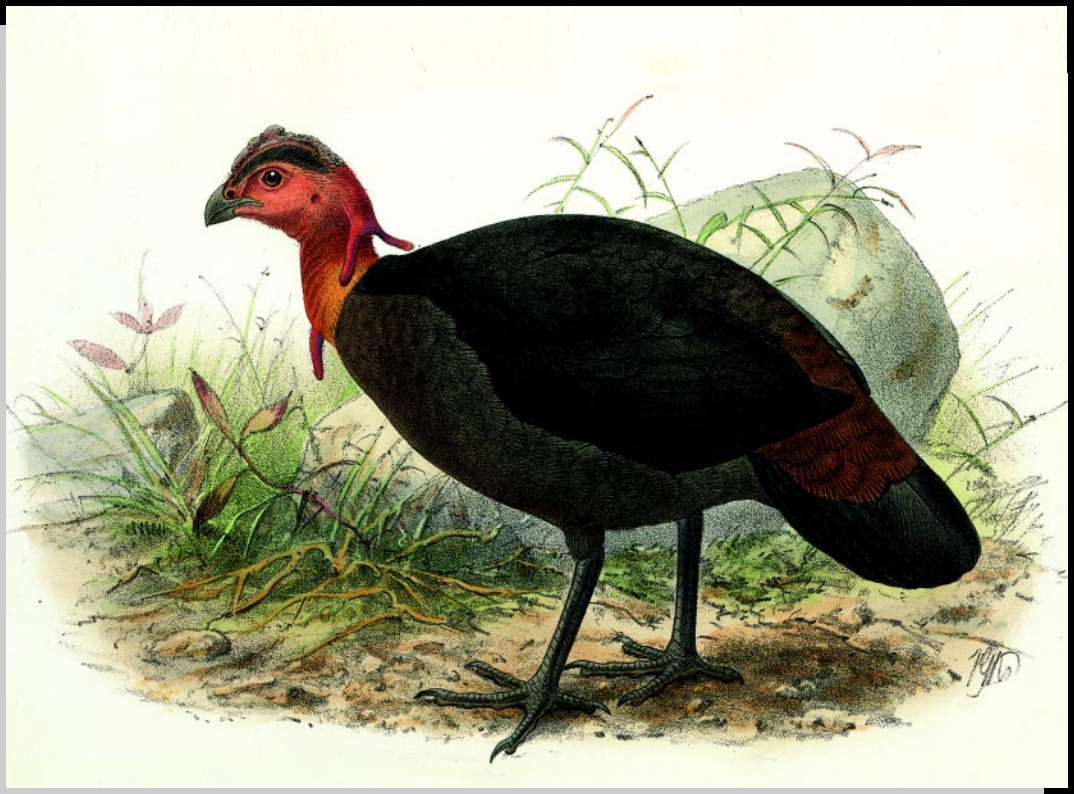
Status Survey and Conservation Action Plan 2000–2004

Megapodes

Edited by René W.R.J. Dekker, Richard A. Fuller, and Gillian C. Baker on behalf of WPA/BirdLife/SSC Megapode Specialist Group



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Foreword

Five years have passed since the publication of *Megapodes – An Action Plan for their Conservation 1995–1999*, during which the Megapode Specialist Group has been active in promoting, initiating, and executing conservation and research projects on megapodes. However, despite all our efforts, the conservation outlook for many species remains bleak. Deforestation continues, while the economic situation in large parts of the range of most threatened megapodes has deteriorated. This has serious implications for conservation in general, and megapodes in particular, as some species are important to the local economy and sustainable use is difficult to explain when food becomes scarce and expensive.

We do, however, know much more about megapodes now than we did five years ago. This has helped considerably to redesign conservation projects in this new *Megapode Action Plan*. Not only do we know much more, the information has also become much more widely available. In 1995, a 262-page monograph on the family was published by Oxford University Press, while in 1999 the Proceedings of the Third International Megapode Symposium came off the press. Both publications, as well as the numerous megapode publications in international journals, show the increased standard and diversity of megapode studies worldwide.

As mentioned above, this has not improved the conservation status of most (threatened) megapodes. Although many of the projects as described in the first Action Plan have been executed, these were mainly short-term studies and surveys. These are, however, necessary steps to reach our conservation goals. The new *Megapode Action Plan* has built on this foundation by describing longer-term conservation projects *in situ*, and focuses on active involvement of the local community and local authorities. The consequence of this is that sufficient funding is required. I therefore hope that this Action Plan will not only make scientists and conservationists enthusiastic, but will also generate money; money necessary to get long-term megapode conservation projects off the ground.

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The malleefowl is an unusual megapode, found in semi-arid habitats in Australia.

Executive Summary

This Action Plan covers the megapodes, a group of Australasian ground-dwelling birds comprising 22 species found from the Nicobar Islands in the west, through Indonesia, the Philippines, and Australia, to Polynesia in the east. Their habit of nesting on or near beaches, often on small islands, makes them vulnerable to disturbance and egg collecting, and several species are greatly threatened. In 1995, the first *Action Plan* for the conservation of these species was published and this document provides an update on the current situation. The objectives of this document are to identify the most threatened species within this family (Chapters 2 and 3), and prioritise the conservation action needed to protect them by outlining project briefs for the most urgent cases (Chapter 4).

This plan of action will be distributed to biologists, conservationists, politicians, policy-makers, government officials, educators, planners, grant-awarding bodies, and commercial concerns that are in a position to help. The greatest threats to the future survival of these fascinating birds are over-exploitation of their eggs, loss of forested habitats where they live, and the introduction of unnatural predators. Much can be done at the local level, although national and international support will prove helpful in some cases. This means that the projects in Chapter 4 should be considered by those with local influence in the areas concerned, as well as by national officials and politicians. The full co-operation and involvement of local people is fundamental to the success of any megapode conservation project.

Chapter 1 gives an overview of the megapodes, outlines the major threats they face, and suggests possible ways to help protect them. It is intended as a broad introduction, and will be particularly useful to those unfamiliar with the group and conservation methods in general. Chapter 2 summarises the threat status of each species. The species identified as threatened are considered in more detail in Chapter 3, which gives information on distribution, threats, and possible conservation measures for each species.

Chapter 4 is the most important part of the document, and contains details of practical work that is most urgently required to help protect each of the threatened species. There is a great variety of work proposed, from small-scale surveys suitable for university students carrying out short-term fieldwork, to more in-depth research programmes requiring much greater financial and logistical resources. Governments and politicians can use these larger projects as a basis for high-profile conservation initiatives, either alone or in conjunction with other conservation projects in the region. In any case, we recommend that researchers wishing to undertake any of these projects develop their ideas in consultation with policy-makers, government officials, grant-awarding bodies, and the Megapode Specialist Group.

The Megapode Specialist Group is pleased to report a large increase in the amount and quality of conservation work since production of the first *Action Plan* in 1995, but many species remain highly threatened and, in some cases, almost unknown in the wild. The Megapode Specialist Group will continue to do its best to stimulate follow up of this Action Plan and will be pleased to advise on its implementation. We look forward to its continued success.

Chapter 1

The Conservation of Megapodes

1.1 Introduction

In 1995, the first Action Plan for the megapodes was produced, providing a comprehensive review of status and outlines for conservation action. During the five-year implementation period of that Action Plan, a large volume of work on these species has been undertaken. The purposes of this update are:

- to provide a new overview statement on megapode conservation worldwide (Chapter 1);
- to integrate this material into revised threat assessments (Chapter 2);
- to justify why certain species are priorities for conservation effort through updated species accounts (Chapter 3);
- to suggest a new set of conservation projects with international priority (Chapter 4).

This document has been prepared on the basis of the most recent information available during 1999, and the projects listed are intended for implementation during 2000–2004. It, therefore, supersedes the 1995 Action Plan, although some general information is repeated for new readers. It provides specific conservation assessments and interpretation of conservation-related information and, as such, the reader should not expect a full account of the biology of this group of birds.

Every effort has been made to gather information and opinion that is up-to-date, from published and unpublished literature, and from correspondence and discussions with people currently involved worldwide in the conservation of megapodes and their habitats. Wherever possible, all substantive statements are backed up with references to the literature. As in the first edition of the Action Plan, a large amount of information has been reviewed and all suggested plans for action have been checked for feasibility by the originators and others. The Megapode Specialist Group is, therefore, confident that this plan has the full backing of its international network of members and that many of the proposed actions will be initiated within the five-year implementation period.

During 2004, the contents of this Action Plan will again be reviewed and updated, and a third edition drafted to cover the period 2005–2009.

1.2 Information on megapodes

Species included in the Action Plan

This Action Plan covers the megapodes of the world. These birds belong to the avian order Galliformes, which contains all the birds often referred to as gamebirds: the megapodes (Megapodiidae), cracids (Cracidae), guineafowl (Numididae), New World quails (Odontophoridae), turkeys (Meleagrididae), grouse (Tetraonidae), and partridges, Old World quails, and pheasants (Phasianidae). Second edition Action Plans for partridges, quails, francolins, snowcocks, guineafowl, and turkeys (Fuller *et al.* 2000), and the pheasants (Fuller and Garson 2000) are being published, while Action Plans for cracids (Strahl and Brooks 2000) and grouse (Storch 2000) have already come off the press. This means that all Galliformes species are now covered by Action Plans.

The species taxonomy and names for megapodes used in this Action Plan follow that of Jones *et al.* (1995) who recognised 22 species in seven genera.

For a full discussion of the higher levels of classification within the Galliformes, including a historical review and an analysis based on DNA comparison techniques, see Sibley and Ahlquist (1990). Brom and Dekker (1992) and Mey (1999) provide background on classification and taxonomy within the megapodes.

A complete list of the species considered in this Action Plan is given in Chapter 2, to which the reader should refer for scientific names.

Distribution and general biology

Megapodes are found from Niuafo'ou Island, Tonga, in the east, through the western Pacific islands of Vanuatu and the Solomon Islands, to New Guinea and surrounding islands, Australia, eastern Indonesia, and the Philippines. Two species occur outside this area, to the north at about 18°N on the Mariana and Palau Islands, and to the west at about 94°E on the Nicobar Islands. The highest diversity of both genera and species is found in New Guinea and Australia (Jones *et al.* 1995).

Apart from the malleefowl, which lives in the semi-arid mallee habitat of southern Australia, all species prefer moist tropical forest and typically are found on oceanic islands. Despite their preference for tropical forest, many megapode species use coastal areas for breeding. Both types of habitat, therefore, are important for their continued survival (Jones *et al.* 1995).

Malleefowl nesting mound. It consists of an inner core of leaf litter buried under a thick layer of sand.

The breeding biology of megapodes is very different from that of all other Galliformes. Some species build large mounds of vegetation in which eggs are incubated by heat from fungal decay of the material. Others bury their eggs in burrows, where incubation temperatures are achieved by heat from volcanic activity or the sun. After a long incubation, the chicks hatch rapidly, dig their way to the surface, and develop without parental care. Because suitable nesting sites are often few and far between, many burrow-nesting megapode species breed communally. These features of megapode breeding biology have profound implications for their conservation.

1.3 Relationship with humans

Megapodes and humans have always had a close relationship. Megapode eggs have been collected for food throughout recorded history, particularly those of the burrow-nesting species, which lay their eggs communally and often in great numbers at volcanic sites and sun-exposed beaches (e.g., maleo, Moluccan megapode, Polynesian megapode, and Melanesian megapode). Tens of thousands of eggs may be collected from a single such site per year (Jones *et al.* 1995). The exploitation, which is for immediate consumption, as well as for sale in local markets, is poorly documented. Originally, it occurred according to strict rules leading to a more or less sustainable use, as still seems to be true in the case of the Moluccan megapode in some areas. However, changing traditions due to immigrations, emigrations, and increases in human populations have led to over-exploitation of eggs almost everywhere else, resulting in reductions and even disappearances of megapode populations.

Digging for eggs of the Polynesian megapode at a nesting ground near Teleka.

Egg harvesting is not necessarily detrimental to a species, so long as it is sustainable. However, many megapodes that are subject to exploitation may also be affected by other pressures, such as forestry or agriculture, which may degrade their habitat and reduce populations to the point that exploitation becomes unsustainable.

1.4 Other sources of information on megapodes

Information on natural history, speciation, ecology, and behaviour of megapodes, as well as a bibliography can be found in the monograph by Jones *et al.* (1995). See Elliot (1994) for another account of the biology of all species. Detailed regional or national accounts are also available; for example, those by Coates (1985) for Papua New Guinea, and Marchant and Higgins (1993) for Australia.

In addition, there have been three international symposia on megapodes, held in New Zealand (1990), Austria (1994), and Australia (1997). Proceedings were produced following the meetings in New Zealand (Dekker and Jones 1992) and Australia (Dekker *et al.* 1999). The papers they contain provide much original information on many different aspects of megapode biology, and especially on their conservation status.

1.5 Background to the second edition

Who are we? – the Megapode Specialist Group

The Megapode Specialist Group (MSG) was formed in October 1986 in Germany, at the conference *Mechanisms of Very Early Development in Animals and Man*. Its purpose is to provide a forum for those interested in the study and conservation of megapodes. The MSG newsletter, now in its 14th year, provides information on current research,

conservation projects, and publications on the study of megapodes (details can be obtained from the Chairman – see Appendix). The MSG organised international symposia in 1990, 1994, and 1997, where megapode scientists and conservationists from around the world had the opportunity to share ideas and materials. A monograph on megapodes was produced in 1995 and the first Action Plan for the conservation of megapodes was published in the same year. For more details see Dekker and McGowan (1995).

Updating the Megapode Action Plan

The content of this Action Plan has built on that assembled for the 1995 edition (Dekker and McGowan 1995, see also McGowan *et al.* 1998), and has been reviewed by active researchers across the world through the network maintained by the MSG and BirdLife International. Each species has been assigned to a threat category, based on the *IUCN Red List Categories* (IUCN 1994). This system of categorising threatened species, which has been adopted globally for expressing status information, was developed to provide a consistent and objective way of assessing threat levels. In order to provide a complete overview of the status of all megapode species, a section giving conservation assessments was produced (see Chapter 2).

The species accounts in Chapter 3 were produced in close co-operation with BirdLife International to a standard format for *Threatened Birds of the World* (BirdLife International 2000), the latest global assessment of the status of threatened birds. Texts for many Asian species have been derived from *Threatened Birds of Asia* (BirdLife International in prep.), a more detailed assessment of the status and conservation requirements of Asian birds. The accounts were designed to explain why each species has been placed in a particular threat category by reference to information on their past and present distributions, estimated population size and trend, and identified threats. Any work in progress is mentioned and a set of explicit conservation targets has been developed for each species.

The final and most important part of the action planning process involved the selection and preparation of a series of project briefs. Through an assessment of progress on all projects proposed in the 1995 Action Plan, we have investigated the effectiveness of the first document. The results of this assessment are given in Chapter 4. Based on that experience, we provide outlines for a new set of priority projects for execution within the period 2000–2004. We suggest a variety of project types involving status surveys, research, population monitoring, habitat protection and management, and conservation awareness programmes. Suggested projects for each species were written in a standard format stressing the aims, justification, and means of implementation. Each outline includes details of objectives, methods to be employed, and estimated timescale and resources required. They were written in a style designed to be attractive to potential benefactors, conservationists, and researchers, and should be used in conjunction with the threatened species accounts in Chapter 3.

1.6 Threats to the survival of megapodes

Threats to megapodes are many and varied, and frequently a species is subject to two or more pressures simultaneously. This section provides background on the major types of threat faced by megapode species, an overview of the importance of different threats, and gives specific examples to illustrate how they are affecting particular species.

Habitat loss and degradation

Habitat loss is suspected to be causing a decline in most of the threatened species covered in this plan and is, by far, the most widespread and damaging threat to megapodes. It takes many forms. Areas of habitat may be destroyed, for example, through deforestation. Habitats may be degraded through intensive livestock grazing, gradually encroached upon through urban or agricultural expansion, or modified through human activities, such as selective removal of vegetation for firewood, commercial purposes, or for food. More than one of these forms of habitat disturbance may affect a given area, and may act either simultaneously or one after another.

This section examines the most serious forms of habitat loss and change. These are, complete habitat destruction and the fragmentation of a species' geographic range that often results, and habitat degradation, where vegetation is not completely destroyed, but its quality is significantly reduced.

Habitat destruction is characterised by complete removal of the existing vegetation structure. For species dependent on forests, the complete removal of all trees in an area (deforestation) causes a catastrophic decline. Timber extraction by logging operations is the primary reason for deforestation. Logging is especially common in areas with tropical forest over level ground, where commercially valuable trees can easily be extracted on a large scale. Many megapodes nest on or near beaches, where habitat destruction through human development is often concentrated. Even if actual nesting grounds and forested areas remain intact, megapodes may be prevented from breeding by road building and other development along the coastal belt, which makes movement to and from nesting grounds difficult, dangerous, or even impossible. A species particularly threatened by this form of habitat destruction is the maleo.

Habitat may also be cleared to make way for agriculture such as plantations of coffee, rubber, and tobacco, the growing of wheat, or for the grazing of livestock. A species severely affected by such habitat clearance is the malleefowl. The species is dependent on mallee habitat, which has been cleared extensively in Australia for wheat and sheep production (Benshemesh 1999). Increasingly, habitats are cleared for conversion of the land to urban settlement, road building, or reservoir construction. The Micronesian megapode is an endangered, forest-dependent species inhabiting the Mariana and Palau Islands in the Pacific Ocean. Since human colonisation in prehistoric times, its habitat has been subjected to clearance and degradation through over-grazing with livestock. It is now extinct on Guam and Rota, and only found in substantial numbers on uninhabited islands. More recently, forested habitats in the southern Mariana Islands are being lost to golf courses and urban development (U.S. Fish and Wildlife Service 1998).

Whatever the reason for habitat destruction, the inevitable result of the process is increased fragmentation in the distribution of a species. Habitat loss frequently leads to the disruption of all but small blocks of suitable habitat, which become separated from each other by large expanses of uninhabitable ground. These habitat "islands" contain populations that are often both small and isolated, making them particularly at risk of extinction through effects such as genetic drift, inbreeding depression, and local catastrophe (Primack 1998). For example, local populations normally able to recover from natural disasters, such as floods, may be rendered too small and isolated to withstand these devastating events. Several extinctions of isolated local populations through such episodes may rapidly add up to large-scale disappearances of a species.

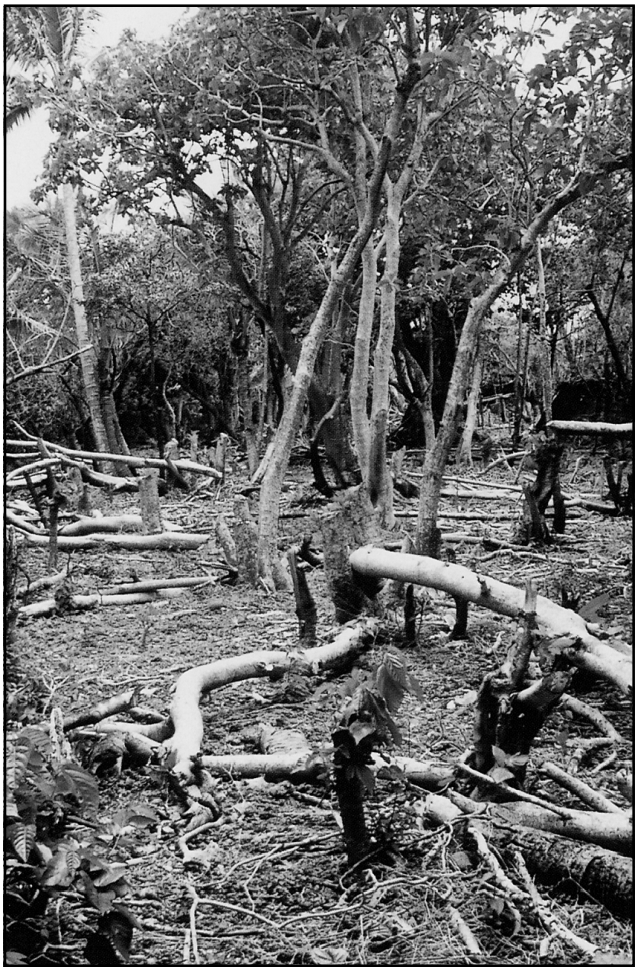
The malleefowl was formerly one of the most widespread of all megapodes, with a more or less continuous distribution across southern Australia. However, habitat clearance has led to a reduction in range of over 80%, and most populations now occur in isolated habitat fragments. Because the malleefowl is a poor flier and disperses mainly on foot, many of these habitat patches are likely to be inadequate for the long-term conservation of this species (Benshemesh 1999). Wildfires, frequent natural features of the mallee environment, may lead to total destruction of such isolated populations, with little or no chance of re-colonisation from the surrounding areas.

Habitat degradation is a reduction in the quality of a habitat without the loss of all original vegetation. It can be a result of such activities as selective removal of forest products and grazing by domestic or feral animals. One example is selective logging, where only a proportion of trees (usually valuable species) is removed from the forest in an area. Its impact can vary from the removal of a small proportion of the standing trees, to the loss of all but a few trunks. The associated problems, such as damage to residual trunks and soil compaction, are discussed by Whitmore (1984), while Marshall and Swaine (1992) more fully discuss the effects of selective logging on tropical forest. The term "selective logging" is often taken to imply that trees are harvested according to sustainable principles and that alterations to forest structure are as limited as possible. At its most extreme, however, selective logging can result in forest that is severely degraded, with few trees left undamaged, and with an unnaturally patchy and irregular canopy.

Studies on the siting of incubation mounds by megapodes have found that the attributes of mound sites differ significantly from random, and that mounds are frequently built in less-disturbed forest (Jones 1988). This suggests that habitat degradation may reduce breeding success in megapodes (R. Sinclair *in litt.*).

Habitat degradation is considered the most important factor threatening populations of the maleo in Sulawesi (Baker and Butchart 2000). Many nesting grounds are located near the coast where pressures from development and increasing human populations have led to removal of

Forests are converted into agricultural land to feed a growing population in the Kingdom of Tonga. The loss of forests has adverse effects on the population of Polynesian megapode there.



substantial amounts of original vegetation. Many areas are now characterised by extensive secondary growth between some original vegetation. In 23 of the 41 known coastal nesting grounds, this degradation has proceeded at such a rate that they are completely isolated from suitable foraging habitat. This is thought to have had severe impacts on chick survival (Baker and Butchart 2000).

Egg collecting

Although, in many animal species, effects of direct exploitation are considered relatively minimal, megapodes are often subject to very high egg-harvesting rates. It can sometimes be difficult to distinguish the effects of direct exploitation and more general threats to species through habitat loss, but this form of threat is considered important for several species of megapode. For example, during the 1990s, some 35,000–40,000 eggs were removed annually from a single nesting ground of the Moluccan megapode in Kailolo. This is believed to constitute more than 80% of the total number of eggs (Heij *et al.* 1997). When harvesting levels remain within sustainable limits, it is possible for humans to derive long-term benefits from megapode nesting grounds without harming megapode populations (see Section 1.7 on Actions for the conservation of megapodes).

On Simbo Island, local people are very efficient at finding eggs of the Melanesian megapode and over 99% are harvested. In 1998, about 180,000 eggs were estimated to have been removed (Sinclair 1999). Found only on the island of Niuafo'ou, the Polynesian megapode is listed as Critically Endangered and egg collecting is thought to be the main reason for its decline during the last 20 years (Göth and Vogel 1999).

Introduced predators

Many megapodes are found on relatively undisturbed oceanic islands with few natural predators. Indeed, the global distribution of megapodes has been linked to this absence of predators (Dekker 1989). Mound-building species are particularly prone to predation by carnivores when working at their mound. Communal burrow-nesting species, such as the maleo and Moluccan megapode, are thought to be slightly better protected against direct attacks by cats, civets, and other carnivores by virtue of their sheer numbers. However, their communal nesting grounds are frequently visited by introduced predator species and the resulting disturbance can have catastrophic effects on nesting success (R. Dekker *pers. obs.*).

The intentional or accidental introduction of predators by humans to much of the Pacific region over the last 200 years has had a great impact on megapodes and many other species. For example, native faunas have been exterminated from most of the western Polynesian islands (Steadman 1999). The most common and problematic predators of megapodes and their eggs are dogs, cats, and red foxes *Vulpes vulpes*. The brown tree-snake *Boiga irregularis* is considered a potential threat to populations of Micronesian megapodes in the Mariana Islands (U.S. Fish and Wildlife Service 1998).

Predation of malleefowl eggs and chicks by the red fox in Australia has long been a problem and eradication programmes are underway, particularly in areas where captive-bred birds are being released to supplement wild populations (Priddel and Wheeler 1997, Benshemesh 1999). Even individual predators can have a significant effect on a megapode nesting ground. A single dog is believed to have killed many Melanesian megapodes at a site on Simbo Island by ambushing them while they were digging (R. Sinclair *in litt.*). Chicks of communal nesters are susceptible to predation by introduced predators due to their localised origin of dispersal. For example, Sinclair (1999) found 66% of radio-tagged Melanesian megapode chicks were killed within 140 hours of hatching.

Other threats

The possibility of a volcanic eruption is a potential threat to the Polynesian megapode on Niuafo'ou Island, a small and active volcanic peak in the Kingdom of Tonga (Richard 1962, Göth and Vogel 1999).

Threatened subspecies and populations

This Action Plan provides a status survey and recommendations for future action for megapode species. The Species Survival Commission of IUCN – The World Conservation Union works primarily at a species level, and our desire has been to produce a document entirely compatible with their past and future publications. On a practical level, there is very little information on which to make judgements on the conservation status of many subspecies and populations of megapode. In view of the worldwide push for increasing rigour in conservation assessments through strict application of the IUCN Red List criteria (IUCN 1994), such an exercise would be unjustified. Therefore, we have not considered subspecies during the production of this Action Plan.

Summary of the threat status of megapodes

The Megapode Specialist Group has concluded that of the 22 species considered, one is Critically Endangered, one is

Endangered, and seven are Vulnerable. The remaining 13 species are considered Lower Risk.

Urgent attention must focus on the Critically Endangered species (Polynesian megapode) and the Endangered species (Micronesian megapode), and detailed proposals for these and other threatened species have been produced (see Chapter 4). The status of all species, including those currently placed in the Lower Risk category, will be monitored at appropriate intervals through future editions of the *Megapode Action Plan*.

1.7 Actions for the conservation of megapodes

Incorporating experience gained from work carried out during the five-year implementation period of the first *Megapode Action Plan*, this section outlines the different forms of conservation action that have proved effective. They have been divided into five areas to emphasise the sequence of actions that must be undertaken to ensure long-term conservation of species. Examples are used to illustrate the different options available, and some new actions are proposed.

Gathering basic information

Surveys: These are the first steps toward understanding a species' requirements and potential threats to its survival. Some megapodes, such as the Bruijn's brush-turkey and Biak megapode, remain virtually unknown. Extensive surveys involve the collection of basic information on the presence or absence of a species at various sites and, if possible, some data on relative abundance and population sizes. Conservation action cannot be proposed without such basic knowledge. Surveys of one sort or another are proposed for seven threatened species that sometimes lack even the most basic field information on distribution and abundance. To generate comparable results for the assessment of long-term changes in abundance, it is important that future surveys are designed to leave the possibility open of repeating the same work at a later date. It is particularly important that methods are clearly described and survey points are accurately located. This last point cannot be overstated. Formal techniques must be used and data collection should be standardised.

Prior to 1998, surveys for the maleo in Sulawesi were restricted almost exclusively to the northern part of the island. However, recent work focused on central and southern areas has provided a wealth of new information, allowing priority areas for maleo conservation to be identified in the context of the entire range of the species (Baker 1998, Butchart *et al.* 1998). Forty-three new sites were located during this work, and eight priority regions have been suggested by the research team (Butchart and Baker 2000).

Basic biological research: Research with conservation objectives should be designed to provide detailed information on the biology of a threatened species, including, for example, that relating directly to its habitat requirements, its tolerance of disturbance, or its use of secondary or marginal habitats. Collecting sufficient data of the type required for individuals or populations will always be physically demanding, labour intensive, and expensive by comparison with extensive survey techniques such as those described above. Thus, research projects need to be designed carefully to tackle important but feasible objectives that are of immediate use in specifying conservation efforts for the species concerned. Data useful for conservation can also be a by-product of "pure" research projects. Research with conservation outputs is recommended here for six threatened species.

Research by Sankaran and Sivakumar (1999) into the biology of the Nicobar megapode has established many new and interesting facts about this species. Of particular conservation importance is the finding that pair bonds are variable and, typically, more than two pairs use a single mound. This information is critically important when undertaking survey work to generate population estimates from mound counts. Additionally, data of this sort are essential for establishing parameters of population dynamics for use in Population Viability Analyses (see below).

Making conservation recommendations

Identifying priority areas for conservation: Once adequate data from surveys and basic biological research have been collected, the information must be synthesised and large-scale patterns described. It is at this stage that threat categorisations can effectively be applied and conservation priorities set in a global context. This is necessary before local and specific conservation recommendations can be made. We will examine one example of the importance of identifying large-scale patterns.

Wherever possible, conservation recommendations should be based on existing structures and frameworks (Dai Bo *et al.* 1998). One of the longest standing conservation actions is the creation of protected areas. Although it is true that enforcement is often weak in protected areas, the fact remains that there is some impetus behind them and they do have legal standing. Although we now see these places as being set aside specifically for the conservation of species or habitats, it is important to realise that there is a variety of reasons why protected areas were first designated (Pressey *et al.* 1994) — many of these areas were not, strictly speaking, set aside for species

or habitat conservation. It is, therefore, advisable to assess how far protected areas are succeeding in conserving megapode species. This sounds simple but is, in fact, a challenging task, both scientifically and in practice. The first step involves assessing how well the current system of protected areas covers the megapodes and identifying species poorly represented by, or even completely absent from, the current network. We can then provide recommendations for embarking on the difficult challenge of trying to fill in these gaps.

In practice, these steps are difficult because data are required at a large scale; the need is for information on localities across entire species' ranges. Although difficult, this is possible and has been attempted for the Galliformes of eastern Asia (McGowan *et al.* 1999). Such work can provide a valuable context for specific field projects. For example, recent survey work in Sulawesi has led to the proposal of eight priority areas for maleo conservation (Butchart and Baker 2000).

The critical feature of this interaction between desktop analysis and fieldwork is that analysis can help direct fieldwork to where it can make the most impact. In turn, the results of fieldwork feed back to help a large-scale assessment of how well the protected area network is covering a species' geographic range.

For the many megapode species found on small oceanic islands, where much of the land is locally owned and managed, the protected area concept may need modification. On such islands, it is likely that major national parks and other forms of protected area designation are not appropriate, as the feeling of local ownership and responsibility may easily be lost. A better approach in these situations may be to develop local partnerships, such as that between WWF and the Simbo Island Megapode Management Committee (R. Sinclair *in litt.*).

Population dynamics of individual species: Once set in the context of large-scale patterns and priorities, it is often desirable to understand the dynamics of populations (changes in numbers over time), and how particular threats and proposed management strategies are likely to affect them.

One way of looking at the population dynamics of a single species is to perform a Population Viability Analysis (PVA). The basic aim is to use information on the life history, ecology, and distribution of the species to assess how population sizes might change in the future as a consequence of alternative management strategies, such as habitat improvement, controlled hunting, and captive breeding. The process allows combinations of actions to be identified that reduce the risk of extinction to a minimum, at least in theory (Clark *et al.* 1991). Various computer programs that simulate the behaviour of populations under different conditions have been developed (Lacy 1993), but data input into these programs must be carefully checked to avoid misleading results. A major limitation for population modelling is the adequacy and reliability of available data. The amount and extent of information needed to run a simulation providing meaningful and feasible models is enormous; hence, there is a need for great caution when attempting such an exercise.

For many threatened species, much of the information required for this analysis is not published, so a popular and useful approach has been to hold international meetings where researchers familiar with a particular species exchange information and ideas while conducting the PVA. These meetings are also useful to discuss the feasibility of implementing different management strategies, and ideally result in the production of a comprehensive and achievable set of actions for the conservation of a species.

The Conservation Breeding Specialist Group of IUCN regularly oversees meetings of this type, which are termed Population and Habitat Viability Assessments (PHVAs). They are held, wherever possible, within a range country of the species in question.

Although no comprehensive PHVA has been held for any megapode species, it is a process that could clearly benefit several species. Anyone considering holding a meeting of this type should arrange it in close consultation with the Megapode Specialist Group and the Conservation Breeding Specialist Group – the latter now provides training courses around the world (see Appendix for contact details).

A PVA is here recommended for one species—the Nicobar megapode.

Types of conservation recommendation

Protecting habitat: Given that habitat loss and degradation are major threats to megapode species, establishing (and maintaining) areas of suitable habitat is usually the best way of ensuring their long-term survival. Thus, even in the absence of detailed recommendations of the type emerging from a PVA, large-scale distribution and habitat information can be used to recommend the designation and expansion of important protected areas as described above. This may either occur formally or result from the development of a local partnership, the latter being particularly appropriate for small oceanic island communities. Such action is proposed for seven of the threatened species covered in this plan. It is necessary that recommendations for protected area designation are based on sound science and effectively promoted through lobbying of governments, local groups, and other parties involved in the decision-making process (see below).

Thus, designation of protected areas, often in addition to those already in existence, is considered to be an important next step for numerous threatened species, as is the protection and management of critical habitats within these areas.

Controlling illegal harvesting and encouraging sustainable use: Humans have always had a close relationship with megapodes (see Section 1.3 on Relationship with Humans), and the eggs of most species are regularly harvested for economic gain and sustenance (Argeloo and Dekker 1996). If such harvesting is carried out within biologically sensible limits, the system may be sustainable and megapode populations may not decline in the long term. In some species of Galliformes, it has been shown that natural mortality rates decrease when population densities are reduced artificially through harvesting (Aebischer 1997). This is a density-dependent process—the birds respond to the lowering of population density with increased reproductive output and improved rates of survival. However, much of this work has been based on studies of hunting of European species, and further investigation is needed to understand whether this density-dependent response is seen when megapode eggs are artificially harvested.

Sustainable harvesting regimes mean that megapode populations need not suffer in the long term and humans can derive lasting benefits from the birds. In some cases, megapode species may actually benefit from sustainable harvesting (the "paradox of wise use") because the economic incentive from harvesting may encourage greater protection of nesting grounds to increase population levels and allow an even greater sustainable yield (Aebischer 1997). The implementation of sustainable harvesting programmes must always be accompanied by population monitoring to assess the effects of particular rates of harvesting, so that appropriate levels can be determined.

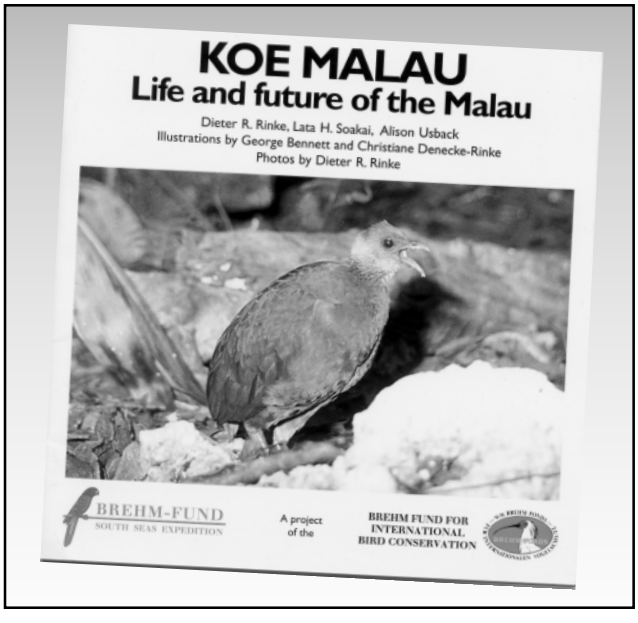
Allowing controlled harvesting within protected areas already affected by illegal collecting may mean that the whole process can be more tightly monitored and regulated, and may provide reliable data to understand further the dynamics of harvested populations. Such programmes, however, should involve wide consultation between local people, non-governmental organisations (NGOs), species experts, and government departments.

Re-introduction and translocation: Re-introduction is "an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct", while translocation is the "deliberate and mediated movement of wild individuals or populations from one part of their range to another" (IUCN 1998). These processes are extremely complex and expensive, and the IUCN Guidelines for Re-introductions (IUCN 1998) should be closely adhered to when designing a re-introduction programme. Re-introduction should be considered only as a last resort, where the historical distribution of a species is well understood and the agents responsible for a species' decline or extirpation in the first place have been addressed. For example, malleefowl are being bred in captivity for release into restored habitat as part of the State Recovery Programme in New South Wales, Australia (Priddel and Wheeler 1999). The Polynesian megapode is today found only on Niuafo'ou Island, Tonga, but was formerly more widespread in Polynesia (Steadman 1999). Translocation of birds from Niuafo'ou to other islands still capable of sustaining the species has been attempted recently on Late and Fonualei, with some success (Göth and Vogel 1999, Rinke 1994). Further work is needed, as is a long-term monitoring programme to assess the effectiveness of this action (see Section 4.1 on Critically Endangered Species).

Conducting conservation awareness programmes: Because of the close relationship between humans and megapodes, there is great potential for conservation awareness programmes to highlight the plight of individual species, and raise awareness of general principles of environmental stewardship and sustainable use. In many situations, especially where direct human causes have been implicated in the decline of a species, effective long-term conservation measures cannot be put in place without a rigorous and well-audited conservation awareness programme amongst local communities. Very few project proposals involving a significant education component are received by the Specialist Group each year, but we nevertheless continue to urge that such initiatives are put together, and here present some guidelines on submitting funding proposals.

Specific conservation awareness programmes are most appropriate at the local community level where a species of concern occurs. Initiatives may include, for example, workshops involving stakeholders to discuss problems and possible solutions, and the establishment of mechanisms for distributing information in communities, such as the

Cover of an educational booklet of the Polynesian megapode or Malau.



distribution of leaflets, construction of an information centre, creation of a nature trail, establishment of nature clubs at local schools with regular events (e.g., slide/video shows, field trips, and talks), and development of a field camp for schoolchildren or teachers.

More generalised awareness programmes could involve funding publications, visual education material, or exhibitions (travelling or static) to provide information about the birds, why their conservation is important, and what people can contribute as individuals and as members of their communities. Such materials need to be carefully designed, taking into account the intended audience.

All conservation awareness programmes must be evaluated to reveal how people benefited from the initiative and what conservation goals were achieved. The latter may not be specific, but the former can be tested using questionnaires and feedback workshops, depending on the situation. Once again, such evaluation exercises must be carefully thought through, and details submitted with project proposals.

The overall message is that conservation awareness programmes should not just be added on to biological conservation projects because it seems the right thing to do. If they are to be effective for conservation, these important initiatives must be carefully planned, executed, and evaluated. Ideally, experiences and evaluations should be published both locally and internationally to aid in the design of future projects (C. Inskipp *in litt.*).

A good example of a long-term conservation programme involving local communities at every level is provided by the Malleefowl Preservation Group, founded in August 1992 in Gnowangerup Shire, Western Australia. As well as undertaking survey work, field studies, and habitat management work, the group has fostered greater community awareness of malleefowl conservation through the production of a Community Action Plan. Other activities included the production of an information pamphlet, and the implementation of a programme for cat sterilisation to help reduce malleefowl chick mortality. Changing farming practices in Western Australia, combined with the fact that malleefowl are frequently found on private land, have emphasised the need for community involvement if the conservation of this species is to be effective (Orsini and Hall 1995, Dennings 1999). A conservation awareness programme is also underway for the Vanuatu megapode (Foster 1999).

Implementing conservation recommendations

In order to use species information and conservation recommendations arising from the various possible actions suggested above, there is a need to place them into context. Typically, this has been done at a governmental level but, increasingly, there are conservation initiatives appearing at regional and local levels. There are a great many global, regional, and national conservation initiatives that deal with issues other than the single species or species group that are covered in this action plan. Many of these initiatives involve either incorporating conservation concerns into governmental policy, or issues relating to limiting the damaging impacts of development programmes. In these and other broad-scale programmes, such as protected area management, the kind of species information presented in, or arising from, plans and work suggested here could play a key role. The objectives of these programmes are to maintain and, where possible, enhance biodiversity and the information in this Action Plan is central to that. Therefore, there is a need to ensure that reliable data on species are used when preparing conservation policy and assessing development needs.

One prime example of a global initiative that is having increasingly local impact is the Convention on Biological Diversity, which was framed during the United Nations Convention on Environment and Development (popularly known as the 'Earth Summit') at Rio de Janeiro in Brazil during 1992. The objectives of the Convention on Biological Diversity are to ensure the conservation of biodiversity, its sustainable use, and the equal sharing of benefits from its use. Four key articles outline how this should be achieved (see Box 1.1).

The global importance of this convention is demonstrated in several ways; for example, the degree to which many countries that are rich in biodiversity are developing national biodiversity strategies and action plans as required under Article 6. The first step in this

Box 1.1. The Convention on Biological Diversity. Key articles relating to the conservation of biodiversity.

- **Article 6: General measures of conservation and sustainable use**

Requires the development of national strategies, plans, or programmes for the conservation and sustainable use of biodiversity.

- **Article 7: Identification and monitoring**

Requires the identification and monitoring of biodiversity and of impacts upon it. It also considers the knowledge necessary for conservation and sustainable use.

- **Article 8: *In situ* conservation (i.e., conservation of biological diversity within natural habitats and ecosystems)**

Requires the management of biodiversity where it occurs naturally, and includes the need for protected areas and the needs of threatened species.

- **Article 9: *Ex situ* conservation (i.e., conservation of biological diversity outside natural habitats)**

Requires the management of biodiversity in places such as zoos and botanical gardens. It also deals with collection from the wild.

process is the production of a biodiversity assessment for a country.

In concert with the rest of the Galliformes Specialist Groups, there is a clear need to ensure that the best information on megapodes is made available to such national biodiversity assessments. This *Megapode Action Plan* and all of the supporting data used to produce it should contain this information. Subsequently, we must bring all available expertise to bear on the resulting national conservation recommendations as they affect threatened megapodes.

Monitoring effects of conservation action

Systematic monitoring of populations is an essential tool for detecting changes in the status of a species at particular sites over long periods of time and should always be used to assess the effectiveness of conservation actions. Careful thought must be given to the design of monitoring programmes, ideally through initial assessments of count reliability that include correlating results of index counts with detailed counts at appropriate times of year.

A large-scale monitoring programme for malleefowl is underway in Australia, where a grid-based system is being used to provide benchmark estimates of abundance. The data are being centralised at Birds Australia (the national ornithological organisation) and a selection of these grids will form the basis of a long-term monitoring programme. Baseline population data have been collected on the Nicobar megapode (Sankaran and Sivakumar 1999) and a monitoring programme building on this foundation is considered an important next step (R. Sankaran *in litt.*). A monitoring programme using line transects to estimate the abundance of adult Melanesian megapodes is being undertaken by the local community. WWF provides the local Megapode Management Committee with technical support in interpreting the data (Sinclair 1999). The committee plans to use these data to assess the success of their management actions.

Summary of conservation action

The Megapode Specialist Group has concluded that of the different conservation actions considered, the most urgent in terms of assisting threatened species conservation are habitat protection (seven of the nine threatened species), surveys (seven species), conservation awareness programmes (six species), monitoring (six species), and basic biological research (six species).

At present, the remaining 13 species are not considered in need of conservation action globally, although action may already be needed locally to prevent them from becoming extinct in certain parts of their ranges. As the vast majority of megapode species are very poorly known in the wild, these species at lower risk present an ideal opportunity for research training. For example, they may be suitable subjects for research into wise use through sustainable harvesting, which could provide economic incentive to conserve both the birds and their habitats (Hudson and Rands 1988, Aebischer 1991). Such studies may also lead to the development of techniques beneficial in the context of threatened megapode conservation.

Chapter 2

Summary of Megapode Conservation Status

In order to prioritise species for conservation, it is desirable to place them in different categories representing the severity of threats they face and the likelihood of them becoming extinct. This allows conservation actions to be targeted at species and areas most in need of attention in a global or regional context.

In November 1994, the IUCN Council approved a new set of such threatened species categories (IUCN 1994), designed to provide an objective system that can be applied consistently by different people and across different groups of organisms, although this only became widely available in 1996. The new system also allows the user of threatened species lists to see exactly how and why each species has been placed in a certain threat category. The three categories indicating threatened status are Critically Endangered, Endangered, and Vulnerable. Species not considered under threat are placed in the Lower Risk category, subdivided into conservation dependent, near threatened, and least concern. All judgements of threat status should be reviewed on a regular basis.

Certain criteria must be met to qualify a species for inclusion in a particular threat category. For example, a species represented by fewer than 2,500 mature individuals and with an estimated continuing decline of at least 20% within five years qualifies as Endangered (criterion C1), and one with fewer than 250 mature individuals and a 25% rate of decline within three years is considered Critically Endangered (criterion C1). These criteria have to be stated clearly and justified whenever a new threat categorisation is made. In this chapter, we present the results of an assessment conducted by experts in each species, through a process co-ordinated by the BirdLife Secretariat and using all relevant information available. The criteria for each threat category are reproduced from IUCN (1994) and presented together with the categorisations of each megapode species.

Full justifications as to why each species has been placed in a particular threat category are given in the following chapter.

NOTE

In the first Megapode Action Plan, the conservation status of species was assessed using the criteria proposed by Mace and Lande (1991). These criteria were widely known as the Mace-Lande Criteria, and have now been given the version number 1.0 in the process to revise the IUCN Red List categories and criteria (IUCN 1994). ***Because the criteria for assigning species to the categories have been revised, the present categorisations cannot be directly compared with those given in the first Action Plan.***

Box 2.1 The IUCN Red List Categories (from IUCN 1994).

Critically Endangered (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN)
A taxon is Endangered when it is not Critically Endangered, but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered, but is facing a high risk of extinction in the wild in the medium-term future.

Lower Risk (LR)
A taxon is Lower Risk when it has been evaluated, but does not satisfy the criteria for any of the categories Critically Endangered, Endangered, or Vulnerable.

2.1 Critically Endangered species

One megapode species meets criteria sufficient for classification as Critically Endangered:

Polynesian megapode (*Megapodius pritchardii*)

Distribution: Niuafo'ou Island, Tonga
Threat status/criteria: CRITICALLY ENDANGERED/ B1+2e
Priority conservation actions: translocation, conservation awareness programme, population monitoring (see Section 4.1)

Polynesian megapode. This species is currently known only from the Kingdom of Tonga.

Box 2.2 Criteria for Critically Endangered (CR)

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

A. Population reduction in the form of either of the following:

1. An observed, estimated, inferred, or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
- **a**) direct observation
- **b**) an index of abundance appropriate for the taxon
- **c**) a decline in area of occupancy, extent of occurrence, and/or quality of habitat
- **d**) actual or potential levels of exploitation
- **e**) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors, or parasites.

2. A reduction of at least 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B. Extent of occurrence estimated to be less than 100km^2 or area of occupancy estimated to be less than 10km^2, and estimates indicating any two of the following:

1. Severely fragmented or known to exist at only a single location.

2. Continuing decline, observed, inferred, or projected, in any of the following:
- **a**) extent of occurrence
- **b**) area of occupancy
- **c**) area, extent, and/or quality of habitat
- **d**) number of locations or subpopulations
- **e**) number of mature individuals.

3. Extreme fluctuations in any of the following:
- **a**) extent of occurrence
- **b**) area of occupancy
- **c**) number of locations or subpopulations
- **d**) number of mature individuals.

C. Population estimated to number less than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, or

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
- **a**) severely fragmented (i.e., no subpopulation estimated to contain more than 50 mature individuals) or
- **b**) all individuals are in a single subpopulation.

D. Population estimated to number less than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.

2.2 Endangered species

One megapode species meets criteria sufficient for classification as Endangered:

Micronesian megapode (*Megapodius laperouse*)

Distribution: Mariana Islands, Palau Islands
Threat status/criteria: ENDANGERED/B1+2b,c,d,e
Priority conservation actions: see Section 4.2

Micronesian megapode. There are probably less than 2,500 birds left in the world.

Box 2.3 Criteria for Endangered (EN)

A taxon is Endangered when it is not Critically Endangered, but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A. Population reduction in the form of either of the following:

1. An observed, estimated, inferred, or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   - **a**) direct observation
   - **b**) an index of abundance appropriate for the taxon
   - **c**) a decline in area of occupancy, extent of occurrence, and/or quality of habitat
   - **d**) actual or potential levels of exploitation
   - **e**) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors, or parasites.
2. A reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B. Extent of occurrence estimated to be less than 5,000km² or area of occupancy estimated to be less than 500km², and estimates indicating any two of the following:

1. Severely fragmented or known to exist at no more than five locations.
2. Continuing decline, observed, inferred, or projected, in any of the following:
   - **a**) extent of occurrence
   - **b**) area of occupancy
   - **c**) area, extent, and/or quality of habitat
   - **d**) number of locations or subpopulations
   - **e**) number of mature individuals.
3. Extreme fluctuations in any of the following:
   - **a**) extent of occurrence
   - **b**) area of occupancy
   - **c**) number of locations or subpopulations
   - **d**) number of mature individuals.

C. Population estimated to number less than 2,500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, or
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
   - **a**) severely fragmented (i.e., no subpopulation estimated to contain more than 250 mature individuals) or
   - **b**) all individuals are in a single subpopulation.

D. Population estimated to number less than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

2.3 Vulnerable species

The following seven megapode species meet criteria sufficient for classification as Vulnerable:

Bruijn's brush-turkey (*Aepypodius bruijnii*)

Distribution: Waigeo Island
Threat status/criteria: VULNERABLE/D1
Priority conservation actions: surveys, research, re-assessment of global status (see Section 4.3)

Malleefowl (*Leipoa ocellata*)

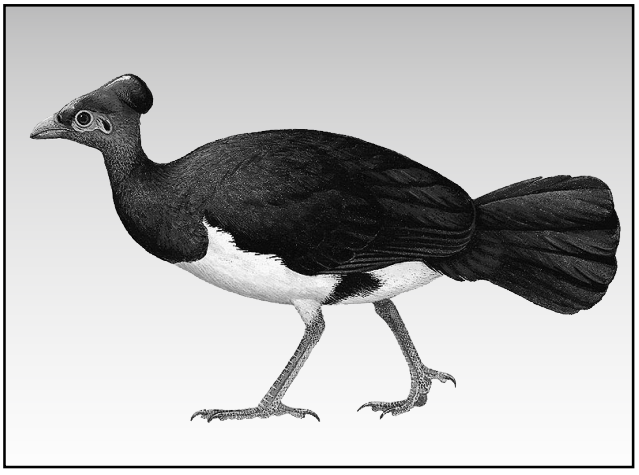
Distribution: southern Australia
Threat status/criteria: VULNERABLE/A1c,e; A2b,c,e
Priority conservation actions: see Section 4.3

Maleo (*Macrocephalon maleo*)

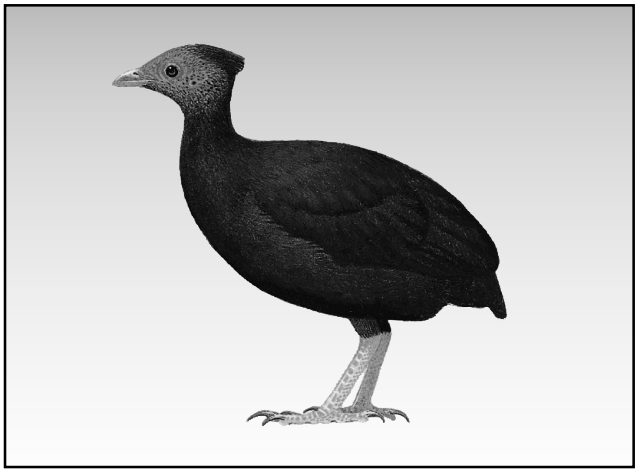
Distribution: Sulawesi and surrounding islands
Threat status/criteria: VULNERABLE/A1a,c,d; A2b,c,d; C1; C2a
Priority conservation actions: habitat protection, research, sustainable harvesting programme, conservation awareness programme, population monitoring (see Section 4.3)

Moluccan megapode (*Eulipoa wallacei*)

Distribution: northern and central Moluccas, Misool Island
Threat status/criteria: VULNERABLE/A1d; A2c,d; C1
Priority conservation actions: habitat protection, research, sustainable harvesting programme, conservation awareness programme (see Section 4.3)



Maleo. A beautiful megapode, well suited to its status as a flagship species for conservation in Sulawesi.



Vanuatu megapode. This species is threatened by unsustainable levels of egg collecting.

Box 2.4 Criteria for Vulnerable (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A. Population reduction in the form of either of the following:

1. An observed, estimated, inferred, or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
- **a**) direct observation
- **b**) an index of abundance appropriate for the taxon
- **c**) a decline in area of occupancy, extent of occurrence, and/or quality of habitat
- **d**) actual or potential levels of exploitation
- **e**) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors, or parasites.

2. A reduction of at least 20%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B. Extent of occurrence estimated to be less than 20,000km^2 or area of occupancy estimated to be less than 2,000km^2, and estimates indicating any two of the following:

1. Severely fragmented or known to exist at no more than 10 locations.

2. Continuing decline, observed, inferred, or projected, in any of the following:
- **a**) extent of occurrence
- **b**) area of occupancy
- **c**) area, extent, and/or quality of habitat
- **d**) number of locations or subpopulations
- **e**) number of mature individuals.

3. Extreme fluctuations in any of the following:
- **a**) extent of occurrence
- **b**) area of occupancy
- **c**) number of locations or subpopulations
- **d**) number of mature individuals.

C. Population estimated to number less than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, or

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
- **a**) severely fragmented (i.e., no subpopulation estimated to contain more than 1,000 mature individuals) or
- **b**) all individuals are in a single subpopulation.

D. Population very small or restricted in the form of either of the following:

1. Population estimated to number less than 1,000 mature individuals.

2. Population is characterised by an acute restriction in its area of occupancy (typically less than 100km^2) or in the number of locations (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Nicobar megapode (*Megapodius nicobariensis*)

Distribution: Nicobar Islands
Threat status/criteria: VULNERABLE/C1
Priority conservation actions: research, re-assessment of global status, habitat protection, conservation awareness programme, population monitoring (see Section 4.3)

Biak megapode (*Megapodius geelvinkianus*)

Distribution: Geelvink Bay Islands (Irian Jaya)
Threat status/criteria: VULNERABLE/C1
Priority conservation actions: surveys, research, re-assessment of global status, predator control (see Section 4.3)

Vanuatu megapode (*Megapodius layardi*)

Distribution: Vanuatu
Threat status/criteria: VULNERABLE/C1
Priority conservation actions: surveys, sustainable harvesting programme (see Section 4.3)

2.4 Lower Risk species

The following 13 megapode species are presently considered Lower Risk:

Australian brush-turkey (*Alectura lathami*)

Distribution: eastern Australia
Threat status: LOWER RISK (lc)

Wattled brush-turkey (*Aepypodius arfakianus*)

Distribution: New Guinea, Japen Island, and Misool Island
Threat status: LOWER RISK (lc)

Red-billed talegalla (*Talegalla cuvieri*)

Distribution: New Guinea
Threat status: LOWER RISK (lc)

Black-billed talegalla (*Talegalla fuscirostris*)

Distribution: New Guinea
Threat status: LOWER RISK (lc)

Brown-collared talegalla (*Talegalla jobiensis*)

Distribution: New Guinea
Threat status: LOWER RISK (lc)

Philippine megapode (*Megapodius cumingii*)

Distribution: Philippines to islands of northern Borneo, Sulawesi
Threat status: LOWER RISK (lc)

Sula megapode (*Megapodius bernsteinii*)

Distribution: Sula Islands, Banggai Islands
Threat status: LOWER RISK (nt)

Tanimbar megapode (*Megapodius tenimberensis*)

Distribution: Tanimbar Islands
Threat status: LOWER RISK (lc)

Dusky megapode (*Megapodius freycinet*)

Distribution: northern Moluccas to islands of western New Guinea
Threat status: LOWER RISK (lc)

Forsten's megapode (*Megapodius forstenii*)

Distribution: central Moluccas
Threat status: LOWER RISK (lc)

Melanesian megapode (*Megapodius eremita*)

Distribution: islands off eastern New Guinea, including the Solomon Islands
Threat status: LOWER RISK (lc)

New Guinea megapode (*Megapodius decollatus*)

Distribution: New Guinea
Threat status: LOWER RISK (lc)

Orange-footed megapode (*Megapodius reinwardt*)

Distribution: eastern Indonesia, New Guinea, and northern Australia
Threat status: LOWER RISK (lc)

Box 2.5 Criteria for Lower Risk (LR)

A taxon is Lower Risk when it has been evaluated, but does not satisfy the criteria for any of the categories Critically Endangered, Endangered, or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (cd)**.
   Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

2. **Near Threatened (nt)**.
   Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

3. **Least Concern (lc)**.
   Taxa which do not qualify for Conservation Dependent or Near Threatened.

Chapter 3

Species Accounts

The previous chapter presented an overview of the conservation status of all megapodes, and assigned a threat category to each. This chapter expands on this information and provides a detailed justification as to why each threatened species has been placed in that particular category. Species considered at Lower Risk are not treated here, as our aim is to draw attention to the species most in need of conservation action. These species accounts have been developed through an extensive review process involving the BirdLife Partnership, the Megapode Specialist Group, the World Pheasant Association, and a worldwide network of ornithologists, co-ordinated by the BirdLife Secretariat. This means that the information presented here has been developed and reviewed by a wide range of active megapode researchers.

Each species is treated in a standard format. After detailing the criteria supporting inclusion in a particular category of threat and supplying a summary justification, the following information is provided:

Range and population: The full geographic distribution of the species is given, together with any available partial or complete estimates of population numbers or density. If any inferences can be made, or data exist on trends in population numbers and geographic range, these are given here. Facts are always distinguished from inferences.

Ecology: Brief details of habitat use, diet, and breeding biology are provided in this section.

Threats: The major known threats facing the species are given, together with some indication as to the relative importance of the different types.

Conservation: This section outlines whether the species is protected by legal instruments or occurs in existing protected areas. It also highlights recent conservation research and action that has been carried out to help protect the species.

Targets: These are the recommendations supplied by various experts on each species, and endorsed by BirdLife International and the Megapode Specialist Group. These targets outline the work most urgently required to help prevent the species from becoming more threatened or even extinct.

3.1 Critically Endangered species

Polynesian megapode (*Megapodius pritchardii*)

Critically Endangered B1+2e

This species qualifies as Critically Endangered because it has a viable population on just one tiny island (which is an active volcano) and is likely to be declining, despite available habitat, owing to harvesting and predation. It has been translocated to two other islands, but further evidence is needed to confirm that these populations are self-sustaining.

Range and population: The Polynesian megapode is endemic to Niuafo'ou, **Tonga** and has been introduced to Late and Fonualei, where its status is uncertain. On Niuafo'ou, it is concentrated around the inner slopes of the caldera and on two cat-free islets in the crater lake. In 1979, the population was estimated at 820 adults (Todd 1983) and in 1991–1993, at 188–235 pairs occupying an area of 641ha in 719ha of suitable habitat (Göth and Vogel 1995). This represents 52–65% of possible carrying capacity, assuming an average of 0.5 pairs per ha (Göth and Vogel 1995). A comparison between the two population figures is not appropriate because of differences in techniques, but comparisons between individual sites and interviews with local people strongly suggest an overall decline (Göth and Vogel 1995).

Ecology: It inhabits broadleaf, secondary to mature forest (Göth and Vogel 1995), but needs open ground with little vegetation, where it can forage in leaf litter and topsoil mainly for insects and worms, but also for small reptiles, seeds, and small fruits (Rinke *et al.* 1993). It uses hot volcanic ash to incubate its eggs, a habit which confines its nesting sites to areas of loose soil close to vents in forests, on open ash, or on beaches of crater lakes (Todd 1983).

Threats: All nesting sites are harvested and at least 50% of all eggs laid are collected or destroyed (Göth and Vogel 1995). Adults are also hunted on a small scale, and adults and chicks are predated by feral cats and dogs. In addition, pigs may compete with this species for food (Göth and Vogel 1995).

Conservation: It is legally protected, although in practice there is no enforcement (Elliot 1994). From 1991 to 1993, 60 eggs were buried at volcanically heated sites on Late (Göth and Vogel 1995), and an additional 35 eggs and

chicks were transferred to Fonualei (Rinke 1994), both uninhabited and rarely visited by humans. Surveys in 1995, 1996, and 1997 showed that breeding was successful on both islands, although there is no evidence that chicks have survived (C. Matevalea *in litt.*). See SPREP (1999) for further information.

Targets:
- **Continue long-term monitoring of the nesting grounds on Niuafo'ou.**
- **Protect the three crater-lake islets as nature reserves, minimise disturbance, and regularly survey for introduced predators.**
- **Enforce the ban on egg collecting or restrict it, preferably through a council of residents endowed with necessary powers.**
- **Establish a long-term monitoring programme on Late and continue translocation following strict guidelines.**
- **Investigate the possibility of translocation to Tofua.**
- **Continue and intensify conservation awareness programmes.**

3.2 Endangered species

Micronesian megapode (*Megapodius laperouse*)

Endangered B1+2b,c,d,e

This species qualifies as Endangered because it has a very small range restricted to isolated, undisturbed, offshore islets, with few birds elsewhere. Given the multiple threats across its range, it is likely to be suffering from a continuing decline.

Range and population: The Micronesian megapode occurs on **Palau** and the **Northern Marianas Islands (to U.S.A.)**, and is extirpated from Guam (to U.S.A.). In Palau, race *senex* is locally common on limestone and outlying islands (*e.g.*, Kayangel), but rare on larger volcanic islands (*e.g.*, Babeldaob). In 1991, the population was estimated at 497 birds, excluding Kayangel (Engbring and Pratt 1985, Engbring 1992). In the Marianas, nominate *laperouse* is mainly restricted to islands north of Saipan (including Farallon de Medinilla (Lusk *et al.* 2000)). In 1997, the population was estimated at 1,440–1,975 birds (the largest subpopulation being 545–810 on Sarigan) (U.S. Fish and Wildlife Service 1998). There is a small remnant population on Aguijan, possibly a persisting re-introduced population (a few birds) on Tinian (U.S. Fish and Wildlife Service 1998, J. Lepson *in litt.*), and a small, re-introduced population (14 birds) on Saipan.

Ecology: It prefers limestone forest, occasionally occurring in adjacent secondary forest and dense coconut groves (U.S. Fish and Wildlife Service 1998). It eats a variety of foods, including seeds, insects, crabs, and plant matter (U.S. Fish and Wildlife Service 1998, Engbring 1988). Nominate *laperouse* nests in burrows in sun-warmed cinder fields or areas warmed by geothermal heat (U.S. Fish and Wildlife Service 1998). Race *senex* nests in mounds made from leaf litter and sand (Engbring 1988).

Threats: Forests are periodically degraded by typhoons and damaged by feral herbivores, and volcanic eruptions pose a continuing threat (U.S. Fish and Wildlife Service 1998). In addition, birds are hunted, eggs are collected (Engbring 1988), and both are taken by introduced predators, such as monitor lizards *Varanus indicus*, rats *Rattus* spp., and feral dogs, cats, and pigs (U.S. Fish and Wildlife Service 1998). The accidental introduction of the brown tree-snake from Guam to other islands is a potentially serious threat (U.S. Fish and Wildlife Service 1998). In Palau, there is increasing tourist use of beaches and possible disturbance to nest sites (Stinson and Glass 1992).

Conservation: A recovery plan exists and the species is protected by federal and local laws (U.S. Fish and Wildlife Service 1998). In the Marianas, more surveys are planned (U.S. Fish and Wildlife Service 1998). In 1998 and 1999, feral herbivores were removed from Sarigan (G. Wiles *in litt.*). The uninhabited islands of Asuncion, Maug, Uracus, and Guguan are wildlife sanctuaries (U.S. Fish and Wildlife Service 1998). In Palau, the Ngerukewid Islands Wildlife Reserve protects 50–80 birds (Wiles and Cony 1990).

Targets:
- **Conduct detailed censuses.**
- **Develop a long-term monitoring programme.**
- **Continue ecological research.**
- **Assess the extent of hunting and egg collection.**
- **Control introduced predators selectively and protect all islands from accidental introduction of the brown tree-snake.**
- **Determine the risk of human disturbance in Palau.**
- **Protect remnant forest in the Marianas from development and feral ungulates.**

3.3 Vulnerable species

Bruijn's brush-turkey (*Aepypodius bruijnii*)

Vulnerable D1

There have been no confirmed records of this species for over 60 years and its population is, therefore, inferred to number

less than 1,000 individuals, qualifying it as Vulnerable. However, there are few data on the species or the threats that may impinge upon it, and this classification may need revision.

Range and population: The Bruijn's brush-turkey is endemic to Waigeo, West Papuan Islands, **Indonesia**. It is known from just 15 specimens (most recently collected in 1938) (Holmes 1989, Jones *et al.* 1995), with the only specified locality being Jeimon, on the east side of Majalibit Bay. None was seen in 1993, when many islanders did not know the bird at all (although some thought it was uncommon) (Dekker and Argeloo 1993), and a 10-day survey in 1986 did not reveal any birds (K.D. Bishop and J.M. Diamond *in litt.*). Based on the extent of available habitat, it has been suggested that the population may number 100–2,500 individuals (Dekker and McGowan 1995, Jones *et al.* 1995).

Ecology: It appears to inhabit mountain forests, including the extremely rugged karst interior of the island, and is presumably sedentary, although it may shift in elevation or habitat use seasonally (Holmes 1989, Dekker and Argeloo 1993). There may be some resource partitioning with the dusky megapode, which occurs widely in coastal areas and on slopes up to 400m (Dekker and Argeloo 1993). There is no information on diet, foraging behaviour, or breeding, although (like other brush-turkeys) it is thought to be a mound builder.

Threats: Waigeo's rugged relief, lack of infrastructure, and apparently intact forest suggest there are no immediate threats to the species (Holmes 1989, Dekker and McGowan 1995). A proposed reduction in the size of the existing reserve on Waigeo and the prospect of cobalt mining were concerns in the late 1980s, but have apparently not come to pass (Dekker and McGowan 1995). Selective logging has been reported in the north and hunting was speculated to be a problem (Dekker and McGowan 1995). The southeast corner of the island was ravaged by fire in 1982, perhaps rendering it unsuitable for the species (Dekker and Argeloo 1993). The introduction of predators represents another potential threat (Dekker 1989).

Conservation: Cagar Alam Waigeo Barat Nature Reserve was established in the late 1980s and covers 1,530 km^2, slightly less than half the island (Holmes 1989, Dekker and McGowan 1995). A two-week survey was conducted in the southeast corner of Waigeo in October 1993, which failed to find the species (Dekker and Argeloo 1993, Dekker and McGowan 1995).

Targets:

- **Conduct further extensive village interviews on Waigeo to gather presence/absence data.**
- **Conduct field surveys to establish the species' distribution and population status.**
- **Conduct research into its habitat requirements and threats.**
- **Research presence and impact of introduced mammalian predators.**
- **Determine how much suitable habitat remains on Waigeo.**
- **Produce and promote management recommendations for the bird and its habitat.**
- **Prevent the introduction of potential ground predators.**

Malleefowl (*Leipoa ocellata*)

Vulnerable A1c,e; A2b,c,e

This species qualifies as Vulnerable because it has undergone a decline of more than 20% over the last 45 years (three generations), based on a decline in its range owing to habitat clearance and fragmentation and the compounding effects of introduced species. Furthermore, this decline is likely to continue and, as numbers get smaller, some reserves may prove too small to support viable populations.

Range and population: The malleefowl was formerly widespread in **Australia** but its range appears to have contracted by over 50%. There are few data on population sizes, but estimates in the 1980s suggested there were only 750 pairs in New South Wales and less than 1,000 pairs in Victoria. Numbers in South Australia are probably higher, perhaps several thousand pairs. There are no population data in Western Australia. It has not been recorded for several decades (and is probably extinct) in the Northern Territory (Benshemesh in press).

Ecology: It is found principally in semi-arid to arid shrubland and woodland dominated by mallee eucalypts *Eucalyptus* and/or wattles *Acacia*. It requires a sandy substrate and abundance of leaf litter for breeding. Higher breeding densities occur on better soils with more rainfall, and habitat that has not been burned for several decades is preferred. It feeds on herbs, seeds, flowers, fruits, fungi, tubers, and invertebrates, and also forages in stubble on adjoining agricultural land. Its "nest" is a mound, comprising an inner core of leaf litter buried under a thick layer of sand. A single female may lay over 30 eggs in a season but on average, each breeding pair produces 8–10 chicks each year (Frith 1959).

Threats: Clearance for agriculture has eliminated much habitat, resulting in localised extinction and fragmented populations (Frith 1962, Benshemesh in press). It is highly sensitive to grazing by introduced herbivores, such as sheep (Frith 1962), large-scale wildfires (Benshemesh 1990),

and predation by introduced foxes (Frith 1962, Priddel and Wheeler 1997).

Conservation: Recommended actions in a national recovery plan are directed at securing existing populations (e.g., preserving habitat, connecting isolated populations, reducing threats from introduced species and wildfire), obtaining further information (e.g., current distribution, population trends and dynamics, habitat requirements, genetic variation), and promoting community involvement in research and management (Benshemesh in press; see also Garnett and Crowley in press).

Targets:

- **Assess the size and distribution of populations in fragments and remoter regions.**
- **Establish national monitoring standards.**
- **Monitor populations in at least 10 sites in each state.**
- **Encourage adoption of suitable fire regimes.**
- **Maintain or establish habitat corridors between fragments.**
- **Close or fence off artificial water supplies in reserves, and remove livestock.**
- **Control goats, rabbits, and foxes.**
- **Foster communication with graziers about malleefowl requirements.**

Maleo (*Macrocephalon maleo*)

Vulnerable A1a,c,d; A2b,c,d; C1; C2a

This charismatic megapode is classified as Vulnerable because it has undergone an observed rapid decline, which is projected to continue based on actual levels of exploitation and decline in extent and quality of habitat, combined with the fact that it has a small population that is continuing to undergo severe fragmentation.

Range and population: The maleo is endemic to Sulawesi and Buton Islands, **Indonesia**. Of the 131 currently or formerly known nesting grounds, 42 have been abandoned, 38 are severely threatened, 34 are threatened, 12 are of unknown status, and only five are not yet threatened (Butchart and Baker 2000). The global population is currently estimated to be in the region of 4,000–7,000 breeding pairs (Butchart and Baker 2000), and declining rapidly (up to 90% in places since 1950) (Argeloo and Dekker 1996). The viability of many smaller populations is becoming increasingly threatened.

Ecology: It inhabits lowland and hill rainforest, up to at least 1,065m, and human-modified habitats when travelling to coastal nesting grounds (Jones *et al.* 1995). It nests communally at traditional sites, typically sandy beaches, lake shores, and riverbanks heated by solar radiation and/or geothermal sources (MacKinnon 1978, Dekker 1990). Eggs are left to incubate and hatch with no further parental support (MacKinnon 1978, 1981).

Threats: Unsustainable harvesting of eggs combined with human disturbance of nesting grounds has caused the abandonment of most coastal nesting colonies and poses a major threat to those remaining (Butchart and Baker 2000). Forest destruction and fragmentation increasingly threaten surviving populations (Dekker 1988). Logging, and agricultural, urban, and road developments have isolated virtually all coastal nesting grounds from non-breeding habitats, significantly elevating the risk of mortality and natural predation of chicks (MacKinnon 1981). Invasive vegetation poses a further threat to nesting grounds (MacKinnon 1981).

Conservation: CITES Appendix I. It has been protected under Indonesian law since 1972 (Inskipp 1986). Over 50% of known nesting grounds (overwhelmingly inland sites) are located inside protected areas (Dekker 1990). Many field studies relating to the species' conservation have been initiated (Dekker and Wattel 1987, Dekker 1990, Argeloo 1994, Dekker and McGowan 1995, Butchart and Baker 2000).

Targets:

- **Monitor daily numbers of birds laying at as many colonies as possible.**
- **Assess status of colonies in southeast Sulawesi.**
- **Continue researching the effectiveness of hatcheries and artificial incubation programmes.**
- **Promote traditional, sustainable egg-harvesting regimes and renew community-based protection initiatives.**
- **Expand management activities in protected areas, particularly scrub clearance at nesting sites.**
- **Extend protected area status to selected key nesting grounds and forest corridors connecting nesting grounds and non-breeding areas.**
- **Encourage eco-tourism to provide alternative local revenue to egg harvesting.**

Moluccan megapode (*Eulipoa wallacei*)

Vulnerable A1d; A2c,d; C1

The rapid population decline of this megapode through over-exploitation is projected to continue, which, combined with its small, declining, and increasingly fragmented population, qualifies it for classification as Vulnerable.

Range and population: The Moluccan megapode is endemic to the Moluccan Islands of Buru, Seram, Haruku, Ambon,

Bacan, Halmahera, Ternate, and Misool off Irian Jaya (from where there is only one record), **Indonesia** (Jones *et al.* 1995). It has undergone a substantial decline, such that the global population is now estimated at about 10,000 individuals. The vast majority of the population nests at two sites, on Halmahera and Haruku (Dekker and McGowan 1995). It is probably extinct on Ambon and Ternate, and is apparently rare on Bacan and Seram.

Ecology: It inhabits dense evergreen rainforest, but also occurs in degraded forest and coastal scrub, from sea-level to 2,000m, although perhaps more typically above 750m except when nesting (Jones *et al.* 1995). It lays and buries its eggs nocturnally in colonies, chiefly on solar-radiated sandy beaches or other loose, unvegetated substrates (Jones *et al.* 1995, Heij and Rompas 1997). Egg-laying occurs year-round, apparently showing marked peaks at some sites during the regionally variable dry season (Baker 1999, Baker and Dekker 2000, Dekker *et al.* 1995, Heij 1995).

Threats: Over-harvesting of its highly nutritious eggs is the main reason for its decline, even in some areas where traditional regulatory management is practised (Dekker 1991, Dekker *et al.* 1995, Heij 1995). Natural predation of eggs and chicks by *Varanus* lizards, snakes, and birds of prey poses an increasing threat as colonies decline (Siebers 1930, Heij and Rompas 1997, Baker 1997). Sand extraction for local road construction and other small-scale development projects potentially endanger nesting grounds (Dekker 1991, Dekker *et al.* 1995). Deforestation (through logging and agricultural encroachment) is presumed to be a threat in its non-breeding habitats (Jepson 1993).

Conservation: It has been legally protected since 1979 (Inskipp 1986). Traditional management regimes for sustainable egg harvesting have been observed for at least 80 years at the two main nesting grounds (Kailolo and Galela), reputedly without serious detriment to the species (Dekker *et al.* 1995). Surveys of nesting grounds commenced in 1995, including a biological study at the Haruku nesting ground (Heij 1995, Argeloo and Dekker 1996, Baker 1997, Heij *et al*. 1997).

Targets:

- **Conduct further surveys of the major historical nesting grounds on Buru.**
- **Monitor breeding success at selected key nesting grounds.**
- **Conduct research into non-breeding season habitat and range.**
- **Campaign for full legal protection of all important viable nesting grounds, particularly on Halmahera and Haruku.**
- **Conduct education programmes and work closely with local people to achieve and maintain sustainable egg-harvest regimes.**

Nicobar megapode (*Megapodius nicobariensis*)

Vulnerable C1

This species qualifies as Vulnerable because it has a small, declining population as a result of the destruction of coastal forest.

Range and population: The Nicobar megapode is endemic to the Nicobar Islands, **India**, where it occurs on all but the islands of Car Nicobar, Pilo Milo, and Chaura. Historical reports from Little Andaman, India, and the Cocos Islands, Myanmar lack substantiating evidence (Sankaran 1995). The population in coastal forests has been estimated at between 2,300 and 4,000 breeding pairs (Sankaran 1995). Population densities are believed to be lower within the interior of islands, but these have not been estimated. The main populations on Great and Little Nicobar appear stable, but extinctions are probably imminent on Megapode and perhaps Kondul islands (R. Sankaran *in litt.*, Sankaran 1995).

Ecology: It inhabits forests and secondary growth, with greatest concentrations in coastal forests. It builds nest mounds of sand, loam, and humus, in which its eggs are incubated. Pairs often share nest mounds. Larger mounds tend to have more stable incubation temperatures and the shortest incubation period (about 72 days). Annual hatching success fluctuates widely (Dekker 1992, Sankaran 1995, Sankaran and Sivakumar 1999).

Threats: The key threats are: loss of coastal forest through conversion to agricultural uses, such as coconut, banana, and cashew plantations, and rice paddy cultivation; road development projects, which threaten to fragment habitat blocks, particularly on Great Nicobar; and settlement expansion. Snaring and shooting for food and unsustainable egg collection are localised problems (Dekker 1992, Collar *et al.* 1994, Sankaran 1995, Stattersfield *et al.* 1998). A proposal to develop Great Nicobar as a free-trade port, creating a dry dock and refuelling base for international shipping at the mouth of the Galatea River is potentially major threat (Sankaran 1995, 1997).

Conservation: It is listed in Schedule I of the Wildlife Protection Act. It occurs in Campbell Bay and Galathea National Parks on Great Nicobar (a Biosphere Reserve), and three wildlife reserves on uninhabited islands. Designation of most of the Nicobars as tribal areas legally prohibits commercial exploitation of natural resources and settlement or ownership of land by non-tribals (Sankaran 1997). Detailed status surveys and ecological studies have been conducted (Sankaran 1995, Sankaran and Sivakumar 1999).

Targets:
- **Monitor coastal populations and survey inland populations.**
- **Conduct a detailed ecological study of its population dynamics and social organisation.**
- **Expand the existing protected areas system to encompass wider tracts of coastal forest on Great Nicobar, the Nancowry Island group, and Little Nicobar.**
- **Lobby against the proposed port development on Great Nicobar.**
- **Initiate a conservation awareness programme to reduce local exploitation pressure.**

Biak megapode (*Megapodius geelvinkianus*)

Vulnerable C1

This little-known megapode is classified as Vulnerable on account of a small estimated population, which is inferred to be declining at more than 10% in three generations, owing to a variety of threats. However, further research may show that this species' range is severely fragmented and hence may be considered Endangered. On the other hand, it may show that its current rate of decline is much slower and, therefore, should be reclassified as Near Threatened.

Taxonomy: The Biak megapode differs somewhat from the dusky megapode in morphology and size, and is recognised as a full species in the latest family review (Jones *et al.* 1995).

Range and population: The Biak megapode is endemic to Biak-Supiori in Irian Jaya, **Indonesia**, and its satellite islands, Mios Korwar, Numfor, Manim, and Mios Num (Jones *et al.* 1995). It is not clear whether one specimen, apparently from Manokwari on mainland Papua, represents a straggler from a nearby island or a mislabelled specimen (Jones *et al.* 1995). Its population size is unknown, but believed to be small and declining. It was formerly common on Biak (Mayr and Meyer de Schauensee 1939) and it was recorded daily in and around Biak-Utara Reserve in 1997 (S. van Balen and B. Beehler *in litt.*), but only "small numbers" were seen recently on Owi (a satellite of Biak) and Supiori (D. Gibbs *in litt.*).

Ecology: It has been recorded in forest, logged forest, secondary growth, dry scrub, and scrub near a river. However, there is no information on its habitat preferences, general habits, food, or breeding biology, although these are probably broadly similar to other *Megapodius* spp. It presumably builds nest mounds or buries its eggs between decaying roots of trees (Jones *et al.* 1995).

Threats: Specific threats are undocumented, but probably include egg collecting (though its widely spaced nest mounds may reduce this risk (S. van Balen and B. Beehler *in litt.*)), hunting, and perhaps predation by introduced mammals (Dekker and McGowan 1995). Much forest on Biak (particularly the southern plains) and Numfor has been destroyed or damaged by logging and subsistence farming, and the remainder is under pressure (Bishop 1982, K.D. Bishop *in litt.*, D. Holmes *in litt.*). Much of Supiori comprises virtually impenetrable, forested limestone mountains, habitat that is likely to be safe from degradation.

Conservation: There are two protected areas on the islands, Biak-Utara and Pulau Supiori Nature Reserves, which cover substantial areas of lowland and hill forest on Biak and Supiori (Stattersfield *et al.* 1998). A further reserve has been proposed for Numfor (Diamond 1986).

Targets:
- **Conduct surveys on all appropriate islands to establish fully its distribution and current population status.**
- **Assess its habitat requirements and threats.**
- **Conduct research into its breeding biology.**
- **Assess status of forest on Biak-Supiori.**
- **Devise a list of management recommendations, including ensuring adequate protection of nesting areas if different from non-breeding habitats.**
- **Prevent potential introduction of ground predators.**
- **Ensure tourist development proposals on Biak are adequately balanced with biodiversity conservation needs.**

Vanuatu megapode (*Megapodius layardi*)

Vulnerable C1

This species qualifies as Vulnerable because it is inferred to have a small population that is likely to be declining, owing to unsustainable egg collecting and loss of coastal forest.

Range and population: The Vanuatu megapode is endemic to **Vanuatu** where it has been recorded from most islands north of Efate (Bregulla 1992). In 1995, it was surveyed on Ambrym where 148 burrows were counted in three breeding grounds. Local villagers reported a decline in numbers (Bowen 1996). The population density was estimated at about 100 birds per km^2 in the Loru Protected Area on Espiritu Santo (Bowen 1997), but birds appear less common in other forests on the island (G. Dutson *in litt.*). There are 1970s records from islands which have not been visited subsequently: Vanua Lava, Aoba, Malo, Malakula, Lopevi, Paama, Epi, Tongoa, and Emae (J. Diamond *in litt.*). On Tanna, its status is uncertain and it may be extinct there (G. Dutson *in litt.*).

Ecology: It inhabits lowland hill forest (to an unknown altitude) and is believed to be poorly tolerant of degraded forest. Away from volcanically heated areas, it nests on beaches and in decomposing vegetation (e.g., around rotting trees). As with other congeners, it is thought to be a dispersive species, flying to nesting and roosting sites, and not at risk from population fragmentation. It forages by scratching in the leaf litter on the forest floor (Bregulla 1992, Bowen 1996).

Threats: On Ambrym, most burrows showed signs of human disturbance and hundreds or thousands of eggs are collected annually. It is hunted by rural communities and killed by feral dogs. Large areas of lowland forest across its range are scheduled for logging, and other forest areas are degraded by agriculture and cattle grazing. Coastal forests, where many communal nesting grounds are located, are particularly threatened. Fires and cyclones also degrade foraging and nesting habitat (Bregulla 1992, S. Maturin *in litt.*, Bowen 1996, Foster 1999).

Conservation: Effective protection measures are limited (J. Bowen *in litt.*), but on Santo it does breed in the Big Bay and Loru Protected Areas, and it is legally protected from hunting between 1 July and 31 March. On Ambrym, local communities, NGOs, and the government are developing a programme of ongoing surveys and protection measures on the communal nesting grounds (Bowen 1996, 1997, G. Dutson *in litt.*, Foster 1999).

Targets:

- **Survey the population at Lake Fanteng on Ambrym.**
- **Assess the success of egg-collecting control measures on Ambrym.**
- **Survey other islands with communal nesting grounds.**
- **Enforce legislation.**
- **Hold workshops with village and church leaders, egg collectors, women's groups, and schoolchildren in villages near nesting grounds to disseminate information about the species and the consequences of egg collecting.**

Chapter 4

Five-year Plan of Action

The previous chapter provided a summary of information that is of conservation importance for all species of megapode, and outlined the conservation targets that, if achieved, should prevent the species from becoming extinct. This chapter builds upon these recommendations by proposing key projects that the Megapode Specialist Group recommends should be started or continued during the period 2000–2004.

Before examining these projects in detail, it is helpful to assess the results of projects suggested in the first edition. This assessment was accomplished by sending out a questionnaire to everyone undertaking projects on megapodes relating to those suggested in the first edition. Of the 10 projects proposed in 1995, two were existing national projects, six have been initiated, and two have not yet been attempted. Of the 26 individual project objectives suggested in the 1995 Action Plan, 20 were achieved by the end of the implementation period, two were attempted but not achieved, and a further objective is pending. Three objectives were not attempted during the implementation period.

These data indicate that a great deal of the work recommended in the first edition of the Megapode Action Plan has been initiated. Indeed, the projects outlined in this second edition are clear evidence of a new phase in megapode conservation, moving on from conducting basic survey work to combining existing data with new biological information to generate well-informed threat assessments and construct management strategies at a variety of scales. Major components of many projects are conservation awareness programmes, which can now be attempted realistically because much of the necessary baseline data has become available over the past five years. The same applies to providing and promoting scientifically based management recommendations to decision-makers. Another major focus is on population monitoring to assess the effectiveness of sustainable harvesting programmes and management initiatives. Throughout, it is intended that local communities be involved wherever possible.

In this chapter, a section is devoted to each species, containing details of suggested priority projects. A national recovery plan is in production for the malleefowl (Benshemesh 1997, 1999, in press), and another has been produced for the Micronesian megapode (U.S. Fish and Wildlife Service 1998). For researchers wishing to work on these species, we recommend establishing contact with the executors of these recovery programmes to co-ordinate work and assess current priorities. For these reasons, we do not include specific project suggestions for these species.

Structure of project outlines: Suggested projects are grouped under each species. They are outlines of what needs to be done, as well as why and how. They are designed to be read as much by people who might then seek or donate funds allowing a project to be carried out, as by biologists wishing to conduct research that should contribute to the conservation of megapodes and their habitats. Together with the species accounts given in Chapter 3, and the references cited therein, they could be used to develop full project proposals. Such proposals can be submitted to the Megapode Specialist Group, which will be able to provide advice and contacts, and help with funding applications through their endorsement procedure and international network.

Each project outline includes entries under a standard set of sub-headings, as follows:

Aims: A brief statement of the project's major objectives.
Justification: Why the project is urgent and valuable.
Project description: Includes a description of how the aims might be achieved, often with some mention of study areas and methods.
Timescale: How long the project might last, including time travelling to and from the study area.
Resources: An indication of the approximate scale of the project through a cost estimate in US$. Estimated costs should be carefully itemised for inclusion in full project proposals. Totals may ultimately differ substantially from what is presented here particularly if researchers work on a voluntary basis. Details of other important resource considerations are provided where appropriate.

4.1 Critically Endangered species

Polynesian megapode (*Megapodius pritchardii*)

Although the three projects suggested for this species could be undertaken individually, we suggest they be co-ordinated as part of a long-term conservation strategy.

Project 1. Monitoring of the Polynesian megapode on Niuafo'ou Island.

Aim: To continue monitoring the breeding population of this species.

Justification: The Critically Endangered Polynesian megapode is known only from the island of Niuafo'ou in the north of the Kingdom of Tonga. The global population may be as low as about 200 breeding pairs and census data indicate that it is in long-term decline (Todd 1983, Göth and Vogel 1999). The species is subject to a variety of threats, and it is essential that the remaining population is monitored at least every five years, preferably more frequently, so that further changes can be identified and appropriate action taken.

Project description: Polynesian megapodes lay eggs throughout the year, although this activity may be suppressed during dry weather. Eggs are laid in burrows where they are heated by underground volcanic activity. These breeding sites, particularly on the crater-lake islets, should be visited to conduct counts during the census period. During this work, the islets could also be searched for feral cats and other introduced predators. If predators are found, eradication is recommended and should be implemented if at all possible.

Timescale: A complete census of the species could be conducted in three months, although the ongoing nature of the monitoring programme means that this work must be undertaken in the context of a long-term strategy.

Resources: Total costs for a single census should remain below $5,000.

Project 2. Raising public awareness of the conservation of the Polynesian megapode.

Aim: To continue and intensify the conservation awareness programme already begun on Niuafo'ou.

Justification: Harvesting of Polynesian megapode eggs and utilisation of other natural resources is an integral part of the culture on Niuafo'ou, and increasing economic pressures are placing further strain on these natural resources. Egg harvesting is believed to be the main reason for the drastic decline in megapode numbers (Göth and Vogel 1999), and the species is now considered Critically Endangered.

Project description: Conservation awareness programmes must work sensitively within the cultural system, and not dictate how Tongan people should use their natural resources. Information must be presented in a clear and understandable format, and ways of reducing direct pressure on the megapode must be balanced by alternative means of sustenance and income for local people. The programme must work in close consultation with the Tongan government and investigate forming an island-wide council of residents to discuss suitable conservation measures.

Timescale: For the duration of this Action Plan and beyond.

Resources: As a long-term and large-scale project, this work is expected to require substantial funding of over $25,000.

Project 3. Translocation programme for the Polynesian megapode.

Aims: To continue the translocation of megapodes from Niuafo'ou to Late and possibly Fonualei; to ensure the outcomes of this work are monitored and methods modified as necessary.

Justification: Fossil evidence indicates that this species was formerly more widespread (Steadman 1999). Some eggs have already been translocated to Late and Fonualei, although the results have not been intensively monitored (Rinke 1994). If the species can be successfully introduced to other islands, its conservation outlook will be drastically improved and it would be downlisted to Endangered.

Project description: Strict guidelines should be followed whenever a translocation is carried out (IUCN 1998), and any removal of eggs should be explained and justified through a public awareness programme. The hatching success of translocated eggs should be monitored on Late and Fonualei and, ideally, information on subsequent breeding success of adults should be gathered. The possibility of translocating birds to other volcanic islands in the Tongan Archipelago could be investigated further.

Timescale: For the duration of this Action Plan and beyond.

Resources: As a project requiring expensive equipment and long-term follow-up, this work is expected to require substantial funding of over $25,000.

Polynesian megapode. Believed to have occurred on several islands in the Kingdom of Tonga; research must now focus on whether they can be successfully re-introduced.

4.2 Endangered species

Micronesian megapode (*Megapodius laperouse*)

Recovery programme for the Micronesian megapode *Megapodius laperouse laperouse*.

The U.S. Fish and Wildlife Service (1998) has produced a comprehensive recovery plan for the Micronesian megapode, and anyone wishing to work on this species should contact the Commonwealth of the Northern Mariana Islands (CNMI), Division of Fish and Wildlife (DFW), Saipan, or the Megapode Specialist Group in the first instance to assess current priorities. The Megapode Specialist Group supports all recommendations made in the recovery plan.

4.3 Vulnerable species

Bruijn's brush-turkey (*Aepypodius bruijnii*)

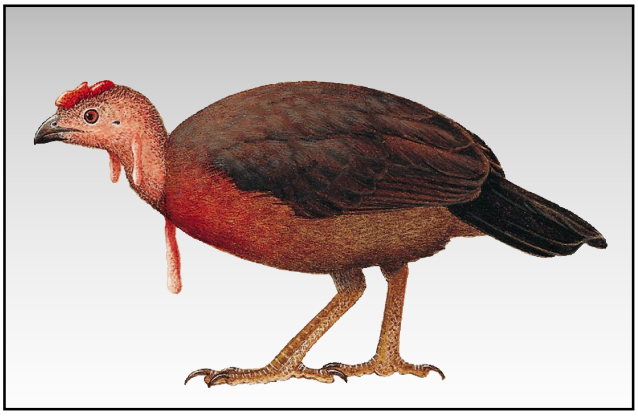
Project 1. Survey for Bruijn's brush-turkey on Waigeo Island.

Aims: To locate this species on Waigeo and describe its basic habitat requirements; to measure population densities and generate a global population estimate.

Justification: Despite several efforts to locate this species, it has never been observed in the wild by ornithologists and so its status remains unknown. However, it is presumed to be Vulnerable. It is considered at risk because the extent of its habitat is very limited.

Project description: The first step is to conduct a systematic search of the island. As long-term fieldwork on Waigeo is difficult, it may be appropriate to concentrate initially on the Cagar Alam Waigeo Barat Protected Area. If possible, habitat at a variety of altitudes should be searched so the altitudinal range of the species can be identified.

Bruijn's brush-turkey. This species has never been observed in the wild by biologists.



Timescale: Initial survey work should take approximately three months, with a minimum of two months actually on the island.

Resources: The lack of infrastructure on Waigeo means that this project may cost $5,000–10,000. Considerable local guidance would be needed to travel to and around the island.

Project 2. Management plan for the conservation of the Bruijn's brush-turkey.

Aims: To identify how much suitable habitat remains on the island; to identify and quantify the threats to the future survival of this species; to produce and promote a list of management recommendations for the species and its habitat.

Justification: The long-term survival of this species depends entirely on the population inhabiting Waigeo. Therefore, appropriate habitat protection or active conservation measures must be implemented based on quantification of the threats faced by the species.

Project description: This study would build upon the previous project, with the details being dependent on the results of that survey work. The amount of suitable habitat remaining on Waigeo should be measured and the most important threats to the survival of the species identified. A management plan for the conservation of Bruijn's brush-turkey should be produced and promoted to the appropriate authorities.

Timescale: Combined with the above survey work (Project 1), the fieldwork necessary to establish appropriate data for a management plan should take 6–12 months.

Resources: Approximately $10,000–25,000 would be needed to carry out this work effectively.

Malleefowl (*Leipoa ocellata*)

National Recovery Programme for the malleefowl *Leipoa ocellata*.

The National Malleefowl Recovery Team (Benshemesh 1997, 1999, in press) is producing a comprehensive recovery plan for this species, and anyone wishing to work on malleefowl should contact the Recovery Programme author or the Megapode Specialist Group in the first

Malleefowl. The National Malleefowl Recovery Team has produced a comprehensive recovery plan for this unusual megapode.

instance to assess current priorities. The Megapode Specialist Group supports all the recommendations made in the recovery plan.

Maleo (*Macrocephalon maleo*)

Project 1. Improving protection of maleo nesting grounds in Sulawesi.

Aims: To campaign for improved protection of maleo nesting grounds both inside and outside existing protected areas; to develop proposals for forested corridors linking known nesting grounds and montane forest.

Justification: The maleo is endemic to the islands of Sulawesi and Buton. It has suffered a considerable decline in numbers in recent times due to over-exploitation of eggs by man, and loss and degradation of habitat. Research work and conservation initiatives have been underway since the late 1970s, but there is now a need for further protection of known nesting grounds to prevent further decline, as well as new protected status for certain priority sites.

Project description: This work should be carried out by, or through, international and national conservation organisations. Lobbying for improved protection of maleo nesting grounds both inside and outside existing protected areas is recommended, including such areas as Tambun and Tumokang in NP Nani Wartabone (formerly NP Dumoga-Bone), Hulurawa and Saluki in NP Lore Lindu, Batu Katunda in NR Morowali, Libun, Tanjung Matop, and Bakiriang. As maleos move between nesting grounds and their inland forest habitat, forested corridors are required. A second part of this project could develop and promote proposals for the establishment and maintenance of such corridors.

Timescale: The need for this work is ongoing and this project should continue through the duration of this Action Plan.

Resources: Costs are likely to remain within $5,000–10,000. Good communication among decision-makers is needed at all appropriate levels.

Project 2. A conservation awareness programme for the maleo.

Aims: To raise public awareness of reasons for the decline in maleo populations and how these trends can be arrested or reversed; to disseminate information on systems for sustainable harvesting of maleo eggs, in conjunction with Project 3.

Justification: Much of the decline in maleo populations results from degradation of habitat in and around nesting grounds, and over-exploitation of eggs. Increased public awareness of the plight of this species and the reasons for its decline may help reverse this trend. Successful implementation of sustainable harvesting will help safeguard this species in the long term.

Project description: Conduct a high-impact, conservation awareness programme through the media and community groups to raise the profile of the species. Local people could be involved in projects to restore degraded habitat around nesting grounds, which can then provide benefit in the form of long-term sources for the sustainable harvesting of eggs. As the symbol of Sulawesi, this species is widely known, and can act as a flagship for more generalised conservation awareness and environmental stewardship programmes.

Timescale: The need for this work is ongoing and this project should continue through the duration of this Action Plan.

Resources: This is a large-scale and long-term project, and is likely to cost over $25,000.

Project 3. Developing a system for sustainable harvesting of maleo eggs.

Aims: To design and promote a system for sustainable harvesting of maleo eggs; to evaluate the effectiveness of hatcheries in maleo conservation.

Justification: Sustainable harvesting of eggs is believed to be one of the best ways to ensure long-term survival at harvested nesting grounds. In the case of the maleo, hatchery projects have also been used to supplement wild populations in certain cases. However, detailed biological information is necessary to design and evaluate such programmes effectively.

Project description: Conduct research to establish the natural survival rate of eggs and chicks, and evaluate the effectiveness of hatchery programmes in maleo conservation. The results of this research should be translated into a system of sustainable harvesting of eggs for the local community.

Timescale: Detailed research work over several seasons is required to establish the necessary biological data. Combined with work on translating this into a system for sustainable harvesting, the whole project could occupy the duration of the Action Plan and beyond.

Resources: This intensive project would require in excess of $25,000.

Moluccan megapode (*Eulipoa wallacei*)

Project 1. Improving protection of Moluccan megapode nesting grounds.

Aim: To campaign for improved protection of Moluccan megapode nesting grounds.

Justification: During the past five years, it has become clear that the vast majority of the global population of this species lays eggs in two nesting grounds. If these sites were lost, there would be a catastrophic decline in this species. Protection for these areas is a major priority to safeguard the future of the Moluccan megapode.

Project description: This work should be carried out by, or through, international and national conservation organisations. Lobbying for improved protection of Moluccan megapode nesting grounds is recommended, including such areas as Kailolo, Haruku, and Galela.

Timescale: The need for this work is ongoing and this project should continue through the duration of this Action Plan.

Resources: Costs are likely to remain within $5,000–10,000. Good communication among decision-makers is needed at all appropriate levels.

Project 2. A conservation awareness programme for the Moluccan megapode.

Aims: To raise public awareness of the importance of these few nesting grounds for the continued survival of the species; to disseminate information on systems for sustainable harvesting of Moluccan megapode eggs, in conjunction with Project 3.

Justification: Being a beach-nester, the Moluccan megapode frequently comes into contact with humans and egg-harvesting levels are high. A conservation awareness programme could focus on assisting local communities to develop long-term sustainable harvesting strategies. This would ensure that both the people and the birds benefit.

Project description: Conduct a high-impact conservation awareness programme through the media and community groups to raise the profile of the species, especially on Halmahera and Haruku. Local people could be involved in projects to manage nesting grounds, which can provide benefit in the form of long-term sources for the sustainable harvesting of eggs.

Timescale: The need for this work is ongoing and this project should continue through the duration of this Action Plan.

Resources: Costs for this project should remain between $5,000 and $10,000.

Project 3. Developing a system for sustainable harvesting of Moluccan megapode eggs.

Aim: To design and promote a system for sustainable harvesting of Moluccan megapode eggs.

Justification: Sustainable harvesting of eggs is believed to be one of the best ways to ensure long-term survival at harvested nesting grounds. For this species, which is subject to high rates of egg harvesting, this could be crucial in ensuring its long-term survival. However, detailed biological information is necessary to design and evaluate such programmes effectively.

Project description: Conduct research to establish the natural survival rate of eggs and chicks, and translate the results into a system of sustainable harvesting of eggs for the local community. It may be necessary to monitor nesting grounds in the long term and, if so, every effort should be made to implement such a monitoring programme.

Timescale: Detailed research work over several seasons is required to establish the necessary biological data.

Combined with work on translating this into a system for sustainable harvesting, the whole project could occupy the duration of the Action Plan and beyond.

Resources: This intensive project would require in excess of $25,000.

Nicobar megapode (*Megapodius nicobariensis*)

Project 1. Improving protection of Nicobar megapode nesting habitat.

Aim: To campaign for improved protection of Nicobar megapode nesting habitat.

Justification: This species has a restricted range and is endemic to the Nicobar Islands. Nicobar megapodes build their mounds in coastal areas and, therefore, suffer from disturbance and habitat destruction and degradation. Many such areas have been located over the past five years and now there is an urgent need for improved protection for these sites.

Project description: This work should be carried out by, or through, international and national conservation organisations. Lobbying for improved protection of these coastal strips within existing protected areas is strongly suggested. In addition, new protected areas are needed in the Nancowry Group. Recommendations for more effective protection of nesting habitat should include reducing hunting pressure at the several locations where Thai poachers come in by boat.

Timescale: The need for this work is ongoing and this project should continue through the duration of this Action Plan.

Resources: Owing to current restrictions, work in the Nicobar Islands must be conducted by an Indian researcher. This project is expected to cost between $5,000 and $10,000.

Project 2. A conservation awareness programme for the Nicobar megapode.

Aims: To raise public awareness of reasons for the decline in Nicobar megapode populations, and how these trends can be arrested or reversed.

Justification: The people of the Nicobar Islands are exempt from Indian Forest and Wildlife Protection Law, and human disturbance (both wilful and incidental) is a major cause for concern with this species. A conservation awareness programme is required to alleviate some of these problems, while providing local people with long-term methods of sustainable harvesting, and reducing disturbance and habitat clearance.

Project description: Conduct a high-impact, conservation awareness programme through the media and community groups to raise the profile of the species among local people. Conservation awareness programmes must work sensitively within the cultural system and not dictate how people should use their natural resources. Information must be presented in a clear and understandable format, and ways of reducing direct pressure on the megapode must be balanced by alternative means of sustenance and income for local people.

Nicobar megapode at its mound, Great Nicobar, March 1992. This species often builds its mounds near beaches.

Timescale: The need for this work is ongoing and this project should continue through the duration of this Action Plan.

Resources: This project is likely to cost between $10,000 and $25,000.

Project 3. Monitoring of the Nicobar megapode.

Aim: To continue monitoring the breeding population of this species.

Justification: Although the broad distribution and abundance of the Nicobar megapode is known, information on population trends is essential for understanding the long-term conservation status of the species. These data can be used to highlight particular regions of concern and establish where further conservation effort should be targeted.

Project description: Periodically re-survey coastal areas in the 16 islands where the species is present. Aim to establish a five-year programme of survey work, beginning in 2000. Survey work should also investigate the interior of the larger islands, as these have not yet been surveyed in detail.

Timescale: Each survey could be completed in two three-month periods during the dry season.

Resources: Each complete survey should cost between $5,000 and $10,000.

Project 4. Population dynamics of the Nicobar megapode.

Aims: To study population dynamics (e.g., survival, recruitment); to investigate the viability of small populations (e.g., PVA).

Justification: As more and more biological data become available on this species, it will be possible to conduct quantitative modelling of population dynamics and project future trends in conservation status.

Project description: All relevant data should be assembled, and any gaps filled by field research or reference to other megapode species. A range of population models should be investigated and appropriate methods developed. Effects of possible management strategies can be investigated, and the project should culminate in a strategic assessment of the best way forward for the long-term conservation of the species.

Timescale: A minimum of three years will be required to collect the necessary data and conduct a PVA.

Resources: As an intensive and long-term project, this work is expected to cost in excess of $25,000.

Biak megapode (*Megapodius geelvinkianus*)

Project 1. Survey for Biak megapode on Biak and surrounding islands.

Aims: To locate this species on Biak and surrounding islands and describe its basic habitat requirements; to measure population densities and generate a global population estimate.

Justification: Owing to confusion about the taxonomic status of this species, recently split from the dusky megapode, very little is known of its conservation status in the wild. It is listed as Endangered as a precaution pending further information on the species. Habitats on the island of Biak are under pressure, and there is an urgent need to clarify the distribution and abundance of the Biak megapode. Gathering such baseline data must be the first step in understanding the overall conservation needs of the species.

Project description: Conduct a basic survey of Biak and surrounding islands. Describe the habitats occupied by the species (e.g., whether it occurs in secondary forest) and identify how much suitable habitat remains on these islands. Estimate population densities and produce a total population estimate.

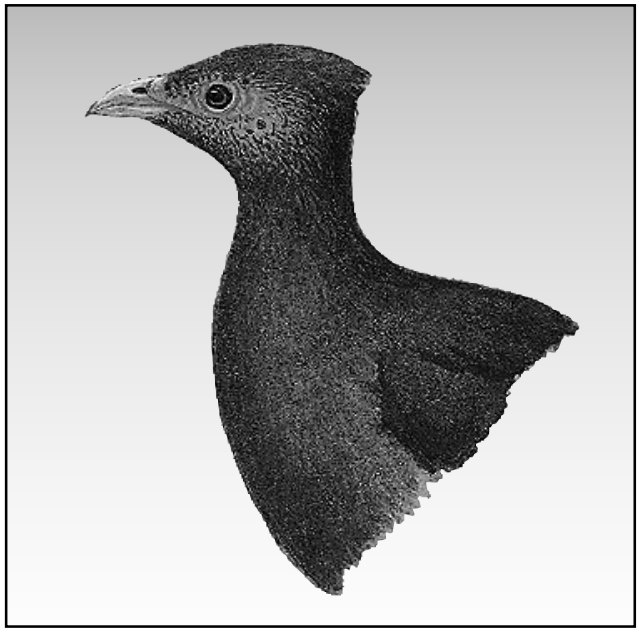
Timescale: This project should require about three months

Resources: Probably less than $5,000.

Project 2. Management plan for conservation of the Biak megapode.

Aims: To identify how much suitable habitat remains on the islands; to identify and quantify threats to the future survival of this species; to produce and promote a list of management recommendations for the species and its habitat.

Justification: Once baseline data have been collected on the Biak megapode, it will be necessary to re-assess its conservation status in the light of this new information. Combining this with data on habitat availability and levels of disturbance will allow an initial assessment of the most urgent conservation priorities to be made.



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Biak megapode. A poorly-known species, partly because until recently it was considered a subspecies of the dusky megapode, a much more widespread and common species.

Project description: This study would build upon the previous project, and the details are dependent on the results of that survey work. The amount of suitable habitat remaining on the islands should be measured, and the most important threats to the survival of the species identified. A management plan for the conservation of the Biak megapode should be produced and promoted to the appropriate authorities.

Timescale: Combined with the above survey work (Project 1), the fieldwork necessary to establish appropriate data for a management plan should take 6–12 months.

Resources: Approximately $10,000–25,000 would be needed to carry out this work effectively.

Vanuatu megapode (*Megapodius layardi*)

Project 1. A sustainable egg-harvesting programme for the Vanuatu megapode.

Aim: To develop, in conjunction with local communities, a sustainable egg-harvesting regime on Ambrym; to monitor the success of this programme.

Justification: Egg harvesting has been implicated as the main factor in the decline of the Vanuatu megapode. An appropriate and sensitive way of reducing this pressure on megapode populations is urgently required to halt these declines, and allow the populations to regain long-term stability.

Project description: Assist local communities on Ambrym through local organisations such as the Vanuatu Protected Areas Initiative, in regulating egg harvesting during the peak nesting period of June to August. This needs to be applied and upheld by all chiefs from nearby villages, and supported by the National Council of Chiefs. Workshops with village and church leaders, egg collectors, women's groups, and schoolchildren in villages near nesting grounds are needed to disseminate information locally about the status, laws, ecology, and threats to this species. To monitor the progress of this work, annual assessments of the species' status and the number of eggs laid should be made at the nesting ground. This model could be extended to other islands in Vanuatu.

Timescale: This project will require at least one year in the first instance. Follow-up survey work would be additional to this.

Resources: This large-scale project would probably cost between $10,000 and $25,000.

Project 2. Survey for Vanuatu megapode.

Aim: To provide information on the distribution and status of the Vanuatu megapode on islands other than Ambrym; to assess its tolerance of degraded forest and its altitudinal distribution.

Justification: Although this species has been studied on Ambrym, extensive survey work is required on other islands to ascertain the true status of this species. In view of its apparent restriction to closed canopy forest, basic details of habitat use are urgently required (Dutson 1999).

Project description: This study should begin by developing an appropriate survey method for the Vanuatu megapode, which is known to adopt a variety of breeding strategies from single-occupation burrows to large communal nesting grounds. They may also build mounds. When a suitable method has been developed, each island where the species is known or thought to occur should be visited and searched.

Timescale: Approximately six months would be required for the basic survey work.

Resources: This project could cost between $5,000 and $10,000.

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