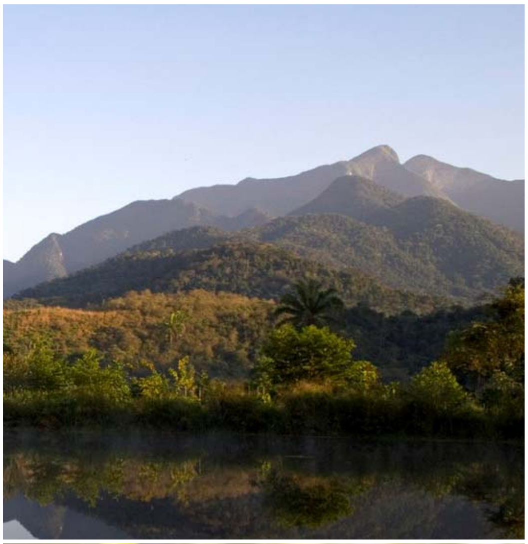
Guidelines for the Re-introduction of Galliformes for Conservation Purposes

Edited by the World Pheasant Association and IUCN/SSC Re-introduction Specialist Group



Occasional Paper of the IUCN Species Survival Commission No. 41

Species Survival Commission

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The IUCN Species Survival Commission is a science-based network of close to 8,000 volunteer experts from almost every country of the world, all working together towards achieving the vision of, "A world that values and conserves present levels of biodiversity."

WPA-IUCN SSC Galliformes Specialist Groups
The Grouse Specialist Group was established in 1993 when it developed from WPA's long-standing grouse network. It was designed to be a global voluntary network of individuals involved in the study, conservation, and sustainable management of grouse. The Pheasant Specialist Group was established in 1991 as a voluntary self-help network of scientists, wildlife managers, conservationists, aviculturists and educators. It was particularly concerned with the plight of threatened pheasant species, and ensuring the survival of viable populations in their natural habitats whilst enhancing the quality of human life. The Partridge, Quail, and Francolin Specialist Group emerged from a symposium hosted by the Game Conservancy Trust in southern England in 1991. Its mandate was to provide a focus for the conservation and management of the smaller Galliformes species, including all of the partridge, quails, francolins, snowcocks, and guineafowl. The Megapode Specialist Group was formed in 1986 to provide a forum for those interested in the study and conservation of megapodes. The 22 species comprise a fascinating, yet poorly known, family of Galliformes also known as brush-turkeys or scrubfowl that rely on environmental sources of heat for the incubation of their eggs.

These Specialist Groups have now joined forces to form a single WPA-IUCN SSC Galliformes Specialist Group covering all of these species and the Neotropical cracids.

World Pheasant Association
The World Pheasant Association (WPA) was founded in 1975 and aims to develop and promote the conservation of all the species in the avian Order Galliformes, which are, broadly speaking, the gamebirds of the world. This group, including pheasants, grouse, partridges, quail, francolins, megapodes and cracids, contains some of the most beautiful and threatened birds in the world. WPA was the umbrella organisation for the Galliformes Specialist Groups and is co-parent with the Species Survival Commission of IUCN of the new Galliformes Specialist Group.

Re-introduction Specialist Group (RSG)
The RSG is a network of specialists whose aim is to combat the ongoing and massive loss of biodiversity by using re-introductions as a responsible tool for the management and restoration of biodiversity. It does this by actively developing and promoting sound inter-disciplinary scientific information, policy, and practice to establish viable wild populations in their natural habitats.

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0. Acknowledgements

These guidelines were compiled by a core group convened by the World Pheasant Association and the Re-introduction Specialist Group. They drew substantially on the expertise of the Galliformes Specialist Groups of WPA and the Species Survival Commission. The following individuals played a leading role in producing and shaping the guidelines: Fernando Angulo (Cracids), Carlos Bianchi (Cracids), Clait Braun (Grouse SG), Francis Buner (Partridge, Quail and Francolin SG), Jack Connelly (Grouse SG), John Corder (Pheasant SG), Anna Fraser (WPA), Ann Göth (Megapode SG), Richard Kock (Wildlife Health SG), Frederic Launay (Reintroduction SG), Philip McGowan (WPA), Sergio Peirera (Cracids), Phil Seddon (Reintroduction SG), Pritpal S. "Micky" Soorae (Re-introduction SG), Theron Therune (Partridge, Quail and Francolin SG).

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The Chairs of the Galliformes Specialist Groups provided leadership and support throughout the process: Ilse Storch (Grouse SG), René Dekker (Megapode SG), John Carroll and Richard Fuller (Partridge, Quail and Francolin SG) and Peter Garson and Rahul Kaul (Pheasant SG). Josephine Orledge, Natalie Clark and Rob Lewis (WPA) provided editorial assistance.

1. Executive summary

Re-introductions are increasingly being used as a wildlife management tool to restore extinct or depleted wild populations into suitable habitats. The *Guidelines for the re-introduction of Galliformes for conservation purposes* have been developed to provide guiding principles for the restoration of viable Galliformes populations in the wild for conservation purposes. It should be noted at the outset that re-introduction is difficult, expensive and requires a long-term commitment if it is to be successful. To date few re-introductions have led to self-sustaining Galliformes populations.

These guidelines provide background information on the aims and objectives of a re-introduction and the issues to consider during the planning phase. The taxonomy, ecology and conservation status of Galliformes is introduced and covers all of the sub-groups: megapodes, cracids, grouse, partridges, quails, francolins, snowcocks, guineafowl and turkeys, and pheasants.

When considering a galliforme re-introduction project for conservation purposes it is essential to look at certain key factors to ensure that the project is appropriate. These include factors such as:

- the availability of suitable habitat (including nesting grounds for megapodes);
- the identification and elimination of previous causes of decline;
- the genetic composition of individuals destined for release in relation to the wild population at release site; and
- how the project would contribute to local and national legislative objectives for biodiversity conservation.

In most cases a feasibility study would be advisable based on clearly defined aim and objectives. In addition, suitable research should be conducted into the biology of the species involved as well as the socio-economic and political issues of such a project. The pre-release and release stages should:

- develop a well-coordinated multidisciplinary team to oversee the entire project;
- fully assess all biological issues such as trapping, transport, rearing techniques (if necessary), behaviour, health and genetic screening;
- ensure adequate political support and obtain necessary licenses; and
- prepare budgets and an effective public-awareness programme.

The post-release stage should ensure that there is scientific monitoring, the evaluation of success indicators, the development of potential intervention strategies and the integration of any lessons learned into future planning for similar and/or related species.

These guidelines include a bibliography section that includes key references on the conservation status and natural history of the Galliformes in general and on re-introductions in particular. There are nine appendices: a list of all known Galliformes species and their IUCN Red List categories, an example of a budget for a re-introduction project, guidance on live trapping, transport, rearing techniques, marking techniques, contact information for Galliformes studbooks, glossary of terms, and a list of Galliformes symposia held to date.

2 The guidelines

2.1 Context of the guidelines

As we learn more about the ecology of the natural world it is increasingly becoming apparent how vulnerable many Galliformes populations are. At the same time, conservation legislation is becoming more widespread and comprehensive at both national and international levels. Because of the deteriorating state of many Galliformes populations, it is often suggested that re-introduction can be used to help ensure the long-term survival of Galliformes in the wild and to restore them where they have become locally extinct. However, such complex projects are typically expensive, politically sensitive and high-profile and therefore it is imperative that potential projects consider the most efficient and effective methodology to obtain success.

In 1987 IUCN developed the *Position Statement on the Translocation of Living Organisms*, acknowledging that translocation was a powerful tool in the management of the natural environment, but warning of potential ecological implications (IUCN, 1987). As the number of re-introductions for conservation purposes continued to increase worldwide, the *Guidelines for Re -introductions* were approved by IUCN Council at its 41st Meeting in May 1995. These guidelines were translated into French, Spanish, Chinese, Russian and Arabic and then printed as booklets in 1998 (IUCN, 1998). This technical document provides general guidance on many of the key issues concerning re-introductions, and is the benchmark for the legislative approval and licensing of many re-introduction projects. It is, however, not family or taxon specific.

Surprisingly, little information has been collated so far to guide or evaluate re-introduction projects, not only those for gamebirds, and perhaps as a result, many such projects have experienced political, socio-economical and/or ecological difficulties. Indeed Sarrazin and Barbault (1996) present a discussion of the challenges facing a potential re-introduction project that remains highly relevant today. Evidently there is a need to establish guiding principles and procedures for reintroducing Galliformes for conservation purposes and to identify species-specific examples. To address this lack of guidance the IUCN/SSC Re-introduction Specialist Group (RSG), the World Pheasant Association (WPA) and the Galliformes Specialist Groups have united to produce best-practice guidelines. There are four WPA-IUCN Galliformes Specialist Groups: Grouse; Megapode; Partridge, Quail and Francolin; and Pheasant. At present there is no IUCN-WPA Cracid Specialist Group.

This document is aimed at those wishing to reintroduce Galliformes for conservation purposes. It refers to current IUCN guidance (see **http://www.iucnsscrsg.org/** and **http://www.iucn.org/themes/ssc/publications/policy/reinte.htm**) and draws on current literature and expert opinion to provide stepwise advice and examples. To be successful, these projects are inevitably long-term and should aim to establish viable, free-living and self-sustaining populations in the wild. These guidelines do not consider nor promote the release of Galliformes for hunting, aesthetic or recreational purposes.

Finally, these guidelines are also set within the current Strategic Plan 2001-2010 (**http://intranet.iucn.org/webfiles/doc/archive/2001/IUCN896.pdf**) of the Species Survival Commission, which has the following three objectives:

1. Decisions and policies affecting biodiversity influenced by sound interdisciplinary scientific information;
2. Modes of production and consumption that promote the conservation of biodiversity adopted by users of natural resources; and

3. Capacity increased to provide timely, innovative and practical solutions to conservation problems.

The development of these guidelines contributes towards several of the (numbered) outputs that have been identified for these objectives of the SSC Strategic Plan:

1.5 Key techniques and policies for the conservation of biodiversity developed and disseminated;

2.2 Tools developed to assist decision-makers in managing natural resources sustainably; and

3.7 Knowledge, expertise and surveillance on emerging issues improved.

2.2 Aim and objectives of guidelines

The aim of these guidelines is to increase the effectiveness of re-introduction as a measure for the conservation of Galliformes species by:

i) providing guidance on when re-introduction for conservation purposes may be desirable and when it is not;

ii) outlining the key issues that need to be considered and giving the reasons why these issues are important;

iii) summarising the conservation status of the Galliformes and the use of re-introduction as a measure for their conservation;

iv) providing detailed guidance that is specific to Galliformes for key steps in the re-introduction process;

v) providing relevant sources of information, such as key contacts and references to important studies; and

vi) providing guidance on evaluating the success of a re-introduction.

These guidelines should be read in conjunction with the generic guidelines for re-introductions produced by IUCN (IUCN, 1998). Please note that the word 'species' as used in these guidelines can be taken to include any target taxon and so may include population or subspecies levels.

2.3 Considering a re-introduction

Article 9 of the Convention on Biological Diversity (which is the main pathway to achieving the goals of the 1992 Rio Earth Summit) obliges signatory countries to adopt measures for the recovery and rehabilitation of threatened species (UNEP, 1992). Re-introduction projects are increasingly being proposed as one of the means of fulfilling this Article. This is because increasing the number or size of viable populations can increase the chances of species survival by, for example:

- bolstering genetic heterogeneity of small populations;
- establishing sub-populations to reduce risk of species loss due to catastrophe; and
- hastening recovery of species after their habitats have recovered from limiting factors.

Furthermore, there is scope for maximising the benefits that can be derived from species conservation through action for species that are considered to have indicator, flagship, keystone or umbrella roles. This may have wider benefits for the integrity of the ecosystem and/or raise awareness of conservation issues in the region.

However, planned and sustained release of animals is expensive, subject to intense public scrutiny, may be limited by the availability of release stock (particularly for threatened species), and in some cases may not be beneficial to biodiversity conservation. It is therefore imperative to assess the costs and benefits before any re-introduction is started to determine whether the release of birds is an appropriate conservation strategy. This is because in most cases it will be more cost effective and efficient to focus resources on the maintenance and expansion of existing populations. Protection and management of suitable habitat will facilitate such natural population expansion and should remain a precursor to any re-introduction.

In the first instance, it is fundamental that all available knowledge of the species is collated, of both wild and captive populations. This should include current and historical population status, distribution, trends and threats, habitat use, degree of intraspecific variation, social systems, home range size, shelter and food requirements, foraging and feeding behaviour, predators and diseases that they are thought to be susceptible to. Furthermore, knowledge from closely-related Galliformes species may help to improve decision-making and re-introduction success. This should reduce the risk that mistakes made in other projects are repeated. It is critical to identify the history and causes of decline or local extinctions in the wild. It is unavoidable that basic biological knowledge is often lacking for threatened species, but every effort must be made to document their life history traits. Furthermore, conditions at proposed release sites must be assessed to ensure that the founder birds are (a) not going to be affected by pre-existing disease or (b) introduce new health risks into the environment, other species or existing populations that may be susceptible to disease transmission (e.g. closely related species).

In addition to the collation of available information, a re-introduction plan for a given species and site should also consider the following:

- the identification of founder stock and assessment of the impacts of removing them from captive or wild populations;
- the identification of suitable release sites; and
- the creation of draft release and post-release monitoring protocols, including an assessment of budget and other resource needs, with associated targets and timetables.

It would probably be inappropriate to consider a re-introduction where any of the following apply:

- there are circumstances where the security of birds or project workers is at risk e.g. civil instability, threat of poaching etc;
- there is inadequate knowledge of, or uncertainty concerning, habitat requirements or life history traits;
- a disease outbreak that affects the health of the donor or reintroduced population;
- the cause(s) of the original extirpation are not well understood or mitigated; or
- there is inadequate logistic, financial, institutional or public support.

3 Re-introduction of Galliformes for conservation purposes

3.1 Guidelines

In order to ensure that a potential re-introduction is thoroughly planned, the key issues to be considered are listed in the table below. These amplify the *IUCN Re-introduction Guidelines* (IUCN, 1998) and are designed to provide guidance on issues that relate directly to Galliformes.

Under the heading 'Rationale' is the number of the section that provides a short background to the issue and, where necessary, further information. Where appropriate the right hand column 'Proposed protocol' gives an Appendix where specific guidance is provided.

	Rationale (Section)	Proposed protocol (Appendix)
1) A re-introduction will usually only be considered appropriate if the following apply:		
i) There is a gap in the native range of a species where suitable habitat still exists	5.1.1	
ii) The issue that caused its local extinction is no longer relevant and no new threats have arisen	5.1.2	
iii) Natural recolonisation is unlikely	5.1.3	
iv) A source of the species exists that would not harm present wild or captive populations and is of appropriate genetic stock	5.1.4	
v) Ultimately, with the resources and area available, a self-sustaining population would result	5.1.5	
vi) Such action is not excusing the degradation of other populations/habitat	5.1.6	
vii) Such action will contribute to the local and national legislative objectives for conservation	5.1.7	
2) It is recommended that the feasibility of the project is investigated by:		
i) Developing clear aim and objectives	5.2.1	
ii) Previous re-introduction attempts on the same or related taxa being thoroughly researched	5.2.2	
iii) Determining and preparing as necessary an appropriate release site	5.2.3	
iv) Determining the availability of suitable release stock (either wild or captive)	5.2.4	
v) Modelling the effects of removing individuals from the donor population and adding them to the founder population	5.2.5	
vi) Considering the possible implications for both the donor and receiving ecosystem	5.2.6	
vii) Examining the attitudes of local people towards such a project	5.2.7	
viii) Exploring the socio-economic costs, benefits and impacts.		
ix) Identifying resource needs and sources	5.2.8	
x) Formulating draft post-release monitoring guidelines with reference to defined aims and objectives, and with regard to available resources		

	Rationale (Section)	Proposed protocol (Appendix)
3) The project should ideally be upheld by:		
i) Construction of a multi-disciplinary team	5.3.1	
ii) Political support	5.3.2	
iii) Correct national and international licensing	5.3.3	
iv) Realistic budgeting	5.3.4	2
v) Effective timing and duration	5.3.5	
vi) Identification of appropriate success indicators	5.3.6	
vii) Development of a conservation awareness programme	5.3.7	
4) The pre-release and release stages of the project should seriously consider the most appropriate:		
i) Trapping (if wild stock) or egg collecting (for megapodes)	5.4.1	3
ii) Transport and holding conditions	5.4.2	4
iii) Rearing techniques and preparation of the individual captive-bred birds for re-introduction	5.4.3	5
iv) Behavioural measures	5.4.4	
v) Health screening	5.4.5	
vi) Genetic screening	5.4.6	
vii) Marking	5.4.7	6
viii) Release strategy	5.4.8	
5) The post-release stage of the project should be prepared before release and include detailed strategies for:		
i) Post-release monitoring		
ii) Continued habitat management	5.5.1	
iii) Evaluation of success (scientific and socio-economic)	5.5.2	
iv) Intervention strategy	5.5.3	
v) Feedback mechanisms	5.5.4	
vi) Long-term financial viability	5.5.5	
	5.5.6	

3.2 Flowchart of activities

FEASIBILITY STAGE

- Considering a *re-introduction* e.g. the availability of habitat within the native range, a *supplementation* where numbers are low within the historic range, or a *conservation introduction* where suitable habitat exists outside the natural range and which does not impact any wild fauna or flora.
- Causes of previous decline addressed and/or reduced to a sustainable level in the long-term.
- If suitable habitat exists, there is a source of birds, either wild or captive, which have been demographically and genetically managed and whose survival upon release is expected to be close to or equal to a wild counterpart.
- The long-term viability of a released population is guaranteed.
- All social, political and economic concerns have been addressed to an acceptable level.
- The release project is carried out within a legal framework and contributes to biodiversity conventions to which the range State is a Party.
- A multidisciplinary team is established which oversees the project, is empowered to take radical decisions and develops and monitors success indicators.

FEED-BACK LOOP

PRE-RELEASE & RELEASE STAGE

- During the trapping of wild birds or use of captive-bred Galliformes for release projects the welfare of individuals should be of the highest importance.
- The transport and holding conditions should meet internationally acceptable guidelines e.g. International Air transport Association.
- The genetic and veterinary screening of Galliformes should be thorough and not risk genetic pollution of stock or the introduction of diseases into release site(s).
- The multidisciplinary team should plan a release strategy that addresses all possible scenarios: e.g. duration of project, evaluation of success indicators after release and the ability to terminate or delay a project due to unforeseen circumstances.

POST-RELEASE STAGE

- Post-release monitoring of the released population(s), as this is the only way to evaluate success indicators.
- Continued socio-political outreach programmes to ensure support of the project during this important release stage.
- Continued fund-raising initiatives to ensure the economic viability of the project as per the conditions laid out by the multidisciplinary team.
- Evaluate any mortalities and provide feedback to the multidisciplinary team to enable them to keep up-to-date with the fate of the released population(s) and make any adjustments in strategy if necessary.

LESSONS LEARNED

- Publish results of post-release monitoring in popular and scientific literature, whether the project is successful or not, so as to provide information for future projects with the same or related species.

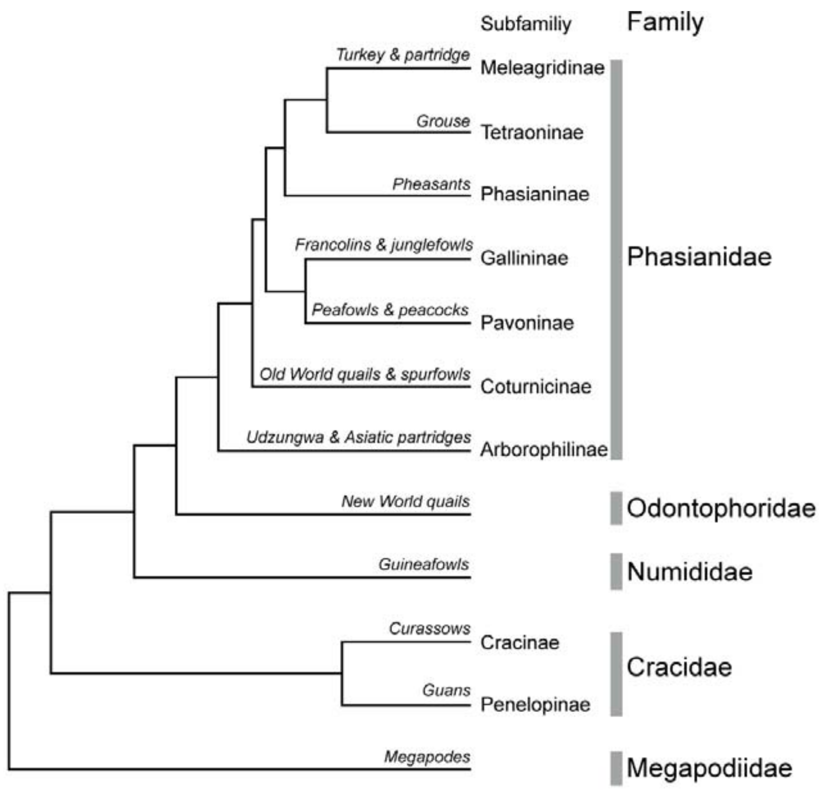
4 Background: taxonomy, ecology and conservation status of the Galliformes

4.1 Taxonomy and conservation genetics

The avian Order Galliformes contains more than 280 species of gamebirds currently distributed in 81 genera (Sibley and Ahlquist, 1990; del Hoyo *et al.*, 1994). Recently, Crowe *et al.* (2006) performed one of the most extensive studies on the phylogenetic relationships of Galliformes based on a combined data set of morphological, behavioural and molecular attributes. They proposed a classification for the group, recognising five monophyletic families: Megapodiidae, Cracidae, Numididae, Odontophoridae and Phasianidae (Figure 1). These same families have been considered by Kolm *et al.* (2007) using a supertree approach in which published phylogenetic trees rather than discrete characters are used to estimate phylogenetic relationships.

These two studies and others published earlier (reviewed in Crowe *et al.*, 2006) show that Megapodiidae, followed by Cracidae, is the sister group to all other Galliformes. However, the remaining relationships are still far from clear. Although many studies have pointed out that Numididae is a sister group to Odontophoridae plus Phasianidae, these relationships typically have limited statistical support. Similarly, the phylogenetic relationships within the Phasianidae are still poorly resolved (e.g. Dimcheff *et al.*, 2002; Dyke *et al.*, 2003, Crowe *et al.*, 2006) and more data are required to improve the resolution of these relationships. Below family-level, well-supported phylogenies have been proposed for megapodes (Birks and Edwards, 2002), many cracids (Pereira *et al.*, 2002; Pereira and Baker, 2004; Grau *et al.*, 2005), grouse (Lucchini *et al.*,

Figure 1: Phylogenetic relationships of Galliformes (modified from Crowe *et al.*, 2006). Family and subfamily names are given to the right and left of grey bars, respectively. Lineages' common names are indicated in italics.



2001; Drovetski, 2003), and some of the Phasianidae groups (Randi *et al.*, 2000; Lucchini *et al.*, 2001).

4.2 Ecology and conservation status

There are several monographs that cover various groups of Galliformes species, referred to in the sections below, and these should be consulted for detailed species-specific information. Other sources include the proceedings of the many symposia that have been held on the Galliformes, listed in Appendix 9.

The first monograph of the megapodes was published in three parts in the late 19th Century by Oustalet (Oustalet, 1879-80, 1880, 1881) and the most recent account of the family (Jones *et al.,* 1995) was the third monograph to be published in the *Bird families of the world* series by Oxford University Press. An extended summary is contained in the Megapodiidae section of Volume 2 of the *Handbook of the birds of the world* (Elliott, 1994). Two editions of the Action Plan *Megapodes: status survey and conservation action plan* by the WPA/Species Survival Commission/BirdLife Megapode Specialist Group (Dekker and McGowan, 1995; Dekker *et al.*, 2000) have been published.

The classic monograph of the cracids (Delacour and Amadon, 1973) has recently been reprinted (Delacour and Amadon, 2004) with a substantial update chapter that summarises all advances in knowledge made in the 30 years since the original book was published (del Hoyo and Motis, 2004). This update chapter built upon the extended summary in the Cracidae section of Volume 2 of the *Handbook of the birds of the world* (del Hoyo, 1994). One Action Plan *Curassows, guans and chachalacas: status survey and conservation action plan for the cracids* by the WPA/Species Survival Commission/BirdLife Cracid Specialist Group has been published (Brooks and Strahl, 2000). An online 'Action Plan' has since been published by an independent group (Brooks, 2006).

Perhaps surprisingly for such an extensively studied group, the only monograph covering all grouse species that were known at the time was *The grouse of the world* published in the early 1980s (Johnsgard, 1983). An extended summary is contained in the Tetraonidae section of Volume 2 of the *Handbook of the birds of the world* (de Juana, 1994). It seems likely that the huge volume of research that has been carried out on many of the grouse species since the mid-1980s has made it impractical to try and include all grouse species within a single monograph. Therefore, the trend has appeared to be towards the publication of monographs on single species, such as blue grouse (Zwickel and Bendell, 2004) and hazel grouse (Bergmann *et al.*, 1996). There is an extensive literature on these species, spread throughout a wide variety of journals and this should be consulted extensively before any plans for a re-introduction are finalised. Two editions of the Action Plan *Grouse: status survey and conservation action plan* by the WPA/Species Survival Commission/BirdLife Grouse Specialist Group (Storch, 2000; 2007) have been published.

Illegal trapping of western tragopan in Himachal Pradesh, Western Himalayas, India © Shahid B. Khan

Several monographs on the world's pheasants were published during the 20th Century: Beebe (1918-22), Delacour

(1977) and Johnsgard (1986; 1999). An extended summary is contained in the Phasianidae section of Volume 2 of the *Handbook of the birds of the world* (McGowan, 1994). Further information may be found in Madge and McGowan (2002) and in Hennache and Ottaviani (2005; 2006). Two editions of the Action Plan *Pheasants: status survey and conservation action plan* by the WPA/Species Survival Commission/ BirdLife Pheasant Specialist Group (McGowan and Garson, 1995; Fuller and Garson, 2000) have been published.

Wet season habitat at the white-winged guan re-introduction site
© Fernando Angulo

The remaining species are not a phylogentically distinct group and include the New World quail (Odontophoridae), partridges, francolin and Old World quail (Phasianidae), turkeys (Meleagrididae) and guineafowl (Numididae). They all fall under the remit of the Partridge, Quail and Francolin Specialist Group. There is one monograph dealing with the species in the Odontophoridae and Phasiandae (Johnsgard, 1988) and one on the guineafowl (Hastings Belshaw, 1985: see also Crowe, 1986). Extended summaries are contained in the Meleagrididae (Porter, 1994), Odontophoridae (Carroll, 1994), Phasianidae (McGowan, 1994) and Numididae (Martínez, 1994) sections of Volume 2 of the *Handbook of the birds of the world*. Further information on some of these species may be found in Madge and McGowan (2002). One edition of the Action Plan *Partridges, quails, francolins, snowcocks and guineafowl: status survey and conservation action plan* by the WPA/Species Survival Commission/BirdLife Pheasant Specialist Group has been published (McGowan *et al.*, 1995) and its successor also included the turkeys (*Partridges, quails, francolins snowcocks, guineafowl and turkeys: status survey and conservation action plan*: Fuller *et al.*, 2000).

4.2.1 Megapodes

Megapodes are a very well-defined family and the twenty-two species are often considered the most primitive of Galliformes (Elliot, 1994; Dekker *et al.*, 2000). Their distribution is generally confined to the Australasian region, stretching from Tonga in the east, through the western Pacific islands of Vanuatu and the Solomon Islands to New Guinea, Australia, eastern Indonesia and the Philippines in the west. Two species occur outside this area, to the north on the Mariana and Palau Islands (Micronesian megapode), and to the west on the Nicobar Islands (Nicobar megapode: Dekker *et al.*, 2000).

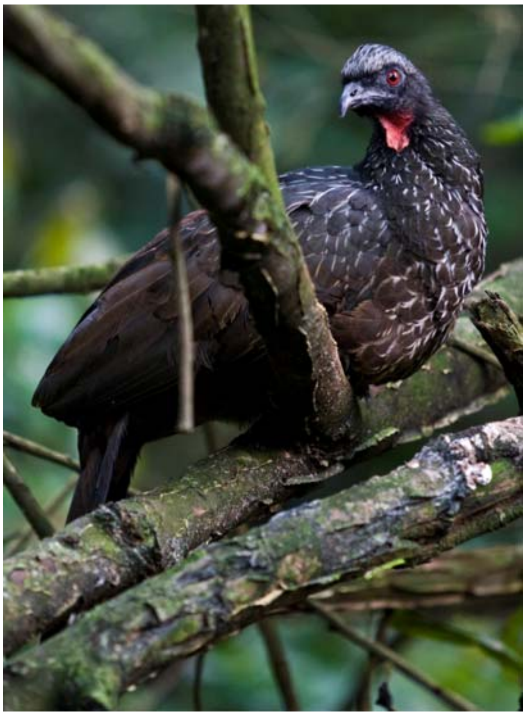
Female malleefowl on a nest mound
© Jessica Van Der Waag

Apart from the malleefowl, which lives in semi-arid southern Australia, all species prefer moist tropical forest and utilise coastal areas for breeding (Jones *et al.*, 1995). Consequently, they are closely united in morphology and breeding habits, which are in turn quite different from other Galliformes (Dekker *et al.*, 2000).

Perhaps the most distinct feature is that the birds bury their eggs to be artificially incubated by the surrounding environment (fungal decomposition, the sun or volcanic activity), and the chicks hatch and develop without any parental care. Furthermore, because suitable nesting sites may be scarce, many species breed communally. These features of life history have profound implications for the long-term survival of megapodes.

According to IUCN Red List criteria, four species are Endangered and five are Vulnerable (BirdLife International, 2008; IUCN, 2008). As with most Galliformes, habitat destruction and degradation are suspected to be the primary cause: for example the malleefowl *Leipoa ocellata* has suffered an >80% reduction in geographic range from timber harvesting (see Dekker *et al.*, 2000). Even the separation of forested and coastal areas by a road can have catastrophic influences on a population. In addition, by laying communally, megapodes provide a particularly abundant and convenient source of food that can be exploited easily. Increasing human populations have lead to unsustainable harvesting of eggs (e.g. Polynesian megapode *Megapodius pritchardii*) and the introduction of predators (dogs, cats, foxes), both of which can have a substantial impact on hatching rates and survival. However, if harvesting levels remain within sustainable limits, it is possible for humans to derive long-term benefits from exploiting megapode nesting grounds, and this is a key direction for promotion of megapode conservation.

There are a number of re-introduction programmes underway for megapodes. For example, malleefowl *Leipoa ocellata* have bred in captivity for release into restored habitat in New South Wales, Australia (Priddel and Wheeler, 1999) and have been the subject of a number of re-introductions attempts (Short, 2004). The Polynesian megapode *Megapodius pritchardii* (known locally as *malau*) has been translocated from Niafo'ou, where it is endemic, to neighbouring islands (Göth and Vogel, 1999; Watling, 2003, 2004). In the latter, however, the extent of establishment is unknown and so clarifying this is an immediate priority. Heij (2005) reports on a series of translocations of eggs of the Moluccan megapode *Eulipoa wallacei* to the traditional nesting ground at Haruku Village on the island of Haruku in the Moluccas, Indonesia. It appears that this was a supplementation and although the population decline has stabilised, and may even have reversed, the role of the translocation in this is not clear (Heij 2005). On 28 May 2007, the 4000th maleo *Macrocephalon maleo* chick raised from a hatchery project in Bogani Nani Wartabone National Park, Sulawesi was released (Tasirin, 2007). During this project eggs from the nesting ground have been carefully transferred to hatcheries where they were incubated in naturally heated soil and protected during the 60 day incubation period. When the maleo chicks emerged from the earth, guardians from local communities took them from the hatchery and let them fly into nearby protected forest. In combination with the protection of nesting grounds this project appears to have been successful so far (Tasirin, 2007).



Dusky-legged guan which has been re-introduced into several private reserves in Minas Gerais State, Brazil © Joao Marcos Rosa/Crax Brasil & Crax International

4.2.2 Cracids

The family Cracidae (curassows, guans and chachalacas) are large, frugivorous birds largely endemic to the Neotropical forests of Central and South America. There are fifty species distributed from southern Texas to the Paraná Delta of central Argentina and Uruguay, and they are amongst the most threatened avian families in the region (Brooks *et al.,* 2000). Although there are major gaps in our knowledge of the geographic ranges of many cracid species, their distributions are puzzling. They appear to be either particularly disjunct or parapatric, possibly as a consequence of habitat change, climate change or geographical barriers, but more investigation into their ecological history is required to understand their current distribution more fully. In addition, researchers still disagree on basic life-history traits, and so there is a clear need for further cracid research. Until such field data are collected, the effectiveness of conservation measures will be limited.

The IUCN Red List illustrates the vulnerability of this family. One species is Extinct in the wild (Alagoas curassow *Mitu mitu*) and a further 16 are listed as Vulnerable, Endangered or Critically Endangered (BirdLife International, 2008; IUCN, in press). This alarming conservation status could have significant wider ecological implications because cracids are thought to play a vital role in maintaining the structure of tropical forests. Chachalacas and guans are thought to play an important role in habitat regeneration through seed dispersal, whilst curassows regulate plant density by eating seeds. Several of these plant species are used heavily by humans, thereby making some cracids likely keystone species. They are also considered an effective indicator species, because their gregarious populations are easily surveyed and they are affected heavily by both hunting and habitat destruction (Brooks *et al.*, 2000).

Unsustainable human exploitation is thought to cause many local declines and extinctions. Cracids provide a major protein source for indigenous people and as such are intensively hunted. Furthermore, as a primary forest species, they are likely to be especially susceptible to habitat destruction. However, there is a growing awareness of their threatened status, and their intrinsic value is being brought to local, national and international attention. A particularly effective way of promoting their conservation may be through ecotourism, whereby revenues generated contribute to local livelihoods.

Cracids are known to breed in captivity and so a number of re-introductions using captive stock have been attempted, most notably in Brazil since the 1990s and in Peru since 2000. The source birds for a re-introduction of rusty-margined guan *Penelope superciliaris* and dusky-legged guan *Penelope obscura* in Brazil were obtained from captive stock and provide a good example for the assessment and mitigation of genetic variability when considering release (Pereira and Wajntal, 1999). Released birds have survived but the current population status is unknown as there was limited private funding for post-release monitoring. The white-winged guan *Penelope albipennis* re-introduction programme began in 2000 in Lambayeque, northern Peru using captive-bred birds from the Barbara D'Achille Breeding Centre. The number of chicks born in the wild is being used to determine success (Angulo, 2004).

The red-billed curassow *Crax blumenbachii* has been the subject of a remarkably successful breeding programme in Minas Gerais state in Brazil since the captive population was founded by six birds in 1978-9 (Silveira *et al.*, 2005). This programme has a 13 stage process from establishing the captive population to the post-release stages (*see Box 1, pg. 16*).

Crax Brasil and Crax International have been involved in the following re-introduction programmes:

Box 1: Red-billed curassow *Crax blumenbachii* captive breeding and re-introduction protocol developed by CRAX – Sociedade de Pesquisa e Manejo da Fauna Silvestre, based in Contagem, Minas Gerais and Crax International

The capture of two pairs of red-billed curassows close to Teixeira de Freitas, southern Bahia in 1978 and 1979, and the addition of another four birds from various parts of Espírito Santo between 1979 and 1985, led to the start of an integrated conservation program by Crax. This programme has 13 steps:

1. Defining the target species;
2. Preparation of the captive breeding project and its official approval;
3. Building the required infrastructure at Crax;
4. Obtaining the breeding stock;
5. Capacity-building in captive breeding and management;
6. Increasing the captive stock;
7. Identification and preliminary assessment of protected areas;
8. Preparation and official approval of re-introduction projects;
9. Building the required infra-structure in the reserves;
10. Re-introducing the birds and/or distributing them to other facilities;
11. Post-release monitoring;
12. Other actions targeting habitat recovery and conservation in the release sites; and
13. Communication, environmental education and exchange of scientific experience.

Source: Silveira et al. *(2005)*

- red-billed curassow *Crax blumenbachii* in (a) Reserva Particular do Patrimonio Natural (RPPN) Fazenda Macedonia, Santo Antonio de Ipaba - Minas Gerais State, (b) Reserva Particular do Patrimonio Natural (RPPN) de Peti Sao Goncalo do Rio Abaixo – Minas Gerais State, (c) Estacao Ecologica de Fechos, Nova Lima - Minas Gerais State, and (d) Reserva Ecologica de Guapiacu (REGUA), Cachoeiras de Macacu – Rio de Janeiro State;
- bare-faced curassow *Crax fasciolata* in the CEMIG Reserve, Igarape - Minas Gerais State;
- black-fronted piping-guan *Pipile jacutinga* in (a) Reserva Particular do Patrimonio Natural (RPPN) Fazenda Macedonia, Santo Antonio de Ipaba - Minas Gerais State and (b) Reserva Ecologica de Guapiacu (REGUA), Cachoeiras de Macacu – Rio de Janeiro State; and
- rusty-margined guan *Penelope obscura bronzina*: in (a) Reserva Particular do Patrimonio Natural (RPPN), Fazenda Macedonia, Santo Antonio de Ipaba - Minas Gerais State, (b) Reserva Particular do Patrimonio Natural (RPPN) de Peti Sao Goncalo do Rio Abaixo – Minas Gerais State and (c) Estacao Ecologica de Fechos, Nova Lima - Minas Gerais State.

Pereira and Wajntal (1999) reported that the dusky-legged guan *Penelope obscura bronzina* and rusty -margined guan *P. superciliaris jacupemba* were breeding in a reforested part of the Atlantic Forest that had been damaged during the construction of a hydroelectric power dam in São Paulo, Brazil. In addition, a conservation breeding programme for the Alagoas curassow *Mitu mitu* (IUCN Red List: Extinct in the wild) has been started.

4.2.3 Grouse

In 2006, the American Ornithologists' Union proposed the 19th species of grouse by suggesting that the blue grouse *Dendragapus obscurus* be split into two species: dusky *Dendragapus obscurus* and sooty *Dendragapus fuliginosus* (AOU, 2006). Grouse have the most northerly distribution of all the Galliformes, occurring throughout the temperate, boreal and arctic areas of the Northern hemisphere (e.g. Gunnison sage-grouse *Centrocercus minimus,* greater sage-grouse *C. urophasianus* and sharp-tailed grouse *Tympanuchus phasianellus*; capercaillie *Tetrao urogallus*; willow grouse *Lagopus lagopus* and rock ptarmigan *Lagopus mutus* respectively). Each species is finely adapted to distinct successional and altitudinal zones, yet they are widely distributed and show a considerable degree of geographic variation in life-history traits and ecology.

These features have effectively protected the grouse family: no species has been extirpated, although the heath hen *Tympanuchus c. cupido*, a subspecies of the greater prairie-chicken, became extinct in 1932. However, the recently recognised Gunnison sage-grouse is listed as Endangered and the lesser prairie-chicken *Tympanuchus pallidinctus* and the greater prairie-chicken *Tympanuchus cupido* as Vulnerable. Four species are considered to be Near Threatened (BirdLife International, 2008; IUCN, 2008). On local and regional scales, many populations of grouse are declining, particularly in densely populated and intensively used landscapes (Storch, 2000). Two recent studies on capercaillie phylogeography have shown that the cantabrian capercaillie (*Tetrao urogallus cantabricus*) has a high level of genetic differentiation in relation to the rest of the capercaillie subspecies (Duriez *et al.*, 2007; Rodríguez-Muñoz *et al.*, 2007). This is also the only capercaillie subspecies adapted to live in pure deciduous forests (Quevedo *et al.*, 2006) and qualifies as Endangered under IUCN criteria (Storch *et al.*, 2006).

Hazel grouse male in a breeding station
© Claus Beyer

Grouse are distinguished from other Galliformes by their convex bill, eye comb, spur-less tarsi and feathered feet and nostrils (adaptations to a cold climate) and their broad range of life histories and mating systems (ranging from monogamy to lekking) has led to them being intensively studied. Research suggests that most of the threats to grouse are a direct result of increasing human population and economic development – primarily habitat loss, contraction and fragmentation for conversion to agriculture or industrial production (Storch, 2000). Predation, direct exploitation and human disturbance are more relevant at a regional level.

Grouse are traditional elements of regional folklore (largely explained by the cultural and economic importance of grouse hunting) and because of this popularity, they are excellent flagship species to promote biodiversity and habitat preservation measures (Storch, 2000). In addition, they are often considered indicator species to the health of the ecosystem because in many cases their habitat requirements are quite specific. Therefore, conservation efforts targeted towards these species are likely to have beneficial effects for the many other species in these distinctive habitats.

The high profile and other traits of grouse make them attractive for re-introduction, and indeed there are many cases where it has been attempted (see for example Connelly, 1997), all involving the translocation of wild adults. Greater sage-grouse and sharp-tailed grouse projects in North America are relatively well documented, and often possess some degree of post-release monitoring and analysis (e.g. Musil *et al.*, 1993; Musil *et al.*, 1994; Reese and Connelly, 1997; Gardner, 1997; Rodgers, 1992; Snyder, 2001). The translocation of Gunnison sage-grouse, greater prairie-chicken and ruffed grouse has also been attempted (Toepfer, 1988; Toepfer *et al.*, 1990; Hoffman *et al.* 1992). Numerous translocations of the white-tailed ptarmigan *Lagopus leucurus* have been particularly successful (Braun *et al.*, 1978; Hoffman and Giesen, 1983; Starling, 1991) as has a re-introduction of Evermann's rock ptarmigan (Kaler, 2007).

Releases of captive-reared black grouse *Tetrao tetrix*, capercaillie (e.g. Klaus and Graf, 2000;

Cheer pheasant male
© Jean Howman

Scherzinger, 2000; Graf and Klaus, 2001) and hazel grouse *Bonasa bonasia* in central and western Europe are numerous. Provisional results of some are encouraging, but none have been proven to establish a viable population to date (Seiler *et al.*, 2000).

4.2.4 Pheasants

There are about fifty species of pheasant, depending on taxonomic authority. All are Asian in their native distributions with the exception of the Congo peafowl *Afropavo congensis* (endemic to central Africa) and a subspecies of the ring-necked (or common) pheasant (*Phasianus colchicus colchicus*), which is endemic to the Balkans of eastern Europe (Boev, 1997). The only surviving population of this subspecies inhabits the Nestos Delta of northern Greece (Sokos *et al.*, 2007): this is also the native western limit of the group, excluding the Congo peafowl (Sokos *in litt.* 2008). Within Asia, pheasants occur east of Java, through the equatorial forests of the Thai-Malay peninsula, to northeastern China. The Pheasant taxa also occur throughout the Himalayan chain and extend as far east as Taiwan (mikado pheasant *Syrmaticus mikado*, Swinhoe's pheasant *Lophura swinhoii*) and Japan (copper pheasant *Syrmaticus soemmerringii*, ring-necked pheasant) (Fuller and Garson, 2000).

Most pheasant species are dependent on heavily wooded habitats. These range from lowland tropical rainforest (e.g. crested fireback *Lophura ignita*) and montane tropical forest (e.g. mountain peacock-pheasant *Polyplectron imopinatum*) to temperate coniferous forests (e.g. western tragopan *Tragopan melanocephalus*). Some species are found in more open habitats, such as subalpine scrub (e.g. blood pheasant *Ithaginis cruentus*), alpine meadows (e.g. Chinese monal *Lophophorus lhuysii*) and grassland (e.g. cheer pheasant *Catreus wallichii*). There is substantial interspecific variation in size and males tend to have striking facial adornments, such as colourful crests, wattles and hackles. These are thought to be a function of sexual selection (i.e. courtship display) and result in some of the most visually spectacular birds in the world (McGowan, 1994).

As large and mainly terrestrial birds, they are significant food sources for humans and thus have long been associated with them (e.g. domestication of the red junglefowl *Gallus gallus*). Indeed, sixteen species have been introduced to non-native locations across Europe and North America for enhancing ornamental collections, sport, and the production of eggs, meat or feathers (Long, 1981). However, in their native ranges, nearly all pheasants have been exploited to some degree and are alarmingly threatened: according to IUCN Red List criteria, three are classified as Endangered (Edward's pheasant *Lophura edwardsi*, Vietnamese pheasant *Lophura hatinhensis* and Bornean peacock-pheasant *Polyplectron schleiermacheri*) and 18 are classified as Vulnerable (BirdLife International, 2008; IUCN, 2008).

Habitat loss, in various forms, is considered to be the primary cause of decline in most cases, usually where areas of forested habitat are degraded or destroyed through agricultural or urban encroachment. Furthermore, over-hunting, human disturbance and hybridisation with released stock have all contributed to recent declines of various species. However, their long relationship with humans can be utilised as a focus for conservation measures, such as habitat protection, sustainable harvesting or, if circumstances allow, re-introduction.

The ambitious, but ultimately unsuccessful, attempt to re-introduce the cheer pheasant to the Margalla Hills National Park in Pakistan suggested that the behavioural quality of the released birds was crucial. The mass rearing of chicks largely or entirely in the absence of adult birds produced poults that roosted on the ground at night and were generally very prone to predation (Garson *et al.*, 1992: see Box 2). Research on introduced and annually re-stocked ring-necked pheasant populations also provides similar results (e.g. Robertson, 1988), and demonstrates that captive-reared birds of both sexes are much less effective at breeding than their wild-reared counterparts (e.g. Hill and Robertson, 1988; Musil and Connelly, in press). Programmes are also underway to release the green peafowl *Pavo muticus*, mountain peacock-pheasant and Malaysian peacock-pheasant *Polyplectron malacense* (Zainal-Zahari *et al.*, 2001; Robbins and Corder, 2004; Robbins and Corder, 2005) (*see Box 2*).

Box 2: Attempted re-introduction of cheer pheasant in Pakistan

The feasibility of this re-introduction project was assessed in 1977 by Sheldon Severinghaus and colleagues (Severinghaus *et al.*, 1979). A site for a soft-release pen (Dhok Jiwan) was selected at only 700m, below the known altitude range for the species, and the site was on the very edge of the geographical range. The habitat (and altitude), given what was then known about the species' biology, seemed suitable: a mix of grass, scrub and scattered tree cover. The Margalla Hills were given greater conservation status in 1978, when the area was upgraded from a Game Sanctuary to a National Park. This resulted in a marked reduction in grass cutting, grazing and browsing by domestic stock, which in the course of time allowed a dense scrub to develop close to the original release pen and more generally. A new release site (Jabri) on the main ridge at >1,000m was established in 1983, and another (Gagra) at a higher and more remote location was used from 1988.

Implementation involved the transport of fertile eggs laid by birds in the aviaries of European WPA members to Islamabad, and thence the few kilometers to the incubation facilities and adjacent release pens. In each year some hundreds of eggs were sent to Pakistan, but avicultural problems such as excessive heat, incubator failure and disease outbreaks amongst the confined poults, resulted in few surviving to the point of release. This required the birds to fly out of their single large release pen, although they could return there via 'pop-holes' in the fence which only opened inwards. Evidence of a lack of anti-predator behaviour in the released birds led to rearing procedures that minimized human contact and increased parent-rearing, at the expense of incubators and broodies, from 1986 onwards. In 1987, the entire population of several hundred chicks died a few weeks after hatching as a result of bacterial and parasitic infections. An attempt was made to soft release smaller groups of poults, simulating the covey (family group) in nature, from multiple pens at Gagra in 1988-89.

The first serious attempt at post-release monitoring in 1981 involved radio-tagging ten poults (all of which were predated by foxes, jackals or civets). In 1984/85 up to six birds survived (from 38) for over six months, with a similar result in 1985. After the change in rearing conditions in 1986 there was evidence of better survival following release, and birds attempted to breed the subsequent year (i.e. 1987) and also in 1989. There is no good evidence that any wild-bred chicks survived beyond three months. By this time, in the light of research on wild cheer pheasant in India and successional changes from grassland to dense scrub in the Margalla Hills, it was concluded that the amount of suitable habitat available amounted to no more that three territories at Gagra and none anywhere else in the National Park.

Source: Garson (2008)

4.2.5 Partridges, Quails, Francolins, Snowcocks, Guineafowl and Turkeys

All other Galliformes are the responsibility of this Specialist Group – one hundred and forty seven species of partridges, quails, francolins, snowcocks, guineafowl and turkeys that are distributed worldwide and which are found on every continent except Antarctica (McGowan *et al.*, 1995). They occur in virtually every terrestrial habitat and are absent from only polar and boreal forest ecosystems. Open habitats that they are found in include tropical open country (e.g. grey-breasted francolin *Francolinus rufopictus*), deserts (e.g. see-see partridge *Ammoperdix griseogularis*, Gambel's quail *Callipepla gambelii*), temperate open country (e.g. grey partridge *Perdix perdix*) and high altitude alpine zones (e.g. Tibetan snowcock *Tetraogallus tibetanus*); whilst forested habitats include lowland tropical rainforest (e.g. crested wood-partridge *Rollulus rouloul*, white-breasted guineafowl *Agelastes meleagrides*), montane tropical forest (e.g. red-billed hill-partridge *Arborophila rubrirostris*, Venezuelan wood-quail *Odontophorus columbianus*), subtropical forests (e.g. Sichuan hill-partridge *Arborophila rufipectus*) and temperate forests (e.g. wild turkey *Meleagris gallopavo*).

As with the grouse family, current knowledge suggests that broad habitat requirements make this group relatively tolerant of habitat disturbance. However, when assessed for extinction risk against IUCN Red List criteria two species are judged to be Critically Endangered (Djibouti francolin *Francolinus ochropectus* and Himalayan quail *Ophrysia superciliosa*), six Endangered and 21 species are considered Vulnerable (BirdLife International, 2008; IUCN, in press). This is a relatively small proportion of treatened species when compared with other Galliformes groups, but the situation may be more fragile than these figures suggest. Firstly, the biological knowledge of several species is sparse and in some cases almost completely unknown (particularly those from remote mountain and tropical areas e.g. chestnut-throated partridge *Tetraophasis obscurus*, Schlegel's francolin *Francolinus* [=*Peliperdix*] *schlegelii*). Secondly, there is very little ecological information on which to judge the conservation status of many subspecies and isolated populations, as taxonomic opinion is divided over their grouping. If too many populations are treated separately, conservation effort may be diluted. Conversely, if too few are treated separately, significant biological diversity may be lost.

Some species in this group have been preserved through introduction or domestication and others are exploited to some degree in their native ranges. This is usually for meat consumption or sport, ranging from low-intensity, subsistence harvesting to levels supporting local economies through sustainable use programmes. If sufficient economic incentives can be gained through harvesting and managing these populations in a sustainable manner, species may be safeguarded. For example, there is considerable interest in restoring the grey partridge *Perdix perdix*, a formerly widely-hunted quarry species, to areas where it has become locally extinct or it is about to (Box 3). As with other Galliformes, partridges and their allies are often intertwined with local arts, religion, customs and folklore (*see Box 3, pg. 22*).

Brood of bobwhite quail
© Theron Terhune

Arguably, one of the most remarkable conservation success stories is the restoration of the wild turkey to almost all states of the USA. It has been estimated that the species may have numbered more than 10.2 million individuals in pre-Columbian times (Cardoza 2002/3). After Europeans arrived and started hunting the species and introducing increasingly intensive agricultural practices, numbers declined and by the mid 20th Century, the population was estimated at about 320,000 in scattered remnants in 18 states. Now the species is found in 49 states with an estimated population of some 5.4 million birds (Cardoza, 2002/3). This was not an easy path to success and many mistakes were made along the way. For example, in the early stages, there was little understanding of the species' biology and the rearing and releasing of birds was thought to be the answer. However, this turned out to be a disaster because of the disease blackhead as well as other problems (John Carroll *in litt.* 2007).

Releasing bobwhite quail
© Theron Terhune

Over time, the eastern states in the USA were reforested and an understanding of the species' biology allowed for land-use practices to be implemented that were more sympathetic to the species. Thus improved habitat conditions, together with a reduction in subsistence hunting, gave translocated wild birds every chance of success when re-introduced.

Grey francolin on a grassy verge in the United Arab Emirates
© Junid N. Shah

Box 3: Re-introduction protocol for grey partridge

Between 2004 and 2006, the Game and Wildlife Conservation Trust, based in England, investigated the best methods of re-establishing grey partridges through releasing in areas where they have either almost or entirely disappeared, and where a suitable environment has been restored. The main points of this research were:

- The experiment was based on 26 sites in eastern and southern England, and followed the fates and breeding success of 2023 released grey partridges, of which 131 were radio-tagged (at one site in each region).
- Five different releasing techniques were compared (bantam-reared and artificially-reared fostered juveniles, unfostered juveniles, family coveys released in late autumn and pairs released in spring).
- For the first six months after release, the survival of fostered birds was highest (20%) with no differences found between bantam-reared and artificially-reared juveniles, followed by autumn coveys (10%), spring pairs (9%) and unfostered juveniles (7%).
- For birds that managed to survive the first six months, the resighting rate after the next six months was much higher (36%), giving evidence of adaptation to the wild.
- Of the birds that survived to the breeding season, on average 89% remained within 1.5 km of the release site, indicating strong site fidelity.
- The breeding success of released birds that survived until autumn averaged 49% for fostered birds, 31% for autumn coveys, 24% for spring pairs and 0% for unfostered juveniles.
- Brood sizes of released birds did not differ from those produced by wild birds in the same areas in autumn.
- Breeding success in southern England was roughly half what it was in East Anglia, probably because of less intensive predator management.

On the basis of this research and over 30 years of grey partridge research and practical experience, the Game and Wildlife Conservation Trust produced Guidelines for Re-establishing grey partridges through Releasing: Where, When and How (Buner and Aebischer, 2008). These Guidelines seek to promote the best practice in grey partridge re-establishment attempts, in line with the internationally accepted IUCN Guidelines for Re-introductions. The main points of those grey partridge re-establishment guidelines are:

- Where grey partridges are still present (over 2 pairs/km2 on at least 4 km2), releasing is inappropriate. Instead, partridge recovery can and should be brought about solely through habitat improvements, predator management and disturbance management.
- Where no to very few grey partridges are still present (less than 2 pairs/km2 on at least 4 km^2), the following steps are required:

1. Before release, make sure that all suitable management measures are in place;
2. Organize suitable release stock;
3. Release birds to build fostering stock. This should include wild translocated birds. If none are available, release reared autumn coveys (ideally parent-reared), then foster chicks at an age of 5 weeks to already established barren pairs in the subsequent summer;
4. Monitor success; and
5. Repeat until the newly established population is self-sustainable. This will probably take at least five years.

Source: Buner and Aebischer (2008)

5 Rationale for each stage proposed in the guidelines

5.1 Assessing the conservation need for re-introduction

5.1.1 There is a gap in the native range where appropriate habitat still exists

The geographic distributions of many Galliformes species have changed considerably because of human activities and this has often led to non-natural gaps in their distribution (e.g. as a result of over-hunting). Further information on the fragmentation of species' distributions can be found in the general texts referred to in Section 3 and the degree to which this is a conservation problem is reported as part of the IUCN Red List process (e.g. Specialist Group Action Plans, BirdLife International 'factsheets' and the Red List itself).

Given the complexity of Galliformes' ecological requirements and their social interactions, it is important that any human-induced gaps in distribution that are identified should be fully assessed as to their potential for re-introduction. Many Galliformes have specific habitat requirements: for example, many primary forest species appear to be unable to tolerate extensive modification of their habitat (e.g. most species of pheasant and partridge from the Sundaic lowland forest of South East Asia [Wells, 1985]). Other species may be adapted to distinct successional stages. In these cases, although habitat may appear appropriate initially, detailed investigation of structure and composition is required to ensure that the habitat will fulfil the species' needs in the long-term (e.g. cheer pheasant [Garson *et al.*, 1992: see Box 2]).

It is important to remain aware of the possibility that habitat conditions may have changed since the extirpation of the original population. Such changes may render potential sites within the species' native range unsuitable for re-introductions. Habitat changes may be due to causes unrelated to historical population declines such that mitigation of the cause(s) of the original declines may not fully address habitat suitability issues. It is also important to consider degradation of apparently good habitat due to existing and planned structures such as powerlines, fences and wind turbines (=towers).

In exceptional circumstances, placements outside of a species' native range may be appropriate if they can be considered 'benign introductions'. The latter are defined in the *IUCN Guidelines for Re-introductions* (IUCN, 1998) as "...an attempt to establish a species, for the purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range". Perhaps the most recognised Galliformes project of this kind was the translocation of the Polynesian megapode from Niuafo'ou in Tonga, to the neighbouring island of Fonualie in the mid-1990s (Dekker, 2003; Watling, 2004), as mentioned in Section 5.2.1. Although the degree of endangerment of the source population was uncertain, it was situated

Polynesian megapode
© Ann Göth

Polynesian megapode eggs being translocated
© Ann Göth

on an active volcano and was also thought extremely vulnerable to introduced predators. Eggs were also taken to the island of Late in 1993 and buried around an inland lake. A survey in 2005 did not find any evidence of resulting Polynesian megapodes (Watling, 2004). In circumstances where stochastic events, such as volcanic eruption, are a distinct possibility, an introduction project outside of the native range may be a highly appropriate part of an overall strategy.

The reverse circumstances may also apply, whereby global extinctions of a keystone species could justify a sub-specific substitution involving the introduction of an appropriate closest extant relative to fulfil an important ecological role. An example of such a substitution is the restoration of ostrich *Struthio cumulus* in the Arabian Peninsula (Seddon and Soorae, 1999).

Early preparation can be useful, as in the case of the white-winged guan. Angulo and Barrio (2004) have surveyed an area outside of this guan's current range to determine the suitability of sites for re-introduction should it ever become necessary.

5.1.2 The issue that caused previous local extinction is no longer relevant

The previous cause(s) of decline and extinction must be identified and no longer operating. Such causes of local extinctions of Galliformes populations are typically human-driven and are often over-exploitation or habitat alteration. For example, the Alagoas curassow in the Atlantic Forest of north east Brazil was driven to extinction in the wild by a combination of these factors in the late 1980s (Collar *et al.*, 1992). However, factors such as disease, predation or competition with introduced species may also prove equally important. The grey partridge has long survived in farmed landscapes (Potts, 1986), but as these have become increasingly intensively managed, populations are thought exceptionally vulnerable to increased predation, nest failure and chick mortality (Anon, 1995). In this case, it is likely that a whole suite of factors will need to be assessed and judged to be suitable before a re-introduction can be attempted (see Box 3).

Hunting has reduced or extirpated many populations of Galliformes
© Ambika Aiyadurai

This highlights the fact that in many cases the pressures that caused local extinctions may well still be operating. Therefore, it is of course imperative to show that the re-introduced population would not suffer the same fate. For example, Galliformes have long been associated with humans as a food source (e.g. megapode eggs: see BirdLife International, 2001; Dekker *et al.,* 2000). Although such Galliformes are elemental to some indigenous peoples' livelihoods, continued hunting or collecting would inevitably prevent any population from becoming re-established. An appropriate example is the re-introduction of green peafowl into Peninsular Malaysia. Here, such a release project was determined appropriate because firearms were no longer freely available and conservation awareness was much increased, compared with forty years ago when the species became extinct (Robbins and Corder, 2005).

The creation of 'beetle banks' restored habitat prior to grey partridge releases
© Francis Buner

As noted in the previous section, many Galliformes have quite specific ecological requirements and so when habitat loss/ degradation is the primary cause of extinction, it may be difficult to determine that the specific form of habitat modification that was a problem, is no longer operating. However, once this has been clarified, the designation of legally protected areas and/or community-based protection of areas may mitigate, and even potentially eliminate, habitat destruction and/or hunting of reintroduced populations. This is happening with the white-winged guan, which has been released on communal lands and is planned to be re-introduced into a state-protected area (Flanagan and Angulo, 2002; Angulo, 2003).

In addition, it is possible that new pressures may have arisen that would threaten any released birds. Furthermore, it is often helpful when contemplating such circumstances to consider changes in the legal/political/cultural environment since the species declined. This could have relevance for future survival success; for example the species may now be legally protected, or social attitudes towards its hunting may have changed. The socio-economic opportunity offered by Galliformes species is potentially huge (e.g. ecotourism or sustainable harvesting), and this could be key in promoting re-introduction projects to the local community.

If the cause of decline was a stochastic event, either ecological or socio-economic, the argument for re-introduction could be weighty (for example, the loss of the Nicobar megapode *Megapodius nicobariensis* on Megapod island in the 2004 tsunami: see Sivakumar (2007) for a summary of post -tsunami issues facing this megapode.

5.1.3 Natural recolonisation is unlikely

If the remaining populations of species are stable or increasing, and if habitat is available, some avian species can naturally recolonise because they hold large territories, have high reproductive output, high dispersal ability etc. Although this may be applicable to some bird families, the majority of Galliformes tend to be relatively sedentary. As a consequence population expansion is fairly slow and may limit natural recolonisation considerably. Nevertheless, the potential for natural recolonisation should be seriously considered, as a re-introduction may not be appropriate if it is possible.

5.1.4 A suitable source of the species exists

Source birds could be sustainably harvested from the wild, or bred in captivity. It is desirable that source animals originate from stable or increasing populations, as one population should not be degraded in favour of another. Furthermore, the sourcing of birds should not have a negative effect on the population dynamics or stability, or cause a genetic bottleneck.

If there is a choice of founder stock for translocation, ideally the birds should be closely related genetically to the native stock and show similar characteristics (morphology, physiology, behaviour, ecology) to the population that has gone extinct. In addition, it must also be ensured that the source population has not suffered from inbreeding and a study of genetic heterozygosity will determine this (Pereira and Wajntal, 2001a, b). It is fortunate that molecular structures of several Galliformes are well studied and so genetic references are available. Randi (2004) explains how DNA analysis can contribute to conservation.

5.1.5 Ultimately, a self-sustaining population would result

A re-introduction should result in a self-sustaining population. A self-sustaining population is not necessarily large in numbers or occupies an extensive area, but is stable or even increasing in numbers in the long-term, survives independently of manipulative actions, and is resilient against genetic inbreeding or even outbreeding (see Edmands, 2007) and stochastic events. The most useful tool to predict such a requirement is Population Viability Analysis (PVA) and Seddon *et al.* (2007) provide a review of its use in re-introduction projects. In many cases to date, predictions of population status have not been made this rigorously.

5.1.6 Such action is not excusing the degradation of other populations/ habitat

Re-introduction may initially appear very tempting as it can be seen to be 'doing something': the erection of facilities, the housing of stock and the release of birds can all be seen and documented. In contrast, it is often difficult to show that progress is being made with other conservation interventions, such as community awareness programmes or habitat protection. Consequently, in some circumstances the pressure to be seen to be taking conservation action may result in re-introduction being proposed when it is not the most appropriate course of action. Therefore, any re-introduction programme should not be determined on these grounds alone and should be part of an overall recovery strategy and include an objective assessment of the species needs. It must be ensured that the re-introduction programme to be initiated is the most appropriate course of action to safeguard (or restore) the species' overall conservation status.

5.1.7 Such action will contribute to legislative objectives

The United Nations Conference on Environment and Development in Rio de Janeiro in 1992 led to the Convention on Biological Diversity. By mid 2006, there were 188 Parties to the Convention. As stated in Section 2.3 *Considering a re-introduction*, this places obligations upon signatories, and re-introduction is one of the tools that may be considered to meet these obligations. The need for re-introduction may be considered as part of the National Biodiversity Strategy and Action Planning process that all signatories should undertake. For example, in the UK, there are targets for both grey partridge *Perdix perdix* (**http://www.ukbap.org.uk/UKPlans.aspx?ID=506**) and capercaillie *Tetrao urogallus* **http://www.ukbap.org.uk/UKPlans.aspx?ID=597**) for range expansion and for which re-introduction may be appropriate. The grey partridge plan led to research designed to identify how to reintroduce the species most effectively (see Buner and Aebischer, 2008).

5.2 Assessing the feasibility of re-introduction

5.2.1 Defining the aim and objectives of a project

Any galliform re-introduction for conservation should have the ultimate aim of producing a viable, free-living population in the wild. This will thereby contribute towards the overall preservation of the individual species and reduce biodiversity loss within the order. Reference to the Species Survival Commission Strategic Plan for 2001-2010 (**http://intranet.iucn.org/webfiles/doc/archive/2001/IUCN896.pdf**) may be useful in general terms and more specific species level targets can be found in Action Plans and through the IUCN Red List (**www.redlist.org**).

The aim and objectives for projects will be specific to each context and should be quantitative, relating to its individual purpose. They should be precise and realistic enough to be achievable, but set primarily in a long-term context. For example, the aim of the white-winged guan re-introduction programme is to establish a population that will be viable in the long term. It seeks to achieve this through two objectives. The first one is the successful breeding by reintroduced individuals and their offspring, so that re-established populations can connect with surrounding extant populations, and thereby avoid inbreeding depression. To enhance the security of the re-introduced birds, the project's second objective is to give to the community (land owners and *campesinos*) a resource that, if well-managed, can be converted into financial benefit, for example, through tourism (Angulo, 2004).

It is vital that the aim and objectives are clear throughout the project for a variety of reasons, and that the objectives include both short- and long-term goals. Whereas long-term goals typically include species preservation and self-sustaining populations, short-term objectives (e.g. survival, reproduction) will provide more immediate insight to the success of the relocation, guiding future decision making. There are three reasons (at least) why well-defined aim and objectives are made clear at the start. Firstly, such statements illustrate background knowledge and planning, and are a necessary element in applying for funding. Secondly, well-defined objectives provide a focus for all people involved, so that energy and emphasis do not drift away from the principal intentions of the re-introduction. Thirdly, they provide a context in which to measure the success of each phase of the overall project (see Seddon 1999; and Sections 5.2.5 *Population Viability Analysis* and 5.3.6 *Identification of success indicators* below).

5.2.2 Biological considerations: previous re-introductions

When investigating the feasibility of a re-introduction project, thorough research into previous translocations of the same or similar species is a fundamental element. This will provide essential insight into the appropriate methods and allow contact with persons of relevant expertise. Published findings should usually be treated with caution, as more recent research may have come to light, and publication bias means that negative outcomes tend not to be widely known. This indicates that in the future all results should be published and not just positive ones.

The Re-introduction Specialist Group, the relevant taxonomic SG and WPA should all be contacted, as well as other relevant Specialist Groups (e.g. Wildlife Health [=formerly Veterinary], Conservation Breeding). There will often be a variety of other international organisations with appropriate expertise as well as those at national or local level, including government agencies.

5.2.3 Biological considerations: choice and evaluation of release site

As explained in Sections 5.1.1 and 5.1.2, the release area for a re-introduction should be within the historical range of the species (where appropriate habitat still exists), and ideally have assured, long-term protection, whether formal or otherwise. Assessing the quality of the habitat is critical and in many cases habitat restoration/management might be required before a project starts. High connectivity with the surrounding landscape, or large areas of contiguous habitat, is usually far more preferable to releasing birds into isolated patches that may be too small to sustain viable populations and that have little potential for natural population expansion through natural dispersal. These issues are all concerned with making the correct ecological assessment of the proposed release site and several of the preceding sections outline the key requirements.

Once sites that satisfy the ecological requirements have been identified, the choice of specific release location will, to a certain extent, depend upon the practicalities of releasing the birds and, more critically, being able to reliably monitor their fates and conduct any post-release intervention that may be necessary.

Overall, there are a number of requirements for the ideal release site, which should:
Ecological considerations
- be within the species' historical range;
- comprise a sufficiently large area of typical habitat;
- present no disease concerns to wild populations of any species;
- have adequate habitat for various activities (e.g. nesting, brood-rearing and roosting cover); and
- ensure that release sites are not in or near areas of high predator density.

Logistical considerations
- have provision for good communication links;
- be secure for project staff;
- be unaffected by human disturbance; and
- facilitate appropriate post-release monitoring.

5.2.4 Biological considerations: availability of suitable release stock

The sourcing of birds for re-introduction must not harm present populations and should be of appropriate (i.e. non-harmful) genetic stock. The taxonomic status of all remaining populations should be studied and, in most cases, the same subspecies or race should be used for re-introduction as those which were extirpated (unless adequate numbers are not available). DNA fingerprinting and microsatellite analysis to obtain this information can be gathered from various resources, e.g. egg shells, feathers and leg scales, without being too invasive. Further information is given under genetic screening in Section 5.4.6.

Some Galliformes species have been subject to intensive breeding for non-conservation purposes in captivity and it is important that no domesticated birds are released. This may apply to some stocks of red junglefowl, *Alectoris* partridges (see Barilani *et al.*, 2007 [Box 4]; Barbanera *et al.,* 2007; in press), bobwhite quail, common quail *Coturnix corurnix* (see Puigcerver et al. 2007) and grey partridge amongst others (*see Box 4, pg. 29*).

It is critical that adequate numbers of birds are available for release, ideally on a regular and predictable basis, meeting the specifications of the project PVA analysis and release strategy.

Box 4: Releasing and hybridisation of wild red-legged and rock partridges

The seven species of *Alectoris* partridges that are found in Europe, northern Asia and southern Arabia are capable of producing fertile hybrids. Only two species overlap in their geographic ranges although natural hybridisation has been reported in contact between zones between some species.

In southern Europe, red-legged *A. rufa* and rock *A. graeca* partridges have declined as a result of habitat changes and over-hunting. At the same time there have been releases of substantial numbers of captive-bred partridges that are often hybrids with the non-native chukar *A. chukar*. To assess whether this releasing has had any impact on the genetic integrity of wild populations of *Alectoris* species in the release areas, 671 samples were taken from nine regions across the native range of all three species (red-legged, rock and chukar). Samples were assigned to each species, or were identified as hybrids, on the basis of the diagnostic morphological traits and geographic distribution.

DNA analysis suggested that:

- 6.2% of the samples were found to have mtDNA haplotypes that were not as expected from their appearance and locality;
- 5.1% of rock partridge samples were hybridised mainly with chukar
- 39 samples from a natural re-legged x rock hybrid zone contained 28% of birds had typical chukar mtDNA.
- Chukar DNA was detectable in Alpine populations of rock partridge up to 100 km from this hybrid zone.

These results (and other studies) suggest that hybridisation with chukar partridges has become a problem across the entire distribution of both red-legged and rock partridge

Source: Barilani et al. (2007)

The following two subsections outline a number of considerations specific to using wild or captive Galliformes for release.

5.2.4.1 Wild source

Fischer and Lindenmayer (2000) found that re-introductions 'appeared' to be more successful when wild sources were used. They did, however, acknowledge that other factors seem likely to be important and that determining success was difficult because of a lack of widely accepted and applied criteria for assessing success.

The use of wild stock could involve removing eggs (e.g. malleefowl), young individuals (e.g. capercaillie [Schroth, 1991]) or adults from established populations (e.g. sharp-tailed grouse [Gardner, 1997] and sage-grouse [Musil *et al.,* 1993, 1994] in Idaho, USA). In all cases, eggs and birds should only be removed from a wild population after the effects of translocation on the donor population have been assessed, and after it is concluded that these effects will not be negative. For example, in the case of a mid-1990s malleefowl translocation, a maximum of half of the total clutch of

Translocation of sage-grouse
© Jack Connelly

eggs was collected from each mound for artificial incubation. The mounds were selected on the basis of recent activity and excavated only once to remove the eggs.

Removing eggs from megapode nests may often be appropriate because the young have no association with the parents. However, the translocation of very young pheasants, where some stay learning from their parents for the next season, might prove to negatively affect their learned behaviour. However, it could be considered whether this learning may be mimicked in different rearing circumstances (see Section 5.4.3).

If release stock is wild-caught (see Section 5.4.1 and Appendix 3 for appropriate methods), care must be taken to ensure that (i) the stock is free from pathogens and parasites before transportation and (ii) the stock will not be exposed to vectors of disease agents which may be present at the release site (and absent at the source site) and to which it may have no acquired immunity (See section 5.4.5).

5.2.4.2 Captive source

Captive propagation can fulfil four functions when planning conservation releases: (i) providing individuals for basic research in population biology, reproductive biology etc. (ii) providing individuals for basic research in care and management techniques (iii) providing demographic or genetic reservoirs for enhancing existing natural population or establishing new ones and (iv) providing a final refuge for species with no immediate hope of survival in the wild (IUCN, 2002). The first two functions should be highly refined before a re-introduction is considered, with information obtained from conservation breeding or elsewhere.

If captive or artificially propagated stock is to be used, it must be from a population in good physical health that has been soundly managed both demographically and genetically according to the principles of contemporary conservation breeding (IUCN, 2002). If the population has been held in captivity for a long time, its genetic health should be assessed using molecular techniques: Ruokenen *et al.* (2007) concluded that as a result of past hybridisation (involving three species) the current captive population of the lesser white-fronted goose was unsuitable for re-introduction or supplementation. Pinceel (2001) reported that a comparison of mtDNA sequences showed that most of the captive European population of Lady Amherst's pheasant *Chrysolophus amherstiae* are hybrids with golden pheasant *C. pictus*. As noted above, some Galliformes species have been intensively bred in captivity and therefore include domesticated populations.

Ideally, subspecies and distinct geographical forms should be managed separately, and caution exercised if this has not been the case in the past (Grau *et al.*, 2003). Translocations should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock (IUCN, 1998).

For threatened species, captive management should not reduce their prospects of survival in its wild habitat in the future. Some species that have been in captivity a long time and which have assumed conservation importance in recent years will have to overcome this adaptation if they are to fulfil their conservation potential. Captive propagation programmes should be founded upon an in-depth evaluation of genetic, demographic and behavioural factors (Hennache and Saint Jalme, 2004).

For example, around 50 birds possessing morphological features of Extinct-in-the-wild Alagoas curassow are still alive in captivity in Brazil. They are all descendants from a breeding programme started in 1979, using offspring from a single male and two females captured from the wild. However, this captive population also includes some hybrids with the congeneric razor -billed curassow *Mitu tuberosa,* so the validity of Alagoas curassow as a species for re-introduction was thought questionable. Grau *et al.* (2003) used molecular markers to study this by detecting potential hybrids present in the stock and estimating genetic variability among the remnant specimens. Concurrent sampling from museum skins confirmed the Alagoas curassow as a valid species, but only those born before 1990. These birds can now be managed appropriately and have potential for a re-introduction scheme (Grau *et al.*, 2003).

Care must be taken to ensure that (i) the stock is free from pathogens and parasites before transportation and (ii) the stock will not be exposed to vectors of disease agents which may be present at the release and to which it may have no acquired immunity (See section 5.4.5 regarding health screening). Behavioural considerations may also be a significant issue when releasing captive-bred stock (see section 5.4.4). Experience with the captive breeding of grouse has shown that the greatest success is likely to be achieved where natural conditions are closely copied and contact with man avoided (Starling, 1991). In the case of the white-winged guan, the re-introduced birds come from captive bred stock at a private captive breeding centre. The most suitable birds for re-introduction, in terms of adaptability, reproduction and survival, are thought to be parent-reared guans born in captivity (Angulo, 2006).

Currently, about half of the Galliformes species are present in captivity around the world, and around 25% of these are threatened in the wild. This stock must be managed to provide an effective population to contribute to future conservation programmes, which should involve maintenance of genetic diversity. Studbooks are designed to achieve this, by documenting the pedigree of individual birds in captivity: each book for each species is held by a coordinator (Hennache and Saint Jalme, 2004).

5.2.5 Biological considerations: modelling the effects upon both donor and founder populations

Computer simulation models are now used routinely to predict changes in the status of populations that are of conservation concern (Seddon *et al.*, 2007), and so are clearly applicable to re-introduction programmes. The build-up of the released population should be modelled under various sets of conditions in order to specify the optimal number and composition of individuals to be released per year and the number of years necessary to promote establishment of a viable population. It should be considered that not all released pairs will produce young. To perform these simulations, reasonable estimates of vital rates (nest success, survival, etc.) of the re-introduced birds are needed and which may be quite a bit lower initially than for resident wild populations.

It is inappropriate to stock (through single or repeated translocations) to densities greater than habitats in the release site can support over time, and the strategy needs to allow time and space for population growth and persistence. Generally, the short-term objective of a release project is to find a method to minimize the risk of extinction, and in the longer-term to promote conditions in which the species retain their potential for evolutionary change without intensive management (minimum viable population [MVP]). For example, when considering the re-introduction of capercaillie to southern Scotland, simulations estimated that a minimum of 60 individuals would be required across 5000 hectares of habitat in order for the population to have a >0.95 probability of surviving for 50 years. Supplementation of populations with two unrelated individuals every five years reduced the minimum viable population to ten individuals

(Marshall and Edwards-Jones, 1998). Alternatively, collation and analysis of numerous grouse re-introduction projects using captive-reared birds, suggests that annual releases of at least 30 birds are necessary for at least six years, in order to establish a population with 50% probability of survival and reproduction (Seiler *et al.*, 2000).

Population Viability Analysis (PVA) is a modelling approach to assessing extinction risk, and is defined as 'a systematic evaluation of the relative importance of factors that place a population at risk' (Soulé, 1987). Although many factors that might affect small populations (see, for example, Mills *et al.*, 2005) are random and stochastic, specific life history traits are normally well defined. Given adequate data, simple, deterministic PVA models are surprisingly accurate, and they work well when focused on a single species under comparable management regimes (Akcakaya and Sjogren-Gulve, 2000; Brook *et al.*, 2000). With severely threatened species it is necessary to 'borrow' parameter values from abundant and better-documented species. However, Keedwell (2004) emphasises that, from practical conservation experience, too much reliance on preliminary PVA could lead to poor management decisions. For the most effective strategy, therefore, it is imperative that feedback and results are applied into the model as post-release data is gathered, and common sense is used when evaluating quantitative outputs.

Often, the model must be run many times, with different combinations of low and high values of each parameter to make sure that all uncertainty within parameter values is accounted for. Sensitivity analysis would then determine which features need to be estimated more carefully and are of significant influence, which in turn gives information about the effectiveness of different management options.

Zhang and Zheng (2007) have conducted a PVA for the Vulnerable Cabot's tragopan *Tragopan caboti* in Wuyanling National Nature Reserve in southeastern China. Part of the reserve is a former forest farm and thus there is a variety of human-modified and natural habitats in the reserve. The model predicted that the population would increase over the next 50 years before declining slightly in the following 50 years. They concluded that this analysis has provided informative guidance for future management of this population.

5.2.6 Biological considerations: implications for ecosystem

An understanding of the effect that the translocation of species will have on the source and founding ecosystem would be valuable in assessing how desirable the proposed re-introduction is. If a species has been extinct for a long time, the niche void may have been filled.

There is little information on the impact of restoring Galliformes to ecosystems (or even removing them from ecosystems). For example, although it has been suggested that cracids may be 'keystone' species because of their frugivorous diet (e.g. Brooks and Strahl, 2000), field data are required to show that this is indeed the case. Despite the lack of information, it is important to consider whether there may be wider ecosystem implications of a re-introduction. For example, altering the numbers of prey species (removing individuals from donor populations and adding them at the re-introduction site) may have an impact on predators and other prey species. Whenever habitat management is considered as an option, it should be borne in mind that the re-introduced species is not the only one using that habitat and that management will have consequences for all species that comprise the ecosystem.

5.2.7 Socio-economic considerations: attitudes of local people

Participatory approaches can be invaluable in assessing local attitudes
© Kerry Waylen

Whilst biological considerations are obviously essential for determining the feasibility of a re-introduction project, addressing human concerns is equally vital if conservation actions are to have the best possible chances of success. Ultimately, releases can only be successful if they have the support of the local community that they may affect, or that could affect them. In terms of criteria used to select a specific site for re-introduction, this means priority might be given to areas which contain locally valued species, where there is high potential for conservation education, or where the prospects for successfully linking conservation and development are promising. In contrast, the lack of local support can make various aspects of the re-introduction very difficult or even impossible to achieve. For example, an ongoing project to re-introduce mountain quail *Oreortyx pictus* to former habitats in one North American locality, had difficulty monitoring survival and reproduction of the released quail because one of the larger landowners has denied access to their land over which the birds have dispersed (J Connelly *in litt.*, 2007).

Rather then being determined by top-down decision making, it is vital that re-introduction planning is conducted as far as possible by local and regional experts, or at least in consultation with them. They will have access to the community structure, recognise attitudes and political etiquettes, and have contacts throughout the area. A thorough assessment of the attitudes of local people to the proposed project is necessary to ensure long-term protection of the reintroduced population, especially if the cause of the species' decline was a result of human activities, as is often the case with Galliformes (e.g. over-hunting, disturbance, loss or alteration of habitat). Participatory approaches should be used where possible, not only to best understand local perceptions (Mukherjee, 1993), but also to build local capacity (so any related conservation projects both involve and benefit local people), and to encourage participation and enthusiasm in any future research and conservation programmes (Kapila and Lyon, 2006). The term used to describe efforts to involve local people in the conservation of their local resources, which often involves some type of enterprise designed to promote both development and conservation, is 'community based conservation'.

James and Hislop (1997) describe in detail efforts to educate and involve Trinidadians in the conservation of the Trinidad piping-guan *Pipile pipile* (known locally as *pawi*) through an education programme run by the Wildlife Section in the early 1980s. In collaboration with educational organisations, articles and posters were delivered to schools, students and teachers were given lectures and field trips, and a museum specimen and lecture were given to hunter groups. The National Parks Section was given resource material to use in an 'Environmental Bus Education Campaign', and the Post Office issued stamps on endangered species that included the species. The Pointe-a-Pierre Wildfowl Trust also tried to increase public awareness of the piping-guan status through personal contact, calendars and postcards.

Community involvement in white-winged guan re-introduction
© Fernando Angulo

A decade later, the National Parks section of the Forestry Division organised a conservation education campaign in North Eastern Trinidad, which lasted one year, from summer 1997 to summer 1998 (Butler, 1998). This was based upon the educational strategy 'Promoting Protection through Pride' developed by the RARE Centre for Tropical Conservation, and used the piping-guan as a flagship species around which activities were focused with school, community and church groups. Fact sheets, posters, billboards, bumper stickers, costumes and songs were all used to inform and generate pride in the species. Comparison of the returns from a questionnaire administered before and after the survey suggested that the campaign was effective: for example, knowledge that the piping-guan is a 'type of bird' increased from 49% to 76% (Butler, 1998). Although Temple (1999) considered that this campaign was 'too little too late' and targeted the wrong audiences for immediate impact, this effect is encouraging for future education programmes.

5.2.8 Socio-economic considerations: socio-economic impacts

Socio-economic studies should be made to assess impacts, costs and benefits of the translocation programme for the local community. There is very little information on this aspect specifically related to Galliformes, although viewing and photographing grouse on leks is becoming more and more popular in North America (J Connelly *in litt.*, 2007). There is also scope for ecotourism to affect the perception that local people have of some species. For example, building on the understanding of local perceptions of the Trinidad piping-guan explored above, recently it has been found that well-established turtle-watching tourism has resulted in more awareness about the species' conservation status than was the case for the similarly Critically Endangered Trinidad piping-guan that lives around the same community (see Waylen *et al.* in press). This is because the birdwatchers that come to see the piping-guan do not stay overnight and therefore no benefits fall to the local community.

5.3 Project logistics

5.3.1 Construction of a multidisciplinary team

It is recommended that any re-introduction programme forms professional partnerships with other organisations, as this will give access to a range of expertise and facilitate thorough planning. In the first instance, the WPA or IUCN/SSC Specialist Groups (http://www.iucn.org/themes/ssc/sgs/sgs.htm) should be the primary point of contact, as they can provide appropriate resources and contacts. Once links are established, it is usual practice to outline respective responsibilities in a Memorandum of Understanding between the parties.

Communication is imperative throughout all levels of participation, and regular contact between local, national and international participants is advised. Quite often, an efficient method is to

form a committee, inviting representatives of all relevant parties and those with technical expertise, to regularly review and evaluate the work-in-progress and future actions.
In addition, to facilitating proper planning and coordination on-site, a local team needs to be established at both the source and release areas to provide effective coordination and smooth operation of day-to-day activities. This should be headed by a project leader.

It is recommended that the following representatives be consulted regularly as part of the re-introduction process or, better still, form part of the multi-disciplinary team:

- WPA/IUCN Galliformes and re-introductions specialists;
- local community representative;
- government representative for policy and legislation;
- government representative on ecological issues;
- veterinarian;
- wildlife manager/park manager;
- conservation breeding specialist (if necessary);
- funding agent; and
- administrative and financial managers (accountants).

It may also be useful to involve forest, range or grassland ecologists who are specialists in the plant community that will support the re-introduced population. In addition, there may be other people necessary according to local context. For example, for a transboundary project, an inter-government representative(s) would be required.

5.3.2 Political support

As re-introductions are generally long-term projects there will be a need for long-term political support. Consultation with relevant legislative agencies must begin well in advance of any planned re-introduction, and it is highly recommended that adequate funding be secured for all programme phases. Potential funding avenues include government agencies, academic research funds, non-governmental organisations, foundations or private/industrial sponsorship.

It is essential that any re-introduction project satisfies all participatory political agents, both local, national and international, so that (i) financial support is easier to obtain (ii) the project fulfils legislative demands and the licensing practicalities will not prove a hindrance in the later stages, and (iii) evaluation of the project can be carried out openly and honestly, therefore being more thorough and useful to all involved.

Each country develops its own policy on biodiversity and sometimes a coherent conservation strategy may not be fully developed. The great variety of measures adopted reflects very different political and cultural situations, and the different influences exerted by history, power structures and economic realities. In addition, the way in which national policies are structured and coordinated are particular to individual organisations and it may be a delicate task to reconcile the different, and sometimes contradictory, demands. This is particularly relevant when projects span regional/national borders.

5.3.3 Correct national and international licensing

The re-introduction policy of the source and receiving country should be assessed. This will include checking existing provincial, national and international legislation and regulations, and provision of new measures and required permits as necessary.

In addition, the legal status of the species to be translocated and the legal status of the land in the source and release sites, must be considered during the planning stage. This will probably include regulations pertaining to the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES is an international trade treaty that was created to regulate international trade in endangered species. Import and export licenses must be obtained for listed species, proving that the stock is of acceptable origin and for an authorised purpose.

5.3.4 Realistic budgeting

Re-introductions are an expensive and long-term conservation measure. To ensure that the project runs efficiently and with the best chance of success, it is important that the budget is detailed and accurate, and that the donors are committed to such financial requirements. Budgeting must be realistic and be based on current market rates, although specific costs will vary between countries. It is sometimes helpful to prepare the different phases of the project separately, e.g. planning, preparation, holding and release, and post-release.

Costs are highly variable relative to the number of staff and source/release strategy, and very few case studies report the cost of the relocation attempt (Fischer and Lindenmayer, 2000), but when compiling a budget, remember to include:

- cash and in-kind contributions;
- project evaluation costs, including post-release monitoring over several years;
- running costs e.g. salaries, fuel;
- transportation costs;
- research equipment;
- any administrative or management costs;
- contingency funds;
- community participation (a value must be given to this contribution); and
- the analysis of data and production of reports, research papers and other communications

Appendix 2 presents a sample budget indicating a minimum set of activities and items that should be budgeted for at each stage of the re-introduction process.

5.3.5 Effective timing and duration of programme

The duration of the programme should be indicated by the Population Viability Analysis (see Section 5.2.5) wherever possible. However, this will assume that the best-possible methods are applied and so in some cases other approaches may be used to propose a realistic duration for the release programme. If advances in knowledge are made during the course of the re-introduction, the methodology used will probably change. This information should then be fed back into the PVA to provide new estimates of efficient release strategy and duration. It should be ensured that appropriate source stock is available and guaranteed for the duration of the release programme.
In addition, the timing of a release should give the released birds every chance of surviving. This will vary according to:

- availability of source stock;
- life history traits of the species e.g. timing of moult, whether monogamous or polygamous;
- geographical location e.g. some species undertake altitudinal migration in the Himalayas and

so the timing of release should take this into account;
- habitat e.g. some habitats change their structure according to the seasons of the year and this may affect the distribution of wild birds and their survival prospects;
- method of sourcing e.g. it may only be possible to trap birds from a wild source population, or to provide birds from a captive programme at certain times of the year; and
- release strategy e.g. soft (using semi-captivity pens) or hard (direct).

Mountain quail may be held for several months and then released
© Gifford Gillette, Idaho State University

Release strategies are likely to vary according to several factors, including the birds' physiology, ecology and behaviour. For example:
- one strategy used with mountain quail is to capture birds from late summer to winter, hold them in a facility for one to several months ensuring they are in sound physical condition and are well nutritionally balanced, and then release them (J Connelly *in litt.*, 2007);
- translocation of northern bobwhite quail is recommended during a one-two month window that is as close to the breeding season as possible (i.e. late February and March). This is in order to capitalise on the reproductive success of the species and minimise mortalities from raptors by avoiding the raptor migration in January and February throughout many portions of their range, particularly in the southeastern United States (Terhune *et al.*, 2006 a, b). Otherwise, the overall benefit of the re-introduction is limited; and
- Coates and Delehanty (2006) examined the relationship between capture date and nesting attempts of Columbian sharp-tailed grouse as part of a translocation programme. They found that female grouse that were captured from source leks at later dates during the lek-visitation period were more likely to nest following translocation than those females captured during the initial days of female visitation to leks. Furthermore, Coates *et al.* (2006) suggested that nest-site availability also influenced the success of sharp-tailed grouse re-introduction.

Time periods of intense territoriality and survival bottlenecks should be avoided for release of birds, whilst seasons offering good vegetative cover giving protection from predators should be preferred.

5.3.6 Identification of appropriate success indicators

Quantifying a 'successful' re-introduction varies across the field of conservation biology, and nowhere is it clearly defined (Reese and Connelly, 1997). As a result, a wide variety of criteria have been used, some critically devised and some developed *ad hoc*.

For example, in the white-winged guan re-introduction programme, the indicators selected were survival, dispersion and reproduction (Angulo, 2003; Angulo, 2004). Using a Minimum Viable Population approach, Beck *et al.* (1994) considered 500 free-living individuals as representing success and regret the low availability of published results using this concept. However, without taking into account life history traits, habitat quality or the eventual meta-population structure (which varies widely between re-introduced populations), this threshold seems relatively arbitrary. Furthermore, Seddon (1999) discusses the importance of also taking into account time frames and project phases when determining how success will be measured.

Since the settlement of a self-sustaining population corresponds to a dynamic process, estimates of extinction probability that combine population size, growth-rate and growth-rate variance should be the main criteria for assessing success. This requires the accurate estimate of demographic parameters, such as survival rates, and the modelling of various dynamic scenarios, including unexpected catastrophic events. An intermediate criterion to assess this success could be the breeding of the first wild-born generation in the release areas (Theron M. Terhune in *litt.*, 2007). Where a species is known to disperse over large distances and thus detection of breeding may be a challenge, the monitoring plan should take this into account.

Although the explicitly formed project objectives will provide some guidelines, it may be useful to define success criteria for three phases, for example:

- survival of founders, e.g. what % survived (to various life stages);
- breeding by founders, e.g. evidence of breeding and/or actual breeding parameters;
- long-term persistence, e.g. breeding performance; and
- PVA modelling.

One way to develop such success criteria for a re-introduction project is to establish at the outset quantifiable, measurable indicators of what it seeks to achieve and then monitor the achievements of the project against those. Ultimately (and perhaps ideally), assessing success should include both temporal and geographic scales - survival or breeding by founders is not very important if the subsequent generation fails to reproduce or occupy available habitat.

5.3.7 Development of a conservation awareness programme

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 conservation awareness programme amongst local communities. Ideally, experiences and evaluations should be published both locally and internationally to aid the design of future projects, and public relations promoted through the mass media.

Shirts are being used to raise awareness of a red-billed curassow re-introduction project © Ariane Alvares

For example, initiatives may include: workshops involving stakeholders to discuss problems and possible solutions, and establishment of mechanisms for distributing information (e.g. distribution of leaflets, construction of an information centre, creation of a nature trail, establishment of nature clubs at local schools with regular interactive events, development of a field camp for schoolchildren or teachers). More generalised awareness programmes could involve funding publications or visual education material to convey why the local community is important in the success of the re-introduction programme. Such materials need to be carefully designed and take into account the intended audience.

Two examples of this dual approach concern the conservation of western tragopan populations and their temperate forest habitats in the western Himalayas. The Himalayan Jungle Project in Pakistan was focused on Palas Valley, where village-level consultations form the basis of all initiatives designed to reduce human impact on surrounding forests (Duke, 1993). The Great Himalayan National Park in India was set up with similar aspirations (Garson and Gaston, 1989) and an eco-development project focused on the park's buffer zone villages has recently been completed (Sanjeeva Pandey *in litt.* 2007: see Pandey, 2008). A further example of this approach is provided by the participatory management of Ke Go Nature Reserve, the only protected area for the Vietnamese pheasant (Vo Quy, 1998).

Another good example 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 has also been conducted for the Vanuatu megapode *Megapodius layardi* (Foster, 1999).

5.4 The pre-release and release stages

5.4.1 Catching of wild stock

When catching stock, whether eggs or birds, the welfare of the species is crucial throughout all handling stages. Each Galliformes species will have a different habitat and set of behavioural traits across the seasons, so trapping techniques should be sensitive to them. The skill of 'walking' a pheasant in the general direction of the trap can be very effective, and well-trained dogs increase capture rates immensely. Night-lighting, pitfall traps, single leg snares, running loop snares, drop fold nets, funnel traps and mist nets are all options under appropriate circumstances (Stoddard, 1931; Terhune *et al.*, 2006 a, b). Generally, however, all trapping requires:

- a good working knowledge of the species;
- experience in setting safe traps which will not injure birds;
- regular inspection;
- practical skills in handling birds so that they are not killed or injured in the trapping process; and
- the facilities to secure the captured bird quickly and to place it in a dark environment (usually vital to subsequent survival in the immediate term).

Trap for capturing sage grouse
© Jack Connelly

A report by Connelly *et al.* (2003) published by University of Idaho College of Natural Resources Experiment Station summarises trapping techniques for sage-grouse and many of these techniques could be applied to other species. In the case of the white-winged guan, the wild stock were caught in two ways: a limited collection of 1-2 day-old chicks and a majority collection of eggs taken from wild nests, which were then hatched under turkeys, ducks or hens. In most cases, both eggs in the clutch of the wild nest were taken. See Appendices 3 and 4 for further advice on trapping and holding conditions.

5.4.2 Transport and holding conditions

The main concern of the transport and holding conditions is that the welfare of the birds is adequately addressed, which will improve survival, reduce injuries and stress related diseases, and speed up adaptation to the new environment. For example, transport time from the white-winged guan captive breeding centre to the release site was 3-4 hours. Birds were transported at night to minimise stress (Angulo *in litt.*, 2005).

Transporting captive-reared grey partridges to the release site © Francis Buner

Transport boxes should have soft roof sections, adequate ventilation holes (conforming to International Air Transport Association regulations if to be transported by airplane: see www.iata.org/whatwedo/cargo/live_animals/index.htm) and enough space for the birds to stand up and turn around. Slatted boxes and particularly hard materials should usually be avoided. Human disturbance and handling time must be kept to an absolute minimum and the correct diet readily available. It may be appropriate to transport or hold birds in pairs, groups or as single individuals, depending on the species' social system.

Species-specific concerns may apply. For example: malleefowl are prone to hyperthermia when stressed; and watermelon seems to be a great food for sharp-tailed grouse and ruffed grouse while they are being held (Gardner, 1997).
If holding for a considerable period of time, it is recommended that large enclosures are prepared, where there is little contact with humans or disturbance. Serious consideration should be given to whether to let the birds see the surrounding environment or not. Birds should obviously be regularly monitored to check for any problems. Legislation normally requires veterinary inspection before release.

5.4.3 Rearing techniques for conservation re-introduction

Rearing Galliformes for release as part of a conservation programme is distinctly different from rearing them for other purposes, such as captivity or shooting. Approaches can generally be divided into those that allow human contact and those that do not. Increasingly, techniques for the latter are becoming more refined and successful (e.g. Scherzinger, 2003).

There are a great many aspects of the rearing process that must be carefully considered before the programme starts breeding birds that are destined for release. These include: method of incubation (e.g. by parent, surrogate or artificial), whether chicks are reared with parents or not (or some combination of the two [e.g. Schroth, 1991]) and ways of ensuring that birds have the behavioural repertoire necessary to survive after release. For example, released white–winged guans have bred in the wild after part-natural and part-artificial rearing, and also when fully parent-reared. In the first case, half-tame birds bred easily even where there was a little human presence (Angulo, 2006). In the latter case, individuals also bred after they were released, but did not tolerate human presence to the same extent (Angulo *in litt.*, 2006). The next section deals with some of the behavioural considerations that will be important in ensuring that released individuals have the greatest chance of surviving in the wild.

Grey partridges reared under bantams
© Arthur Scott

5.4.4 Behavioural measures

Although a released individual's probability of survival should approximate that of a wild counterpart (IUCN, 1998), it probably will not because of unfamiliarity with habitats, local predator populations etc., as well as the fact that released birds are often under stress. The aim of a re-introduction is to re-establish a viable, self sustaining population and so it is not possible to be concerned with the fate of each individual released. However, it is clearly important that each bird has the highest possible chance of survival, although this may not be as high as the survival rate of a wild counterpart. Whether or not it achieves this will depend to some extent on the behavioural responses that the individual makes to a wide variety of cues in the environment into which it is released. Important behavioural patterns to get right include (but are not restricted to): appropriate vigilance techniques, identification of predators and suitable reactions to them, choosing the correct food items, interacting with conspecifics and, of course, a whole suite of reproductive behavioural patterns.

Håkansson and Jensen (2005) found differences between the survival of released red junglefowl and wild birds. This implies that life in captivity can have an influence on behaviour, possibly due to altered selection pressures. However, the extent to which the differences were due to genetic changes caused by small breeding populations or adaptations to the different captive environments has not yet been elucidated. Most bird species rely heavily on individual experience and learning as juveniles for their survival – hence they should be given the opportunity to acquire the necessary information to enable survival in the wild through training in their captive environment (including familiarisation with natural foods, diseases and predation dangers). However, caution when training is advised; Starling (1991) reports that Scherzinger found capercaillie chicks quickly became habituated to predator models, and Pedersen reported that willow grouse chicks would respond only to avian and not to mammalian predators.

Young individuals, although naturally prone to high mortality, often present the advantage of being less affected by captivity. Captive-bred individuals released as adults may suffer limitations in their learning abilities and therefore show reduced survival. Moreover, in some species the cultural transmission of behavioural traits may be disrupted if young individuals are isolated from their parents before acquiring such traits (Sarrazin and Legendre, 2000).

Capercaillie released from breeding stations are often aggressive to humans
© Siegfried Klaus

Facilities that use large flight pens and plant natural vegetation, spread feed on the ground, minimise human contact, and mimic mortality threats have produced pen -reared northern bobwhite quail that behave appropriately (Terhune *in litt.*, 2006.). A trained Harris' hawk was used to prepare white-winged guans to respond appropriately to aerial predators prior to release (Angulo, 2004). Trained hawks killed chickens in front of the white-winged guan in a semi-captivity cage. Guans reacted appropriately to this, trying to escape next time the hawk flew over the pen.

The ambitious, but ultimately unsuccessful, attempt to re-introduce the cheer pheasant to the Margalla Hills National Park in Pakistan showed that the behavioural quality of the released birds was crucial (see Garson *et al.*, 1992: Box 2). Other studies have also shown that that captive-reared pheasants of both sexes are much less effective at breeding than their wild-reared counterparts (e.g. Robertson, 1988, Hill and Robertson, 1988: Musil and Connelly, in press).

5.4.5 Health screening of release stock

Transmission of microorganisms, parasites, pathogens and disease is a serious concern in a re-introduction for two reasons. Firstly, the source bird or egg and its pathogens could be harmful to the ecosystem at the release site and secondly, the environment at the release site might contain agents to which the arriving birds have no immunity and could prove detrimental to their health. Therefore, it is a pre-condition for a successful re-introduction that birds are healthy and not carrying any infectious or contagious diseases. Healthy Galliformes will also cope better with the stresses of movement, and are more able to adapt to their new environment.

The veterinarian involved in the project should obtain and review all available information concerning the health of the animals to be reintroduced, the source population and the wild population which is to be supplemented. Sources of information could include published literature, necropsy reports, diagnostic records of local and national laboratories, national government departments and vet colleges. It is recommended that Woodford (2001) is consulted. Information on the endemic diseases of livestock and wildlife in the source and destination areas should be collected from existing reports or by active surveillance, such as road kills, hunted animals, rehabilitation centres etc.

Prospective release stock must be subjected to a screening process before transportation from source, and again following transportation and quarantine at the release site. The stress of transport and acclimatisation to new conditions could cause disease to manifest which was previously sub-clinical or allow opportunistic pathogens to override the immune system and cause disease. Sick or unhealthy birds must be removed from the programme.

Care must be taken to minimise the risk of infection with disease-causing agents during transport and holding; biosecurity, hygiene management and disease control is a vital part of the programme. Stock must meet all health regulations prescribed by the veterinary authorities of the recipient area and adequate provisions must be made for quarantine if necessary. For re-introductions, the analysis of risk should go further than if it were just focusing on livestock or human disease concerns. The process should include assessment of the potential risk of parasites and microorganisms causing problems in other synanthropic species in the recipient area. This is not a simple procedure and can be expensive. Each species will tend to have particular issues and susceptibilities and these should be explored to prioritise interventions.

Birds destined to be released in Newcastle Disease free areas should originate from other clean areas only. Vaccination against Newcastle Disease is NOT recommended and vaccinated birds must NOT be reintroduced.

There are a few published case reports outlining parasite and microorganism assessments. Released white-winged guans were screened for mycoplasma, *Salmonella*, Newcastle's Disease and Gumboro (=Infectious Bursal Disease) and tested for the presence of discarded parasites, both internal and external (Angulo, 2004). Bobwhite quail are screened for avian pox, cryptosporidiosis, ulcerative enteritis and blackhead. Buner and Schraub (2008) placed grey partridge in quarantine for one month prior to release and fed them a mixture of seeds and pellets with a low dose of Phlubenol added to prevent endogen parasite infections.

Complete individual medical records should be kept, preferably using a recognised records system such as the Medical Animal Records Keeping System (MedARKS) or, in the future, the Zoological Information Managemenet System (ZIMS): see **http://www.zims.org/CMSHOME/**. It is important to create a database of diseases at source and release sites, in both captive-to-wild and wild-to-wild projects, and this should be made available to other practitioners.

All birds that die, whether pre-release or post-release, should have a complete post mortem and histopathological examination performed by a recognised pathologist. Records should be maintained and a comprehensive set of tissues stored in 10% buffered formal saline and histopathological slides stored for future reference.

5.4.6 Genetic screening of release stock

Genetic techniques are powerful tools to identify species correctly, evaluate the genetic variability and detect hybrids among captive stocks and estimate the relatedness of potential breeding pairs. Techniques such as DNA fingerprinting, microsatellite analysis and DNA barcoding have been implemented and performed routinely in many science laboratories around the world. Their implementation and maintenance costs can fit the budget of any well-planned conservation programme, increasing the

Taking bobwhite quail samples for genetic analysis
© Theron Terhune

chance of successfully saving Galliformes from extinction.

The phylogenetic relationships of many Galliformes are still not as clear as we would like and hence the complete integration of phylogenetic knowledge and conservation actions is not yet possible. For example, it is imperative that species be well defined to evaluate their conservation needs. For many years, the species status of the Extinct-in-the-wild Alagoas curassow and the razor-billed curassow was questioned (Silveira *et al.*, 2004). Phylogenetic analyses of DNA sequences were able to demonstrate that they are indeed two distinct species occupying discontinuous areas in South America (Grau *et al.*, 2003; Pereira and Baker, 2004) and so the need for an action plan to return the Alagoas curassow to the wild became more pressing (Silveira *et al.*, 2004). The future of species and subspecies definition and identification is bright: the *All Birds Barcoding Initiative* has the goal to develop a global standard for taxonomy by sequencing and documenting a particular gene for all living species of birds (Hebert *et al.*, 2004), and making that information publicly available in a public database (**http://www.barcodingbirds.org/**). As of June 2008, the database contained DNA barcodes for only about 20% of all the recognised species of Galliformes, clearly indicating that more taxonomic studies at the molecular level are required. Undoubtedly, conservation programmes can benefit from this database to establish species' identities, prior to any initial step in captive breeding.

One other serious concern affecting captive breeding and re-introduction programmes is the presence of undetected hybrids among the breeding stock. In the Alagoas curassow, studies of genetic variability using DNA fingerprinting (a technique that estimates the degree of consanguinity based on the specimens' genome) was able to distinguish between pure and hybrid birds kept in captivity. Based on these results, a management strategy was developed to avoid breeding hybrid birds in captivity and releasing their offspring into the wild (Grau *et al.*, 2003).

Monitoring the genetic variability of captive stock and their offspring is very helpful in establishing breeding pairs which have the least amount of consanguinity, thus increasing the potential genetic variability of the captive offspring to be released. For example, in the last two decades in Brazil, efforts have been taken to recover declining populations of the endangered red-billed curassow and repopulate a reforested area with two species of guan, rusty-margined guan and dusky-legged guan originally found in the region prior to the construction of a hydro-electric dam. The genetic variability of the captive stocks and captive-born birds were analysed using DNA fingerprinting (Pereira and Wajntal, 1999, 2001). The genetic variability of the captive stocks was similar to that observed in non-threatened avian species. Therefore, the potential negative effects of decreased fertility and survival rates associated with low genetic variability was not expected not be a problem. However, the estimated genetic variability of the offspring to be released was similar to that expected for first-degree relatives, reflecting the unequal reproductive success of stock birds. Based on the genetic results, breeding pairs were managed to minimise their genetic relatedness, equalise the contribution of captive birds to the re-introduction programme and increase the genetic variability of the released offspring. The re-introduction programmes of red-billed curassow and the guans were successful; in the years following the initial release, a large number of wild-born birds were observed in the release area and its surrounding habitat (Pereira and Wajntal, 1999; IBAMA/MMA 2004).

5.4.7 Marking

It is important to be able to determine the fates of individuals if the overall success of the re-introduction programme is to be accurately assessed. This requires that the individuals that are released can be recognised and then identified when subsequently monitored. Therefore, considerable thought must be given to the post release monitoring strategy and the marking necessary to achieve it. It is also important to be prepared to be flexible and this is highlighted by experience with the white-winged guan. Combinations of coloured plastic leg rings were used, allowing the birds to be identified after release (Angulo, 2004). Subsequently, however, the plastic became brittle and shattered and so marked birds could not be distinguished from each other. The programme now considers it better to use aluminium or some other ring type that will last longer. This allows birds that have been released to be distinguished from those that are native to the area. Detailed considerations for marking are given in Appendix 6.

Juvenile mountain quail being fitted with a leg-ring
© Gifford Gillette, Idaho State University

Radio-tracking allows the movements of birds to be monitored without the necessity of seeing each individual in order to identify it. This has great benefits in allowing:

- birds to be located in dense habitat where they are difficult to see;
- birds to be located without undue disturbance; and
- all individuals to be located provided that the radio-tags still function, the birds have not undertaken unusual movements, or have dispersed.

The radio-tags should not impede the bird's natural movement or flight in any way, not be prone to snagging, and be the relevant weight for the bird's body weight, on which there is guidance available (see White and Garrott, 1990; Kenward, 2000). Researchers should also design studies which examine the effect of banding and radio-tagging on individuals, and also evaluate which methods provide the most reliable demographic data (Terhune *et al.*, 2007; Palmer and Wellendorf, 2007; Buner and Schaub, 2008). These devices should be fitted a couple of weeks before the birds are released to allow full acclimatisation to them. Bird handling skills are vital at this stage. Please see Appendix 6 and also the section *Guidance on handling birds after they have been trapped* in Appendix 3.

5.4.8 Determination of release strategy

All of the preparation for release and all of the work outlined so far in these guidelines will be ineffective if the wrong release strategy is employed. The strategy needs to be very specific to the species, habitat and practical context in which it is being carried out. For example, see Box 3 for a proposed release strategy for grey partridge.

The key considerations for release include:

Autumn release pen for a soft release of a grey partridge covey
© Francis Buner

- soft vs. hard release;
- acclimatisation of release stock to release area;
- time of year, which year(s), one release or several;
- number of birds per release;
- group size of birds and composition;
- predator control (see below);
- supplementary feeding; and
- set criteria for supplementary releases to avoid open-ended release programmes with no set end-point.

It is vital that there are enough individuals available for the re-introduction programme. If there are not enough birds then success will be much more difficult to achieve. For example, a study of bobwhite quail that were relocated into managed habitat with an existing population (i.e. a supplementation) in Tennessee suffered from small numbers of birds (Jones, 1999).

Several of the re-introduction projects mentioned in these guidelines have used predator control as part of the release strategy. Nearly all Galliformes have evolved as prey species and, as such, their life histories are adapted to coexist with predators. In some situations, such as the intensively managed ecosystems of Europe and North America, predator control may have a positive impact on galliform populations (Storch, 2007). It will not, however, lead to self-sustaining, viable populations independent of management intervention. Predator control may also be undesirable and impractical in less human modified ecosystems.

The strategy employed may vary significantly according to the source of the birds and/or the recipient habitats. For example, translocated wild birds will have different requirements from those that have been captive bred. The latter will involve particular challenges, such as low survival, a possible need for pre-release training (e.g. predator or food recognition), and post-release supplementary care. See Sokos *et al.* (in press) for a discussion of the aims of release and the choice of appropriate techniques.

Specific examples of important considerations For the white-winged guan (see Box 5), the best results were achieved by releasing an equal number of males and females (as it is a monogamous species) that have just reached sexual maturity (2-3 years old) and were raised by parents in captivity. Prior to release, the birds were maintained for at least 3-4 weeks in semi-captivity.

Box 5: Considerations for release of white-winged guans

In order to find out how best to familiarise white-winged guan individuals to their new surroundings, in terms of both survivorship and ease of surveillance, three different pre-release methods were tested. The first method was the "big cage": a large semi-captivity cage constructed out of rope mesh, built in a ravine covering an area 70m x 30m (i.e. 2100m^2), with a highest point of 13m. This enclosure included part of the ravine's permanent watercourse and native trees and bushes such as *Ficus padifolia*, overo *Cordia lutea* and Mutingia calabura, which are natural food sources of wild guans. Ten individuals were kept inside the cage for a period of 1-18 months. The second method, the "small cage" consisted of a semi-captive cage located on a mountain slope, covering an area of 25m x 5.5m (138m^2), with a height of 2m. Water was artificially supplied and the main type of bush found inside the enclosure was overo. Six individuals were kept inside this cage for periods of 1-5 months. The last method involved taking individuals from the Olmos captive-breeding centre straight to the re-introduction site, and hard-releasing them directly into the wild without the use of pre-release cages. This method was used when the replacement of individuals was required

See: Angulo (2003)

They were then released just after the rainy season; a period when there is plenty of food, water and cover, which also coincides with the species' reproductive season (Angulo *in litt.*, 2006). The size of the release group was increased from two, to six, to 10, and predator control has been conducted (Angulo, 2003).

Establishing artificial leks may be helpful for grouse re-introductions. Female sharp-tailed grouse in Oregon (Snyder, 2001) were transplanted after they had attended leks for several days, giving the birds a chance to mate before capture and removal. It has also worked to some degree with sage-grouse in Montana (Eng *et al.*, 1979). Predation in the two-three weeks immediately following release is seen as a significant problem, and the control of predators during this time is particularly important (Starling, 1991). Both sage-grouse and Columbian sharp-tailed grouse were reintroduced in Idaho, USA using a soft-release technique and birds were translocated during the spring breeding season (Gardner, 1997; Musil *et al.*, 1993, 1994).

Researchers have successfully released groups of 6-12 quail at different locations in southern regions of North America with total release numbers ranging between 50 and 80 individuals at each site (Terhune *et al.*, 2006a, b). In most cases, survival and reproduction were similar between groups (resident and translocated) for several releases conducted in these regions (Terhune *et al.*, 2006a, b). These sites commonly employed supplementary feeding and management of mammalian nest predators in addition to other commonly used management techniques (e.g. prescribed fire, annual disking, conservative harvest, etc.). More recently, researchers have observed similar success when releasing wild birds in an isolated, fragmented habitat (Theron M. Terhune, unpublished data).

5.5 Post-release stage

5.5.1 Post-release monitoring

Monitoring of founding populations and subsequent generations is an essential part of any re-introduction project as it allows the success of the project to be determined. Gaining agreement and resources from all parties as to which level of post-release monitoring is to be used can be difficult, and it should be made clear from the start of the programme how this decision will be made. Monitoring is typically required for at least 3-5 years, depending on the species. However, the level or intensity of monitoring may decrease over time. For example, a reintroduced sage-grouse population could be monitored using radio-telemetry for the first three years of the project. Following documentation of lek establishment and successful reproduction, monitoring might then change to spring lek counts and summer brood counts. These techniques are less costly and time consuming than telemetry and will allow an ultimate assessment of project success (J Connelly *in litt.*, 2006).

Night monitoring of mountain quail
© Gifford Gillette, Idaho State University

It is critical to obtain clear objectives for monitoring that are derived from the already defined indicators of re-introduction success. This will then determine the specific data that needs to be collected in order to meet these stated objectives. This could involve all or a sample of individuals, and direct (e.g. tagging, telemetry) or indirect (e.g. spoor, informants) methods. In the short-term, health or behaviour effects from transport and release could be detected; in the long-term, analysis is required to study the birds' adaptation to a new environment and respective viability. This should include investigations into survival, mortality, site fidelity, dispersal, establishment, behaviour patterns and interactions, and habitat use at the very least. Other chronic problems will also be evident, such as failure to reproduce or persistent weight loss. Intervention may be necessary if the situation becomes unfavourable.

A post-release monitoring programme should be designed with specific objectives and hypotheses, and with standardised data collection. Precision and accuracy of the data gathered on each parameter (survival, breeding, reproduction etc.) should also be assessed wherever possible. Behaviour patterns and interactions should be monitored. The necessary post-release monitoring equipment must be budgeted for and made available. These may include vehicles (and their associated expenses), radio tags, radio receivers, global positioning systems (GPS), computer and internet facilities. Some monitoring protocols that have been used for galliform species are given in Box 6 (see below).

Box 6: Some monitoring protocols that have been used

Bobwhite quail: radio-transmitters, autumn population abundance counts (quadrat and point) have been used (Wellendorf *et al.*, 2004; Wellendorf and Palmer, 2005), as has mark-recapture via trapping (Terhune *et al.*, 2006a, b; Terhune *et al.*, 2007; Palmer and Wellendorf, 2007). Malleefowl (from Sims, 2000): 24 birds out of a total of 67 released were radio-tagged and tracked for a few days to six months post-release. Tracking was performed daily for the first few weeks and then reduced to 2-3 times per week for 1-3 months, then to once every two weeks. Permanent omni-directional antenna on 30m towers were used, in combination with hand-held Yagi antenna on a 6m mobile aerial. Not every bird was located daily, but all signals received were monitored for mortality. Four of these 24 radio-tagged birds died during monitoring. This limited sample suggests a survival rate of over 80% at six months post-release. The longer a signal went undetected, the more difficult it was to relocate, as birds were sometimes found to have moved as much as 10-15km a day, changing direction from one day to the next. Aerial tracking was used to relocate signals on several occasions. During the day, the signals often fluctuated significantly in strength (probably due to foraging activity), and tracking at night was found to produce better results, as birds were generally roosting several metres above the ground in trees. Long-term monitoring consisted of opportunistic sightings of birds and their footprints by park and feral animal control staff, which patrol sand tracks across the area on a daily basis. Public sightings were also recorded. White-winged guan: telemetry was used to monitor the dispersal of the released birds and to determine which of the release techniques used was best.

See: Angulo (2004)

Veterinary involvement should continue so that obviously diseased birds can be examined and/or removed for diagnosis. Post-mortems of dead birds should be performed to establish the cause of death.

5.5.2 Continued habitat management

Habitat protection, monitoring and restoration should continue where necessary to ensure that, at the very least, there is no decline in habitat quality or extent. Bearing in mind that habitat loss or modification may well have been a primary cause of the species' local extinction, it is imperative to ensure that this does not happen again. Therefore, monitoring habitat conditions should be integrated into the overall monitoring programme and spatial modelling (i.e. GIS) used to provide insights into areas of optimal habitat. It should be remembered that any management may well affect other species and this must be taken into account.

Wherever possible, available habitat should be extended. For example, establishment of appropriate contact zones between similar forest fragments inhabited by bare-faced curassow *Crax fasciolata* was considered to be a high priority (Pereira and Wajntal, 2001b). In the Harz Mountains, habitat management in favour of capercaillie was started many years before the first release. Re-introduction into this area, where the original population had disappeared, has led to a population of 60-80 adults dispersed over a wide range of the upper part of the Harz Mountains. Traditional leks with 1-4 displaying cocks have been established and hens are rearing wild broods. Between 1980 and 1992, 393 capercaillie (226 cocks, 167 hens) were released into spruce-beech mixed forests of the Sauerland/North Rhine-Wesphalia, where this species became extinct in 1974. In contrast to the Harz, no habitat improvement was initiated before the release. A large portion of the released birds succumbed primarily to predation. The small population is still insufficient to perpetuate itself and, therefore, the project was terminated (Klaus, 1997).

Successful translocations of wild northern bobwhites in southern portions of North America were all preceded by intensive habitat management (and in many cases, supplementary feeding and mammalian predator management was common), and researchers advised against translocating bobwhites to habitats that were considered sub-marginal in either quantity or quality (Terhune *et al.*, 2006a, b).

5.5.3 Evaluation of success (scientific and socio-economic)

It is a stark reality that a significant proportion of released birds will die, especially in the early stages (Anglestam and Sandegren, 1982; Wagner, 1985; Haarstick, 1985). For example, in a German project to release captive-reared capercaillie, only two cocks survived the first winter, largely due to predation and accidents (Schroth, 1991).

The success of any re-introduction should be measured against the achievement of the original objectives of the project, and the subsequent health and adaptation of the re-introduced birds. In addition, all conservation awareness programmes must be evaluated to identify the socio-economic benefits from the initiative, and be tested using questionnaires and feedback workshops, or similar. Success should be continually measured. Connelly and Braun (2007) discuss how success of sage-grouse conservation actions may be measured.

Many released birds will die
© Francis Buner

Two years after the re-introduction of the white-winged guan had started the survival rate was 55% and the dispersion distance was 13 km. This should eventually allow the released birds to connect with wild populations (the nearest wild population was located 12 km from the release site) (Angulo, 2004). Another indicator of the success of this programme was the confirmed breeding of released birds e.g. one particular pair produced a chick a year after release and then two chicks in the following year (Angulo, 2004).

5.5.4 Intervention strategy

Even if all of the steps above have been followed, there is always a chance that an unforeseen situation may arise that will need some form of intervention to keep the re-introduction programme on track. Also, any planned interventions undertaken as part of the release (e.g. supplementary feeding, veterinary support, habitat management) will need to be reviewed and perhaps amended as the re-introduction progresses. Therefore, it is important to have a system in place for making decisions; in extreme cases this may involve revising, rescheduling or discontinuing the programme, e.g. the cessation of cheer pheasant re-introduction programme into the Margalla Hills near Islamabad in Pakistan.

Supplementary feeding (or other management) may be necessary after release © Francis Buner

Connelly (*in litt* 2007) reported that one sharp-tailed grouse transplant unknowingly released birds within about 50 metres of a nesting pair of red-tailed hawks. The nest was discovered only after grouse started to die in large numbers shortly after release. The release site was then moved and the re-introduction was successful. This is an example of where a multi-disciplinary committee can decide to adapt the project by removing the grouse or removing the predator(s), or do nothing at all.

5.5.5 Feedback

There is an acute lack of reporting on the success or otherwise of conservation intervention, including re-introduction and this is a real concern. Disseminating lessons learnt is vital for informing subsequent re-introductions. Regular publication in scientific and popular literature, as well as contact with the appropriate Specialist Group, are highly recommended. Publishing results in scientific literature is strongly encouraged, especially for projects that do not achieve their success indicators. These experiences can be valuable lessons and are important in preventing future projects from making similar mistakes, thus avoiding wasting resources and funds.

5.5.6 Long-term financial viability

It is imperative that the budget for the re-introduction has clear income sources for all stages of the project and that it will be provided over a long enough period to allow the best chance of success. Appendix 2 provides an example of the activities that should be budgeted for throughout the project.

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7 Appendixes

7.1 Appendix 1: Galliformes species and their Red List status

This list of species is grouped under the WPA-IUCN Specialist Group responsible for them (at present there is no WPA-IUCN Cracid Specialist Group). It is the list used for the IUCN Red List and the 2008 Red List Category is given for each species (see BirdLife, 2008; IUCN, 2008).

7.1.1 Cracids

Chachalacas, guans and curassows (Cracidae)

Species	IUCN Category
Plain chachalaca *Ortalis vetula*	LC
Grey-headed chachalaca *Ortalis cinereiceps*	LC
Chestnut-winged chachalaca *Ortalis garrula*	LC
Rufous-vented chachalaca *Ortalis ruficauda*	LC
Rufous-headed chachalaca *Ortalis erythro*ptera	VU
Rufous-bellied chachalaca *Ortalis wagleri*	LC
West Mexican chachalaca *Ortalis poliocephala*	LC
Chaco chachalaca *Ortalis canicollis*	LC
White-bellied chachalaca *Ortalis leucogastra*	LC
Speckled chachalaca *Ortalis guttata*	LC
Little chachalaca *Ortalis motmot*	LC
Buff-browed chachalaca *Ortalis superciliaris*	NT
Band-tailed guan *Penelope argyrotis*	LC
Bearded guan *Penelope barbata*	VU
Baudo guan *Penelope ortoni*	EN
Andean guan *Penelope montagnii*	LC
Marail guan *Penelope marail*	LC
Rusty-margined guan *Penelope superciliaris*	LC
Red-faced guan *Penelope dabbenei*	LC
Crested guan *Penelope purpurascens*	LC
Cauca guan *Penelope perspicax*	EN
White-winged guan *Penelope albipennis*	CR
Spix's guan *Penelope jacquacu*	LC
Dusky-legged guan *Penelope obscura*	LC
White-crested guan *Penelope pileata*	NT

Species	IUCN Category
Chestnut-bellied guan *Penelope ochrogaster*	VU
White-browed guan *Penelope jacucaca*	VU
Trinidad piping-guan *Pipile pipile*	CR
Blue-throated piping-guan *Pipile cumanensis*	LC
Red-throated piping-guan *Pipile cujubi*	LC
Black-fronted piping-guan *Pipile jacutinga*	EN
Wattled guan *Aburria aburri*	NT
Black guan *Chamaepetes unicolor*	NT
Sickle-winged guan *Chamaepetes goudotii*	LC
Highland guan *Penelopina nigra*	VU
Horned guan *Oreophasis derbianus*	EN
Nocturnal curassow *Nothocrax urumutum*	LC
Crestless curassow *Mitu tomentosum*	LC
Salvin's curassow *Mitu salvini*	LC
Razor-billed curassow *Mitu tuberosum*	LC
Alagoas curassow *Mitu mitu*	EW
Helmeted curassow *Pauxi pauxi*	EN
Horned curassow *Pauxi unicornis*	EN
Great curassow *Crax rubra*	NT
Blue-billed curassow *Crax alberti*	CR
Yellow-knobbed curassow *Crax daubentoni*	NT
Black curassow *Crax alector*	LC
Wattled curassow *Crax globulosa*	VU
Bare-faced curassow *Crax fasciolata*	LC
Red-billed curassow *Crax blumenbachii*	EN

7.1.2 Megapodes

Megapodes (Megapodidae)

Species	IUCN Category
Australian brush-turkey *Alectura lathami*	LC
Wattled brush-turkey *Aepypodius arfakianus*	LC
Bruijn's brush-turkey *Aepypodius bruijnii*	EN
Red-billed brush-turkey *Talegalla cuvieri*	LC
Black-billed brush-turkey *Talegalla fuscirostris*	LC
Brown-collared brush-turkey *Talegalla jobiensis*	LC
Malleefowl *Leipoa ocellata*	VU
Maleo *Macrocephalon maleo*	EN

Species	IUCN Category
Moluccan megapode *Eulipoa wallacei*	VU
Nicobar megapode *Megapodius nicobariensis*	VU
Tabon megapode *Megapodius cumingii*	LC
Sula megapode *Megapodius bernsteinii*	NT
Orange-footed megapode *Megapodius reinwardt*	LC
Tanimbar megapode *Megapodius tenimberensis*	NT
Dusky megapode *Megapodius freycinet*	LC
Biak megapode *Megapodius geelvinkianus*	VU
New Guinea megapode *Megapodius affinis*	LC
Melanesian megapode *Megapodius eremita*	LC
Vanuatu megapode *Megapodius layardi*	VU
Micronesian megapode *Megapodius laperouse*	EN
Polynesian megapode *Megapodius pritchardii*	EN

7.1.3 Grouse

Grouse (Phasianidae)

Species	IUCN Category
Hazel grouse *Bonasa bonasia*	LC
Chinese grouse *Bonasa sewerzowi*	NT
Ruffed grouse *Bonasa umbellus*	LC
Black grouse *Tetrao tetrix*	LC
Caucasian grouse *Tetrao mlokosiewiczi*	NT
Western capercaillie *Tetrao urogallus*	LC
Black-billed capercaillie *Tetrao parvirostris*	LC
Greater sage-grouse *Centrocercus urophasianus*	NT
Gunnison sage-grouse *Centrocercus minimus*	EN
Siberian grouse *Dendragapus falcipennis*	NT
Spruce grouse *Dendragapus canadensis*	LC
Dusky grouse *Dendragapus obscurus*	LC
Sooty grouse *Dendragapus fuliginosus*	LC
Sharp-tailed grouse *Tympanuchus phasianellus*	LC
Greater prairie-chicken *Tympanuchus cupido*	VU
Lesser prairie-chicken *Tympanuchus pallidicinctus*	VU
Willow ptarmigan *Lagopus lagopus*	LC
Rock ptarmigan *Lagopus muta*	LC
White-tailed ptarmigan *Lagopus leucura*	LC

7.1.4 Partridge, Quail, Francolin

Old World quail (Phasianidae)

Species	IUCN Category
Snow partridge *Lerwa lerwa*	LC
Chestnut-throated partridge *Tetraophasis obscurus*	LC
Buff-throated partridge *Tetraophasis szechenyii*	LC
Caucasian snowcock *Tetraogallus caucasicus*	LC
Caspian snowcock *Tetraogallus caspius*	LC
Tibetan snowcock *Tetraogallus tibetanus*	LC
Altai snowcock *Tetraogallus altaicus*	LC
Himalayan snowcock *Tetraogallus himalayensis*	LC
Rock partridge *Alectoris graeca*	LC
Chukar *Alectoris chukar*	LC
Philby's partridge *Alectoris philbyi*	LC
Rusty-necklaced partridge *Alectoris magna*	LC
Barbary partridge *Alectoris barbara*	LC
Red-legged partridge *Alectoris rufa*	LC
Arabian partridge *Alectoris melanocephala*	LC
See-see partridge *Ammoperdix griseogularis*	LC
Sand partridge *Ammoperdix heyi*	LC
Stone partridge *Ptilopachus petrosus*	LC
Black francolin *Francolinus francolinus*	LC
Painted francolin *Francolinus pictus*	LC
Chinese francolin *Francolinus pintadeanus*	LC
Grey francolin *Francolinus pondicerianus*	LC
Swamp francolin *Francolinus gularis*	VU
Coqui francolin *Francolinus coqui*	LC
White-throated francolin *Francolinus albogularis*	LC
Schlegel's francolin *Francolinus schlegelii*	LC
Forest francolin *Francolinus lathami*	LC
Crested francolin *Francolinus sephaena*	LC
Ring-necked francolin *Francolinus streptophorus*	NT
Finsch's francolin *Francolinus finschi*	LC
Grey-winged francolin *Francolinus africanus*	LC
Red-winged francolin *Francolinus levaillantii*	LC
Moorland francolin *Francolinus psilolaemus*	LC

Species	IUCN Category
Shelley's francolin *Francolinus shelleyi*	LC
Orange River francolin *Francolinus levaillantoides*	LC
Nahan's francolin *Francolinus nahani*	EN
Hartlaub's francolin *Francolinus hartlaubi*	LC
Double-spurred francolin *Francolinus bicalcaratus*	LC
Clapperton's francolin *Francolinus clappertoni*	LC
Heuglin's francolin *Francolinus icterorhynchus*	LC
Harwood's francolin *Francolinus harwoodi*	VU
Red-billed francolin *Francolinus adspersus*	LC
Cape francolin *Francolinus capensis*	LC
Hildebrandt's francolin *Francolinus hildebrandti*	LC
Natal francolin *Francolinus natalensis*	LC
Ahanta francolin *Francolinus ahantensis*	LC
Scaly francolin *Francolinus squamatus*	LC
Grey-striped francolin *Francolinus griseostriatus*	NT
Yellow-necked spurfowl *Francolinus leucoscepus*	LC
Grey-breasted spurfowl *Francolinus rufopictus*	LC
Red-necked spurfowl *Francolinus afer*	LC
Swainson's spurfowl *Francolinus swainsonii*	LC
Erckel's francolin *Francolinus erckelii*	LC
Djibouti francolin *Francolinus ochropectus*	CR
Chestnut-naped francolin *Francolinus castaneicollis*	LC
Handsome francolin *Francolinus nobilis*	LC
Jackson's francolin *Francolinus jacksoni*	LC
Mount Cameroon francolin *Francolinus camerunensis*	EN
Swierstra's francolin *Francolinus swierstrai*	VU
Grey partridge *Perdix perdix*	LC
Daurian partridge *Perdix dauurica*	LC
Tibetan partridge *Perdix hodgsoniae*	LC
Long-billed partridge *Rhizothera longirostris*	NT
Madagascar partridge *Margaroperdix madagascariensis*	LC
Black partridge *Melanoperdix niger*	VU
Common quail *Coturnix coturnix*	LC
Japanese quail *Coturnix japonica*	LC
Stubble quail *Coturnix pectoralis*	LC

Species	IUCN Category
New Zealand quail *Coturnix novaezelandiae*	EX
Rain quail *Coturnix coromandelica*	LC
Harlequin quail *Coturnix delegorguei*	LC
Brown quail *Coturnix ypsilophora*	LC
Blue-breasted quail *Coturnix chinensis*	LC
Snow mountain quail *Anurophasis monorthonyx*	NT
Jungle bush-quail *Perdicula asiatica*	LC
Rock bush-quail *Perdicula argoondah*	LC
Painted bush-quail *Perdicula erythrorhyncha*	LC
Manipur bush-quail *Perdicula manipurensis*	VU
Himalayan quail *Ophrysia superciliosa*	CR
Udzungwa forest-partridge *Xenoperdix udzungwensis*	EN
Hill partridge *Arborophila torqueola*	LC
Rufous-throated partridge *Arborophila rufogularis*	LC
White-cheeked partridge *Arborophila atrogularis*	NT
Taiwan partridge *Arborophila crudigularis*	NT
Chestnut-breasted partridge *Arborophila mandellii*	VU
Bar-backed partridge *Arborophila brunneopectus*	LC
Sichuan partridge *Arborophila rufipectus*	EN
White-faced partridge *Arborophila orientalis*	VU
Grey-breasted partridge *Arborophila sumatrana*	LC
Roll's partridge *Arborophila rolli*	LC
Malaysian partridge *Arborophila campbelli*	LC
Chestnut-bellied partridge *Arborophila javanica*	LC
Red-breasted partridge *Arborophila hyperythra*	LC
White-necklaced partridge *Arborophila gingica*	VU
Orange-necked partridge *Arborophila davidi*	EN
Chestnut-headed partridge *Arborophila cambodiana*	VU
Red-billed partridge *Arborophila rubrirostris*	LC
Hainan partridge *Arborophila ardens*	VU
Scaly-breasted partridge *Arborophila chloropus*	LC
Chestnut-necklaced partridge *Arborophila charltonii*	NT
Ferruginous partridge *Caloperdix oculeus*	NT
Crimson-headed partridge *Haematortyx sanguiniceps*	LC
Crested partridge *Rollulus rouloul*	NT

Species	IUCN Category
Mountain bamboo-partridge *Bambusicola fytchii*	LC
Chinese bamboo-partridge *Bambusicola thoracicus*	LC
Red spurfowl *Galloperdix spadicea*	LC
Painted spurfowl *Galloperdix lunulata*	LC
Ceylon spurfowl *Galloperdix bicalcarata*	LC

New World quail (Odontophoridae)

Species	IUCN Category
Bearded wood-partridge *Dendrortyx barbatus*	VU
Long-tailed wood-partridge *Dendrortyx macroura*	LC
Buffy-crowned wood-partridge *Dendrortyx leucophrys*	LC
Mountain quail *Oreortyx pictus*	LC
Scaled quail *Callipepla squamata*	LC
Elegant quail *Callipepla douglasii*	LC
California quail *Callipepla californica*	LC
Gambel's quail *Callipepla gambelii*	LC
Banded quail *Philortyx fasciatus*	LC
Northern bobwhite *Colinus virginianus*	NT
Black-throated bobwhite *Colinus nigrogularis*	LC
Crested bobwhite *Colinus cristatus*	LC
Marbled wood-quail *Odontophorus gujanensis*	LC
Spot-winged wood-quail *Odontophorus capueira*	LC
Black-eared wood-quail *Odontophorus melanotis*	LC
Rufous-fronted wood-quail *Odontophorus erythrops*	LC
Black-fronted wood-quail *Odontophorus atrifrons*	VU
Chestnut wood-quail *Odontophorus hyperythrus*	NT
Dark-backed wood-quail *Odontophorus melanonotus*	VU
Rufous-breasted wood-quail *Odontophorus speciosus*	LC
Tacarcuna wood-quail *Odontophorus dialeucos*	VU
Gorgeted wood-quail *Odontophorus strophium*	EN
Venezuelan wood-quail *Odontophorus columbianus*	NT
Black-breasted wood-quail *Odontophorus leucolaemus*	LC
Stripe-faced wood-quail *Odontophorus balliviani*	LC
Starred wood-quail *Odontophorus stellatus*	LC
Spotted wood-quail *Odontophorus guttatus*	LC
Singing quail *Dactylortyx thoracicus*	LC

Species	IUCN Category
Montezuma quail *Cyrtonyx montezumae*	LC
Ocellated quail *Cyrtonyx ocellatus*	NT
Tawny-faced quail *Rhynchortyx cinctus*	LC

Guineafowl (Numididae)

Species	Category
White-breasted guineafowl *Agelastes meleagrides*	VU
Black guineafowl *Agelastes niger*	LC
Helmeted guineafowl *Numida meleagris*	LC
Plumed guineafowl *Guttera plumifera*	LC
Crested guineafowl *Guttera pucherani*	LC
Vulturine guineafowl *Acryllium vulturinum*	LC

Turkeys (Phasianidae)

Species	IUCN Category
Wild turkey *Meleagris gallopavo*	LC
Ocellated turkey *Meleagris ocellata*	NT

7.1.5 Pheasant

Pheasants (Phasianidae)

Species	IUCN Category
Blood pheasant *Ithaginis cruentus*	LC
Western tragopan *Tragopan melanocephalus*	VU
Satyr tragopan *Tragopan satyra*	NT
Blyth's tragopan *Tragopan blythii*	VU
Temminck's tragopan *Tragopan temminckii*	LC
Cabot's tragopan *Tragopan caboti*	VU
Koklass pheasant *Pucrasia macrolopha*	LC
Himalayan monal *Lophophorus impejanus*	LC
Sclater's monal *Lophophorus sclateri*	VU
Chinese monal *Lophophorus lhuysii*	VU
Red junglefowl *Gallus gallus*	LC
Grey junglefowl *Gallus sonneratii*	LC
Sri Lanka junglefowl *Gallus lafayetii*	LC
Green junglefowl *Gallus varius*	LC
Kalij pheasant *Lophura leucomelanos*	LC

Species	IUCN Category
Silver pheasant *Lophura nycthemera*	LC
Edwards's pheasant *Lophura edwardsi*	EN
Vietnamese pheasant *Lophura hatinhensis*	EN
Swinhoe's pheasant *Lophura swinhoii*	NT
Aceh pheasant *Lophura hoogerwerfi*	VU
Salvadori's pheasant *Lophura inornata*	VU
Crestless fireback *Lophura erythrophthalma*	VU
Crested fireback *Lophura ignita*	NT
Siamese fireback *Lophura diardi*	NT
Wattled pheasant *Lophura bulweri*	VU
Tibetan eared-pheasant *Crossoptilon harmani*	NT
White eared-pheasant *Crossoptilon crossoptilon*	NT
Brown eared-pheasant *Crossoptilon mantchuricum*	VU
Blue eared-pheasant *Crossoptilon auritum*	LC
Cheer pheasant *Catreus wallichi*	VU
Elliot's pheasant *Syrmaticus ellioti*	VU
Hume's pheasant *Syrmaticus humiae*	NT
Mikado pheasant *Syrmaticus mikado*	NT
Copper pheasant *Syrmaticus soemmerringii*	NT
Reeves's pheasant *Syrmaticus reevesii*	VU
Common pheasant *Phasianus colchicus*	LC
Golden pheasant *Chrysolophus pictus*	LC
Lady Amherst's pheasant *Chrysolophus amherstiae*	LC
Bronze-tailed peacock-pheasant *Polyplectron chalcurum*	LC
Mountain peacock-pheasant *Polyplectron inopinatum*	VU
Germain's peacock-pheasant *Polyplectron germaini*	NT
Grey peacock-pheasant *Polyplectron bicalcaratum*	LC
Malaysian peacock-pheasant *Polyplectron malacense*	VU
Bornean peacock-pheasant *Polyplectron schleiermacheri*	EN
Palawan peacock-pheasant *Polyplectron napoleonis*	VU
Crested argus *Rheinardia ocellata*	NT
Double-banded argus *Argusianus bipunctatus*	EX
Great argus *Argusianus argus*	NT
Indian peafowl *Pavo cristatus*	LC
Green peafowl *Pavo muticus*	VU
Congo peafowl *Afropavo congensis*	VU

Appendix 2: Example budget

The table below shows items that should be budgeted for at each stage of a re-introduction project. The list is not exhaustive, but it does show that there is potentially significant expenditure in at least the *Pre-release and release* and the *Post-release* Stages. This shows that funding must cover the life of the project and beyond for proper dissemination of results.

Activity/item	Stage			
	FEASIBILITY	PRE-RELEASE & RELEASE	POST-RELEASE	LESSONS LEARNED
Suitable release site surveys				
Acquisition of species for release (either wild or captive-bred)				
Socio-political outreach				
Veterinary screening				
Genetic screening (if necessary)				
Preparation of release site				
Public awareness campaigns and costs of fund-raising				
Personnel costs for project (e.g. researchers, managers, consultants, etc.)				
Equipment and vehicle costs				
Costs of permits (e.g. capture, CITES, etc.)				
Publication of project reports, scientific papers, outreach materials, etc.				

Appendix 3: Live trapping

Abridged from Pheasant Specialist Group *Code of Practice on live trapping of pheasants*

Introduction

1. Conservation of wild Galliformes includes the need to obtain data on populations, behaviour, demographic parameters and other information. Although much important data can be collected remotely using observations of free-ranging animals, there are significant limitations. Many species are secretive and difficult to observe. In addition, some data are simply difficult or impossible to collect without capturing and marking the animal. However, capture and marking of animals, whilst providing immense opportunities, also comes with risks. This guidance is intended, therefore, to ensure that the capture and marking of wild Galliformes is carried out in the most humane fashion and does not significantly alter the birds' behaviour.
2. Two WPA-IUCN/SSC Specialist Groups, the Pheasant Specialist Group and the Partridge, Quail and Francolin Specialist Group, have formulated this guidance to provide detailed practical guidelines for capturing and handling Galliformes.
3. Since a high percentage of Galliformes are threatened, any research which creates disturbance to them and/or their habitat should be conducted in such a way as to cause the minimum of disruption. Actual trapping techniques are not published here.

General issues

1. The principal aim is to capture the bird with the minimum level of disturbance, avoiding mortality and injury.
2. Snares and traps should be set in such a way as to minimise the capture of other species.
3. Snares and traps should be checked on a regular basis, at least every two hours, to ensure that the bird is not a stressed position for longer than absolutely necessary and to minimise the risk of predation. Disturbance when monitoring traps can discourage birds from using the area. Therefore, remote monitoring might be considered if practical. If it is possible to monitor traps with bionoculars, this may prove effectve.
4. When checking traps it is recommended that researchers carry with them all the necessary equipment, such as measuring tools, rings or tags, ring pliers and radio tracking gear, for processing and releasing the bird on the spot. This will reduce the stress of the bird being handled in the trap, taken back to a base position, and then returned for release at the site of capture.
5. Snares should be disabled during the hours of darkness so that nocturnal species are not caught accidentally.
6. Field researchers must have appropriate permits. Many countries have particular regulations covering the trapping or snaring of animals, and it is the responsibility of the researcher to investigate local legislation so that no laws are broken. For example, in the UK it is illegal to capture any game pheasant other than for ringing (banding) during the "closed breeding" season (Feb. 2nd to Sept. 30th), or to use leg snares without a licence.
7. If radio-tracking is to be used in a field project, the method of trapping the birds must be detailed in the project proposal, including the proposed number of birds to be caught.
8. Project reports should include data on trapping results. It is only in this way that information can be passed on future investigators about the most appropriate and humane trapping methods.
9. Principal Investigators should ensure that they have researched the species to be captured before undertaking their study. For example, mountain peacock-pheasants suffer considerably from stress.
10. Any transportation of wild birds must comply with relevant legal regulations. The International Air Transport Association Live Animals Regulations offer helpful guidelines (see www.iata.org).

Snaring

1. Birds can be injured, killed or predated as a result of leg snaring. Therefore, it is vital that any leg snaring is undertaken only by those with sufficient expertise and training. Such training should be received from someone who has previously trapped birds for scientific study. Many hunters, although efficient at catching birds, have no need to keep the bird alive or healthy, so may use

methods not suitable for minimising stress or injury.
2. If training is required and cannot be arranged locally, please contact the Pheasant Specialist Group for advice and help.
3. No leg snare should be set in such a way that it results in the bird being suspended off the ground by one leg.
4. No leg snare should be sufficiently long that it allows a trapped pheasant to take off at speed from the ground with sufficient momentum to inflict injury to its leg.
5. A bird that has been snared by the leg will often run in circles around the base of the trap. This can result in the snare winding around its base or the surrounding bushes, and shortening until the bird has no movement at all or it becomes entangled. Fitting a swivel to the snare can limit these problems.
6. With any form of leg snare, the material (often nylon fishing line) can cut into the flesh. By using a slightly thicker gauge nylon, the researcher can limit this injury. A mild disinfectant cream can be applied to any such injury before releasing the bird, but it should be well-rubbed in so that sand and grit do not adhere.
7. It is virtually impossible to create species-specific leg snares where there are other ground-dwelling birds, as well as mammals and reptiles. Even tortoises can be caught accidentally. A trap that leaves a turkey comfortably on the ground could leave a bobwhite dangling in the air.

Other methods of trapping pheasants

1. Baited walk-in funnel traps are often used in the UK Gamebird industry to recapture feral birds prior to the breeding season, and may present a humane option in some circumstances. These traps work best for game pheasants when a finer wire netting funnel is attached to the opening. After the bird has walked into the trap, it tramples down the wire funnel, thereby blocking its escape route. However, it is not known that this method has been used outside the game pheasant industry, where the birds have previous experience of wire netting and are not alarmed by it.
2. Any wire traps should be of weldmesh construction, rather than chicken wire, so as to avoid any self-inflicted "panic" injuries by wild birds.
3. Wire traps should have a soft roof fitted to the inside to minimise scalping. Cloth or foam works well in this situation.
4. Large traps designed to capture a number of pheasants can result in a dominant male bird inflicting injury on a weaker male or a female. Single cage traps avoid this possibility.
5. The mesh on any trap is recommended by the Game and Wildlife Conservation Trust in the UK as 7.5 cm square (3inches), so that any captured bird cannot get its neck trapped in the mesh.
6. Drop nets, which can be triggered automatically by a trip wire or manually from a hide, have proved to be a successful alternative to leg snares in northern India. They have the advantage of restraining the captured bird against the ground, thus preventing the sort of leg injuries that pheasants can inflict upon themselves by trying to fly rapidly out of a snare. A series of drop nets can be used to "funnel" birds along a particular path, which can be made to decrease in width as it nears the traps.
7. Mist-netting is widely used for catching many groups of birds for research purposes and these nets may catch Galliformes occasionally, particularly in densely forested areas. However, they are expensive and unproven as the principle means of catchig pheasants.
8. In the UK, partridges and grouse are sometimes caught for study by night-time dazzling with high-powered lights and there are specific guidelines about the use of such lights. The use of lights elsewhere is not known.

Guidance on handling birds after they have been trapped

1. Once a pheasant has been caught in a snare, it must be handled carefully so that no injury occurs.
2. Covering the bird immediately with a dark cloth so that it cannot see helps the handler, since the bird will usually struggle less.
3. The bird should be held firmly around the top of both legs, where they join the body. Here the leg bones and muscles are at their thickest, and can withstand any sudden movements that the bird might make as it tries to escape.
4. The bird should never be held by the lower leg or only one leg.

5. Once a firm grip has been placed around both thighs, and whilst the head is still in darkness, the snare can be released.
6. If the bird is to be held for any length of time (for example, whilst a radio-transmitter is being fitted) the wings should also be folded to the bird's body and held there, either by hand or by wrapping a cloth around the body.
7. Never hold the bird by the head or neck.
8. Birds that cannot be handled immediately should be kept in a cardboard box or cloth bag.

Other sources that might be consulted include:

Anon (2001) Code of Conduct for contributors. *Oryx* 35: 99-100.

Anon (2006) Guidelines for the treatment of animals in behavioural research and teaching. *Animal Behaviour* 71: 245–253. (see www.elsevier.com/framework_products/promis_misc/ASAB2006.pdf)

Appendix 4: Transport and holding conditions

1. Have sound boxes available before they are needed.
2. Pheasants travel best if they are in a dark, well ventilated environment.
3. Food and water should not be given immediately after capture, but should be available if travel is longer than a day. (International requirements stipulate a much shorter time, but many pheasants seldom drink at all during transport.)
4. It should be possible to provide additional food and water if required without opening the box and thus disturbing the bird.
5. It is a legal requirement in many countries to carry and complete an animal transport certificate.
6. Boxes should be sufficiently robust that they will not collapse under pressure nor fall apart if they get wet. There are International Air Transport Association guidelines that must be followed for any international movement of Galliformes.
7. Boxes should have a padded roof so that the bird cannot damage its head.
8. The box should be sufficiently large to allow the bird to turn round.
9. There should be spacers on each side to ensure that air vents cannot be covered if more than one pheasant box is being transported.
10. A small amount of wood shavings, not sawdust, should be used to absorb droppings whilst the bird is in the box. Too much will result in the bird inhaling shavings or getting dust in its eyes.
11. Handles on each end of the box make it much easier for one person to lift and much more stable for the bird when being moved.
12. Boxes must be labelled to ensure they are kept the right way up and to show that a live animal is inside.

Appendix 5: Catching pheasants in an aviary

1. Plan everything you intend to do with the bird before you catch it, so that you do not have to keep the bird confined for longer than necessary.
2. Have a good catching place identified beforehand, where you know you can persuade the bird to go and where there are no obstructions if you are using net. A corner of the aviary or somewhere where the bird is already constrained, such as a night shelter or a safety porch, is usually best. If catching the bird within such a small area, obviously only one person is needed, and additional people usually just create further panic in the bird. If the aviary has a slope, catching the bird at the bottom of the slope is usually easier.
3. Do not catch a bird by hand as this may harm it.
4. Use a good catching net. For example, it should be about 60 or 70 cm wide and almost a metre deep. It should have a padded rim so that it cannot injure the bird, and the net material should be a strong cloth. Black cloth will enclose the bird in a dark environment. In this way it cannot see dangers and so it relaxes, reducing stress. The net should have a short or telescopic handle as this makes it much easier to manoeuvre around bushes and shrubs in the aviary.
5. When catching Galliformes within a large aviary, it is much easier and quicker if there are two people, one with the net and one driving the bird towards the catching site you have already decided upon. Do not chase it around the aviary like trying to catch a butterfly.
6. When the bird is in the net, feel for the body and take hold at the top of the thighs.
7. First, check that the bird is fit and well, and that the eyes are bright and clear. Feel down the breast bone which sticks out a bit like the bow of a ship. On either side of this bone, the muscles should be plump and firm. These muscles are the ones that the bird uses to fly. If the bird becomes unfit or unwell, these muscles deteriorate until you can feel the rib bones underneath them. Then check that the soles of the feet are clean and uncut, and the area around the toes is not swollen (bumblefoot).
8. If the bird is to be fitted with a ring (band), check the number of the ring and record it. Use the proper ringing pliers to gently close the ring around the bird's leg.
9. If feathers are to be collected for DNA sampling, have a polythene bag ready

Appendix 6: Marking (including radio-tagging)

(Based on Pheasant Specialist Group Code of Practice on live trapping of pheasants)

1. All animals should receive a metal ring (band) or in some cases a patagial tag for individual identification. In Europe, AVIORNIS supplies numbered rings for captive stock.
2. Note that in some northern climates, metal rings have been shown to build up ice and snow, causing damage to the leg of the bird. If this happens, a suitable plastic ring can be used instead.
3. The researcher should be trained in proper ringing techniques.
4. Patagial tags should generally be avoided except in cases where long-term work has shown minimal impact on the study animals, or when marking juveniles whose legs cannot yet receive leg rings. For most pheasant species, an adult ring can be fitted on a juvenile bird once it is around 40-45 days old. Prior to this, the ring will usually fall off as the leg and foot are too small.
5. Coloured plastic tags for remotely identifying individuals have been widely used; however, they may cause problems. Any tag visible to researchers is also visible to predators.
6. Any tag attached to an animal must minimise the possibility that it interferes with the animal's behaviour. For example, some colour combinations may reduce breeding opportunities for individuals by disrupting courtship displays.
7. Radio-telemetry provides additional opportunities and challenges. It is an expensive technique and researchers should be well-trained before depending on it.
8. Two important issues make telemetry a challenge for research – weight and attachment.
9. Researchers should follow well-established guidelines for transmitter size and weight. For example, researchers successfully used 6g transmitters on 160g bobwhite quail in the USA, and the current practice is to use similar transmitters for 400g grey partridge. In the past, researchers have used 18g transmitters on 1000g common pheasants, but more recently transmitters of about 12g have been used.
10. Harness design is crucial and often species specific. The general rule is that larger species in excess of 2000g should be given some type of backpack harness. For smaller species, neck collars or necklace transmitters seem best.
11. When attaching radio harnesses it is critical that the researcher understands how to handle the bird without injuring it and is aware of how the radio transmitter should sit on the animal.
12. Backpacks should be tight enough to allow the bird to preen, but must not interfere with flight or other movements.
13. Necklace transmitters should be tight enough to allow the bird to preen, but loose enough to allow the passage of food into and out of the crop.

Other sources that might be consulted include:

Anon (2001) Code of Conduct for contributors. *Oryx* 35: 99-100.

Anon (2006) Guidelines for the treatment of animals in behavioural research and teaching. *Animal Behaviour* 71: 245–253.
(see **www.elsevier.com/framework_products/promis_misc/ASAB2006.pdf**)

Appendix 7: Studbooks

International Studbooks for selected species are maintained under the auspices of the World Association of Zoos and Aquariums (WAZA: **www.waza.org**). Each studbook has one or more studbook 'keepers' who are responsible for maintaining suitable records and guiding the breeding programme. Usually staff of WAZA Member Institutions serve as studbook keepers, although several Galliformes studbooks are maintained by WPA members. The International Studbook Office is hosted by the Zoological Society of London whose Zoological Director acts as International Studbook Coordinator. Within WAZA, the Committee on Inter-Regional Conservation Cooperation (CIRCC) is the body dealing primarily with studbook issues.

A list of the studbooks currently maintained can be found on the WAZA website (see **www.waza.org/conservation/index.php?main=conservation&view=breeding**).

Studbooks are currently maintained for nine species of Galliformes, which are (with year of approval in brackets):

1. Horned guan (2002);
2. Red-billed curassow (1991);
3. Blyth's tragopan (1988);
4. Cabot's tragopan (1979);
5. Edward's pheasant (1976);
6. Vietnamese pheasant (2000); and
7. Congo peafowl (1988).

(Although the mountain peacock-pheasant and Malaysian peacock-pheasant studbooks are listed on the WAZA website, they were discontinued at the end of 2007).

Appendix 8: Glossary of terms

Augmentation – see supplementation.

Benign introduction – an attempt to establish a species for the purpose of conservation: outside their recorded distribution, but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within the species' historic range (modified from IUCN, 1998).

Captive – Galliformes kept in a small managed area, with deliberate husbandry, veterinary intervention and food supplementation. Can be in or out of the historic range.

Clutch – the number of eggs laid by a female at one time.

Conservation introduction – see benign introduction.

Critically Endangered – when used in the context of the IUCN Red List, a taxon is classified as 'Critically Endangered' when there is an extremely high risk of extinction in the wild in the immediate future (IUCN, 2001). **See** **http://www.iucnredlist.org/info/categories_criteria2001**.

Endangered – when used in the context of the IUCN Red List, a taxon is classified as 'Endangered' when there is very high risk of extinction in the wild in the immediate future (IUCN, 2001). See **http://www.iucnredlist.org/info/categories_criteria2001**.

Endemic – occurring in a particular geographical area only.

Extinct – when there is no reasonable doubt that the last individual has died (IUCN, 2001). See **http://www.iucnredlist.org/info/categories_criteria2001**.

Extinct in the wild -

Flagship species – popular charismatic species that serve as symbols to stimulate conservation awareness and action locally, nationally, regionally or globally.

Hybridization – cross breeding between individuals of different species.

In situ – within the historical range.

Inbreeding depression – the loss of individual reproductive fitness, and thus population vigour and long term viability, due to breeding between closely related individuals.

Incubation – the hatching of eggs by means of heat (natural or artificial).

Indicator species – a species sensitive to environmental change, which can therefore provide a measure of health for the ecosystem.

Introduction – the introduction of a species by human agency (either intentional or accidental) outside its historically known native range (modified from IUCN, 1987). There is the potential for an introduced species to become invasive or behave as an alien species.

IUCN Red List – a comprehensive inventory of the global conservation status of species, using a set of criteria to evaluate extinction risk (IUCN, 2001). See **http://www.iucnredlist.org/info/categories_criteria2001**.

Keystone species – a species whose loss would cause significant changes in the general structure and processes of an ecosystem.

Monitoring – regular, statistically-designed analysis of a population in order to record its numbers, composition, behaviour and distribution.

Notifiable disease – a disease that must be reported as specified under national or international regulations.

Parapatric – distribution of species that meet in a very narrow zone of overlap.

Reinforcement – see supplementation.

Re-introduction – an attempt to re-establish a species in an area that was once a part of their historical range, but from which they have become extinct (for any reason) (modified from IUCN, 1998).

Source population – the population from which the birds targeted for translocation will come from.

Species – individuals that can interbreed and produce fertile young only among themselves.

Subspecies – a morphologically, behaviourally, ecologically and geographically distinct variety within a species.

Substitution – the introduction of a closely related species/subspecies to replace a species that has become extinct in the wild and in captivity. This should occur in suitable habitat within the extinct species' former range (modified from Seddon and Soorae, 1999).

Supplementation – the addition of species to an existing wild population (modified from IUCN, 1998).

Translocation – the movement of individuals for the purpose of conservation from one natural habitat to another. If the habitat they are being moved to is vacant then it is a re-introduction, if the habitat has a few existing individuals then it is a supplementation, if it is a similar habitat but in a different eco-geographical area then it is a conservation introduction.

Viable population – a population that is large enough to ensure long-term survival.

Vulnerable – when used in the context of the IUCN Red List, a taxon is classified as 'Vulnerable' when facing a high risk of extinction in the wild in the immediate future (IUCN, 2001). See **http://www.iucnredlist.org/info/categories_criteria2001**.

Appendix 9: Galliformes symposia

WPA and the Galliformes Specialist Groups have held a wide range of symposia since the first WPA symposium in 1978. A list of the major meetings covering the various groups of species are listed below, together with the citation of the proceedings that records them.

1978 - Grouse
Inverness, Scotland, UK 1978
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Antwerp, Belgium 1993
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