prior to commercial marketing to reduce poaching incentives. Resulting revenues could then be used to fund OBP conservation. However, incentives to poach will be eliminated only if returns from poaching are low. Therefore, this policy succeeds only if returns from legal sales of OBP are low. Thus, the policy is of limited use for funding OBP conservation in the wild even though it might provide an additional basis for ensuring overall survival.

Diversity

Social choice theorists express the idea of individuals having a preference for diversity via the idea of convexity. Convex preferences imply that mixtures are preferred to extremes. Applied to species conservation, those with convex preferences prefer to protect a mix of a large number of species rather than larger numbers of a smaller ranging mix. Alternatively, birdwatchers have convex preferences if they prefer to observe a mix of species rather than a single species. A preference for natural diversity is claimed to satisfy a human need for sensory and intellectual stimulation termed *biophilia* (Wilson, 1984).

On the basis of convexity ideas and biophilia there do not seem to be strong biodiversity reasons for favouring preservation of the OBP along the lines of, for example, Weitzman (1998). This approach uses genetic distance data to determine conservation strategies to maximise biodiversity. With respect to the OBP there are other parrots in the *Neophema* group which are genetically similar and which are more abundant and easier to preserve.

Plants and animals have evolved from a single origin of life and have a unique evolutionary history or *phylogeny*. Of the attempts to establish the phylogeny of the world's 10,000 bird species, that due to Sibley and Alquist (1990) using DNA comparisons across 1,700 species has substantially influenced modern taxonomies. One way of assessing species distinctiveness is to establish the 'genetic distance' of particular species from others as suggested in Weitzman (1998). Within the *Neophema*, Bourke's Parrot (*N. bourkii*) historically was the most distinctive in terms of behavioural, ecological and morphological characteristics. It has therefore recently been segregated into its own monotypic

genus — *Neopsephotus*. Unlike *N. bourkii*, *N. pulchella* and *N. splendida*, the remaining 4 *Neophema* (including the OBP) have a coastal distribution rather than one in the dry interior — they are therefore referred to as 'coastal *Neophema*' (Eades, 1998). The OBP has close relatives in this coastal group.

Also, while the OBP is possibly not a suitable cage bird species (Silva, 1989 cites contrary arguments that are discussed further in Brown (1984). See also Smales et al (1999) for a related literature on captive breeding.) it is being raised in captive breeding programs and being released into the wild where it apparently behaves like wild-raised stock by, for example, undertaking biannual migrations (Starks, 1997). Conserving the bird as a caged bird, in this way, helps ensure its survival. Clearly however, what many conservationists hope to conserve is not OBP-related DNA but a composite good — the OBP in its natural environment. For many, the caged-bird trade is an undesirable, long-term conservation outcome.

Species distinctiveness, as taxonomists agree, is partly a subjective characterisation. There is no widely agreed approach to defining what a species is let alone to measuring the distinctiveness of a species from others within a genus (Meffe et al, 1997:60-85; Mallet, 1996). This is important issue if one is attempting to prioritise conservation decisions at the species level since then species demarcations need not have been established in terms of a common norm. Taxonomy and the prioritisation of biodiversity conservation then involve inevitable subjectivity. This subjectivity however bites in each direction. In particular, taxonomic arbitrariness does not always work against the conservation of species with apparently close relatives as is the case for OBP. Much biodiversity is below the species level so conservation (of populations) below the species level is important. Given subjective taxonomic boundaries there may be an increased case for risk-averse conservation managers, to preserve at a doubtful taxonomic boundary.

Finally, using genetic arguments it has been suggested that conservation efforts for OBP should be abandoned because of the OBP's low population. Brown et al (1985) consider this possibility but reject it based on qualifications to the '50/500' rule discussed above. However, the small OBP population size may bear on the issue of survival prospects. Post Sibley-Alquist DNA work is throwing new light on species uniqueness issues. It may be that *both* small population size and genetic uniformity are conservation problems. Even if a large OBP population can be replenished from a small stock of only 150 birds, the population may have low genetic diversity and therefore a uniform, vulnerable immune system. Such vulnerabilities may be discovered even in large populations as DNA research proceeds.

Joint conservation

Habitats, certain economic activities and a considerable number of other species are simultaneously preserved if the OBP is preserved. There are complementarities in conserving the OBP with other bird species. The Western Treatment Plant (WTP) at Werribee for example, is a significant wintering location for the OBP.

WTP is also an economically viable (sewage) waste disposal centre for more than half of Melbourne's residents and is an economically viable commercial sheep and cattle property as well. The lagoons and countryside of WTP are a major Australian environmental resource — the wetland is listed by the International Union for the Conservation of Nature as a *Wetland of International Importance*. This wetland is protected by an international agreement signed by the Australian Government. Over 250 bird species have been recorded at WTP (this is about one third of the known bird species in Australia) and the WTP's management authority claims that the area supports more than fifty per cent of the world population of OBP. At WTP, there are also significant concentrations of migratory waders from the northern hemisphere during summer and many migratory and resident waterbirds. There are also mammals (for example, the Common Dunnart: *Sminthopsis murina*) and significant flora (WTP, undated).

Conservation of the OBP at WTP does not conflict significantly with its economic role as a waste disposal facility and farm. Moreover, conservation of the OBP simultaneously advances other conservation benefits. This suggests that the opportunity cost of OBP conservation at WTP is low. While the land value of the 10,851 hectares at WTP is high because of the site's proximity to urban Melbourne, this proximity boosts its conservation value and the economic value of its sewage disposal capability.

Finally, one should recognise that the WTP is not a homogeneous conservation zone. Particular parts of the area have special significance to the OBP. The Murtcaim Wildlife Reserve (including the Spit Wildlife Reserve famous among bird observers) is an area of land jointly managed by Parks Victoria and Melbourne Water which is crucial to the OBP and which faces particular management problems. The Spit is a fragile and vulnerable environment. Other well-defined areas in neighbouring Port Phillip Bay are also of importance. We should also recognise that there are specific issues in terms of habitat conservation and protection from feral animals (particularly foxes) that impinge heavily on the OBP. Thus, while there is 'jointness' in conservation effort which improves the economic case for conservation, there are also reasons for promoting the conservation of specific species such as the OBP.

Existence and option values

Australians who know of the OBP may seek to preserve it in order to retain the option to view it at some time in the future — there is an *option value* on its conservation. Other Australians will never have heard of the OBP but, if its rarity and consequent extinction vulnerability is explained to them, then the high contingent valuations that have been obtained for mammal species (for example, Leadbeater's Possum: *Gymnobelideus leadbeateri*) suggest they will attach a high value to simply knowing that the OBP will survive — they would attach a high *existence value* to the OBP. Jakobsson and Dragun (1996) obtained two contingent valuation estimates of the value of protecting Leadbeater's Possum of between \$29 (and \$20) to \$75 (and \$60) per Victorian household annually. These

imply perhaps implausibly substantial aggregate desired conservation expenditures of \$40-160m annually in Victoria. People derive this benefit from knowing that the OBP will survive even should they have no desire to ever see it. This benefit can be linked to the guilt they would otherwise feel were they to allow the OBP to become extinct.

In addition, individuals may display *altruism* by seeking OBP conservation so future generations may have the option of observation. Such altruism can be motivated by the view that our children might hate us for the world we took away from them.

While these are compelling arguments in some respects, they are not arguments distinctively applicable to a particular species such as the OBP. Virtually any living matter, even an intermediate form of 'life' such as the smallpox virus, should 'almost never' be made extinct if costs of controlled conservation are small enough (Clarke and Shrestha, 1987).

Other non-economic arguments

Aesthetics alone can imply a case for conservation although it is difficult, with respect to the OBP, to categorise sources of aesthetic virtue (qualities that excite an admiring pleasure) other than rarity combined with a fortuitous cheapness to conserve. This might not seem a problem to biologists or conservationists who, in any event, often categorise economist attempts to pin down sources of aesthetic value as tedious philistinism. However, this criticism represents a misunderstanding of the objectives of economic inquiry. Economists search for the reasons that people value things in odd areas — snob goods, addictive drugs, existence, option and other values. In these terms why is the OBP so socially valuable?

To say that a concerned group of people seeks the OBP's survival for *non-economic reasons* without specifying these reasons is an empty case. Moreover, it poses the difficulty that it is not necessarily the concerned group that funds the outcome. Is funding therefore an unmotivated and unfair redistribution toward those with elitist, conservationist preferences? Do such individuals have more 'refined' preferences than the majority who pay preservation-ensuring taxes so that this elite therefore have the right to claim public funding on the basis of an irrefutable (and probably nearly empty) *merit good* argument?

Some content can be assigned to the merit good view, without invoking elitist preferences, by supposing that while individual preferences are respected in making decisions, these preferences should be informed and should rely on expert views of, for example, conservation biologists. Thus if it can be argued that if the community generally seeks species conservation there might be a non-elitist role for expertise in assigning dollars to those conservation areas known to yield a high potential conservation payoff.

Finally, are public choices regarding species conservation, as revealed in surveys or in political choices, subject to such strong biases that they are of limited prescriptive value in social decision-making? It is argued, for example, that while

minorities have strong motivations to preserve species the majority is unconcerned either way. Alternatively, special interest groups may promote a case for species destruction based on concentrated economic interests while the majority have low unfocused preferences favouring conservation. In these instances, concentrated views favouring conservation (or destruction) will dominate social decision-making for political economy reasons — specifically because of the high transaction costs of giving weight to more diffuse viewpoints.

There are other arguments for conservation of the OBP that are less important for the specific OBP case than those cited. One is that continued existence of bird species provides important signaling indicators of general environmental health. Here birds have an instrumental role in signaling preservation of a healthy environment. This is a general argument supporting preservation of many species. It provides no specific motivation for conserving OBPs. A related argument is that the continued OBP survival signals preservation of environmental authenticity. This is both a general and a questionable argument. Dubos (1980) emphasises how human beings have transformed environments in a positive way: the 'wooing of the earth' requires both the conversion of wilderness into humanised environments and the preservation of natural environments. The case for pursuing authenticity is therefore questionable and, even if accepted, largely irrelevant for the OBP on mainland Australia given the highly-altered character of much (though not all) OBP winter habitat.

Conclusions

There is a strong, partially non-economic, aesthetic argument for conserving the OBP and this author would be disturbed if he understood that any reader went away with any other impression after reading this paper. The case for conserving the OBP based on economics alone however is uneasy in its details when subject to careful analysis. In the main, it is based on the low cost of increasing the survival prospects of the OBP. The argument seems unrelated to specific OBP characteristics and, in this sense, is uneasy.

While an economic argument for conservation, based on aesthetics as a public good, can be constructed this is irrefutable and therefore unscientific unless aesthetic criteria are specified which could potentially be shown, using data, to not apply to either the OBP or other species. With respect to the OBP, relevant aesthetic criteria based on beauty, lifestyle or genetic distinctiveness are either not obviously apparent or else weak. There exist comparably beautiful birds that are morphologically and genetically similar. In addition, preservation could perhaps be achieved by commercialisation of OBPs via captive breeding and possibly even the caged bird trade. That nature lovers might collectively despise the caged-bird trade could suggest devoting resources to the liberation of factory chickens rather than conserving OBP. There are similar (and different) parrot species with similar migratory lifestyles to the OBP.

The main economic argument for preservation is that, fortuitously, the cost of conservation is low relative to alternative economic uses of land. This low cost

reflects the fact that OBP conservation helps preservation of other flora and fauna because of habitat overlaps.

The essence of our argument can be set out as an application of Weitzman's (1998) use of diversity theory to analyse choice in biodiversity decision-making. This approach prioritises species candidates seeking conservation effort and assigns to species i the cardinal ranking:

$$R_i = [D_i + U_i](\Delta P_i/C_i)$$

where: D_i = distinctiveness of i (a measure of how different i is);
 U_i = direct utility of i (how much it is liked);
 ΔP_i = measure of how much survivability of i can be enhanced; and
 C_i = cost of improving survivability of i by ΔP_i .

The higher is R_i the higher the ranking. Provided ΔP_i is small, for all species i , use of this measure to prioritise conservation efforts approximates the optimal policy of maximising biodiversity subject to budget. Given substantial efforts in Australia to conserve the OBP, this ranking measure is *revealed* high in the minds of cost-minded conservationists. Our argument is that OBP distinctiveness is low so D_i is low. Also, aesthetic arguments for conserving OBP seem difficult to set out precisely so, ignoring south-west Tasmanian tourism values, U_i is also low. The reason therefore for assigning a high ranking to OBP is that ΔP_i is high relative to C_i . Specific OBP attributes are irrelevant — the main argument is that extinction prospects for the OBP can be reduced at low cost. If costs of reducing extinction risks were more substantial then the case for conserving the OBP (or other species) based on its intrinsic characteristics would be less strong.

Existence and option value arguments confirm a case for conservation although we have not uncovered versions of such arguments specific to the OBP. Finally, the apparently strong economic argument that a species like the OBP should be conserved because it is scarce and has high marginal value to those who value bird life is correct but has surprising implications. It implies, for example, that all rare species should be conserved irrespective of their uniqueness properties or the possibilities for conservation effort to reduce their survival probabilities. Basing conservation value on claimed rarity hinges on subjective taxonomic issues, which is unsatisfactory if conservation funding has to be indivisibly allocated among competing ends.

The economic case for conserving the OBP is partly fortuitous and fairly compelling but uneasy in several respects.

References

- Blakers, M., S. Davies and P. Reilly (1984), *The Atlas of Australian Birds*, Royal Australian Ornithologists Union, Melbourne University Press, Melbourne.
- Brown, P. (1982), 'The Orange-Bellied Parrot', *Bird Keeping in Australia* 27:82-87.
- Brown, P. and R. Wilson (1984), *Orange-Bellied Parrot Recovery Plan*, National Parks and Wildlife Service, Tasmania.
- Brown, P., R. Wilson, R. Loyn and N. Murray (1985), 'The Orange-Bellied Parrot — An RAOU Conservation Statement', Royal Australian Ornithologists Union, Moonee Ponds, Victoria (RAOU Report 14).
- Cayley, N. (1968), *What Bird is That?*, Fifth Revised Edition, Angus & Robertson, Sydney.
- Christidis, L. and W. Boles (1994), *The Taxonomy and Species of Birds of Australia and its Territories*, Royal Australian Ornithologists Union, Hawthorn, Victoria (Monograph 2).
- Christidis, L., R. Schodde, D. Shaw and S. Maynes (1991), 'Relationships Among the Australo-Papuan Parrots, Lorikeets and Cockatoos: Protein Evidence', *Condor* 93:302-317.
- Clarke, H. (1999), 'International Species Protection Agreements: Migratory Shorebirds in the East-Asian Australasian Flyway', *The Stilt* 35:18-24.
- Clarke, H. (2000), 'Prioritising Avifauna Conservation', *The Australian Journal of Environmental Management*, forthcoming.
- Clarke, H. and R. Shrestha (1987), 'Renewable Resource Management with a Backstop Technology and Nonautonomous Prices', *Journal of Environmental Economics and Management* 14:159-182.
- Collar, N., M. Crosby and A. Stattersfield (1994), *Birds to Watch 2: The World List of Threatened Birds*, Birdlife International, Cambridge.
- Crome, F. and J. Shields (1992), *Parrots and Pigeons of Australia*, The National Photographic Index of Australian Wildlife, Angus & Robertson, Sydney.
- Dubos, R. (1980), *The Wooing of Earth*, Charles Scribner's Sons, New York.
- Eades, D. (1998), 'Neophemas for Neophytes: Coastal Neophema Parrots Part I: Group Characteristics', *Wingspan* 8(1):10-15.
- Elgar, B. and P. Menkhorst (1983), 'Orange-bellied Parrot, *Neophema chrysogaster*', *Action Statement* 43, Department of Conservation and Natural Resources, Victoria.

- Forshaw, J. (1989), *Parrots of the World*, Third Revised Edition, Lansdowne, Singapore.
- Garnett, S. ed. (1993), *Threatened and Extinct Birds of Australia*, RAOU/Australian National Parks and Wildlife Service, Royal Australian Ornithologists Union (Report 82).
- Gill, F. (1995), *Ornithology*, Second Edition, W.H. Freeman & Co, New York.
- Higgins, P. (1999), *Handbook of Australian, New Zealand & Antarctic Birds, Volume 4 Parrots to Dollarbird*, Oxford University Press, Melbourne.
- Jakobsson K. and A. Dragun (1996), *Contingent Valuation and Endangered Species: Methodological Issues and Applications*, Edward Elgar, Cheltenham.
- Loyn, R., B. Lane, C. Chandler and G. Carr (1986), 'Ecology of Orange-bellied Parrots *Neophema chrysogaster* at Their Main Remnant Wintering Site', *Emu* 86:195-206.
- Mallet, J. (1996), 'The Genetics of Biological Diversity: From Varieties to Species', pp. 54-76 in K. Gaston (ed.), *Biodiversity: A Biology of Numbers and Difference*, Blackwell Science, Oxford.
- Meffe, G., C. Carroll and Contributors (1997), *Principles of Conservation Biology*, Sinauer Associates Inc. Publishers, Massachusetts.
- Menkhorst, P., R. Loyn and P. Brown (1990), 'Management of the Orange-bellied Parrot', pp. 239-252 in T. Clark and J. Seebeck, (eds), *Management and Conservation of Small Populations*, Chicago Zoological Society, Chicago.
- Morgan, A. (1918), 'The Birds of the South-Eastern Part of South Australia', *South Australian Ornithologist* 4:13.
- Rounsevell, D. (1990), 'Review of OBP Programme', Orange-bellied Parrot Recovery Team, Tasmania, mimeo.
- Schodde, R. and S. Tidemann eds (1993), *The Reader's Digest Complete Book of Australian Birds*, The Reader's Digest Services, Sydney.
- Sibley, C. and J. Ahlquist (1990), *Phylogeny and Classification of Birds, A Study in Molecular Evolution*, Yale University, New Haven and London.
- Silva, T. (1989), *A Monograph of Endangered Parrots*, Silvio Mattacchione & Co., Canada.
- Smales, I., P. Brown, P. Menkhorst, M. Holdsworth and P. Holz (1999), 'The Role of Captive Management in the Recovery Program for the Orange-bellied Parrot *Neophema chrysogaster*', *International Zoo Yearbook*, London Zoological Society, London.
- Starks, J. (1997), 'Winter Surveys of the Orange-bellied Parrot *Neophema chrysogaster* in South-Eastern Australia in 1995', *Birds Australia Report Series*, December.

Stephenson, L. (1991), *The Orange-bellied Parrot Recovery Plan: Management Phase*, Department of Parks, Wildlife and Heritage, Tasmania.

Trounson, D. and M. Trounson (1996), *Australian Birds*, Fourth Edition, National Book Distributors, NSW.

Melbourne Water (undated), *Western Treatment Plant, Environment*, Melbourne.

Weitzman, W. (1998), 'The Noah's Ark Problem', *Econometrica* 66(6):1279-1298.

Wilson, E. (1984), *Biophilia*, Harvard University Press, Cambridge, Mass.

Several ornithologists helped with this work. Without implicating them in any conclusions I thank Rohan Clarke, Peter Lansley and particularly Peter Menkhorst for their views. I also thank Eric Jones and four anonymous referees. An earlier version was presented to the Workshop on Achievements of and Challenges for Agricultural and Resource Economists in Australia, November 2, 1998, La Trobe University.