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WPA

CAPTIVE BREEDING
SYMPOSIUM

ZOO - ANTWERP



WPA INTERNATIONAL CAPTIVE BREEDING SYMPOSIUM

ORGANISED BY
WPA BENELUX AND THE CAPTIVE BREEDING ADVISORY COMMITTEE

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The Royal Society of Antwerp celebrating its 150th Anniversary and, Antwerp City acting as the Cultural Capital of Europe may be good reasons for organizing this 1st Captive Breeding Symposium of the World Pheasant Association at Antwerp Zoo. But these were only festive circumstances creating a suitable climate, not the real fundamental reasons. Galliformes and WPA itself were just "enough" for us to offer our jubilating house as a place to meet for this special occasion. When Dr Lovel, one of WPA's founders, came to Antwerp Zoo short after the start, he immediately, got active co-operation and enthusiasm. When some years later the Benelux chapter was created in the Netherlands, Antwerp joined immediately, and still plays an active part. We believe in the mission statement of WPA and we believe in the authority of the WPA-team. On the other hand the Zoo's commitment with Galliformes was worldwide known since the end of the 19th Century. Rare species of today like Hastings tragopan, Blyth's tragopan and many others were kept and bred in the Zoo more than one century ago while, now recently, scientific breeding programmes for Imperial pheasants, Congo peafowl and Cracid species among others, have been started or co-ordinated here.

So it is not by chance that this first Captive Breeding Symposium for Galliformes is hosted by Antwerp Zoo. It is not an unique event either. The first EEP-meeting took place at Antwerp, as well as the first EAZA-meeting. The World Parrot Trust's BeNe-Chapter had its inaugural meeting here, etc.

This can not be pure coincidence.

A first something always shows a kind of reserve, a kind of "let's wait and see" feeling before we join. That is a normal and typical behaviour, in animals as well as in human beings.

Nevertheless this first C.B.S. must be an exception ! More than 85 participants from 12 different countries, does not look like a first something anymore. It proves that you believe in the quality and the value of a symposium like this one. The programme speaks for itself with lecturers from 9 different countries all over the world in merely one and a half day, covering a large variety of topics. I really hope all visa problems could be cleared in

time !

Let this symposium be the first one in a long row, let it be a valuable contribution to survival of threatened species among which, unfortunately, pheasants are extremely well represented.

We are proud to be your host. I wish you good luck.

Fredric J. Daman

Director, Royal Zoological Society of Antwerp

De Koninklijke Maatschappij voor Dierkunde te Antwerpen, die dit jaar haar 150 jarig bestaan viert en Antwerpen zelf, de stad die dit jaar de eer heeft de Culturele Hoofdstad van Europa te zijn, mag een goede reden zijn om het Eerste Captive Breeding Symposium te organiseren in de Antwerpse Dierentuin. Maar dit zijn slechts feestelijke omstandigheden die een geschikt klimaat scheppen, niet de echte wezenlijke reden. Hoenderachtigen en de WPA zelf zijn op zichzelf al "voldoende reden" voor ons om ons jubilerende huis ter beschikking te stellen als plaats van samenkomst voor deze speciale gelegenheid.

Toen Dr Lovel, een van de grondleggers van de WPA, kort na de oprichting naar Antwerpen kwam, kreeg hij onmiddelijk alle medewerking en een geestdriftig onthaal. En toen enkele jaren later de Benelux-Chapter werd opgericht in Nederland, sloot Antwerpen zich hier onmiddellijk bij aan en zij speelt nog steeds een actieve rol. Wij geloven in de doelstellingen van de WPA en in de autoriteit van het WPA-team. Aan de andere kant was de betrokkenheid van onze dierentuin bij de hoenderachtigen al sinds het einde van de 19e eeuw bekend. Wat nu zeldzame soorten zijn, zoals de Westelijke tragopaan en de Blyth's tragopaan en vele andere, werden meer dan een eeuw geleden al in de dierentuin gehouden en ook gefokt, terwijl meer recentelijk wetenschappelijke fokprogramma's voor onder andere de Keizerfazant, de Congopauw en Hokko-achtigen begonnen zijn en hier gecoördineerd worden.

Dus het is niet toevallig dat de Antwerpse Dierentuin de gastheer is van dit 1st Captive Breeding Symposium. Het is ook geen uniek evenement. De eerste EEP-vergadering vond plaats in Antwerpen, evenals de eerste EAZA-vergadering. De inaugurele bijeenkomst van de BeNe Chapter van de World Parrot Trust was hier, en ga zo maar door.

Dit kan niet enkel toeval zijn.

Bij een eerste van iets is er altijd sprake van enige reserve, een soort van "laten we wachten en zien" gevoel alvorens we ons aansluiten. Dit is een normaal en typisch gedrag zowel bij dieren als bij mensen. Desalniettemin is dit eerste C.B.S een uitzondering ! Met meer dan 85 deelnemers uit 12 verschillende landen lijkt het niet meer op een eerste bijeenkomst. Het bewijst dat u gelooft in de kwaliteit en de waarde van dit symposium. Het programma spreekt voor zichzelf met sprekers uit 9 landen van over de gehele wereld in slechts anderhalve dag, die een groot aantal onderwerpen aansnijden. Ik hoop dat alle visa problemen op tijd konden worden opgelost !

Laat dit symposium het eerste zijn in een lange reeks en laat het een waardevolle bijdrage leveren aan het overleven van bedreigde soorten waaronder, helaas, de fazanten een grote plaats in nemen.

We zijn er trots op uw gastheer te mogen zijn. Ik wens u veel succes.

Fredric J. Daman

Director, Royal Zoological Society of Antwerp

OPENING ADDRESS

J.A. Assink
chairman WPA-Benelux

It is with great pleasure to welcome you in the Antwerp Zoo for the 1st WPA - Captive Breeding Symposium, which is jointly organised by WPA's Chapter Benelux and WPA's Captive Breeding Advisory Committee. I would in particular like to welcome our distinguished guests from all over the world who took the trouble to come to Antwerp, Europe's cultural capital for 1993.

Why a captive breeding symposium ?

The World Pheasant Association has a long history in conservation of which captive breeding is an important part. Since many years the international conventions took place mostly in the United Kingdom, but also in Germany and in the Benelux countries. Due to the ever increasing number of conferences it was decided three years ago to discontinue this convention. Grouse symposia, Pheasant symposia and Cracid symposia often with a better scientific background gave more specialisation to the specific subjects. Unfortunately the captive breeding community did not have the possibility to communicate, to learn from and to teach each other on subjects like housing, nutrition, record keeping etc. Fortunately this did happen on a local basis but not on an international basis.

This lack of international communication was clearly distinguished by the council and a new conference was added to give extra attention to captive breeding as a tool for conservation. Every three years this captive breeding symposium will take place in different WPA-chapters.

I hope this symposium will help in better understanding the problems the captive community has to face and hopefully will provide guidelines to secure species from final extinction. We have an immense task as professional and amateur aviculturists to fulfil with a great responsibility and we must succeed, because we will probably not have a second chance. Extinction is forever.

Comparison, following guidelines of studbookkeepers, stable collections not depending on marketprices will be keywords in a successful future.

Many institutions and private support made this symposium possible. I would like to thank Antwerp Zoo and all other patrons for their help and support.

Thank you: Communicate and learn in this beautiful Zoo and City of Antwerp.

DEMOGRAPHY AND POPULATION GENETICS IN CONSERVATION PROGRAMS

Helga De Bois
Royal Zoological Society of Antwerp

ABSTRACT

The ultimate objective of a conservation program is to maximize the probability that a population will survive on the long-term, while preserving the original biological characteristics of the taxon. This requires, amongst many other things, the inclusion of several demographic and population genetic principles into the management strategy.

Obviously, a population manager will always collect a number of basic demographic and genetic data, such as numbers, sex, ages, pedigrees. However, the mere collection of these data is not sufficient. Several analyses are needed to monitor the health of the population and to develop a sound demographic and genetic management.

This paper presents an overview of the most important demographic and genetic parameters that have to be monitored in the frame of a conservation program, and discusses how this information should be integrated into the global management to improve the survival chances of the population.

SAMENVATTING

Het uiteindelijke doel van een conservation programma is het maximaliseren van de waarschijnlijkheid dat een populatie op lange termijn zal overleven, terwijl de oorspronkelijke biologische karakteristieken van het taxon behouden blijven. Dit vraagt onder andere om het insluiten van bepaalde demografische en populatie genetische principes in de beheersstrategie.

Natuurlijk zal een populatiebeheerder altijd een aantal demografische en genetische basisgegevens verzamelen, zoals aantallen, geslacht, leeftijd, afstamming. Echter, het alleen verzamelen van deze gegevens is niet voldoende. Verschillende analyses zijn nodig om de vitaliteit van een populatie te bepalen en om een duidelijk demographisch en genetisch beheer te ontwikkelen.

Deze lezing geeft een overzicht van de belangrijkste demografische en genetische parameters die gevuld moeten worden in het geheel van een conservation programma, en bespreekt hoe deze informatie ingepast moet worden in een wereldwijd beheer om de overlevingskansen van een populatie te verbeteren.

CAPTIVE BREEDING STRATEGY FOR THE GALLIFORMES

J.A.Assink
World Pheasant Association - Benelux

INTRODUCTION

In light of the ever increasing pressures on the wild populations of the Galliformes, the World Pheasant Association has laid out recommendations for an international captive breeding strategy for this important group of birds, to work in conjunction with future international legislation and other nature conservation strategies.

The World Pheasant Association, as the internationally recognised IUCN/ICBP Specialist Group concerned with the Galliformes, accepts the need for legislation in order to prevent international commercial trade in wild caught birds. This document has been written as an aid to those structuring future legislation and as a detailed guideline to both the professional and amateur aviculturist.

The Order Galliformes (263 species in a total of 94 genera) is widely represented in all five continents. This Order consists of three Families: Megapodes from Australasia; Cracids from South and Middle America and the Phasianids (including pheasants, partridges, quail, grouse, francolin, guineafowl and turkeys), which are distributed throughout the world. Many of these species have restricted territories where even a minor local change can dramatically harm the world population.

Over the past thirty years several species have become extinct and an increasing number are now endangered or threatened. The prime cause of this grave situation is erosion of habitat, mainly as a result of dramatic increase in human population. It is also recognised that human disasters, such as warfare or pollution can swiftly devastate vast areas with virtually no warning.

Gamebirds have been kept in captivity for over 2000 years. As a result avicultural techniques with this group are well known and many species are represented in captivity. Due to their successful adjustment to captivity and the ease of propagation of most species it has not been necessary to make excessive demands on wild populations. Knowledge of modern science and a greater awareness of the need to conserve the existing captive bloodlines has created an increasingly large body of responsible aviculturists. These people, both professional and amateur, communicate through the World Pheasant Association. The WPA currently has 13 chapters spread throughout the world and has widely distributed publications.

It has been established that, through careful management of the existing captive gene pool, it is possible to preserve many of the endangered and threatened species as self-sustaining captive populations. These captive populations are held in collections throughout the world, thereby making it essential occasionally to exchange bloodlines in order to maintain the natural vigour of the species. Legislation can unwittingly inflict severe damage on such operations.

Where populations do not contain adequate genetic diversity it can be necessary to introduce wild birds to captivity. WPA agrees to such introductions so long as this causes no adverse pressure on the wild population. Any such importation would be part of an approved project, with both licence and record system. Suitability of any avicultural establishment, or individual, to take part in such projects has been, and continues to be, monitored with only accredited establishments or individuals taking part.

1. WPA Conservation Strategy

The Conservation Strategy outlines WPA's aims and objectives relating to the worldwide conservation and preservation of gallinaceous birds in the wild. Included are details of current status in the wild and habitat pressures; together with WPA projects undertaken and recommended. This Captive Breeding Strategy is an adjunct to WPA's Conservation Strategy and is incorporated in many of its long term conservation projects.

2. The Role of Captive Breeding as a tool for Conservation

Captive populations can be vital to the long term survival of a species, not only as a safeguard for future survival but also for educational and scientific purposes.

These include:

- a) Increasing scientific knowledge of the Order through all disciplines. For example, the study of behavioural patterns can contribute to improved management of wild populations as well as having relevance to reintroduction programmes.
- b) Reintroduction programmes and research studies in the country of origin help educate the people to a greater awareness of the importance of their wildlife and its conservation.
- c) Representatives from captive populations held in zoos, and similar collections accessible to the general public, play an important role in educating the public the need for conservation throughout the world.

It must be stressed that once a captive self-sustaining population of a species has been established, and is properly managed, there should be no need to interfere with any wild population.

The WPA supports the views of IUCN on captive breeding which include the recommendation:

"IUCN urges that those national and international organizations and those individual institutions concerned with maintaining wild animals in captivity commit themselves to a general policy of developing demographically self-sustaining captive populations of endangered species wherever necessary".

PLAN OF ACTION

The World Pheasant Association recommends their captive breeding strategy to governments; amateur and professional breeders; nature conservation organisations and captive breeder organisations.

SURVIVAL OF CAPTIVE POPULATIONS

In order to be able to sustain captive populations for the future, WPA has laid down the following guidelines to achieve the ultimate goal of sound established captive populations, which can in the future be the source of birds for reintroduction projects.

- **IDENTIFICATION:** WPA recommends leg ringing (or similar accepted identification system) for all captive bred Galliformes. WPA encourages its avicultural members to take part in the Aviornis International leg ringing scheme.
WPA insists that all birds involved in any of its captive breeding projects are permanently identified either by a closed leg-ring or microresponder.
- **RECORD KEEPING:** WPA undertakes to keep detailed records of all birds involved in its captive breeding programmes. This data will be regularly made available to international wildlife record holders. These records will be a tool on which to base management recommendations for individual species.
WPA also monitors the global captive populations of Galliformes by conducting regular censuses. Comparative analysis of results highlights priorities for special management.
- **EDUCATION:** Through symposia, publications and special courses, the World Pheasant Association stimulates the awareness of professional and amateur breeders to the important role they can play in the conservation of species.
- **BREEDING FOR CONSERVATION AND BIOLOGICAL BASED PRINCIPLES:**
Maximising the genetic diversity of any species selected for a WPA breeding programme. Such programmes should start with as large a founding group as possible and increase the population to its optimum level as soon as possible; equalise founder representation; monitor for avoidance of inbreeding.
WPA Members taking part in any WPA breeding programme have to meet the standards as laid down in the Code of Conduct for Accredited Establishments.
Background papers available in the Galliformes Survival Manual
(Paper kindly offered by EEP-Executive Bureau).
- **HUSBANDRY:** The studbook keeper and/or species coordinator of any WPA Breeding Programme will be assisted by other specialists in providing advice on all avicultural aspects of the species concerned.
- **RESEARCH:** Behavioural, veterinary and nutritional research is needed in order to maintain a species under captive conditions over a length of time. The Scientific Advisory Committee of the World Pheasant Association continues to cooperate with scientific institutions in order to stimulate research.
- **SELECTION OF TAXA FOR GALLIFORMES SURVIVAL PROGRAMMES:**
In close cooperation with EEP's Bird Taxon Advisory Committee the WPA has laid down guidelines for selection of species for future cooperative breeding programmes.
- **GUIDELINES FOR COORDINATORS OF BREEDING PROGRAMMES:**
The World Pheasant Association has laid down guidelines for studbook/register keepers and species coordinators in close cooperation with the existing organisations concerned with monitoring captive breeding.

TRADE in WILD-CAUGHT GALLIFORMES

Although the World Pheasant Association is opposed to trade in wild-caught Galliformes, it does approve of importation from the wild, conditional on adequate knowledge of any adverse affect on a given wild population, where:

- i) import contributes to approved conservation projects.
- ii) import helps in establishing captive populations of species not hitherto represented in captivity.
- iii) import is necessary to strengthen the genetic variability of an existing captive population.
- iv) it is shown that an endangered wild population is being actively conserved and a captive population (with its ability to produce large numbers of birds) would benefit this project.

Import in all these cases is only appropriate when it does not serve any commercial purpose, and is part of a project agreed by the responsible governments and conservation organisations.

TRANSPORT of GALLIFORMES

The World Pheasant Association recommends that all involved in the shipping of Galliformes provide the birds with adequate transport boxes that meet the requirements for: size; ventilation; prevention of injury; feeding and watering; are of sufficiently strong construction and are correctly labelled.

Transporters, transport agents and customs officials should endeavour to limit the handling time of birds in transit to the minimum.

Amateur and professional breeders of the Galliformes will have to fulfil all the necessary paperwork to comply with national and international regulations. Members of WPA, in particular, have a great responsibility in this matter having undertaken to adhere to the principles within this strategy.

PRIORITIES FOR SPECIES IN NEED OF IMMEDIATE BREEDING PROGRAMMES

In February 1993 the Galliformes CAMP-meeting (Conservation Assessment and Management Plan) was held at Antwerp Zoo. The World Pheasant Association, ICBP and CBSG jointly produced data-sheets on the Galliformes with an exception for the Cracids. These data-sheets are the results of intensive discussions of more than twenty specialists gathered from all over the world. These valuable data will result in action plans for each Galliformes Specialist Group and for WPA's Captive Breeding Advisory Committee (CBAC).

Recommendations were given for a range of species in order to learn more about their present status in the wild and to propose actions to minimize the pressure on these species which received a threat category following the Mace/Lande criteria.

Some of the species were also indicated with CM (Captive Management) whereby captive breeding may be valuable as a tool to preserve a particular specie. These species indicated with CM were given a high priority and professional and amateur aviculturists have an immense responsibility in establishing selfsustaining captive populations.

The Captive Breeding Specialist Group (SBSG) of IUCN however gives high priority to all species that have received a Mace/Lande Threat Category and are in need of captive breeding programmes. 51 species of Galliformes, excluding the Cracids are necessary to maintain the existing stock in captivity. However 19 species were given the highest priority and the Captive Breeding Community including professionals and amateurs are strongly asked to maintain these species in captivity as a reserve population with professional management including studbook, identification and research on all aspects of captive breeding.

The 19 species highlighted for priority are:

Taxonomic name	English name	Wild population Est.	M/L sts	Captive pop. est.
<u>Megapodiidae</u>				
<i>Leipoa ocellata</i>	Malleefowl	1000-10.000	V	> 50
<u>Phasianidae</u>				
<i>Francolinus erckelli</i>	Erckel's Francolin	5000-50.000	-	> 150
<i>Margaroperdix madagascarensis</i>	Madagascar Hill Partridge	5000-50.000	V?	< 250
<i>Melanoperdix nigra</i>	Black WoodPartridge	> 1000	V	< 10
<i>Rollulus roulroul</i>	Roulroul Partridge	1000-100.000	V	> 1000
<i>Tragopan satyra</i>	Satyr's Tragopan	5000-20.000	V	> 1000
<i>Tragopan blythii</i>	Blyth's Tragopan	500-5000	E	50
<i>Lophura leucomelanos moffitti</i>	Black Kalij	?	?	30
<i>Lophura edwardsi</i>	Edward's pheasant	0-1000	C/EX	< 1000
<i>Lophura erythrophthalma erythrophthalma</i>	Malay Crestless Fireback	1000-10.000	V	> 250
<i>Lophura erythrophthalma erythrophthalma</i>	Borneon Crestless Fireback	100-5000	V/E	< 50

<i>Crossoptilon mantchuricum</i>	Brown Eared Pheasant	1000-5000	E	> 1000
<i>Syrmaticus humiae</i>	Hume's Bartailed Ph.	1000-10.000	V	< 1000
<u><i>Polyplectron inopinatum</i></u>	Mountain Peacock Pheasant	1000-10.000	E ?	25
<u><i>Polyplectron malacense</i></u>	Malay Peacock Pheasant	1000-10.000	V	< 250
<i>Polyplectron emphanum</i>	Palawan Peacock Pheasant	1000-5000	E	> 1000
<u><i>Afropavo congensis</i></u>	Congo Peafowl	50-50.000	?	+ 100

* For the underlined species an international studbook exists

Four rare species in captivity, *Lophura hatinhensis* Vo Quy's Pheasant, *Tragopan melanocephalus* Western Tragopan, *Lophophorus lhuysii* Chinese Monal and *Rheinardia ocellata* Rheinhard's Argus Pheasant are presently kept in small numbers in captivity. WPA should give all possible assistance to improve the quality of husbandry of these particular species and to realise co-operative programmes to maintain them in captivity.

The Vo Quy's Pheasant however might be a subspecies of *Lophura edwardsi*; clarification is necessary and if confirmation of this theory is true, the Vo Quy's Pheasant can be part of the management plan for the Edward's Pheasant.

Projects for priority species will be worked out and the already existing 5 international studbooks will continue their work.

Added is the international studbook for the *Tragopan caboti* Cabot's Tragopan, which is not actively run, due to extensive cross breeding with other species. DNA testing with the help from Cabot's Tragopans from the Breeding Centre in China and the help of Leicester University may help us in solving these problems.

CBAC has distinguished two further projects which are regarded as urgent.

* Jungle Fowl Management: An active European Study Group has been working for many years on these species and it appeared that only by proper management and sufficient knowledge of recognizing junglefowl species these ancestors of all domestic chickens can be established in captivity. The educational value is of great importance.

* Cheer Pheasant management: Attempts to re-introduce this species in parts of Pakistan, where the Chee pheasant has disappeared, have been undertaken. It is clearly felt that the captive population should be managed in order to provide different bloodlines for this project.

SAMENVATTING

Beleidsplan voor het Fokken van Bedreigde Hoenderachtigen

In het licht van de steeds groter wordende druk op de wilde populaties hoenderachtigen, heeft de World Pheasant Association aanbevelingen gedaan voor een internationale strategie voor het fokken van deze belangrijke groep vogels, om in de toekomst samen te kunnen werken met de internationale wetgeving en andere strategieën betreffende natuurbehoud.

De World Pheasant Association, zijnde de door de IUCN en ICBP (Internationale Unie voor het Instandhouden van Bedreigde Soorten en de Natuurlijke Hulpbronnen en de Internationale Raad voor Vogelbescherming) internationaal erkende specialistische groep met betrekking tot de hoenderachtigen, aanvaardt de noodzaak van het wettigen om de internationale handel in wildvang vogels te voorkomen.

De Orde van de Hoenderachtigen (263 soorten gegroepeerd in 94 genera) is verspreid over alle vijf continenten. De Orde bestaat uit 3 families: Grootpoothoenders uit Australazië; Hokko's, Goeans en Chachalaca's uit Zuid en Midden Amerika; en de Fazantachtigen (fazanten, patrijzen, kwartels, ruigpoothoendes, frankolijnen, parelhoenders en kalkoenen), die verspreid zijn over de gehele wereld. Veel van deze soorten leven in beperkte territoria waar zelfs een kleine lokale verandering, de wereldpopulaties van een soort, dramatisch kan beïnvloeden.

Gedurende de laatste dertig jaar zijn verscheidene soorten uitgestorven en een steeds groter aantal zijn nu kwetsbaar of bedreigd. De belangrijkste oorzaak van deze ernstige situatie is de erosie en het verdwijnen van de habitat, hoofdzakelijk veroorzaakt door een dramatische groei van de menselijke populatie. Het is ook bekend dat menselijke rampen, zoals oorlogsvoering of vervuiling vrijwel zonder waarschuwing snel enorme gebieden kan verwoesten.

Fazanten worden al meer dan 2000 jaar in gevangenschap gehouden. Dientengevolge zijn foktechnieken met deze groep welbekend en veel soorten worden in gevangenschap gehouden. Omdat zij zich zo gemakkelijk hebben aangepast aan de omstandigheden in gevangenschap en de meeste soorten gemakkelijk tot fokken overgaan is het niet nodig geweest om grote aantallen uit het wild te importeren. De kennis van moderne foktechnieken en een grotere bewustwording van de noodzaak om de bestaande bloedlijnen in gevangenschap in stand te houden hebben geresulteerd in een grote groep verantwoordelijke houders van deze vogels. Deze mensen, zowel professionele als privé liefhebbers, onderhouden contacten door middel van de World Pheasant Association. De WPA heeft momenteel 13 chapters over de gehele wereld en zij verzorgd ook wijd verspreide publicaties.

Het is aangetoond dat, door een zorgvuldig beheer van de bestaande genenpoel, het mogelijk is om veel kwetsbare en bedreigde soorten als een op zich zelf staande populatie in stand te houden. Deze gevangenschapspopulaties worden gehouden in collecties over de gehele wereld, waarbij het van tijd tot tijd noodzakelijk is om bloedlijnen uit te wisselen om de natuurlijke kracht van de soort te behouden. Internationale wetgeving kan zonder dat dat de bedoeling is ernstige schade toebrengen aan zulke ondernemingen. Daar waar populaties niet over voldoende genetische verscheidenheid beschikken kan het noodzakelijk zijn om vogels uit de natuur te halen. De WPA stemt toe in dergelijke operaties indien dit geen nadelige druk op de wilde populatie heeft. Een dergelijke import moet deel uit maken van een goedgekeurd project, met een erkend data systeem. De geschiktheid van zowel instelling als persoon om deel te nemen aan een dergelijk project was en zal altijd gevuld worden, zodat alleen goedgekeurde instellingen en/of individu hieraan deel zullen kunnen nemen.

AN UPDATE ON THE RE-INTRODUCTION OF THE CHEER PHEASANT IN PAKISTAN

MAZHAR HUSSAIN

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INTRODUCTION

Scientific management of the native Pheasants of Pakistan started with the establishment of the World Pheasant Association of Pakistan (WPAP) as the first overseas chapter of the World Pheasant Association (WPA). The preliminary information collected showed that among the five native pheasants of Pakistan; the Monal, Western Horned Tragopan, Koklass, Cheer and White Crested Kalij' conservation measures were urgently required to save the vanishing population of the Cheer pheasant *Catreus wallichii*. Further surveys and studies revealed that the Cheer's range occupied a narrow belt in Himalayan foot-hills (1000-3250 m.alt.); extending from Hazara Division in Pakistan through North-west India and into west-central Nepal. In Pakistan the bird used to live in sub-tropical Pine forests of Margallah, Murree, Hazara, Dir, Swat and Azad Kashmir but had become extinct from greater part of its range and only a small population survived in Neelam Valley of Azad Kashmir. The species was enlisted as endangered in Red Data Book of IUCN. It was, therefore, decided to restore the Cheer in its ancestral range in Pakistan.

Though, there was great determination and enthusiasm among conservationists and scientists for the programme, it faced some major constraints; that the captive stock of cheer was not available locally to provide eggs for the programme, information on habitat was extremely inadequate and avicultural skills almost non-existent. The re-introduction programme, therefore, involved captive breeding of the species in Pakistan, selection of a release site, rearing of chicks for release, release of pourets, post-release monitoring and protection, habitat management, creating public awareness and enlisting local support for the programme.

Since 1977, the re-introduction programme was implemented every year in Margallah Hills National Park jointly by the Capital Development Authority (CDA) and WPA. Later the NWFP Forest and Wildlife Department also joined the programme for re-introducing the species in Hazara forests.

This paper is intended to present a brief update of the Pakistan Cheer Re-introduction Programme without attempting a sophisticated scientific analysis.

CAPTIVE BREEDING

Through the generosity and co-operation of a number of aviculturists in UK, the first cheer eggs were sent to Pakistan in 1977 which were hatched and reared at Clifden Murree with the help of a local worker especially trained by WPA. Only a few birds could be raised which were distributed to WPAP Members for captive breeding. Every following year supply of large quantities of eggs by WPA UK and Benelux countries became a regular feature and cheer breeding started in Pakistan by setting up hatcheries at Abbottabad (NWFP), Ghoragali (Punjab), Kalabagh (PAF), Muzaffarabad (AJK) and Islamabad (CDA), under control of the respective Wildlife departments.

The CDA Islamabad played a leading role in cheer breeding and re-introduction in collaboration with WPA, WPA UK and WPA Benelux. Establishment of breeding and re-introduction facilities at Murghzar mini zoo and Jabri release site helped in promotion of aviculture and re-introduction techniques and also served the training and educational needs. Benefiting from

this experiences the NWFP cheer breeding and re-introduction programme has taken a good start by setting up a breeding center at Dodial.

For promotion and cheer breeding in private sector "Adopt-Cheer" scheme was introduced and cheer eggs and birds provided to the interested breeders. Presently cheer breeding is done in Government aviaries at Jabri, Marghzar (CDA), Dodial (NWFP), Saidpur (Punjab) and Muzaffarabad (AJK), in addition to private collections. Though Cheer is good breeder, yet non-availability of standard diet and medicines are major problems in captive breeding of the species in Pakistan. Cheer stock is not yet enough to supply eggs for re-introduction programme.

REARING METHODS USED :

Various rearing methods were used starting with intensive one using incubators and gradually developing more suitable ones to produce more and behaviorally better chicks for release. The techniques employed have been discussed by (Young & Hussain, 1990) and are summarized below:

1. INTENSIVE REARING USING INCUBATORS: In early years of the project mechanical incubators were used for hatching eggs and chicks reared with the help of broody hens at the release site. There was daily human contact with the chicks which induced tameness in them. Another problem with incubators was the frequent interruptions in their operation due to electricity break-downs.

2. INTENSIVE REARING USING BROODY HENS: In this method hatching and rearing was done with the help of broody hens at release site. In 1986, modifications were introduced to minimize human contact. Screens were placed around each rearing compartment containing a family group of a hen and chicks and supplies of feed, water and medication only supplemented at night. Overall, the use of broody hens resulted in a higher hatching success as compared to incubators and the chicks showed the correct range of feeding and predator-avoidance behaviors from an early age. However, the chick's behavior still did not appear to be as well developed as those in the wild.

3. ENCLOSURE-REARING USING BROODY HENS: Unlike the previous two methods where the chicks were not allowed into the large release enclosure until 6 weeks of age, the broody hens and their adopted clutch of eggs were moved into the enclosure at the first signs of hatching. Thus the chicks were in a "wild" environment right from the start. In 1987, this method was tried together with the intensive rearing system using broody hens. The chicks showed well developed predator-avoidance behavior from an early age but there was higher risk of mortality due to avian predators, more stress on chicks and rapid transmission of disease (e.g. an outbreak of Pseudomoniasis in 1987).

4. ENCLOSURE-REARING USING NATURAL CHEER PARENTS: In 1988, five large closed-top pens (12.4m x 7.6m x 5.2m high) were constructed at Jabri and a captive-reared hen cheer placed in each. Five male cheer surviving from the 1986 release and living close to the enclosures were recaptured and placed with hens in pens. Each pair was then allowed to breed and rear its own young with the minimum of human disturbance. Fewer birds could be released each year by this method by comparison with the intensive rearing methods. However, the chicks were of higher quality and in fact some of these chicks released in 1988 were reported to survive longer and attempted to breed in the wild.

HATCHING AND REARING RESULTS :

Hatching and rearing results for Margallah and Dodial are shown in table-I. At Margallah the combined results of hatching through various methods varied from 23.3% to 60.8% (mean = 44.5%). At Dodial the hatching success was between 11.72 & 45.42% (mean = 26.7%). The comparative data for the hatching results of "Incubators versus Broodies" and "Broodies versus Cheer Hens" is given in Table-II for the year when the two methods were used together.

Broodies gave significantly better hatching results as compared to the incubators whereas there was no significant difference between hatching results of Broodies and Cheer Hens (Table-II). However, the quality of chicks produced through cheer hens was high in respect of their behavior and adoption of wild conditions (Young & Hussain, 1990).

It was also observed that besides fertility the hatchability of eggs was influenced by the air temperature; early batches set in May gave better hatching and survival results as compared to later batches of June (Ridley & Islam, 1982, Burt, 1986).

CAUSES OF MORTALITY DURING REARING :

Number of chicks which died of various causes during rearing is given in Table-III. Due to difficulties of access to laboratory and absence of proper storage facilities for corpses, post-mortem analysis of about 28% dead chicks at Margallah and about 38% at Dodial could not be done. However, available post-mortem reports showed that highest mortality at Margallah occurred due to infectious diseases (44.7%) while 23.8% chicks died of injuries (mainly caused by bad weather) and 3.3% were killed by predators (including hawks, kites, snakes and monitor lizard).

Among diseases the bacterial infection caused by *Pseudomonas aeruginosa* (which occurred in 1987) was responsible for 47.7% mortality whereas viral infections (ND/Fowl Pox), gut problems, coccidiosis, enteritis, Diarrhea and respiratory tract infections equal proportions (11.2% - 13.0%), (Table-IV).

At Dodial the Histomoniasis caused massive mortality (68.6%) often in conjunction with other diseases (per.comm., Gillian Stewart).

RELEASE SITES :

The first potential release site for cheer in Margallah Hills was selected in "Dhoke Jewan" valley near where the last sighting of wild cheer was reported in 1976. A pre-release pen of 50m x 50m was constructed near a natural spring at an elevation of 670m. Chicks were reared and released in this pen for four successive years but was then abandoned due to its several disadvantages; most notably high temperature, high humidity, lack of roosting trees and a long distance from the apparently suitable cheer habitat. A second release site was, therefore, selected uphill in better cheer habitat at "Jabri", at an elevation of 1200m. A similar pre-release pen was constructed and facilities for rearing including cages, sheds and broody house added subsequently. The rearing sheds and release enclosures were redesigned and extended in 1986 for behavioral preconditioning of the chicks. The habitat at Jabri changed considerably due to growth of bushy vegetation and increase in disturbance. For this reason two more release sites were located in two further valleys called "Sara" (810m) and "Gagra" (1230m). Cheer poult reared at Jabri were released from here in both 1988, 1989 and 1990. Sara has not yet been used for release.

In addition to the above sites in Margallah, three release sites at "Manshi, Malkandi" and "Kashian" forests of Kaghan valley in Hazara were identified. A test-release made at Malakandi (1300m) in 1983 confirmed the potential of the site for cheer re-introduction. Wild cheer is locally reported in Kashian but needs to be verified. Malakandi and Kashian will be used for future releases in Hazara.

RELEASE OF POULTS :

Release of poufts from various release sites in Margallah is shown in Table-V. Uptill now a total number of 697 poufts have been released.

SURVIVAL AND BREEDING OF RELEASED BIRDS :

Monitoring of the birds released until 1985 was mostly done by casual sightings. Two detailed surveys were done in 1985 and 1986 which revealed that no birds released from 1978 to 1985 survived beyond January of the year following their release.

Survival of 14 birds (11 males & 3 females) of 1986 release was recorded at Jabri in the following spring (1987). The three females paired; one female laid nine eggs and hatched seven chicks, one chick survival to six week age when both the mother and the chick contacted disease and died, second female was predated while nesting and the third moved away about 3 km across the Gokina valley and lost radio contact. Eight males were frequently sighted till spring 1988 and five of these were re-captured.

28 birds (20 at Gagra and 8 at Jabri) of 1988 release were recorded through radio-tracking in Spring, 1989. Among 20 survivors (9 cocks & 11 hens) at Gagra, one cock settled in the pen with two hens during the breeding season. Both hens bred and produced 10 chicks, 5 of which survived to the age of eight weeks and left the pen at the end of August, 1989. Another female, which nested about 0.5 km away from the pen, was seen with three chicks in early July and again on 5 September. No information on the breeding success of the other females was available. Among the eight survivors (5 males & 3 females) at Jabri, one male paired with tow females after establishing a territory about 50m south of the pens. One female was killed by a predator during the breeding season and the remaining pair abandoned its territory and moved down the valley. This pair was sighted once during August, apparently without chicks.

In the following years, two males were heard at Gagra during a survey in Spring, 1990 but none heard or seen in subsequent survey in 1991.

Predation is reported to be the major cause of mortality after release due to heavy pressure of predators in Margallah Hills and lack of predator-avoidance behavior in released birds (Hussain, 1989).

CONCLUSION AND DISCUSSION

Overall results show that during last 15 years of the project, out of 6007 eggs set, 2448 (40%) chicks hatched, 941 (38.4%) reared successfully and 697 released in Margallah. Only few birds are believed to be surviving in the wild. There are less than 50 (20%) captive birds in various collections out of 244 held for the purpose. Success on various aspects of the project varies and is generally below normal. However, being unique in its nature with a difficult target of re-establishing an extinct bird in the wild and given the constraints, the project has made considerable progress and has potential for achieving its objectives. Better results in rearing, captive breeding and post release survival can be achieved with re-adjustment of priorities and procedures.

For continuing the re-introduction project, captive breeding programme needs to be expanded and organized involving the private sector. This will help reduce dependance on importation of the eggs which are though, generously provided by WPA UK and WPA Benelux, yet the arrangements involves high cost and effort.

The persistent disease problems which account for about 45% losses in chick rearing need to be redressed by strictly following the hygiene and disease prevention procedures as tried at Jabri and by improving the diagnostic and curative measures by availing the facilities now available in the country.

The project has succeeded in devising suitable rearing techniques to produce high quality chicks for release. A good number of breeding cheer pairs will, however, be required for adopting parent rearing techniques as suggested by Young & Hussain (1990). Adequate facilities for raising adults for rearing chicks exist at Jabri and Dodial. However, it will be advisable not to make further ambitious releases before certain conditions are met with. Most important requirement in this regard, as suggested by "Gaston, Young and Kaul" (1992) as a result of their studies on wild cheer populations in India, is the habitat management. The project history shows that detailed studies for habitat evaluation were not conducted except periodic evaluation of the release sites. Since inception of the project the habitat in Margallah Hills has been changing considerably necessitating shifting of release sites. However, it is a good co-incidence that the recent ecological studies conducted on wild populations in India (Gaston et.al, 1992) and the new Management Plan of Margallah Hill National Park (IUCN, 1992) both suggest evaluation and management of the cheer habitat in Margallah. Extension of Park limits in adjoining Punjab and NFWP forests proposed by the MHPN management plan will provide larger cheer habitat. Similar strategy will be required for the potential release sites in Hazara.

The most outstanding achievement of the project is the conservation awareness and interest created by it. It is unique that besides, Governmental and Non-governmental wildlife conservation and management organizations, several individuals, groups and companies engaged in various professions at various places in Europe and Asia are trying to bring the cheer back home in Pakistan. More important is the interest and consciousness aroused by the project in overall nature conservation in Pakistan. The W.P.A.'s cheer re-introduction project is referred to as an outstanding conservation effort. Partly inspired by this project the residents of Islamabad have organized themselves for environmental conservation by setting up the "Margallah Hills Society". The society's slogan on cheer "**WE HAVE A COMMON CAUSE**" has earned widespread popularity.

ACKNOWLEDGEMENTS

The Pakistan Cheer Re-introduction Project owes gratitude to all individuals, companies, NGO's and departments both overseas and in-country who rendered help, co-operation and support during the last fifteen years of the project.

Generous supply of eggs by the breeders and WPA members in Benelux countries and UK, free transportation of eggs and other supplies and preparation of Public awareness material by British Airways is highly appreciated. Personally, I express my thanks to WPA International, WPA Benelux and WPA Pakistan, CDA and Govt. of Pakistan for arranging my participation in the symposium. Particularly, co-operation and support of Mr. Han Assink, Chairman WPA/CBAC chairman WPAP and Mr. Rashid Mehmood Randawa Director General Environment, CDA is gratefully acknowledged.

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Table I SUMMARY OF OVERALL REARING RESULTS (1978-93)

A: MARGALLAH

YEAR	EGGS SET		CHICKS HATCHED		CHICKS SURVIVED	
	(No)	(No)	%	(No)	%	
1978	174	88	50.57	12	13.64	
1979	262	120	45.8	34	28.33	
1980	237	55	23.21	15	27.27	
1981	74	45	60.81	17	37.78	
1982	199	79	39.7	3	3.60	
1983	267	94	35.34	60	83.83	
1984	295	83	26.04	38	45.78	
1985	299	120	40.13	92	76.76	
1986	364	197	54.12	129	65.48	
1987	1024	481	48.97	8	1.65	
1988	667	316	47.38	210	66.48	
1989	273	140	51.28	99	70.71	
1990	262	129	49.24	84	65.12	
1991	110	47	42.73	20	42.55	
1992	109	45	41.28	2	4.44	
1993	131	73	55.73	5	6.85	
TOTAL	4747	2112	44.49	828	39.2	

B. DODIAL

YEAR	EGGS SET		CHICKS HATCHED		CHICKS SURVIVED	
	(No)	(No)	%	(No)	%	
1989	283	70	24.73	6	8.57	
1990	273	124	45.42	28	23.39	
1991	256	30	11.72	22	73.33	
1992	184	64	34.75	35	54.69	
1993	254	48	16.10	21	43.75	
TOTAL	1250	336	20.07	112	33.03	

Table III CAUSES OF CHICKS MORTALITY IN VARIOUS YEARS

1. MARGALLAH

Cause	1979/81	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL	%
Un-known	72	49	11	22	1		109	16	13	6	8	7	18	332	28.14
Injury	17	15	11	12	21		61	78	18	16	9	6	17	281	23.81
Predation	11					8	3	1	8	2		6		39	3.31
Diseases	31	12	7	11	6	59	300	11	2	21	10	25	33	528	44.75
Total	131	76	29	45	28	67	473	106	41	45	27	43	68	1180	100.00
%	11.1	6.44	2.46	3.81	2.37	5.76	40.08	8.98	3.47	3.81	2.29	3.64	5.75		

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Table II COMPARATIVE HATCHING SUCCESS (%)

A. BROODIES VERSUS INCUBATORS

YEAR	SITE	BROODIES INCUBATORS	
		BROODIES	INCUBATORS
1983	Margallah	50	17
1984	Margallah	37	26
1985	Margallah	47	28
1990	Dodial	54	45
1991	Dodial	10	13
1992	Dodial	38	0

B. BROODIES VERSUS CHEER

YEAR	SITE	BROODIES	CHEER
1988	Margallah	69.7	36.5
1990	Margallah	57.3	46.3
1991	Margallah	23.6	50
1992	Margallah	49.4	25

Mean 50 39.4

(Sc.Dif. = 8)

(Data: Margallah = Young et al. (1986),
Dodial: Saeed Zaman pers.comm.)

Table IV

MORTALITY CAUSED BY VARIOUS DISEASES IN VARIOUS YEARS

1. MARGALLAH

CAUSE	1979/81	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total	%	
Gut infections	27	7	9	6	6							2	12	69	13.07	
Resp. infections	4		2			53								59	11.17	
NDV/Fowl Pox		12				18		2	2		16	9		59	11.17	
Pseudomoniasis						252								252	47.73	
Internal worms							15	8		2				25	4.73	
External worms								15						8	1.52	
Others								30	11		4	2	5	4	56	10.61
Total	31	12	7	11	6	59	300	2	21	10	25	33	528	100.00		
	5.87	2.27	1.33	2.08	1.14	11.17	56.82	2.08	0.38	3.88	1.88	4.73	6.25	100.00		

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2. DODIAL

TOTAL MORTALITY RECORDED % MORTALITY DUE TO VARIOUS DISEASES

YEAR	No.	(Results of 134 Post Mortem reports)	YEAR	RELEASE SITE	AGE (Weeks)	No.
1988	22	Histomoniasis	1978	Dhoke Jewan	6,7	10
1989	13	Bacteria and Enritis	1979	Dhoke Jewan	6,7	30
1990	31	Coryza and related conditions	1980	Dhoke Jewan	6,7	6
1991	34	Fungal infections	1981	Dhoke Jewan	6,7	17
1992	50	Parasite and Coccidiosis	1983	Jabri	7,8	50
1993	4	Bad Weather	1984	Jabri	7,8	38
		Others	1985	Jabri	8,10	91
Total	154	Total	1986	Jabri	10,14	100
			1988	Jabri, Gagra	6,18	205
			1989	Jabri, Gagra	10,14	79
			1990	Jabri, Gagra	10,14	60
			1991	Jabri	10,14	11

(*Data: Courtesy, Gillian Stewart, WPA Volunteer Dodial, 1993)

Table V POULTS RELEASED IN MARGALLAH HILLS NATIONAL PARK

YEAR	RELEASE SITE	AGE (Weeks)	No.
1978	Dhoke Jewan	6,7	10
1979	Dhoke Jewan	6,7	30
1980	Dhoke Jewan	6,7	6
1981	Dhoke Jewan	6,7	17
1983	Jabri	7,8	50
1984	Jabri	7,8	38
1985	Jabri	8,10	91
1986	Jabri	10,14	100
1988	Jabri, Gagra	6,18	205
1989	Jabri, Gagra	10,14	79
1990	Jabri, Gagra	10,14	60
1991	Jabri	10,14	11

TOTAL

SAMENVATTING

De huidige stand van zaken van het Wallich reïntroductie project in Pakistan

De resultaten van de afgelopen 15 jaar laten zien dat van de 6007 verzonden broedeieren er 2448 (40%) zijn uitgekomen, waarvan 941 (38.4%) met succes zijn grootgebracht. Hiervan werden er 697 uitgezet in Margallah. Op het ogenblik zijn hier nog slechts enkele van in leven. Er zijn minder dan 50 (20%) vogels in gevangenschap in verschillende collecties, waarvan er 244 voor dit doel werden gehouden. Het succes met de verschillende aspecten van het project varieert en is over het algemeen normaal te noemen. Het is echter door zijn unieke karakter van het herintroduceren van een in Pakistan uitgestorven vogelsoort en onder de gegeven omstandigheden, heeft het project toch de nodige vorderingen gemaakt en het heeft kansen om zijn doel te bereiken. Betere resultaten bij het grootbrengen, het kweken in gevangenschap en de overleving van vogels die uitgezet zijn kunnen bereikt worden door de prioriteiten en procedures aan te passen. Om het project voort te kunnen zetten moet het fokprogramma in gevangenschap uitgebreid worden en de privésector dient hierbij direct betrokken te worden. Dit zal de afhankelijkheid verkleinen van de import van broedeieren die, ofschoon genereus geschenken door WPA leden in de UK en de Benelux, toch aanzienlijke kosten met zich mee bracht.

De aanhoudende ziekteproblemen die voor 45% tot de verliezen bijdroegen dienen te worden verbeterd door het strict volgen van de hygiënische maatregelen en het voorkomen van ziekten zoals in Jabri reeds getracht wordt en door het verbeteren van de diagnose en de curatieve middelen met de mogelijkheden zoals die op het ogenblik aanwezig zijn in Pakistan.

Het project is erin geslaagd de goede fokmethoden te gebruiken waardoor kuikens van een hoge kwaliteit het leven zagen die geschikt zijn voor de herintroduktie. Er zal echter een aanzienlijk aantal broedparen nodig zijn voor de adoptie ouder opfokmethode zoals gesuggereerd door Young en Hussain. Goede mogelijkheden voor het kweken van volwassen dieren die op hun beurt kuikens kunnen groot brengen gebeurt al in Jabri en Dodial. Het is echter verstandig niet nog meer ambitieuze herintrodukties te doen alvorens bepaalde condities zijn gewaarborgd. Het belangrijkste in dit opzicht, zoals voorgesteld door Garson, Young and Kaul (1992) als resultaat van hun studies van het Wallichproject in India, is de habitat beheer. De geschiedenis van het project leert dat, behalve een periodieke evaluatie van de uitzettingterreinen, gedetailleerde studies nodig zijn om de waarde van een habitat vast te kunnen stellen. Sinds het begin van het project is de situatie in de Margallah Hills sterk aan verandering onderhevig. Dit maakte het verplaatsen van de herintroduktie gebieden noodzakelijk. Het is echter een goede samenloop dat de recente ecologische studies uitgevoerd aan wilde populaties in India, (Garson,92) en het nieuwe beheersplan van het Margallah Hills National Park uitgevoerd door de IUCN in 1992 beide de evaluatie en het beheer van de Wallich habitat voorstaan. Uitbreiding van het park in de aangrenzende delen van India (Punjab) en de Noordwestelijke grensprovincie, zoals voorgesteld door het NHNP beheersplan, zal een grotere waarde aan de Wallich habitat geven.

Het belangrijkste van het project is echter dat het een bewustwording in gang heeft gezet en interesse heeft doen ontstaan bij de bevolking van Islamabad. Het kan uniek genoemd worden dat naast de regering en gegroepeerde conservation organisaties verscheidene individuele personen, groepen en bedrijven, woonachtig op verschillende plaatsen in de wereld, in Europa zowel als in Azië de Wallichfazant weer terug in zijn thuisland Pakistan poggen te brengen.

Het WPA Wallich reïntroductie programma wordt genoemd als zijnde een uitstekende conservation streven. Gedeeltelijk geïnspireerd door dit project hebben de inwoners van Islamabad zich verenigd in society voor lokale conservation: de "Margallah Hills Society". De slogan van de society voor de Wallich " WE HEBBEN EEN GEZAMENLIJK DOEL" mag zich in een brede populariteit verheugen.

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BREEDING OF THE CHINESE MONAL (LOPHOPHURUS LHUYSII) IN CAPTIVITY

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The Chinese Monal *Lophophorus lhuysii* is an endemic and rare pheasant in China and is classified as an endangered species by CITES. The Beijing Center for Breeding Endangered Animals has the largest population in captivity in China. Since 1988, we have studied the breeding of the Chinese Monal over a five year period. This paper presents a part of the results.

A) Rearing of chicks method and condition

1. Material resources

The chicks were reared from eggs which were artificially incubated.

2. Study method

After hatching the chicks from 1-40 days old, the body was weight before feeding at 8.00 a.m. and every ten days all the measurements were taken. From 41-90 days this was done every ten days, and after 90 days, every 30 days the same measurement were taken. The weight and measurement coincides with the Logistic equation. At the same time we have studied the morphology, moult, and behaviour of the chicks of the Chinese Monal.

3. Nutrition and feeding method

The prepared diet was mainly vegetarian, such as pellet (commercial chicken pellet and powder materials), grains (wheat and rice), vegetable and fruit (tomato, celery, spinach, green bean, apple, peach, watermelon etc.) and animal fodder as the supplementary material (such as egg, mealworm).

Drinking water was offered after 12 hours from hatching, after 24 hours the fodder was given and after three day the fodder contained more vegetables and fruits, the ratio is the pellet and powder fodder are 2/3, vegetable and fruit are 1/3 with a little boiled egg (after one week plus sands). Mealworm were added in one or two times a day after twenty days, then the fodder was changed the pellet with grain, wheat, rice after fifty days old. Drinking water was supplied three times a day.

4. Rearing temperature

The chicks of the Chinese Monal stayed in the baby chick breeder for 30 days, from day 1-10 days the temperature is 34-35°C; 11-20 days it is 31-32°C; and 21-30 days is 28-29°C. After 31-50 days, the baby chick was moved to the rearing room, where the temperature is kept at 24-26°C, after 51 days then it is transferred into the aviary, and the temperature is the same as the outdoor temperature.

5. Rearing conditions

The baby chick brooder is made of wood shaving, and it is treated against insects and its 20 cm length, 60 cm width and height. In the top of the wood box is a heater suspended over the top. The bottom was installed with wire metting (the netting pere, 1.5 x 1.5 cm) under the wire netting is the faces plate. In the wood box should be put a feedbin, a shallow water dish and a sand plate as well.

The baby chick rearing room was built in a 30 square meter space and separated into different sections, each one is three square meter. The room was fitted with 1.5 meter length, 2 meter height and 1.5 meter width, the playground 3 meter length, 2 meter width and height, the ground is made of bricks with sand both in room and playground. The diameter of perch is net too thin according to the monal toes size.

B) Rearing results

1) Survival of rearing chicks

The survival rate of the Chinese Monal in 1989-1993 is 90% .

2) Growth and rearing of chicks

The speciality of the Chinese Monal after hatching from the egg is that the remiges are more developed than in other pheasants chicks, the remiges length is 56-73 mm (average is 62 mm).

The whole body of the baby chick is covered with down; chin, neck, breast and abdomen pale yellow; forehead, crown, occiput and sides of head, back dotted with fluvessent streaks, wings rufous, tail mottled vermiculation; pale bands in upper wing coverts with black shaft mark; Tarsus, toes yellow; bill black and pale in the base; tip of the egg-teeth white; iris brown.

Day 10. scapular shaft rufous white with v shaped bands.

Day 15. shaft of the greater coverts white, v shape bands at tip; tail with rufous bands.

Day 20. body shaft grown, feathers grey black, tip pale rufous; head and upperpart deep brown; head mottled with stripes; wing black with rufous tips or vermiculation; wing covert and inner primaries pale shaft; breast and abdomen mottled with ochreous spots, greater coverts with white tips. Egg tooth has fallen off.

Day 50. fledgling feather in male and female is the same. Underpart down is similar with the female adult and has white needle spots.

Day 90. male and female are different, male breast is blue black, tips yellow white, inner web of 1 lateral rectrices metallic blue green, the spur appears and is about 2 mm. Female plumage is similar as in the female adult.

Day 100. Female, breast scapular region are metallic blue-green.

Day 120. Male breast, scapular and back are copper and purplish blue, upper tail covert bluish-green; head grey black with white spots; circum-orbital region grey blue; female is grey around the circum-orbital region.

One year old Male forehead, crown, head covered with blue-green and scarlet in hind head; cheek, forehead, sides of neck glossed with rufous spots; body feather changing from purple to blue; lore blue, lower back rump white; tail with rufous bars; spurs 9 mm long a round tip. Female dark brownish black; lower back, rump white; remiges and tail finely mottled with pale brown bars; lore skin rufous white.

Two year old Male plumage is like the adult, spur 12 mm long and sharp.

The weight, wing tail, tarsus and middle toe growth data (1- 120 days) of the fledgling of Chinese Monal is coincided with the Logistic equation, in detail see Figure 1, Figure 2, Figure 3, Figure 4 and Figure 5.

In the above results, the weight and measurements of wing, tail, tarsus, middle toe as well as weight coincided with the Logistic Equation relatively dominant.

One year-old and two year-old chick weight, wing, tail, tarsus, middle toe length compared with the adult, see table 1.

Table 1

year	sex	<u>Weight, measurement of the Chinese Monal</u>					August 1993
		weight (gram)	wing (mm)	tail (mm)	tarsus (mm)	middle toe (mm)	
Adult	♂	3900	355	320	99	84	sharp (spur)
	♀	3060	330	281	83	73	
one year old	♂	3150	330	263	95	75	round (spur)
	♀	2920	321	241	80	69	
two year old	♂	2810	352	316	100	85	12 more sharp (spur)

The Logistic curve of the chicks weight

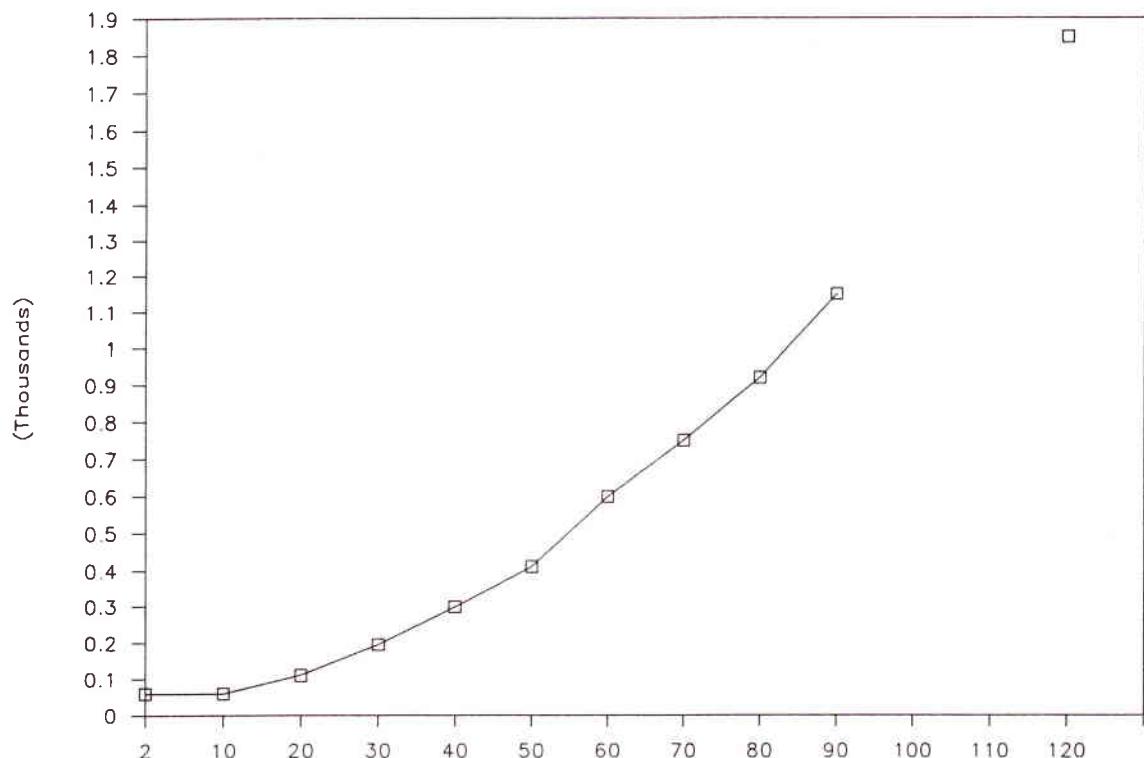


Fig.2 The Logistic curve of the wing

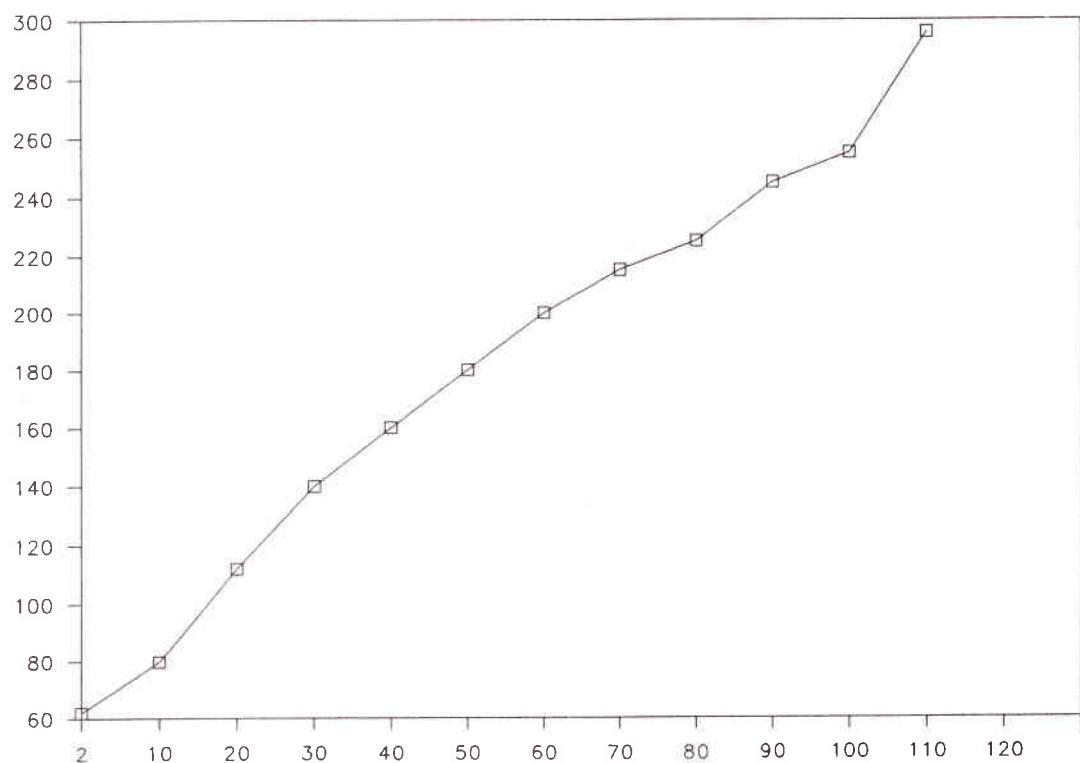


Fig.3 The Logistic curve of the tail

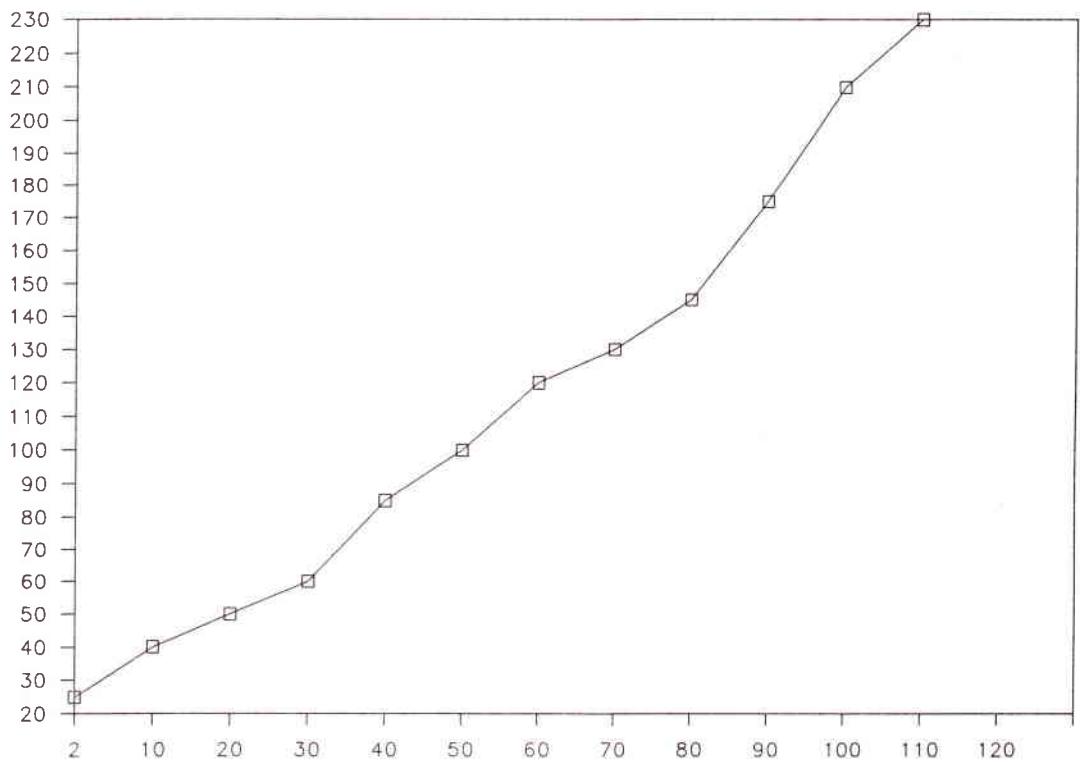


Fig.4 The Logistic curve of the tarsus

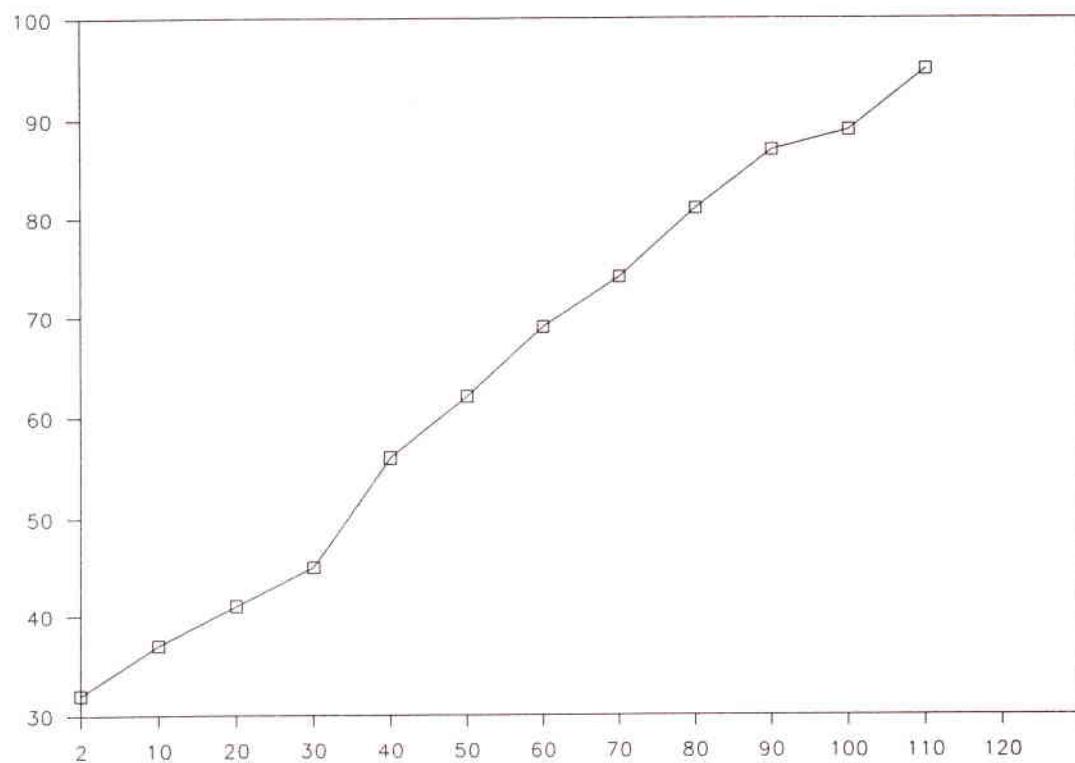
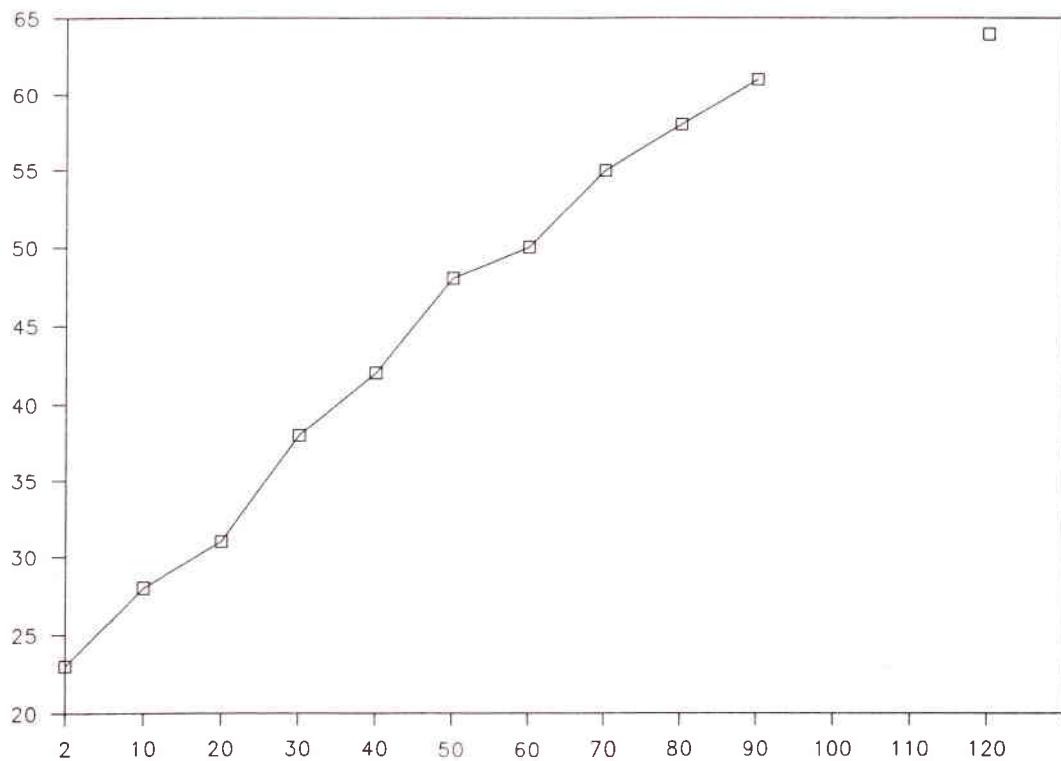


Fig.5 The Logistic curve of the mid.toe



SAMENVATTING

De Chinees Glansfazant *Lophophorus lhuysii* is een endemische en zeldzame fazantesoort in China en is geklassificeerd als een bedreigde diersoort door CITES. In het Beijing Centrum voor het Fokken van Bedreigde Diersoorten bestaat de grootste populatie in gevangenschap in China. Sinds 1988 werd er het broedgedrag van de Chinees Glansfazant bestudeerd. Deze lezing geeft een deel van de gevonden resultaten weer.

1. Opfokken van kuikens, methode en condities

Met behulp van broedmachines werden de kuikens uitgebroed.

2. Studiemethode

Na het uitkomen van de kuikens werden gedurende een lange periode vele gegevens genoteerd zoals onder meer het gewicht, de ruifasen en het gedrag.

Besproken wordt ook het dieet en drinkgedrag alsmede de temperaturen waarbij de kuikens gedurende de beginfase van hun jonge leven werden gehouden. Evenals de opfokruimte en dergelijke.

Opvallend is dat de overleving van de kuikens tussen 1989 en 1993 zeer hoog ligt en 90% bedraagt.

Ook werden van de haantjes zowel als de hennetjes de opeenvolgende ruifasen genoteerd met de daarbij behorende kleurveranderingen.

Geconstateerd werd dat gelijk na uitkomst de slagpennetjes van het jonge kuiken reeds een lengte hebben van gemiddeld 56-73 mm. Daarnaast wordt een volledige kleurbeschrijving gegeven met de veranderingen die in de verschillende levensfasen optreden totdat het kuiken het volgroeide stadium heeft bereikt.

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CAPTIVE BREEDING OF VO QUY'S PHEASANT

(Lophura hatinhensis)

in the HANOI Zoological Gardens

Dang Gia Tung
Head, Phasianidae Conservation Group
Hanoi Zoological Gardens

On behalf of the Hanoi Zoological Gardens, I am very pleased to have the opportunity to attend this Symposium at the Antwerp Zoological Gardens, which is celebrating the 150th Anniversary of its establishment. The Antwerp Zoo is famous for its collection of Galliformes, particularly the Imperial Pheasant, making it a very suitable location for this Symposium.

Vietnam has three species of endemic taxa of pheasant, one of these being the Vo Quy's pheasant *Lophura hatinhensis* with its endemic home in central Vietnam.

Collection of breeding stock for *L. hatinhensis*

In 1990, local hunters brought numerous wild birds to the Hanoi Zoo, including specimens of *Lophura diardi* and *Lophura hatinhensis* included 6 individuals consisting of 4 males and 2 females collected from Minh Hoa District, Quang Binh Province in the central region of Vietnam. Unfortunately 2 males and 1 female later died due to injuries from their capture with snares. In 1991, the Hanoi Zoo purchased an additional female, making two pair of *L. hatinhensis* for study and exhibition at the Hanoi Zoo.

It has been during this time that Prof. Vo Quy of Hanoi University formally described the species, since this was the first time that specimens were exhibited. Earlier recorded sightings of the species had been known since 1964, but this was the pair at the Hanoi Zoo were the first known to be living in captivity.

Living conditions

At the end of 1990, the specimens of *L. hatinhensis* were transferred to a new breeding area which was specially configured for Phasianidae, including many contiguous cages. Each cage has an area of 28m², with a height of 3.2m and a 2.4m with two-thirds of the outside area surrounded by a steel net mesh of 5cm x 5cm with a sandy base planted with pan-palm, wooden plants and grass in imitation of the local forest landscape. The remaining third of the area was occupied with a roofed shelter which protected the specimens from the heavy rains and cold winter weather in Hanoi. One cage was reserved for each of the breeding pairs.

With such living conditions, the pairs adapted gradually to the new surroundings, exploring their new environment and adjusting to the food. During the first year in captivity, the two pairs did not generate, but moulting occurred as normal, from the end of June through October, with the heaviest during the months of July and August.

During the moulting season, the intensity of daily activities was reduced. The specimens generally rested in a standing position and preened themselves under the groves of plants. Both the male and female have faded reddish faces. By October, the male developed a very glossy green plumage with stripes and the female had a reddish-brown plumage in preparation for the breeding season.

Breeding Habits and Displays

As the moulting season ended, the daytime activities of the specimens increased gradually. The two males sometimes produced special calls, informing the other of their territory, and walking near the females. The crests of both the male and females were blazing red, with the male's crest having erect white feathers and his tail feathers spread and the wings inclined, displaying his beautiful plumage for the female. The female also exhibited special behaviour for the male, which consisted of standing still with her wings hanging down and her tail waving in reply to the male, often pecking lightly at the crest and plumage of the male. Each of these displays took 2-3 minutes, usually during the morning hours or following a rainstorm. Sometimes, the male would aggressively chase the female as if to subdue her by force, making the female fly and cry out. These displays increased for several months with the highest intensity during the months of February and March, after which the frequency of these displays decreased gradually until the end of the laying season.

Laying and Hatching

After laying, the males and females were separated since the sexual activity of the male was not fully exhausted, and they would continue to pursue the females.

During the 1992 breeding season, only one of the females produced eggs, and in 1993 both females successfully produced eggs. The eggs were a faded brown colour with numerous white spots towards the narrower top of the egg and less at the bottom of the egg. The females did not lay the eggs on the ground at the base of the trees and among other vegetation, but instead chose to lay the eggs on a small wooden dias hooked in a tree about 2.5 metres above the ground. The females put straw into the small wooden dias and laid the eggs into the straw.

Below is a listing of the quantity and average size of the eggs produced by each female over the past two years:

	♀ L1	♀ L2	Cumulative Average
1992	Egg number: 7 Av. weight: 32.14 g Size: 47.0mm x 35.9 mm Chicks hatched: 5		
1993	Egg number: 5 Av. weight: 35.8 g Size: 47.3mm x 36.9mm Chicks hatched: 3	Egg number: 7 Ave weight: 35.7 g Size: 49mm x 36.7 mm Chicks hatched: 6	Egg no.: 19 Ave weight 34.5 g Size: 47.7 x 36.5 Chicks hatched: 14

The eggs were kept in dark boxes with humidity < 70% and the temperature maintained in the range of 22-25°C for a period of time not exceeding one week. The Hanoi Zoo staff did not allow the *L. hatinhensis* females to hatch their own eggs since it would be difficult for the staff to monitor and protect the eggs. As has been the practice of the Hanoi Zoo in breeding *Lophura nycthemera*, the staff selected five of the best standard domestic chicken hens from a group of 25 to hatch the *L. hatinhensis* eggs. 48 hours after laying, the eggs can be candled to reveal the embryo, with the clearest time at 4-5 days after laying. After a period of 12 days, the eggs were again candled to eliminate embryos which had died. The first signs of hatching began to occur on the 18th day after laying.

When candled, the air compartment in the eggs were no longer parallel to the intersection of the egg, but were inclined at an angle. The small beak of the embryo chick was clearly visible at the edge of the air compartment. From the 19th day, the opening period for the chicks began. At this time, it was possible to see the embryo's movement when candled and also to hear the faint cry of the chick inside the egg.

From the 20th-21st day, the chicks began to peck from inside of the egg, about 1/3 of the way down from the bigger end of the egg at the edge of the inclined air compartment. The chick first pecked a small circular hole and broke free from the egg, with the head and later the legs appearing. The opening time took about 8-15 hours from when the chick first started pecking. When the chicks started pecking lower and towards the smaller end of the egg away from the air compartment, the survival rate of the chicks was reduced.

Through observation of two hatching seasons at the Hanoi Zoo, the hatching period of *L. hatinhensis* has been defined as taking 21-22 days. The newly hatched chicks were kept warm by the mother hens for two to three hours after hatching, which allowed the plumage to dry and the small chicks the time to walk and exercise. From a total of 19 eggs, 13 chicks survived through hatching, for a rate of 68.4%. This rate corresponds with the rate for *L. nycthemera*, but is lower than for *Polyplectron bicalcaratum* and *Gallus gallus* which are also bred at the Hanoi Zoological Gardens.

Raising *L. hatinhensis* chicks

During 1992, the first year of hatching the *L. hatinhensis* chicks, none of the five chicks survived beyond three weeks of age due to a lack of experience and technical means at the Hanoi Zoo.

In 1993, with greater experience and newly acquired equipment, the breeding was more successful with a total of 19 live chicks being hatched. The average weight of the 14 total newly hatched *L. hatinhensis* chicks during 1992 and 1993 was 23.4 g.

During the first week after hatching this past season, the chicks were kept in wooden boxes warmed by an infrared light to the temperature of 32-34°C. Preliminary food requirements for the chicks were met by feeding ripened fruit and seeds. After the chicks were one week old, they were transferred to a larger caged enclosure. At this time, the wings were about 5cm long with 7-8 feathers and the chicks could fly to an altitude of about 40 cm. The temperature was maintained at about 30°C.

Eight weeks after hatching, the chicks had sufficient feathers covering the entire body to be allowed to roam freely in an open setting, allowing the chicks to develop their natural habits.

As of the preparation of this paper, the seven surviving chicks have now reached the age of six months, weighing from 600-800 g. There are two females and five males among this group of chicks. They are currently in the period of changing plumage as they grow older. One problem which the Hanoi Zoo staff continues to monitor is parasitosis.

As this is still a period of learning for the captive breeding of *L. hatinhensis* at the Hanoi Zoological Gardens, the staff shall continue to share new information and knowledge as it is gathered.

Discussion and Petition

1. This report covers the preliminary success of the Hanoi Zoological Gardens in the captive breeding of *L. hatinhensis*. Support and technical assistance from the World Pheasant Association could further the work of the Hanoi Zoo for the preservation of this species.
2. The Hanoi Zoo is concerned with the conservation of Galliformes and supports the strategies of WPA. Saving these beautiful and important birds will require many different measures, as experience has proven with the Imperial Pheasant.
3. The Hanoi Zoo is particularly concerned about the survival of the three endemic *Lophura* species in Vietnam, and is ready to cooperate with the WPA in this effort.

ACKNOWLEDGEMENTS

The staff of the Hanoi Zoological Gardens and the author of this paper express their thanks to the President of the World Pheasant Association (WPA) and the President of CBAC, Mr. Han Assink and Mr. Michel Klat for their support which has allowed the participation of the Hanoi Zoo at this symposium.

The author of this paper also thanks Mr. David Hulse, WWF Country Representative for Vietnam and WWF Vietnam Programme staff members Mr. Jonathan Eames and Dr. Nguyen Cu for their efforts and logistical support in Hanoi during the preparation for attending this Symposium.

With the shared concern and deep sympathy for the conservation of Phasianidae, the Director of the Hanoi Zoological Gardens has assigned the author of this paper to present the findings of the Hanoi Zoo's captive breeding programme for the Vo Quy's Pheasant.

With assistance from: Le Sy Thuc
 Nguyen Thi Giao
 Nguyen Thi Ha
 Truong Van La

SAMENVATTING

Een nieuwe soort, de Vo Quy's fazant *Lophura hatinhensis*, werd ontdekt in 1964 (Vo Quy 1975) met een enkele exemplaar (mannelijk) in een laagland bosgebied in het district Ki Anh, van de provincie Nort Annam, Vietnam. Later werden nog enkele exemplaren van deze soort bekend die in hetzelfde gebied in 1974 gevonden werden, deze waren ook van het mannelijk geslacht.

Veel informatie werd verkregen van lokale jagers.

In april 1990 gelukte het de staf van Hanoi Zoo om twee paar Vo Quy's fazanten aan te kopen die kwamen van een niet geïdentificeerde plaats op de markten van Ki Anh of van de aangrenzende provincie Quang Binh in Centraal Annam. Een vogel is sindsdien gestorven, maar momenteel hebben we twee paar van deze soort in Hanoi Zoo.

In 1992, het eerste jaar dat er kuikens werden geboren van de *L. hatinhensis*, werd geen van de kuikens ouder dan drie weken. In 1993, met de nodige ervaring en nieuw verkegen uitrusting, was de fok succesvoller met een totaal van 9 uitgekomen kuikens. Het gemiddelde gewicht van de 14 kuikens die er in totaal waren uitgekomen in 1992 en in 1993 bedroeg 23.4 gram. Gedurende de eerste week na het uitkomen werden de kuikens gehouden in een houten kist verwarmd met behulp van een infrarode lamp bij een temperatuur tussen de 32-34°C. Het eerste voedselaanbod bestond uit rijp fruit en zaden. Op een leeftijd van 7 dagen verkegen ze een grotere ruimte. De vleugels waren nu 5 cm lang met 7 tot 8 slagpennetjes en de kuikens konden vliegen tot op een hoogte van 40 cm. De omgevingstemperatuur werd gehouden op 30°C.

Acht weken na het uitkomen hadden de kuikens voldoende veren ontwikkeld dat het gehele lichaam bedekt was en ze in een open loopren gehouden konden worden om zo hun natuurlijke gewoontes te ontwikkelen.

Bij het maken van deze tekst waren de zeven overgebleven kuikens zes maanden oud en wegen ze tussen de 600 en 800 gram. Het zijn twee vrouwtjes en 5 mannetjes. Momenteel verwisselen ze hun kuikenkleed voor hun jeugdkleed.

Een probleem wat ons voortdurend bezighoudt is parasitosis. En omdat we nog veel zullen kunnen leren van het broeden en groot brengen van de *Lophura hatinhensis* in Hanoi Zoological Gardens zal de staf nieuw verkregen informatie en kennis blijven delen met andere belangstellenden.

MONITORING EGGS

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We monitor eggs very closely at the Incubation Research Station at Birdworld and have found some interesting results. The incubation rooms were developed to be user friendly. The building is well insulated and air conditioned to a constant 70° F. (21° C.) dehumidified which allows us to have incubators running at a very low humidity if required. All incubators are monitored via a computer and any temperature problems will set off an alarm during the day and at night a digital communicator will phone me up. All this gives us a very stable and easy to use environment do continue our incubation research. We regularly take in eggs from aviculturalists who can't hatch them, and once the problem is found via close monitoring the information can be passed on so they can hatch their own eggs out. Because of this work I am often called to design incubation rooms and work as a incubation consultant. At moment I am doing work in Portugal, Morocco and Russia as well as England.

Why we monitor eggs so closely.

I had problems with certain eggs in that the veins under the shell did not seem to grow fast enough and the embryo ended up dead in shell. All eggs that do not make it in the research station are sent for PMs which showed nothing. After these results occurred repeatedly with species such as Night Heron (*Nycticorax nycticorax*) eggs I decided to monitor closely the growth in other species to see how eggs normally develop.

The percentage of vein growth over the egg is worked out by eye and to eliminate human error as much as possible I was the only Incubation Technician who candled the eggs. (I am not suggesting that I do not make mistakes but it is better that only one person estimates the percentage of vein growth over an egg so as to ensure reliable comparisons). Estimating vein growth is not too difficult as most eggs grow in a similar fashion.

I am in the process of monitoring every species that I can get my hands on so that I will have a normal growth chart for as many as possible. Twenty eggs is the minimum number in my opinion that is required to produce one of these growth charts. At the end of each season all the data is collated with results from previous years so that some of these growth charts are averages obtained from an ever-increasing number of eggs.

It is difficult to explain the results without graphs but I will try. It was clear that all eggs seem to grow at different rates during their incubation period. By this I mean when you candle your eggs eggs the veins seem to cover the egg at varying rates of coverage. Basically the veins grow fast, then have a much slower period of growth and then speed up so that by 60% of the incubation period the whole of the inside of the egg is covered in veins. Each species has its own growth pattern which will only vary if you turn your eggs in different ways.

With some species we had problems. Night Heron eggs were the worst and never got complete vein growth and were always dead in shell.

Incubation consists of **Temperature, Turning and Humidity**. I ruled out temperature and humidity as much work has been done on temperature and humidity is easy to control. So turning was looked at in detail. The results were very interesting indeed. If Night Heron eggs incubated in the traditional way, turned 24 times a day on tilting trays, very slow and limited vein growth and dead in shell. On rollers turned 24 times a day on their side, better vein growth even to complete vein growth but late in incubation and hatching success still very poor. If on rollers turned 24 times a day and also hand turned 7 times a day then success. Complete vein growth before 60% of the incubation period and more importantly successful hatchings.

I have been experimenting with a moving carpet incubator which turns eggs 96 times a day on their sides. This was the only incubator which would incubate Night Heron eggs without any hand turning. It is interesting to note that the eggs in this machine when they were turned went all over the place. Perhaps this is more like what happens to eggs in a nest !

You may think that turning eggs 96 times a day is crazy but there was a paper written as long ago as 1960 by I.S. Robertson which showed in Hen's eggs that the best hatching results were obtained by turning the hen's egg 96 times a day !

Question: Why do they need more turning ?

After checking thousands of files for a link between eggs of species that needed to be turned differently the answer started to be seen. On day 0 it was very difficult to see the yolks of species like night herons when candling them.

Various yolk-to-albumen ratios are taken from a paper by C. Carey , H.Rahn and P.Parisi in 1980 entitled CALORIES WATER LIPID AND YOLK IN AVIAN EGGS.

We found Night Herons have a very small yolk of only 19 % and need turning more often or it might be more accurate to say that they need turning more naturally.

Most of the waterfowl eggs are 40% yolk or more and most pheasant eggs are 35% or more and they are all easy to incubate with any method of turning producing excellent vein growth.

Parrot eggs have smaller yolks, between 20 to 30%, and do not incubate very well if they are turned by rocking them 45 degrees from the vertical 24 times a day. They do better if they are on their sides when turned in this way. Rollers are the best way to turn parrot eggs. Using rollers you will get good results with normal growth charts and successful hatchings.

LAZY EGGS THAT NEED ATTENTION.

If you incubate many eggs you will sometimes come across an egg that does not look quite right when you candle it but it is difficult to decide what is wrong.

If you monitor your eggs very closely using growth charts you will occasionally come across an egg that is growing too slowly and normally these eggs will not make it. Most end up dead in shell.

These lazy eggs can be saved if you catch them early enough. By comparing them to the normal vein growth chart for that species you can soon spot a lazy egg. You must then turn this egg as much as you can. 7 times a day by hand plus 24 times a day by rollers is the minimum to aim for.

I candle all my eggs every other day and compare them to the vein growth charts. If a lazy egg if found it is moved to a moving carpet incubator which turns eggs 96 times a day on their sides. Why don't I just incubate all parrot eggs on a moving carpet incubator ? Ideally I would, but they are experimental machines which hopefully will soon be on the market - but be warned, they are not cheap.

I have measured many yolk-to-albumen ratios of eggs and a pattern is emerging that is fairly clear. There is a link between the size of the yolk and how you turn your eggs which is significant in successful hatching. Night Heron eggs for example have one of the smallest yolks and need to be turned more often and in a more natural way. Eggs with normal yolks of 35% or more seem to be easy to incubate with the simplest of turning methods.

Finally, to back up this theory, it interesting to note that eggs that are never turned such as megapode eggs have a yolk which averages 67%. Similarly, reptile eggs that are never turned have massive yolks.

A question arises from this work :

Will chicks from normal eggs be stronger if they are turned more often and can this increase hatchability ?

Conclusions :

- 1. EGGS FROM DIFFERENT SPECIES NEED TO BE TURNED IN DIFFERENT WAYS FOR MAXIMUM SUCCESS.**
- 2. YOU CAN MONITOR YOUR EGGS TO FIND OUT IF THEY ARE BEING TURNED PROPERLY.**
- 3. PROBABLY EVERYBODY SHOULD BE TURNING THEIR EGGS MORE OFTEN**
- 4. WITH MORE SPECIES BECOMING ENDANGERED WE MUST BE ABLE TO HATCH EGGS WITH A HIGH SUCCESS RATE AND THIS CAN ONLY BE DONE IF EGGS DURING ARTIFICIAL INCUBATION ARE MONITORED CLOSELY FOR TEMPERATURE, HUMIDITY AND TURNING.**

SAMENVATTING

HET MONITOREN VAN BROEDEIEREN

Broedeieren worden zeer nauwkeurig in hun ontwikkeling gevolgd bij het Incubation Research Station van Birdworld en we hebben hierbij enige interessante resultaten gevonden. De broedkamers zijn ontworpen om gebruiker vriendelijk te zijn. Het gebouw is goed geïsoleerd en de luchtemperatuur wordt constant op 21° C. gehouden, ook de vochtigheidsgraad staat onder controle. Dit stelt ons in staat om de broedmachines met een zeer lage vochtigheidsgraad te laten draaien indien dit gewenst is. Alle broedmachines staan in verbinding met een computer die bij een temperatuurprobleem een alarm in werking stelt, waardoor ik zowel 's nachts als overdag onmiddellijk gewaarschuwd wordt. Dit geeft ons een zeer stabiele en goede werkomgeving om ons broedonderzoek te kunnen uitvoeren. Regelmatig krijgen we ook eieren van fokkers die geen goede resultaten hebben, als dan het probleem is gevonden kunnen ze hun eigen eieren laten uitbroeden. Ook word ik vaak te hulp geroepen om broedkamers te ontwikkelen en als broed- consultant te werken. Momenteel werk ik in Portugal, Marokko en Rusland alsmede in Engeland.

Waarom volgen we de eieren zo nauwkeurig.

Bij sommige eieren bleek de groei van de bloedvaten niet snel genoeg te verlopen en het embryo stierf voortijdig in de dop. Al deze eieren werden voor een post mortem onderzoek opgestuurd, maar dit toonde geen resultaat. Omdat dit gegeven vaak voorkwam bij eieren van soorten als de kwak (*Nycticorax nycticorax*) besloot ik de groei bij andere soorten nauwkeurig te volgen om te zien hoe deze ontwikkeling normaliter verloopt.

Het percentage groei van de bloedvaten wordt op het oog bepaalt en om menselijke fouten te voorkomen was ik de enige die dit onderzoek uitvoerde. (Ik suggereer niet dat ik geen fouten maak maar het is beter dat een persoon het percentage groei van de bloedvaten in een broedei schat om betrouwbare vergelijkingsmateriaal te hebben). Het schatten van de groei is niet al te moeilijk daar de meeste eieren op eenzelfde manier groeien.

Ik ben bezig om van zo veel mogelijk soorten een groeicurve te maken. Het minimum aantal eieren dat hiervoor nodig is is twintig. Aan het eind van elk seizoen zullen de verkregen gegevens gekoppeld worden met die van voorgaande jaren zodat gemiddelden verkregen zullen worden van een steeds groter aantal eieren.

Het is duidelijk dat de bloedvaten in de eieren met verschillende snelheden zullen groeien gedurende de broedperiode. In het begin zullen de bloedvaten snel groeien, dan maken ze een periode door van langzame groei en tenslotte gaat het weer snel zodat na 60% van de broedperiode de binnenkant van het ei bedekt zal zijn met bloedvaten. Elke soort heeft zijn eigen groeipatroon die alleen zal veranderen als de eieren op verschillende manieren gekeerd worden.

Broeden bestaat uit Temperatuur, Draaien en Vochtigheidsgraad. Temperatuur en Vochtigheidsgraad sloot ik uit omdat hier al veel onderzoek naar gedaan is en het gemakkelijk te controleren is. Daarom werd vooral de aandacht gelegd op het draaien. De resultaten waren verbazend. Als eieren van de kwak werden bebroed op de normale wijze, dus door ze 24 keer per dag te draaien op hellende lades, bleek dat de groei van de bloedvaten zeer langzaam verliep en het embryo uiteindelijk astierf. In vlakbroeders was het resultaat iets beter, de groei van de bloedvaten bleek voltooid maar de broedduur liep uit en de uiteindelijke uitkomst was nog matig. Indien de eieren in deze platte lades ook nog 7 x per dag met de hand werden gekeerd waren de resultaten wel gunstig met een volledige bloedvatgroei voordat 60% van de broedperiode voorbij was en belangrijker succesrijke uitkomsten.

Geëxperimenteerd werd ook met een broedmachine met een bewegend kleed die de eieren 96 maal per dag op hun zijde keert. Dit was de enige broedmachine waarbij de eieren van de kwak uitkwamen zonder met de hand gekeerd te moeten worden. Het is interessant om te vermelden dat de eieren bij deze broedmachine wanneer ze werden gekeerd over de hele bodem rolden. Misschien is dit meer wat werkelijk gebeurd met eieren in een nest !

U kunt denken dat het 96 maal keren per dag van de eieren te veel van het goede is maar al in 1960 werd geschreven door I.S.Robertson dat bij kippeëieren de beste resultaten werden verkregen indien de eieren 96 maal per dag werden gekeerd.

De vraag is nu: *Waarom moeten ze vaker gekeerd worden ?*

Na het doorzoeken van duizenden dossiers voor een schakel tussen eieren van soorten die op een andere manier gekeerd zouden moeten worden werd het antwoord duidelijk. Op dag 0 was het heel moeilijk om de dooier te zien van soorten als de kwak als ze werden geschouwd.

Verscheidene dooier - eiwit verhoudingen werden gevonden in een artikel van C.Carey, H.Rahn en P.Parisi in 1980 getiteld Calories Water Lipid and Yolk in Avian Eggs.

Gevonden werd dat de kwak een zeer kleine dooier produceert van 19% en meer gekeerd moet worden of misschien kan beter gezegd worden zij moeten natuurlijker gekeerd worden.

De meeste eieren van watervogels bevatten 40% of meer dooier en bij de meeste fazanteëieren is dit 35% of meer en deze zijn ook makkelijk uit te broeden met behulp van een broedmachine waarbij elke methode van keren een uitstekende groei waarborgt.

Papegaiaeëieren bevatten minder dooier, tussen de 20 en 30% en zijn ook moeilijk uit te broeden als ze 45° schuin staan en 24 keer per dag worden gekeerd. Ze doen het beter als ze op hun kant liggen en zo gekeerd worden. Met rolladen zijn de beste resultaten te behalen bij papegaiaeëieren met een normale groeicurve en succesvolle uitkomsten.

LUIE EIEREN DIE OM AANDACHT VRAGEN

Als u veel eieren uitbroedt zal u soms een ei tegenkomen bij het schouwen dat er niet helemaal goed uitziet maar het is moeilijk te bepalen wat er fout is.

Als de groei van de spin nauwkeurig gevolgd wordt zal u soms een ei tegenkomen dat langzamer groeit en normaal gesproken zal zo'n ei ook niet uitkomen. De meeste embryo's sterven af voor het uitkomen.

Deze 'luie' eieren kunnen gered worden als u het vroeg genoeg in de gaten heeft. Als ze vergeleken worden met eieren met een normale bloedvatgroei voor die soort kan een lui ei snel herkend worden. In zo'n geval moet u dit ei zo vaak mogelijk keren. 7 Keer per dag met de hand en 24 keer door de broedmachine is het minste om te doen liefst vaker.

Ik schouw mijn eieren om de dag en vergelijk de groei van de bloedvaten met de bloedvat groeicurves. Als een lui ei gevonden wordt wordt het overgebracht naar een broedmachine met een bewegend kleed die de eieren 96 maal per dag op de zij keert. Waarom ik niet alle papegaiaeëieren in een dergelijke machine uitbroedt ? In het ideale geval zou ik dit doen, maar het zijn nu nog experimentele machines die hopelijk spoedig te verkrijgen zullen zijn - maar wees gewaarschuwd, ze zijn niet goedkoop.

Ik het vele dooier-eiwit verhoudingen van eieren gemeten en er verschijnt een patroon dat vrij duidelijk is. Er bestaat een verband tussen de grootte van de dooier en hoe de eieren gekeerd worden die van belang is bij het succesvol uitbroeden. Eieren van de kwak bijvoorbeeld hebben een van de kleinste dooiers en moeten vaker gekeerd worden en liefst op een natuurlijker manier. Eieren met normalere dooiers van 35% of meer blijken in de broedmachines uit te komen met de eenvoudigste manier van keren.

Tenslotte om deze theorie te ondersteunen is het interessant te weten dat eieren die nooit gekeerd worden zoals die van de grootpoothoenders een dooier bevatten van gemiddeld 67%. Evenzo, eieren van reptielen die nooit gekeerd worden hebben enorme dooiers.

Een vraag volgt uit dit werk:

Zullen kuikens uit normale eieren sterker zijn als ze vaker worden gekeerd en kan dit de uitkomstpercentages verhogen ?

Conclusie :

1. EIEREN VAN VERSCHILLENDEN SOORTEN MOETEN VOOR EEN MAXIMAAL SUCCES OP VERSCHILLENDEN MANIEREN GEKEERD WORDEN.
2. MEN KAN ZIJN EIEREN VOLGEN OM UIT TE VINDEN OF ZE OP DE JUISTE WIJZE WORDEN GEKEERD.
3. WAARSCHIJNLJK ZOU IEDEREEN ZIJN EIEREN VAKER MOETEN KEREN.
4. MET MEER SOORTEN DIE BEDREIGD WORDEN MOETEN WE IN STAAT ZIJN OM EEN GROOT UITKOMST PERCENTAGE TE HALEN EN DIT KAN ALLEEN GEDAAN WORDEN ALS GEDURENDE HET KUNSTMATIG BROEDEN, DE BROEDGEGEVENS WORDEN GEMETEN VOOR TEMPERATUUR, VOCHTIGHEIDSGRAAD EN HET KEREN.

Reference :

C. Carey , H.Rahn and P.Parisi. 1980 ; CALORIES WATER LIPID AND YOLK IN AVIAN EGGS.

PARASITES AND GALLIFORMES

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SUMMARY

The most important endo- and ectoparasites in Galliformes are visualised in a large number of colour slides.

The morphological differentiation of a number of worm species is demonstrated. The live cycle is discussed and the diagnostic method by egg differentiation is shown.

The most important worm species recorded are *Ascaridia*, *Heterakis*, *Capillaria*, *Syngamus*, *Cyatostoma*, *Trichostrongylus*, *Amidostomum*, *Davinea*, *Raillietina* a.o..

Protozoal infections are shortly discussed and lesions of *Trichomonas*, *Histomonas*, *Lankesterella*, Coccidiosis a.o. are shown.

The most important ectoparasites as *Dermanyssus*, *Columbicola*, *Campanulotes*, *Megninia*, *Falculifer*, *Cnemidocoptes* a.o. are briefly discussed.

SAMENVATTING

De belangrijkste endo- en ectoparasieten bij Galliformes worden getoond met behulp van een groot aantal kleurendia's.

De morphologische verschillen van een aantal wormsoorten worden getoond. De levenscyclus wordt besproken en de diagnostische methode door eidifferentiatie wordt getoond. De belangrijkste wormsoorten zijn o.a. *Ascaridia*, *Heterakis*, *Capillaria*, *Syngamus*, *Cyatostoma*, *Trichostrongylus*, *Amidostomum*, *Davinea*, *Raillietina*.

Protozoaire infecties worden kort besproken en letsel van o.a. *Trichomonas*, *Histomonas*, *Lankesterella* en Coccidiosis worden getoond.

De belangrijkste ectoparasieten zoals *Dermanyssus*, *Columbicola*, *Campanulotus*, *Megninia*, *Falculifer*, *Cnemidocoptes* worden in het kort besproken.

**The Grouse Family:
A Review of their Captive Status and Practical Aviculture**
by
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1. Introduction : Grouse are not well represented in either institutional or private collections though generally speaking they breed relatively easily in captivity; the difficulty is keeping them alive to breeding age.

The largest number of captive grouse have been either wild caught or captive bred for restoration efforts on the part of government agencies. Generally these people have not had the experience dealing with live specimens or determining habitat suitability or minimizing the dispersal activities of the release stock (Toepfer and Anderson 1990). Whether captive propagation is being undertaken as a hobby, part of an interpretive zoological program, directly to increase the reserve of an endangered species genetic reservoir or ultimately to enhance the species status in the wild the following summary should serve a useful introduction to the topic.

2. Review of Species in Captivity:

In spite of the IUCN CBSG policy that encourages government agencies in all countries to encourage the capture of wild birds so that they be made available to experienced aviculturists, many countries have discouraged acquisition of breeding stock. This is the prime reason that little progress has been achieved with the tetraonids. Many species are annually hunted by the thousands but no birds are available for avicultural research, an unfortunate dichotomy.

Of the 16 species of grouse listed by Johnsgard (1983) nearly half are not regularly represented in avicultural collections, yet 4 species or subspecies are suffering from very reduced habitat threatening their existence. Many other local or regional populations of other species have been or are threatened with severe habitat alteration. There is a great need to improve grouse avicultural techniques and begin to establish genetically meaningful captive reserves. It is ironic that in NA we find the worlds rarest grouse species. The further irony is that the worlds last extinct grouse, the heath hen, is also a close relative of the now endangered Attwater's prairie chicken. What have we learned! Are government biologists and aviculturists doing enough to prevent this next tragedy? The answer is clearly no!

Of the Eurasian species the black-breasted hazel hen *Bonasa sewerzowi*, Caucasian black grouse *Tetrao mlokosiewiczi*, sharp-winged grouse *Dendragapus falcipennis*, and the black-billed capercaillie *Tetrao parvirostris* have only occasionally been represented in captivity and little progress has been achieved on their aviculture. In North America little avicultural progress has been achieved with the sage grouse *Centrocercus urophasianus*, or white-tailed ptarmigan *Lagopus leucurus* and outside some birds being held for scientific experimentation both are probably only represented in the authors collection at this time.

The circumpolar rock ptarmigan *Lagopus mutus* is more commonly represented in European than North American collections (Aschenbrenner 1994 in press).

The capercaillie *Tetrao urogallus* is represented in over 200 aviaries in Norway and Sweden. This is due to recent government sponsorship of breeders to captive rear birds for reintroduction. Also on the positive side, the next most widely represented captive bred species in Europe and America is the North American ruffed grouse *Bonasa umbellus* with perhaps some 60 to 75 breeders keeping them. The Eurasian counterpart, the hazel hen *B. bonasia*, is becoming popular though probably less than a third of the number of breeders would presently house a pair. Following the ruffed grouse in popularity would be the N.A. dancing grouse, the greater prairie chicken *Tympanuchus cupido* and the sharp-tailed grouse *T. phasianellus*. These favorites are also probably represented in around 30 to 40 collections at this time. The blue grouse *D. obscurus*, spruce grouse *D. canadensis*, and black grouse *T. tetrix*, are probably present in some 20 to 30 collections at any one time. The willow ptarmigan *L. lagopus* including its UK race the red grouse *L. l. scoticus* is probably in fewer than 15 collections. Excluding the recent and probably temporary Scandinavian experience with capercaillie probably no more than 150 to 200 breeders worldwide presently have a pair of grouse.

Following from the Norwegian capercaillie project mentioned earlier there is a pilot commercial operation to sell processed capercaillie meat to the restaurant market that has had some limited success. However the major market for most grouse breeding projects is producing the breeder stock for aviculturists, scientific research or for reintroduction efforts. Some black grouse have been bred for shooting preserves in Czechoslovakia; red grouse and capercaillie are presently undergoing captive breeding evaluation for restocking possibilities in the UK; and in NA the southern race of the pinnated grouse, the Attwater prairie chicken *T.c. attwateri* is presently undergoing exhaustive field research by the USF&Ws and some initial captive studies in a belated effort to save this highly endangered species.

((Note: I may be able to add a few more specifics to this after my European travels and discussions with breeders in September.))

Some current captive and field research has been initiated by both Chinese and Russian biologists to preserve the geographically restricted black-breasted hazel hen and the black-billed capercaillie but these projects are greatly hampered by the lack of funds and a firm commitment on the part of key government agencies.

Large scale specialized grouse farming is approaching a reality but cannot take that final leap forward until vaccines are developed against common poultry diseases or immunity is developed in the breeding stock. The authors experience in rearing over 550 grouse two seasons ago to have over 300 die in a few days due to a Clostridium outbreak from contaminated commercial feed is indicative of the 'surprise' problems (Grouse News #5 June 1993).

3. Avicultural Techniques:

a) Source and Purpose of Birds The source and purpose of the birds should play an important role in the choice of breeding stock. For example, if the objective is to release birds into the wild in a stocking or a reintroduction program then, after the problems of determining the desirability of the potential habitat, one must consider the appropriate subspecies for this particular area. It is the obligation of aviculturists to keep the subspecific lines pure. One must also consider if the birds availability is compatible with the desired time for a release. For example, is the stocks breeding cycle at a time of minimal dispersion or migration.

For a lekking species you might start with introducing males at a suitable or historic lek so that they can immediately 'identify' with the area. Wild trapping a subpopulation or releasing a group of pen reared and already dancing males could help establish the new lek by reducing 'searching' dispersal. One or more females might be housed in the immediate vicinity to encourage the males to stay and display. Alternatively, if the season only permits that females and their broods are available then they could be reared on site and then released into the adjacent habitat directly or through pens that initially let the chicks come and go but retain the adults. Or several wild broods might be translocated.

The point is that the birds must not only be released into suitable year round habitat, but that the birds must be conditioned to finding food and shelter in these habitats and be released at a time to minimize dispersal tendencies. You want them to settle down to breeding and rearing young as quickly as possible.

If the purpose of the birds is for avicultural breeding stock then the originating race may not be important at that time. In any event it is important to at least know of the geographic origin of your stock in the event that later reintroductions become an option. Even if the prime objective is to just learn and enjoy working with the species it is important for aviculturists credibility that racial origin be recorded for possible later application. Equally important to knowing the racial origin of a stock and protecting its genetic purity is maintaining the 'within' species maximum genetic diversity.

b) Husbandry & Health The successful rearing of grouse will happen if you can keep the birds healthy. Minute bacterial, viral or parasitic levels often quickly flourish into deadly levels with grouse. The problem that causes a pheasant to merely 'sneeze' kills the grouse.

Successful husbandry starts with a proper management system incorporating entry animal quarantine; internal isolation and hospital facilities; and effective prophylactic, diagnostic, and treatment programs for disease and parasite control. These programs are in turn dependant upon adequate bird marking and record keeping systems. And ultimately the health of the birds depends upon providing the proper nutritional, psychological and physical needs of the different species.

Grouse disease is a vast and complex topic that cannot be dealt with here. Suffice to say that we subject all new birds to 30 day minimum quarantine during which time they are given a prophylactic blackhead treatment (Emtryl is still most effective though less available) and are dewormed with either or alternatively Tramisol (levamisole phosphate) or ivermectin. Most dead birds are necropsied by the regional veterinary laboratory and bacterial and viral cultures are prepared when necessary. While we will specifically treat for any identified disease we also twice annually, prior to and following the breeding season, give prophylactic treatment for worms (as above) and for coccidia (amprolium or nitrofurozone).

Since the clostridium scare, upon finding one or more 'healthy' birds dead, we also immediately start a treatment program using Solu-tracin 200 (bacitracin methylene disalicylate) pending confirmation of autopsy and culturing --- though the problem has not resurfaced in over a year. In a large pond aviary containing pheasants, waterfowl, shorebirds, turacos and ruffed grouse we give the above treatments four times a year --- and we still lose an occasional grouse. If we withhold greens and fruit we can administer the drugs in the water. Generally we prefer to simply add the appropriate amount to a slurry of chopped and blended fruit. Due to the small amount offered we know if it is totally consumed.

Some aviculturists have incorporated prophylactic levels of various vermicides and bactericides into the feed mixture. The long term effect on reproduction of this procedure is still being investigated but the practice is gaining popularity. My concern with this practice is that it is not likely to assist in developing grouse with more resistance to pathogens. But keeping the birds alive must also be the prime initial target.

Obviously cleanliness is a major key to grouse culture. The problem is that grouse generally live in remote areas devoid of humans and their farm animals. These isolated grouse populations have simply not had the evolutionary opportunity to develop resistance to the many organisms and parasites of domesticated poultry. It is interesting to note that the species most frequently kept successfully are those species with the historically closest association with the farm: the ruffed, sharp-tailed and black grouse. It is likely that they have developed through repeated exposure the greatest resistance to disease and parasites.

c) Pens: Many aviculturists achieve the necessary cleanliness by brooding, rearing and wintering the birds on wire bottomed pens. Indeed this is by far the easiest method, though to me distasteful as it seems to inhibit some of the natural behaviors that I so enjoy seeing. A common compromise is to winter the birds on wire and then and only then put the birds briefly into vegetated and ground breeding pens just prior to egg laying. Since many species will lay eggs in the wire bottomed pens they obviously lay in these 'short season' breeding ground pens. Cleaning under these wire bottomed pens can be done weekly, monthly, yearly or never according to one very successful breeder. I have found in our wetter climate that spilled food, even one meter below the pen, is a dangerous aspergillus culture bed. A slight compromise, but one that still requires daily cleaning, is to put down a .25 to .35m layer of sand on which the birds walk. Shrubs or trees grow up through the sand but it is very easily cleaned of the daily dropping. The sand permits effective drainage to reduce dampness and it inhibits earthworms and various insects that carry pathogens and parasites. Combining wire floored brooding and winter pens with sand floored breeding pens is double insurance.

Some grouse breeders very effectively overwinter birds in individual wire pens 0.5 x 1.0m and 0.5m high. Pairs are often housed in adjacent pens to maintain pair bonding or familiarity. The bottoms of these elevated pens can be either heavy plastic or wire. I prefer the 2.5cm square plastic coated weld wire for strength and reduced aggravation on the birds feet. Galvanized after weld wire is satisfactory for most species but at least white-tailed ptarmigan seem allergic to the bare metal.

The pens size seems less important to the birds than to the breeder in most cases. The classic wire bottomed breeding pens pioneered by New York State in the 1930's and 1940's and used in rearing thousands of ruffed grouse were only 1.8 x 2.4m (6 x 8 feet) and about 0.8m high and were elevated about 0.5m off the ground (Bump et al 1947). My basic sand bottomed breeding pens are 2.4 x 8.5m and 3.6m high (8 x 28 x 12 feet high). The sides have a 1.0 m high wooden barrier between pens (about 0.2m is buried in sand) with all internal side and roof meshing above this of 1.0 to 2.5cm nylon. The top is roofed over for a distance of 3.0m to provide the only protection from the elements. Under this roof goes the feed and water containers.

All my brooder, breeding and wintering pens contain many tree limbs for perches. Since the basic pens are nearly 4m high the top level of perches is well above the keepers head and gives the birds a great deal of security. The perches are about 0.3 to 0.6m below the top netting so owls

The many perches allow exercise and physical separation of birds as well as removing the birds from direct contact with the ground. The frequent climbing and flying to perches also strengthens the chicks and adults legs and wings and improves the birds general fitness.

Grouse eat and kill most pen vegetation. The various species of cedar and juniper seem most resistant to being eaten but sharp-tails will ring even these species. If elderberries are given a chance to get started they can survive and provide great beauty, excellent cover and fine edible berries. It is essential to ring plant stems and trunks with wire or nylon mesh to insure their survival. When branches become strong enough to support the birds body weight they will perch on these branches and strip all leaves.

Because I wish to enjoy and study the birds behavior I keep all my birds full winged. In the heavy direct flying species (capercaillie, sage and black grouse) to prevent damage and loss from unexpected 'spooking' and the birds flying into posts and roofs I have stretched polynetting below the inside roofs or solid ceilings. I have also placed 'drop' nettings 2.0 m in front of side walls when the pen is more than 10m long to absorb the shock of fast flying birds. The drop netting hangs from below the upper layer of perches near the ceiling to 1.0 m off the ground and cushions the 'throwback' effect of a bird fast flying into a wall mesh. A simpler technique is to clip the primaries on one wing of the strong flyers or of aggressive males.

Outer perimeter pen security is maintained by burying heavy fox wire 0.5m deep, providing a 1.2m lower solid wooden barrier with a double upper mesh with steel wire on the outside and nylon mesh on the inside of the vertical supports. Just above ground level, at the top of the wooden barrier and along the top we run an electrified wire. We also run llamas in a peripheral enclosure to intimidate or scare off coyotes, foxes and dogs. The internal pen divisions are all nylon mesh that does little damage to birds. All pen doors open into alley ways to give a double door security.

Lek Pens: For the capercaillie which have potentially very aggressive males that are substantially larger than females it is easy to incorporate selective 'bolt' holes that permit the smaller hens access to the males quarters when they choose but enable them to seek privacy in the larger laying pen which may house 5 to 50 hens. Each laying pen may be serviced by one or more adjoining single male pens of 6 to 10 square meters each. Pens for all lekking species can be 6.0 x 6.0 m to several times this dimension. Thirty square meters will adequately house 1.3 (male to female ratio designation) capercaillie. Other lekking species like the three prairie grouse or the black grouse can be housed from 1.1 to 1.10 sex ratios in similarly sized and larger enclosures.

With the prairie grouse I also prefer to start the breeding season with several males in each pen. The dominant male quickly takes command and lesser males either move out of the way (sage) or assume the nonaggressive female position to avoid conflict (prairie chickens and sharp-tails). If a severe beating occurs I then remove either the alpha male if it is very aggressive, or the beta male(s) and give the alpha male first options for the season. If there is only one male you have a more limited genetic distribution. However, if you do not need to know the exact parentage then to increase the gene mixing after a week you may exchange males. This can be repeated again another week later. This weekly shift of males also insures that less fertility will be lost if one male is ineffective --- or disliked by the hens.

In other species, blue grouse, ruffed grouse, hazel hen(?) two or more females can effectively run with each cock. One exception is the spruce grouse, and particularly the Franklin race *D.c.franklinii* where the females will kill each other at the onset of breeding.

In ruffed grouse running 1.2 or even 1.4 it is preferable to have several pens, even quite small, but accessible through bolt holes. This just offers more privacy and escape. The additional hens also seem to reduce or maybe spread out the males attention and help to eliminate hens getting killed by aggressive males. The problem of over-aggression in the males is partly overcome with extra space but particularly by offering escape routes, cover and many perches where the females can seek solitude. While our high pens give security and escape to females they can cause a problem if insufficient ground cover is not provided for the nesting hen. She may be too exposed and vulnerable to attack when on the ground and seek high perches from which to lay eggs. Placement of soft styrofoam pads below the perch sites can be effective but provision of more ground cover is best. The trick is to apply this brush or wood cover late in the season to prevent sheltered, dark, damp aspergillus culture sites.

Most of the ptarmigan seem to prefer imposed monogamous pairing. But as with the spruce grouse or other species by housing females in adjacent pens you can daily or every two days easily move a single male to the different pens to service two females. Increasing the female ratio has the downside of reducing the genetic diversity but allows greater breeding density within limited pen space or the utilization of otherwise unpaired hens.

At the nesting season I always dig out two or three 8 to 10 cm scrapes per pen to soften the soil under bushes or lean-to supports for nesting. Again it is important that the females can nest with minimal disturbance from the males so we introduce 'salvaged' Christmas trees (we get 125 to 150 free trees the day after Christmas) at the beginning of April for additional nesting cover. Placement of a 0.3m long wooden lean-to against a wall forms both an escape 'hide' and a nest site.

d) Incubation and Rearing: Most species of commonly reared grouse will incubate and rear their own young. However, if maximizing the production is important then you would pull all eggs or the first clutch(s) and leave the hen to sit the final set. The problem I find with letting the hen sit is that we keep the pens so clean that there is little natural food, bugs or greens, available for the chicks and the larger enclosures mean little of the supplemented food is found per unit of ground covered by the chicks. This can be overcome by confining the hen and brood to smaller pens or parts of pens where the feed trays are more apparent.

The incubation of grouse eggs is generally straight forward following standard poultry criteria; the eggs should lose 15% weight over the incubation period (this is generally attained by 50 to 53% relative humidity); the temperature is maintained at 37 degrees centigrade (99.5F) in forced air incubators; frequent egg turning is preferred (every 15 minutes is better than every 60 minutes); and turning is stopped 3 days prior to hatching.

Capercaillie eggs have traditionally been difficult to hatch in either tilting or rolling tray incubators and placement under banty hens for a minimum of 10 days is recommended. My own intensive plotting of egg weight loss, with the required prolonged daily open incubator, has resulted in both delayed and reduced hatching success. So be careful about too much data collection! Generally speaking grouse eggs have high fertility and hatchability with minimal attention if the temperature and humidity are properly maintained.

Hatching is facilitated by moving the eggs 2 to 3 days before pipping and hatching respectively to a separate maximum humidity hatcher. As soon as several chicks hatch, but not too frequently as you do not want to open the hatcher more than necessary and reduce the humidity, the wet chicks are moved to another dry hatcher to facilitate drying for 16 to 24 hours. From here

the chicks are moved to the First Stage Brooder. Since these brooders have concentrated heat at one end the chicks quickly learn to select the temperature of choice by distance from the lamps. This same principle of 'self regulated' temperature control is applied in the Second and Third Stage Brooders.

If you experience a delayed hatch from lower incubation temperature, and if the drawdown of fluid has been too great or the relative humidity of the hatcher is too high and there is a delay from pipping to full hatch, it is sometimes possible to assist the chick out with forceps. It is important to not damage the peripheral blood vessels inside the shell so as to prevent bleeding. If there is any danger to the chick of contamination from the surrounding hatcher and brooder and particularly of the newly exposed umbilical cord, I suggest dabbing the area with iodine on a swab. This area is very vulnerable to infection entry. We also swab the toe punched wound if this has been necessary for identification purposes to plot blood lines.

I use a three stage brooder program. The First Stage Brooder (.30 x 1.0m x .30 high with 2 ordinary lamps at one end) is used from hatching to up to 8 to 10 days of age. The floor of the brooder is covered with paper toweling which is changed at each feeding. The 2nd stage brooder is also portable but kept indoors and has a wire bottom and is 0.5 x 1.25m x .30 m high and is used up to 4 to 6 weeks of age. The final Third Stage Brooders also double as wintering pens and are 1.0 x 5.0 m and 3.0 m high. Half the roof is enclosed. These are wire bottomed, outdoors and have the option of having heat lamps if the weather is cold. In all brooders the heat source is ordinary light bulbs on rheostats to control heat. The 40 to 60 watt bulbs are dipped into blue paint to over half height so the brightness is toned down. This means that the birds have light 24 hours per day, as with many northern grouse species.

e) Feeding Considerable research has been done on grouse nutrition in the wild and most recently in captivity (Aschenbrenner in Press 1994). This latter work suggests an area of great break through in grouse culture. Except for newly hatched chicks which eat a high protein diet based on insects, the non-migratory grouse have evolved an efficient year round use of abundant local vegetation that is generally low in protein (often only 4 to 8%) and high in fibre. Aviculturists, often following the lead of the poultry industry, have generally been led into providing too nutritious a diet in too great an abundance.

The challenge facing grouse breeders is getting back to either a natural diet or one offering suitable levels of the protein/fibre ratios, the subsequent correct digestive tract pH, and foods that are nutritious while keeping the birds physiologically and psychologically fit. Aschenbrenner (pers. comm.) recently wrote that using a totally natural diet the past couple of years has enabled him to rear capercaillie chicks literally without loss. On a natural diet focusing on conifers and dandelions he also has capercaillie hens producing up to 50 and 65 eggs per season. He largely attributes this incredible survival improvement to the lower protein levels with their subsequent lower gut pH levels which inhibits pathogenic organisms. Can we derive commercial feeds that accomplish this? This would certainly seem a valid avenue of research.

Most grouse breeders utilize as much natural green vegetation (conifers, willow, dandelions, to name but a few) as possible and supplement this with available fruits. The bulk diet, usually available in unlimited amounts, is generally commercially available chicken or gamebird cereal pellets: maintenance ration (12-16% protein) in winter, breeder ration (18-20%) in spring, and starter crumbles (28-30%) for 1 to 8 day old chicks and grower pellets (20-24%) for growing chicks. The lower protein levels are probably still too high for all but the tiny chick grouse. The addition of an abundance of greens and shrub buds in early spring is a sure stimulus

to breeding and likely increases fertility and hatchability. We start the breeders onto dandelions as soon as they are available in March or April.

Many breeders supplement the chick starter with chopped egg and various greens and fruits. Some utilize mealworms if the chicks are slow to start eating on their own. Hanging greens from the sides of the brooders invites jumping and feeding. By first dipping leaves into water and then into crumbles these hanging feeders stimulate the eating of the crumbles. Little water will be consumed if the chicks are eating much fruit and greens. Appropriately sized grit should be available from hatching. Early in the season we try to keep hatches to every 3 days so chicks have companions as a stimulus to feed and to reduce imprinting to humans. Along this line of reasoning after purchasing several imprinted rare pheasants that don't mate naturally, we started to place chick brooders in proximity to adult birds of that species to assist in species identification by the chicks. At the Third Stage Brooder level we ran adults on the ground below the chicks.

We give five feeds daily to the chicks through to four weeks of age. After that it is gradually reduced to two feeds per day by 12 weeks. Adults are fed once daily.

Food presentation is very important. The objective is to avoid feeds getting mouldy or contaminated by feces or water or air disseminated pathogens. Water should be changed daily or an automatic watering systems used that inhibits contamination and facilitates cleaning of the cups. Feeds should be off the ground; fruits on removable plates, greens in wire bins that hold leaves off floor, pellet feeders set over wire base so birds don't pick up dirty or mouldy feed.

4. Transport and Permitting Adult grouse are strong, durable and easy to transport and can readily be moved via express mail or air express. In the USA the N.E.S.T. commercial cardboard shipping crates were designed in cooperation with the postoffice and this is a very safe, efficient and rapid delivery system. Grouse provided with half an apple, which is largely water, or half a head of lettuce, will not drink or need water. The IATA regulations for containers are not nearly as satisfactory for the birds but must be followed for international shipments.

As with many endangered bird species one of the greatest threats to the species survival is the superabundance of paper work required to comply with thoughtless anti-conservation Endangered Species, CITES or other regional or national government regulations. For many species to survive this nonsense must stop!

Summary: Grouse represent one of natures most prolific and important elements in the northern ecosystem. The ultimate survival of several wild tetraonids now depends upon the level of wisdom that man brings to bear on the conservation or 'wise use' of this resource. Paramount in this struggle will be both the speed and willingness of governments to not only maintain suitable habitats but in the most urgent manner facilitate the live capture of breeding stock; ease, for established breeding facilities, the deleterious international laws restricting the movement of both endangered and presently common species across borders to facilitate breeding programs and interchange of genetic diversity; and finally their survival in many emergency situations will depend upon the dedicated investment of more time and money by aviculturists to further expand our avicultural expertise and establish reservoirs of captive breeding stock suitable for release into the wild.

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SAMENVATTING

DE FAMILIE DER RUIGPoothoENDERS Een Overzicht van hun Status in Gevangenschap en Praktische Avikultuur

David Hancock

Ruigpoothoenders zijn niet goed vertegenwoordigt in dierentuinen en privé collecties ofschoon zij over het algemeen wel vrij gemakkelijk broeden; de moeilijkheid ligt eerder bij het opfokken van de kuikens tot teelbare leeftijd.

Het grootste deel van de ruigpoothoenders dat momenteel in gevangenschap verblijft is afkomstig uit het wild of in gevangenschap gefokt met als doel herintroductie van overheidswege. Over het algemeen hebben deze mensen geen ervaring met levende dieren en met het bepalen van de geschiktheid van een habitat en in hoeverre de vrij gelaten vogels zich zullen verspreiden (Toepfer en Anderson 1990).

Of het fokken in gevangenschap nu wordt ondernomen als hobby, als onderdeel van een zoölgisch programma of direct om de genetische diversiteit van een bedreigde soort te behouden of om het aantal van de soort in het wild te vergroten, hopelijk kan deze voordracht bijdragen aan een waardevolle introductie van deze groep vogels.

De ruigpoothoenders vertegenwoordigen een der meest vruchtbare en belangrijke elementen in het noordelijke ecosysteem. De uiteindelijke overleving van verscheidene ruigpoothoenders hangt nu af van de mate van wijsheid die de mens bij het behoud van de natuur in dienst stelt of van het 'verstandige gebruik' van deze bron. Van het grootste belang in deze strijd zal zowel de snelheid als de bereidwilligheid van diverse regeringen zijn, niet alleen om geschikte habitats te behouden maar ook in de dringendste gevallen van het levend vangen van fokmateriaal; vereenvoudig de omstandige internationale wetgeving die het vervoeren van zowel bedreigde als niet in gevaar zijnde soorten bemoeilijkt om fokprogramma's mogelijk te maken en tevens het uitwisselen van genetische diversiteit mogelijk te maken. Tenslotte zal hun overleven in veel noodsituaties afhangen van de toegewijde investering van veel tijd en geld door fokkers en liefhebbers om de aviculturele kennis te vergroten en om reservoirs vast te leggen van fokgroepen in gevangenschap die geschikt zijn om eventueel in het wild te herintroduceren.

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THE BREEDING OF QUAIL AND PARTRIDGE IN CAPTIVITY

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ABSTRACT

There is a major contribution to be made today by the Aviculturist in breeding Quail and Partridge in captivity, both for science and for conservation. The back-yard can be an ideal study area for those who are interested; no travel has to be undertaken, and often behaviour patterns can be observed under conditions which might take years for a fieldworker to experience. Little is known to science about many of these species and captive breeding can add to our knowledge, particularly aspects relating to display, reproduction, taxonomic inter-relationships and the husbandry required to maintain viable on-going populations for the future.

SAMENVATTING

Vandaag de dag kan er een grote bijdrage geleverd worden door de fokkers met het fokken van kwartels en patrijzen, zowel voor wetenschappelijke doeleinden als voor conservation. De tuin kan een ideale plaats zijn voor diegenen die hierin geïnteresseerd zijn; er hoeft niet gereisd te worden en vaak kunnen gedragspatronen geobserveerd worden onder condities die jaren zouden vergen van een veldwerker. Van veel soorten is slechts weinig bekend en het fokken in gevangenschap kan bijdragen aan onze kennis, vooral aspecten die te maken hebben met de balts, reproduktie, taxonomische inter-verwantschappen en de methoden die nodig zijn om een levenskrachtige populatie voor de toekomst te verkrijgen.

INTRODUCTION

The modern aviculturists is well aware of the conservation issues of our time and, taking a responsible line, is quite prepared to assist in conserving the species in his/her possession, rather than taking more birds from the wild. A contribution can also be made to science as the back-yard is the ideal area for studying the birds' behaviour throughout their lives, whereas a fieldworker may wait many months to observe what is a daily occurrence in the aviary.

We know very little about the reproductive biology of quail and partridge, of their taxonomic inter-relationship, or the husbandry required to maintain an on-going viable breeding population. Of the 132 species listed in the wild (Howard & Moore 1991), only approximately 22 species of quail and 26 species of partridge are known to have been kept in captivity. This differs considerably from their more colourful cousins, the pheasants, where most species have been bred in captivity. Possibly the reason for this is that there has been little incentive for trappers to bring them into captivity. On the other hand, certain species, such as the Japanese Quail, *Coturnix japonica*, has been held and bred in captivity for its eggs and meat since Roman times. The Grey Partridge, *Perdix perdix*, and Red-legged Partridge, *Alectoris rufa*, have been raised as quarry birds for many years, and in more recent years the Chinese Painted Quail, *Coturnix chinensis*, has been kept and bred purely for ornamental purposes.

A great deal of knowledge has been accumulated over many years about these species, but very little is known about many aspects of other species in the wild. This is where the private breeder can make a great contribution, by noting daily events such as whether the eggs are still fertile after the first primary feather has dropped by the male, or whether the hen moves the chicks from the nest to another location as soon as they are hatched. These are just two examples of everyday occurrences which can be recorded without moving out of the home, and are a part of the overall knowledge required for good husbandry.

BEHAVIOUR

The Hill Partridge family, *Arborophila*, are noted for building domed nests in captivity, constructed from long grasses or other readily available materials. However, in some cases, their nests in the wild are similar of other ground nesting birds, a scrape surrounded by grass. Once the nest is built, the male stands erect next to the female, displaying his red throat patch which is normally hidden for most of the year. This behaviour has been observed in four species, *A. torqueola*, *A. javanica*, *A. orientalis* and *A. brunneopectus*. Once the hen is at the nest, the pair bonding starts with the cock offering a titbit to encourage the hen to stay around. After a day or so, the pair bonding is complete and both sexes will defend the nest against all intruders.

The Crested Wood Partridge, *Rollulus roulroul*, builds a similar domed nest and the hen will enter it to lay, closing the entrance behind her. However, it has been observed in the wild that they build and lay in a traditional type nest which just has a few leaves strategically placed over the top. One wonders why? In captivity, the same species can be stimulated into nest-building by providing a temperature around 20°C and watering their habitat with a fine spray. It can also be noted that the hen's plumage takes on a surface bloom when she is in breeding condition. Similar observations have been made with female Ferruginous Wood Partridge, *Caloperdix oculea*, and Black Wood Partridge, *Melanoperdix nigra*.

REPRODUCTION

In the wild most quail and partridge lay one clutch of eggs per season, and, should the eggs be predated early in the incubation period, there is a good possibility that they will nest and lay again. Birds held in captivity can be persuaded to lay several clutches per season if the first is taken for artificial incubation. In the case of the Sumatran Hill Partridge, *A. orientalis*, the hen lays only 2-3 eggs per clutch. This species can be triple-clutched in captivity. This raises the question of whether they extend their breeding period in the wild beyond one clutch per season. Other species of the same genus which live in a similar habitat have larger clutch sizes. Do they double clutch in the wild?

Taking this subject a stage further, the modern aviculturist uses every method available to obtain the maximum possible hatch from the eggs laid each season, and using egg density as a method of monitoring weight loss during artificial incubation, it has been noted that eggs laid by species living and nesting in similar habitats and altitudes actually require differing humidity levels during incubation.

In the case of the Common Hill Partridge, *A. torqueola*, the normal humidity requirement is 55% RH (relative humidity), whereas for the Sumatran Hill Partridge, *A. orientalis*, the requirement is 58% RH. Moreover, the Barred Backed Hill Partridge, *A. brunneopectus*, requires 65% RH (Harvey per comm. 1991).

It would be interesting to learn whether this varying requirement is the same in the wild, or whether the hen has adjusted the shell density to accommodate to her living environment. Interestingly, it has been noted that eggs from the Crested Wood Partridge, *R. roulroul*, when laid in a tropical environment need a different humidity level in incubation to eggs from the same species laid in arid conditions. To add to the mystery, we also know that quite often the first and the last eggs of a clutch need a slightly different humidity than the main group. So the question we have to ask is whether the hen is able to adjust the shell density to accommodate the conditions prevailing at the time?

There is one important point to remember; when monitoring any of the temperatures or humidity levels, ensure that the equipment is accurate, as experience has shown that results can be useless if the equipment is unreliable and the data proves to be inaccurate when published.

Breeding in captivity provides a unique opportunity to witness events and characteristics not normally seen in the wild. A covey of Scaled Quail, *Callipepla squamata*, has been seen to roost in a circle, each bird facing outwards, which is presumably nature's way of preservation.

Similarly, the Californian Quail, *Callipepla californica*, will lay a clutch of 7-16 eggs which, when they have completed their incubation, will all hatch within 10 minutes of seeing the first external pip. The chicks can clearly be heard calling to one another prior to hatching.

PARENT REARING

Few aviculturists set out to allow their birds to parent-rear their own young. Wild caught pairs are very nervous when first taken into captivity and a lot of work has to be undertaken to bring them to a point where they will nest and lay; usually they will not sit for more than a few days and subsequently the eggs are lost having gone cold when they are deserted. So the practice is to "pull" the first clutch and place them under a bantam or in an incubator to hatch artificially, and to hope that the hen will produce a further clutch. From a conservation point of view, the instinct to sit their own eggs must not be lost should it be considered the specie is likely to be re-introduced to the wild. Tests have proved that, given the right habitat and food, and the required predation control, quail and partridge chicks can be successfully raised, usually from F1 and F2 parent stock. The aviary must also be wired so as not to lose the very small chicks at the hatching stage, and suitable cover must be provided to protect them against storms. Every effort should be made to retain the birds' natural instincts.

HUSBANDRY

Most quail and partridge are reasonably easy to keep in captivity, providing they are correctly housed, given the right diet and monitored for infestations. However, for successful breeding their natural environment must be considered. With tropical species heat should be provided during the winter months if it differs from their own weather. Live food provides a good incentive to stimulate breeding, and is pre-requisite for the parent-rearing of chicks. Bear in mind that in the wild the pair will site their nest near to a food source, ready for the chicks when hatched. This may not be possible in the confines of an aviary. Plenty of cover and areas of seclusion are always helpful if breeding is to be successful. Conversely, species from a cool climate should be given plenty of shade and cover, and not to be subjected to high humidity if breeding is to be considered.

In essence, husbandry is meeting to species' needs whilst in captivity, studying their natural requirements and trying to provide similar. Above all, once success has been achieved, record the information. The aviculturist can be very bad at recording such data, unlike the scientist who needs to publish reliable information for career enhancement.

TAXONOMIC INTER-RELATIONSHIP

To the private breeder, taxonomy is one of those mystiques which is usually left to the scientist, but in fact, making observations, and noting birds' characteristics can make one ponder the question of their origins. An example of this is the Black Francolin *Francolinus francolinus*, from Asia and the Madagascan Partridge *Margaroperdix madagascariensis*, from Africa. When placed in adjacent pens, marked similarities can be seen: both are ground dwelling and have similar body conformation, plumage and movement; their eggs are also of a comparable colour, shape and size. So, did the Madagascan Partridge evolve as an island population from Asia? Taxonomic tests have revealed that this could well be so (Crowe 1991). A similar conclusion might also be drawn when the Rain Quail, *Coturnix coromandelica*, and the Harlequin Quail, *Coturnix delegorguei*, are compared.

CONCLUSION

The WPA Captive Breeding Strategy lays out the basic requirements for the species under its care, and gives guidance in its Codes of Practice. Other information is provided regarding genetics, transportation, close-ringing and legislation where applicable. Without doubt, the aviculturist can make a major contribution to captive breeding by monitoring and recording results and behaviour for the future. Such observations will be vital when re-introductions are being considered. Hopefully, science will also wish to tap in to this major source of information and will build on it for our greater understanding.

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QUAIL known to have been bred in captivity.

Bearded Tree Quail	<i>Dendrocygna barbata</i>	Baardboomkwartel
Mountain Quail	<i>Oreortyx picta</i>	Bergkuifkwartel
Scaled Quail	<i>Callipepla squamata</i>	Blauwschubbenkwartel
California Quail	<i>Callipepla californica</i>	Californische kuifkwartel
Gambel's Quail	<i>Callipepla gambelii</i>	Gambel kwartel
Elegant Quail	<i>Callipepla douglasii</i>	Douglas kwartel
Barred Quail	<i>Philortyx fasciatus</i>	Bandkwartel
Bobwhite Quail	<i>Colinus virginianus</i>	Virginische boomkwartel
Blackthroated Bobwhite Quail	<i>Colinus nigrogularis</i>	Zwartkeelkwartel
Crested Bobwhite Quail	<i>Colinus cristatus</i>	Gekuifde boomkwartel
Spotwinged Bobwhite Q.	<i>Odontophorus capueira</i>	Capueira kwartel
Mearns Quail	<i>Cytonyx montezumae</i>	Montezuma kwartel
Eurasian Quail	<i>Coturnix coturnix</i>	Europese kwartel
Japanese Quail	<i>Coturnix japonica</i>	Japanse kwartel
Rain Quail	<i>Coturnix coromandelica</i>	Coromandelkwartel
Harlequin Quail	<i>Coturnix delgoruei</i>	Harlekijnkwartel
Chinese Painted Quail	<i>Excalfactoria chinensis</i>	Chinese dwergkwartel
Stubble Quail	<i>Coturnix pectoralis</i>	Zwartborstkwartel
Brown Quail	<i>Coturnix ypsilophorus</i>	Moeraskwartel
Jungle Bush Quail	<i>Perdicula asiatica</i>	Frankolijnkwartel
Painted Bush Quail	<i>Perdicula erythrorhyncha</i>	Ind.roodsnavelkwartel

PARTRIDGE known to have been bred in captivity.

Rock Partridge	<i>Alectoris graeca</i>	Eur. steenpatrijs
Chukar Partridge	<i>Alectoris chukar</i>	Chukarpatrijs
Przewalski Rock Partridge	<i>Alectoris magna</i>	Przewalski steenpatrijs
Philby's Rock Partridge	<i>Alectoris philby</i>	Philby steenpatrijs
Barbary Partridge	<i>Alectoris barbara</i>	Barbarijse patrijs
Red-legged Partridge	<i>Alectoris rufa</i>	Rode patrijs
See See Partridge	<i>Ammoperdix griseogularis</i>	Perzische zandpatrijs
Common Hill Partridge	<i>Arborophila torqueola</i>	Heuvelbospatrijs
Rufous-throated Hill P.	<i>Arborophila rufogularis</i>	Roodkeel bospatrijs
White-trotted Hill P.	<i>Arborophila crudigularis</i>	Witkeel bospatrijs
Brown-breasted Hill P.	<i>Arborophila brunneopectus</i>	Bruinborst heuvelpatrijs
Chestnut-headed Hill P.	<i>Arborophila cambodiana</i>	Cambodja bospatrijs
Sumatran Hill Partridge	<i>Arborophila orientalis</i>	Sumatraanse bospatrijs
Javan Hill Partridge	<i>Arborophila javanica</i>	Javaanse bospatrijs
Scaly-breasted Hill P.	<i>Arborophila charltonii</i>	Kastanjeborst bospatrijs
Bamboo Partridge	<i>Bambusicola fytchii</i>	Indische bamboepatrijs
Chinese Bamboo P.	<i>Bambusicola thoracica</i>	Chinese bamboepatrijs
Ferruginous Wood P.	<i>Caloperdix oculea</i>	Roestgele bospatrijs
Crimson-headed Wood P.	<i>Haematoptyx sanguiniceps</i>	Roodkopbosspatrijs
Madagascar Partridge	<i>Margaroperdix madagascariensis</i>	Madagascar patrijs
Black Wood Partridge	<i>Melanoperdix nigra</i>	Zwarte bospatrijs
Grey Partridge	<i>Perdix perdix</i>	Grijze patrijs
Long-billed Wood P.	<i>Rhizothera longirostris</i>	Langsnavel patrijs
Crested Wood Partridge	<i>Rollulus roulroul</i>	Roulroul
Caucasian Snowcock	<i>Tetraogallus caucasicus</i>	Kaukasisch sneeuwhoen
Himalayan Snowcock	<i>Tetraogallus himalayensis</i>	Himalaya sneeuwhoen

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BREEDING CRACIDS IN THE U.S.A

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ABSTRACT

For almost 25 years the Houston Zoo has been involved in Cracid breeding. At one time we kept chachalacas, guans and curassows. Over time however, the collection began to specialize only in curassows and then only the rarer species such as *Pauxi pauxi*, *Crax globulosa* and *Crax alberti*.

In March of 1991 a special Cracid workshop was held in conjunction with the American Association of Zoological Parks and Aquariums. Conclusions and recommendations were based on the workshop presentations and Stuart Strahl's Action Plan for Cracids.

In the next two years a Cracid Taxon Advisory Group (TAG) was established, a Curassow Husbandry Manual written, five curassow studbooks approved and a Third International Cracid Symposium planned for September, 1994 in Houston, Texas.

The TAG has been able to revive an interest in Curassows. Where there was once only 3 U.S. Zoos keeping *Pauxi pauxi*, there are now eight. *Crax globulosa* is now in seven collections, not two.

According to surveys, in private U.S. collections, the Great curassow, the Bare faced curassow, the Black curassow, Common piping guan and Crested guan are the best represented. But not every collection was a survey participant. The Cracid TAG has targeted the Northern Helmeted Curassow for breeding programs and therefore, we will be encouraging U.S. Zoological participation in those programs.

Size, hunting pressure, low reproduction rate, and habitat destruction have been the major factors in the decline of curassow populations.

Four forms are considered in critical danger: *Mitu mitu*, *Pauxi pauxi*, *Crax alberti* and *C. blumenbachii*. Six additional species or subspecies are considered threatened (Strahl 1989). The captive numbers of *Mitu mitu*, *Pauxi pauxi* and *C. blumenbachii* may exceed those of the small wild populations remaining in Eastern Brazil. Curassows are amenable to captive breeding, and it may be inferred that they are suitable subjects for re-introduction programs where forest habitat can be maintained and hunting controlled. Though they are held in a number of zoological collection throughout the world, there have thus far been few coordinated exchanges between those institutions to maintain genetic diversity. It is hoped that with future improvements in captive husbandry procedures and further co-operation between zoological collections, field workers, and government agencies will insure the conservation of these unique birds.

Het Fokken van Cracids in de Verenigde Staten

SAMENVATTING

Bijna 15 jaar is de dierentuin van Houston nu betrokken bij het fokken van hokko's en aanverwante soorten. Op een gegeven ogenblik hielden we chachalaca's, sjakoehoenders en hokko's. Na enige tijd echter specialiseerden we ons tot de hokko's en wel speciaal tot de zeldzamere soorten zoals de Noordelijke helmhokko, de Knobbelhokko en de Blauwsnavel hokko.

In maart 1991 werd een speciaal Hokko werkkamp gehouden tezamen met de Amerikaanse vereniging van dierentuinen en aquaria. Conclusies en aanbevelingen werden gebaseerd op de gehouden voordrachten en Stuart Strahl's Actie Plan voor Hokko's en aanverwante soorten.

In de volgende twee jaar werd de Taxon Advies Groep (TAG) opgericht, werd een werkschema beschreven en werden vijf Hokko stamboeken erkend. Bovendien werd het derde Hokko symposium vastgelegd dat zal plaatsvinden in september 1994 in Houston, Texas.

De TAG is er in geslaagd de interesse in hokko's te doen herleven. Waar er enkele jaren geleden nog slechts 3 dierentuinen in de V.S. die hokko's hielden, nu zijn dat er acht. De Knobbelhokko bijvoorbeeld is thans aanwezig in zeven collecties, waar dat er voorheen slechts twee waren.

In privé collecties in de Verenigde Staten worden vooral grote hokko's gehouden, verder de Bruine hokko, de Sclaters hokko, de Zwarte hokko, de Witkopgoean en het Bruinrug-sjakoeoen. De Hokko Taxon Advies Groep heeft voor de Noordelijke helmhokko fokprogramma' voorgesteld en daarom zullen we proberen de Amerikaanse dierentuinen vooral te interesseren in deze soort.

De voornaamste factoren van de achteruitgang van de hokko populaties zijn: het formaat van deze vogels, de jachtdruk, hun langzame reproductie en habitat vernietiging.

Vier soorten worden beschouwd als zijnde in onmiddellijk gevaar: dit zijn de *Mitu mitu*, *Pauxi pauxi*, *Crax alberti* en *C. blumenbachii* (resp. de Mesbekhokko, de Noordelijke helmhokko, de Blauwsnavelhokko en de Roodsnavelhokko). Bovendien zijn er nog zes soorten of ondersoorten meer bedreigd (Strahl 1989). De aantallen in gevangenschap van de *Mitu mitu*, de *Pauxi pauxi* en de *Crax blumenbachii* zullen de kleine populaties in het oostelijk deel van Brazilië waarschijnlijk overtreffen. Hokko's zullen in gevangenschap gemakkelijk tot broeden overgaan. En het kan gezegd worden dat zij geschikte dieren zijn voor herintroductie programma's daar waar bos habitat bewaard is gebleven en de jacht onder controle wordt gehouden.

Ofschoon ze gehouden worden in een vrij groot aantal zoölogische collecties over de gehele wereld heeft er tot nu toe weinig uitwisseling plaatsgevonden tussen deze instituten om de genetische diversiteit in stand te houden. Hopelijk zullen in de toekomst verbeteringen bij het houden van deze vogels en een verdere samenwerking tussen zoölogische collecties de instandhouding, samen met veldwerkers en de betreffende regeringen, van deze unieke vogels kunnen waarborgen.

INTRODUCTION

Cracid breeding programs in the United States have had their ups and downs. In the late 1960s several private individuals and a few zoos began collecting cracids. This family of large, forest dwelling frugivorous birds, endemic to the Neotropics was relatively new to United States aviculture. And as with new or rare species tended to be valued, with few exceptions, for their uniqueness rather than their ideal candidacy for long term breeding programs.

Noted aviculturists such as Mickey Ollson achieved many first breedings but, over time interest in the group cracid waned. The reasons for the decline are varied; retirement of some of the principle breeders, pursuit of different interests, and a reluctance of Northern facilities to house the cold sensitive family. In addition, in 1972 an import embargo was imposed on the United States due to an outbreak of Newcastle's Disease. Subsequently our present quarantine regulations were enacted and importation was not as easy as it once was.

Many aviculturists shifted their priorities to psittacines and parrots became the flagship group for Neotropical conservation. The publication of Delacour and Amadon's book Curassows and Related Birds in 1973 sparked some interest but, in those facilities still raising cracids, it became increasingly difficult to surplus young amongst only a handful of experienced zoos and private breeders.

With few breeders and curtailed importation of new blood-lines, it became evident that the United States stock of cracids was dangerously inbred. Species such as the Blue-billed curassow *Crax alberti*, the Nocturnal curassow *Nothocraz urumutum* and the Crestless curassow *Mitu tomentosa* were showing signs of infertility, poor hatchability and embryo deformities. The common piping guan had already been hybridized between subspecies of *cumanensis* and *grayi*.

Inbreeding was not the only problem, space limitations also became critical. Without accurate and reliable field data, zoos found it difficult to justify valuable conservation space to cracids. The situation was about to change.

In February-March of 1988, a Second International Cracid Symposium was held in Caracas, Venezuela (the first took place in Mexico in 1981). This Symposium was the largest avian conservation conference ever held in Latin America, attracting over 200 participants from the United States, Europe and more importantly nearly every Central and South American country in which the Cracidae are found. Over 80 papers and posters were presented, and regional plans for the conservation of the Cracidae were explored. Several of my American colleagues were overwhelmed by the field research which had been accomplished since 1981 and we were elated by the enthusiasm of a new group of Latin American biologists concerned about cracid conservation. We returned home with a purpose and a clear list of priorities and recommendations for our breeding programs.

In 1991, Andrea Ouse (General Curator at Mickey Ollson's Wildlife World Zoo) Wendy Turner (then Curator at New York's Wildlife Survival Center in Georgia) myself and others organized a special Cracid Workshop. The workshop was held in conjunction with the American Association of Zoological Parks and Aquariums regional conference in Atlanta, Georgia. Conclusions and recommendations were based on the workshop presentations regarding captive husbandry and Stuart Strahl's (ICBP/SSC) Action Plan for Cracids.

The purpose of the Workshop was two-fold. We wanted to emphasize that Cracid husbandry was not difficult and that conservation of the family was now essential for their survival. More importantly, we needed to identify individuals and zoos who might be even marginally interested in cracid breeding programs and get them involved. We proceeded to recruit and sometimes coerce commitments for keeping a certain number of birds should they become available. We published these commitments along with the proceedings of the workshop and held those individuals to their promises. In all fairness and kidding aside, all participants willingly became a part of the program as their time and facilities allowed.

In the next two years a Cracid Taxon Advisory Group (TAG) was established (with myself as Chair), a Curassow Husbandry Manual written, five curassow studbooks approved and a Third International Cracid Symposium planned for September, 1994 in Houston, Texas. The TAG, I believe, has been instrumental in helping revive an interest in cracid breeding in the United States. It will now be our responsibility to maintain and foster that interest into long term, self sustaining management programs for the Cracidae.

My involvement with cracids began in 1978 when I started working at the Houston Zoological Gardens. For almost 25 years the Houston Zoo has had an active breeding program for cracids, including guans and chachalacas. Species such as Wattled Guan *Aburria aburri*, Spix's Guan *Penelope jacquacu* and Piping Guan *Pipile pipile* as well as at least 6 species of chachalaca including the Plain Chachalaca *Ortalis vetula* the only cracid found in the United States restricted to Texas naturally.

Over time, however, due to space limitations and a diminishing interest elsewhere, the collection became specialized with only curassows. At one time we held 10 of the 15 species and had raised young from 9 species.

At present we keep only the more threatened species such as Blue-billed *Crax alberti*, Northern Helmeted *Pauxi pauxi*, Bare-faced *Crax fasciolata*, Wattled *Crax globulosa* and Yellow-knobbed *Crax daubentoni*. We do, of course, have several more common species on loan to other facilities. Other zoo facilities such as, San Diego, Rio Grande (in New Mexico) New York, Busch Gardens (Florida) and Wildlife World Zoo have notable cooperative programs with Houston. The private sector too are close partners with Houston and other zoos aforementioned. There are many other United States facilities holding cracids which are not active participants in known breeding programs and they tend also to not participate in surveys. Andrea Ouse attempted to summarize recent cracid surveys in the United States in 1991. She found that only about 4 species out of the whole family are well represented in the United States. These are the Common Piping Guan, Great Curassow, Razor-billed Curassow *Mitu tuberosa* and the Crested Guan *Penelope purpurascens*. Certainly there are more holders of cracids than the surveys indicate, but major represented species would seem to be accurate using the unscientific method of "word of mouth contacts". How many birds are held in any one place is only part of the picture. How inter-related are the specimens being held is the more important question, which general surveys do not answer. Another problem worth keeping in mind when reading survey results, is that a survey, whether it is ISIS which is updated frequently, or a listing of private collections updated annually or so, is a static process. By the time it is compiled, sorted, and published it may be old news. Therefore, I will attempt to relate a brief captive history and current captive and wild status of some of the species of cracids kept currently in the United States.

Great Curassow *Crax rubra*: It is of intermediate conservation priority in Mesoamerica, Columbia and possibly Ecuador, and is a heavily persecuted game species through much of its range. A revision of taxonomy may comprise several undescribed subspecies or races especially between Central America and the Columbia/Panama/Ecuador populations. As stated before it is well represented in United States collections. Birds from Panama (redder females) are kept in Mickey Ollson's collection although there is only one founder pair. Other races or subspecies are kept by Dr. Estudillo in Mexico.

Razor-billed Curassow *Mitu tomentosa* (found only in two collections, all related to a few original birds from Mickey Ollson) has a low conservation priority rating. *Mitu mitu* on the other hand is probably extinct in the wild and *Mitu salvini* has an intermediate priority for Columbia, Ecuador and Peru. *Mitu mitu* can be found in one collection in Brazil and *Mitu salvini* in several Latin American collections.

Common Piping Guan *Pipile pipile*: The only subspecies of Piping Guan which has a high conservation priority is the Trinidad Piping Guan *Pipile pipile pipile*. All sub-species in the United States, and there are many according to surveys, are either Blue Throated (wattled) *Pipile pipile cumanensis* or White throated *Pipile pipile grayi* or unfortunately a mixture of the two. In a preliminary studbook produced by Alan Rost of the Jacksonville Zoo in Florida, Alan states that only half of the Blue throated Piping Guans hatched at Ollson's Rare Bird Farm between 1969 and 1973 may have been pure, and these are indistinguishable from other Blue throated appearing chicks which were known to be sired by White throated birds.

Crested Guan *Penelope purpurascens*: This is another well represented United States cracid which does not have a conservation priority. It is a Mesoamerican species larger than some curassows. In the last few years some new birds have appeared in the general United States population and preliminary surveys reveal a healthy gene pool.

There is perhaps only one other guan species in the United States now. This would be a few remaining Spix's Guan *Penelope jacquacu* from a relatively small gene pool. Only a few chachalaca species are represented, mostly of the Plain chachalaca *Ortalis vetula* and the Grey-headed Chachalaca *Ortalis cinereiceps* from Panama.

Black curassow *Crax alector*: Their status in the wild is not a conservation priority. Twenty years ago they were a commonly kept species in the United States but in the 1980s their numbers dwindled. Both forms, the yellow cered and red cered (*erythrogaster*) were seen, and often interbred; many offspring had intermediate coloration and today it is rare to see any birds with red coloration. Recent confiscations of *alectors* in the United States have provided a more diverse gene pool with which to work. Most birds are kept in the private sector.

Nocturnal curassow *Nothocrax urumutum*: The Nocturnal has a widespread range in South America and although not particularly threatened it is certainly a unique taxa worthy of captive breeding efforts. There are 9 specimens in the United States, all belonging to the Houston Zoo. Thirteen years ago the zoo built up a population of approximately 40 birds which were dispersed to various collections. Unfortunately, breeding success from these birds was minimal and several were lost due to cold related injuries. The 9 remaining birds are inbred (original stock consisted of 3 founder birds) and the Cracid TAG has recommended sending all specimens to Belgium to be paired with birds in Geer Schere's collection. It is hoped that in the future we can again exhibit Nocturnals in the United States and they will be of a more diverse genetic stock. Removal of these 9 birds will allow us more space to concentrate further on those species which the TAG has been granted approval for studbooks.

Bare-faced Curassows *Crax fasciolata*: The nominate Bare-faced curassow from Brazil, Paraguay and Argentina is not well represented in the United States and many birds are closely related to one another. *Crax fasciolata fasciolata* is not of conservation priority, although it may be vulnerable throughout its range. The subspecies *grayi* is of intermediate priority and *pinima* is on the verge of extinction in its former range in northeastern Brazil. Neither subspecies can be found in the United States. However, another group of Bare-faced, which Houston acquired in 1984 exhibits different female coloration than the others. It is probably a geographic race or color morph from Eastern Bolivia but we have kept them separate from any nominate forms. There are other specimens of this "race" in Europe as well, and the Cracid TAG is investigating their taxonomic status through study skins. This work is taking place with the help of Dr. John O'Neil at Louisiana State University. If the Houston birds (probably numbering 15 now) can be bred with the nominate form the potential for damaging inbreeding can be stopped in the United States.

Yellow-knobbed Curassow *Crax daubentoni*: This species is of intermediate conservation priority in its native Venezuela and Columbia. Populations in the US derive from two pair of founder birds sent to New York and Houston in 1986 from Dr. Estudillo-Lopez's collection. They were very successfully bred by both institutions. Recently a few more unrelated birds in the private sector have been located. The TAG has restricted breeding until a studbook is completed and priorities for breeding and distribution can be determined.

Wattled Curassow *Crax globulosa*: Once the most numerous curassow in US collections, inventory of surplus birds at the Houston Zoo in 1970 included 24 Wattled Curassows! In 1990, twenty years later, there were fewer than 24 known birds in the US and all were closely related to one another. However, this year the TAG has reorganized birds in various collections and has established 7 new pairs including an aged male which was determined to be an unrepresented wild caught bird. Determination of relatedness is very difficult with this species. Many records were lost or never recorded. Hopefully the studbook will shed more light on the inbreeding problem. We have additionally started a DNA fingerprinting project for this species. The Wattled curassow receives a high conservation priority rating. Endemic to riverine, gallery forest this species has been severely reduced throughout its range in Brazil, Columbia and Peru, and appears to be highly threatened in Ecuador and Bolivia.

Blue-billed Curassow *Crax alberti*: The Blue-billed is perhaps the least known and one of the most endangered species in the immediate conservation priority category. Its status in Northern Columbia is unknown, but reports indicate that apart from a few forest patches bordering National Parks, the species is virtually extirpated. There are 10 birds in the US. Most of these originate from a mother/son pair established in Houston in the 1970s. Through the generosity of private aviculturist Tom Carter, we were able to obtain an aged wild caught male which had been alone in another collection for many years. So far we have only produced one female offspring from this bird. This male has a few medical problems and may be incapable of further reproduction. In 1992 the San Diego Zoo was able to obtain a male Blue-bill from the Cali Zoo in Columbia. We immediately sent a female to California and this August have been rewarded with one healthy chick and 2 more fertile eggs. These new chicks may finally be the turning point in establishing a healthy population of Blue bills in the US. Patience and cooperation can be rewarded, as is further evidenced by Houston's *pauxi* breeding program.

Northern Helmeted Curassow *Pauxi pauxi*: This species receives a very high conservation priority . It has a fragmented distribution in the Andes and coastal ranges, extending from NE Columbia through N Central Venezuela. It is heavily hunted throughout its range (even in national parks) and is critically endangered on a local scale due to habitat fragmentation.

For almost 20 years there were only 2 pauxi pauxi in the US, both were females living at the Houston Zoo. It was not until 1986, with the cooperation of the Bronx Zoo and Dr. Estudillo-Lopez that we received 2 male *Pauxi pauxi* and the Bronx received one pair. Only one of our females bred but she continued to breed until her death in 1991 at the approximate age of 26 years. Concurrently, the Rio Grande Zoo had received a pair of birds from another private collection in Mexico and they began breeding as well. A relatively good population of N. Helmeted Curassows has been established from these original birds (including the rare red phase) and 10 facilities are now participating in the program.

The future for cracid breeding programs in the United States is on an upswing now. The United States Cracid TAG has been able to revive an interest in cracids and hopefully our published protocols will help new aviculturists become more experienced with husbandry for the entire family. Many of the newly established threatened pairs of curassow are young and breeding success may not be realized immediately. However, when we hopefully, face the problem of surplus young we will be better prepared and organized to manage these breeding programs than we were in the past.

To assist in their management the TAG has established six primary goals:

1. Target Northern Helmeted Curassow and Wattled Curassow for intense breeding programs and encourage wider avicultural participation in those programs.
2. Establish studbooks for the two targeted species as well as Blue-billed, Bare-faced and Yellow-knobbed curassows.
3. Continue efforts to stress permanent identification of all cracids in captivity using bands and transponders.
4. Establish close working relationships with private sector and assist in any way possible their continuance in cooperative breeding programs.
5. Establish firm cooperative links with Latin American and European colleagues.
6. Identify and initiate additional cracid research projects. New goals will be developed after the Cracid CAMP, to take place in September, 1994.

Although they are all extremely important, I have underlined those goals which I feel will have a greater impact in the years to come. Assuredly, they will be the most difficult goals to accomplish as they involve people not birds. These goals call for a monumental degree of cooperation and working relationships that must supercede political borders and other divisions.

The 25 members of our TAG hail from the zoo community, the private sector, field researchers, veterinarians, academia and advisors from the species countries of origin. A diverse group, but a group nonetheless, held together by a common goal, cracid conservation.

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WPA INTERNATIONAL PROJECTS, the future

Dr.T.W.I.Lovel
Foundermember of the World Pheasant Association

ABSTRACT

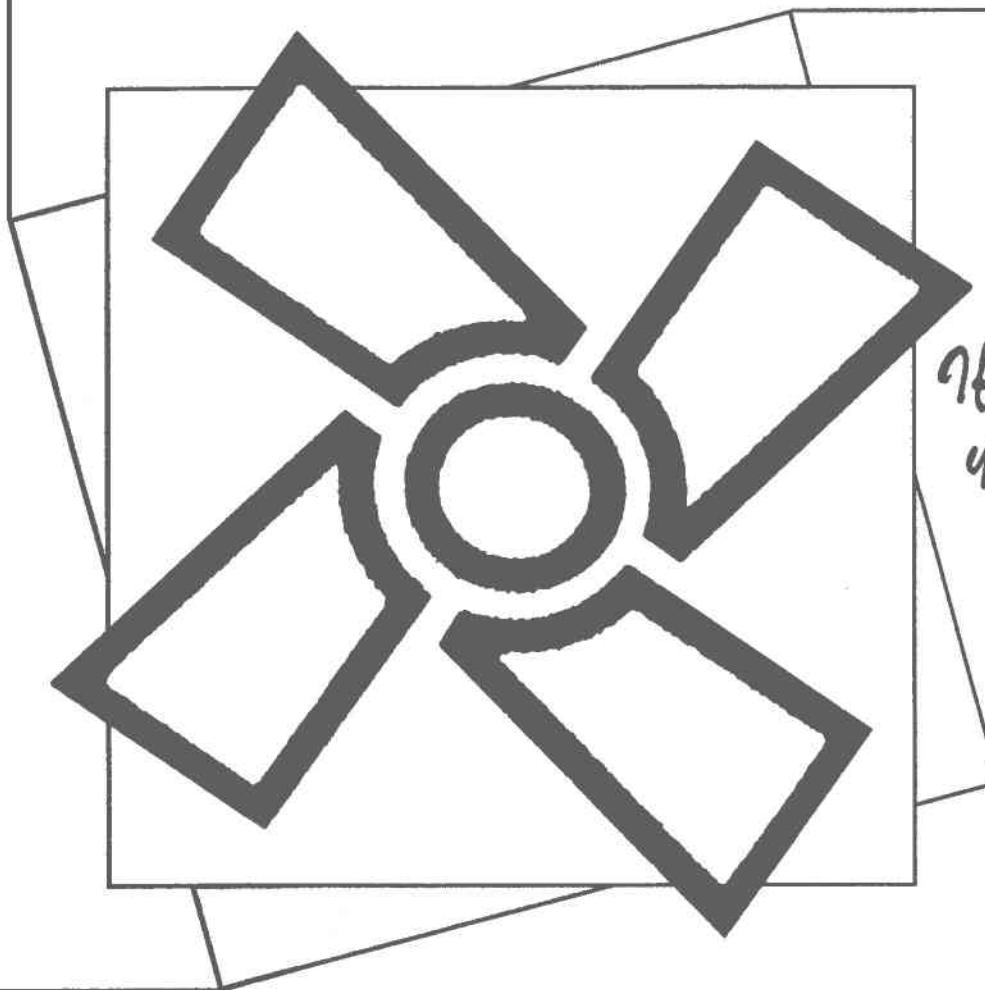
In its 18 years existence, WPA has undertaken many projects, most of which have been concerned with the conservation of populations, and their habitats in the wild. Some projects, have been subjected to serious review by professional scientists, before during and after the fieldwork, so that scarcer resources might be utilised to best advantage, and so that information acquired might be widely disseminated.

Now we are developing a Captive Breeding Strategy, it will be essential that every project be subjected to the same constructive criticism, so that money, time and invaluable birds are not wasted. Furthermore, just as in the wild we must study the habitat and the local people as well as the bird, so in captivity we must consider the motivation, the needs, the hazards and the optimum conditions required by the owners of these artificial habitats, the breeders themselves.

SAMENVATTING

In de 18 jaar van haar bestaan, heeft de WPA vele projecten ondernomen, waarvan de meeste betrekking hadden op het behoud van populaties en hun habitat in de oorspronkelijke verspreidingsgebieden. Enkele van deze projecten zijn grondig geanalyseerd door wetenschappers, zowel voor, gedurende als na het eigenlijke veldwerk. Zo dat ook de kleinste populaties op de beste manier geholpen kunnen worden en de verkregen informatie wijd verspreid kan worden.

Nu zijn we de 'Captive Breeding Strategy' aan het ontwikkelen en het zal essentieel zijn dat elk project aan dezelfde vorm van constructieve kritiek onderworpen zal worden, zodat geld, tijd en de onvervangbare vogels niet verspild worden. Verder moeten we, net zoals we in het wild het habitat en de lokale bevolking bestuderen naast de vogelsoort, in gevangenschap de motivatie moeten beschouwen, de noden, de risico's en de optimale condities die de eigenaars moeten hebben van deze kunstmatige habitats, de kwekers zelf.



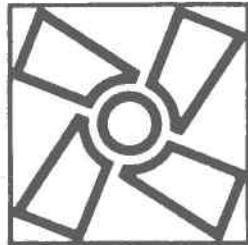
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