

A review of captive Galliformes in European zoos

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Abstract Since the 19th Century, all European menageries and zoos have become living museums and environmental resource centres, moving away from lots of small cages with a single species to a fewer number of large enclosures showing several species in a semi-natural environment. This has resulted in a decrease in the number of captive Galliformes in European zoos. The European Association of Zoos and Aquaria (EAZA) Galliformes Taxon Advisory Group's Regional Collection Plan of 2007, which gives the status of captive Galliformes in EAZA institutions, was analysed for this study. Between 1996 and 2006 the captive populations of various Galliformes in European zoos, decreased by 20%, resulting in only 7183 galliform individuals belonging to 125 taxa. Of these, only 46 species had captive populations of more than 20 birds. There was a decrease in the size of captive populations for almost all species over the last ten years, in some cases dramatically so (70% to 100%). It is likely that this downward trend will continue in the future, resulting in a drastic reduction in the number of taxa and individuals. The main cause is reduced space now available in many zoos. The only taxa that have maintained or even increased their captive population size are those included in cooperative conservation breeding programmes, those with an educational value, those able to be held in large mixed (enclosures) exhibits or species newly kept. In the future, European zoos will probably hold only endangered galliform species registered in conservation programmes. Biotechnologies, such as DNA analyses, artificial insemination with frozen semen and sophisticated management software will be major tools in maintaining genetic diversity of *ex situ* stocks. The zoos within the native range countries of Galliformes are urged to enhance their breeding capacity and complement the work of *in situ* research teams.

Keywords EAZA, *ex situ* conservation, Regional Collection Plan, Taxon Advisory Group, zoos

Introduction

Historically, European zoos were often flagships for the captive breeding of galliform species. Some of them are well known for the first importations of pheasant species, for example London Zoo (*Lophophorus impejanus* 1854, *Lophura leucomelanos hamiltoni* 1857, *Catreus wallichi* 1858, *Tragopan satyra* 1863, *T. temminckii* 1864, *T. blythii* 1870, *Argusianus argus* 1878); Antwerp Zoo (*Chrysolophus amherstiae* 1870, *Lophura ignita rufa* 1871); Clères Zoo (*Lophura edwardsi* 1924, *Lophura imperialis* 1924, *Rheinardia ocellata* 1926); Jardin d'Acclimation of Paris (*Lophura diardi* 1862, *Lophura swinhoei* 1866, *Lophura e. erythrophthalma* 1872,). Often they were also the place of first captive breeding (Delacour, 1925; Delacour, 1977; Mallet, 1964; Roles, 1973), for example Clères (*Lophura edwardsi* 1925, *L. imperialis* 1925), Antwerp Zoo (*Afropavo congensis* 1960) and Jersey Wildlife Preservation Trust (*Francolinus adspersus* 1963, *Francolinus afer* 1973).

Until the end of the 1960s, most European zoos kept many Galliformes and developed good collections, despite the absence of coordinated breeding programmes. The presentation and selling of birds was more important than conservation, although these collections were used for taxonomic, biological or behavioural studies. Things began to change at the beginning of the 1970s, when an interest in conservation grew rapidly and some zoos started to play an important role in the *ex situ* conservation of Galliformes. The first international studbook for pheasants was initiated at the end of the 1960s for the Congo peafowl *Afropavo congensis*, which created a network of participants and stimulated the management of threatened species under captive conditions. In 1975, WPA initiated a studbook for the Edwards's Pheasant *Lophura edwardsi* as part of a global conservation breeding programme (Lovel, 1979), and later, when a number of galliform species was collectively managed, the basis of a monitoring system was initiated.

Important research programmes were also conducted by zoos in order to save captive stocks of Galliformes, often in collaboration with private breeders. For example, Antwerp Zoo tried to obtain phenotypes of imperial pheasants by hybridizing the last living specimen of this taxon with Edwards's or silver pheasants and then back crossed the first or second generation with the remaining pure specimen (Carpentier et al., 1975). At the beginning of the 1970s, Jersey Wildlife Preservation Trust bred in captivity Edwards's pheasant females from America with males from England in an attempt to increase genetic diversity. At the same time, many techniques (artificial incubation, veterinary assistance, DNA testing, hygiene, designated foods and artificial insemination) were developed by zoos in their efforts to breed valuable galliform species. These technical advances also became very useful for the private sector.

The interest in captive breeding for conservation was strengthened by the development of a world zoo database, the International Species Information System (ISIS, 1973) and the establishment of the European Zoos Association, ECAZA (1988), then EAZA (1992), and of *ex situ* European conservation programmes such as EEPs (European Endangered Species Programmes) or ESBs (European Studbooks). In 1994, there were three EEPs for pheasants (*Afropavo congensis*, *Polyplectron emphanum* and *Lophura edwardsi*). In 1989 the first European Taxon Advisory Groups (TAG) were initiated; the EAZA Galliformes TAG was created in 1997. At the same time the publication of the World Zoo Conservation Strategy (1993) defined clearly the roles of zoos, not only in *ex situ* conservation, but also in education of the public to conservation more generally. In addition, this document underlined the close interdependence of *ex situ* and *in situ* conservation and called for all parties to cooperate. The EAZA Galliformes TAG published its first Regional Collection Plan (RCP) in 2000 (Hennache 2000) with recommendations for three EEPs, six ESBs and 29 species for monitoring. An updated RCP has recently been published (Hennache et al., 2007). Information from these publications has been analysed here to provide a review of the status of captive Galliformes in EAZA institutions over past years.

Results

In December 2006, 146 EAZA institutions (out of 305) kept Galliformes, 55% of which held

one to five galliform species and only 14% held more than 15 species. Between 1996 and 2006 the EAZA population of Galliformes decreased by 20%. There are currently 7,183 individuals covering 125 of 761 subspecies. Only 46 of these 125 taxa have populations of more than 20 birds. In fact 44% (3190 birds) belong to only eight taxa (TABLE 1), none of which are included in the first RCP (2000) or are threatened in the wild. 43% of EAZA institutions keeping Galliformes have less than 50% of these species listed in the RCP.

TABLE 1 The eight principal taxa of galliform species held by EAZA institutions.

Species	Number
Lady Amherst pheasant <i>Chrysolophus amherstiae</i>	180
Golden pheasant <i>Chrysolophus pictus</i>	302
Silver pheasant <i>Lophura nycthemera ssp</i>	153
Blue peafowl <i>Pavo cristatus</i>	1500
Temminck's tragopan <i>Tragopan temminckii</i>	134
Chinese painted quail <i>Coturnix chinensis</i>	196
Japanese quail <i>Coturnix japonica</i>	126
Helmeted guineafowl <i>Numida meleagris</i>	599
Total	3190

The captive population of almost all galliform species held in zoos has decreased over the last ten years (TABLE 2), in many cases by between 70 and 100%. Examples include ocellated turkey *Agriocharis ocellata*, cheer pheasant *Catreus wallichii*, bronze-tailed peacock pheasant *Polyplectron chalcurum*, Mikado's and Hume's pheasants *Syrmaticus mikado* and *S. humiae*.

It is likely that in a few years species like Blyth's tragopan *Tragopan blythii*, koklass pheasant *Pucrasia macrolopha*, Lafayette and green junglefowl *Gallus lafayettei* and *G. varius*, Bornean crested fireback pheasant *Lophura ignita nobilis*, brown eared-pheasant *Crossoptilon mantchuricum* and copper pheasants *Syrmaticus soemmerringi* will no longer feature in captive collections.

In contrast, the captive population of some species has increased, e.g. Vietnamese pheasant *Lophura hatinhensis*, Cabot's tragopan *Tragopan caboti* and crested woodpartridge *Rollulus roulroul*. These are either taxa new in zoos or popular species. For some species the number of birds held in

captivity remained stable, e.g. Edwards's pheasant *Lophura edwardsi*, mountain peacock-pheasant *Polyplectron inopinatum*, Himalayan monal *Lophophorus impeyanus* and Congo peafowl *Afropavo congensis*. These are often managed by an EEP or an ESB or are colourful birds that are easy to obtain.

Discussion

The main cause for a decreasing captive galliform population in zoos may be the availability of suitable space, particularly as there is now a trend to build large exhibits for a number of mixed species, such as tropical aviaries or African and Asian exhibits, at the expense of a larger number of small aviaries. Often, large mixed exhibits cannot house numerous galliform species. The only taxa able to maintain or even to increase their captive populations are those included in cooperative conservation breeding programmes, with educational value, those are able to be held in mixed exhibits or those that are new captive species (e.g. Vietnamese pheasant).

With the exception of the managed taxa (EEP and ESB), zoos obtain many birds from the private sector and frequently there are few or no checks to investigate the relatedness of purchased birds. In these cases breeding and conservation are not priorities and the individuals are obtained just to form part of an exhibit, where they are part of the scenery. For example, the number of helmeted guineafowl *Numida meleagris* kept by EAZA participants (600) is directly linked to an increasing number of African exhibits in zoos, and the increased captive population size of crested wood-partridge (36 to 69 participants and 168 to 425 individuals over the past ten years) results from the possibility of keeping this species at liberty in large tropical houses with other species.

Many EAZA institutions that have reduced the number of their aviaries choose to keep species without any conservation or educational value and even hold hybrids such as red junglefowl *Gallus gallus* ssp, ruffed pheasants *Chrysolophus* sp, silver pheasant *Lophura nycthemera* ssp. instead of dedicating their remaining aviaries to the conservation of threatened species.

Therefore one wonders what about the future for captive Galliformes in European Zoos.

TABLE 2 Number of captive individuals in 1996 and 2006 and number of EAZA institutions keeping the species (in brackets).

	1996 (EAZA survey and ISIS data)	2006 (ISIS data)
<i>Aepyodius arfakianus</i>	6,5,0 (5)	2,3,0 (3)
<i>Alectura lathamii</i>	4,3,0 (3)	5,2,0 (4)
<i>Agriocharis ocellata</i>	16,24,0 (11)	3,3,1 (4)
<i>Meleagris gallopavo</i>	29,44,17 (17)	8,25,23 (12)
<i>Dendragapus falcipennis</i>	0,2 (1)	3,3,0 (1)
<i>Tetrao tetrix</i>	9,13,4 (6)	15,11,1 (8)
<i>Tetrao urogallus</i>	42,43,1 (17)	22,37,9 (14)
<i>Afropavo congensis</i>	44,33,5 (10)	38,39,4 (18)
<i>Argusianus argus</i>	25,30,6 (18)	21,27,3 (23)
<i>Catreus wallichi</i>	51,66,5 (35)	13,11,4 (8)
<i>Crossoptilon crossoptilon</i>	51,52,0 (32)	14,14,3 (14)
<i>Crossoptilon mantchuricum</i>	16,14,1 (16)	5,4,0 (5)
<i>Gallus gallus</i>	83,110,7 (28)	44,59,36 (20)
<i>Gallus lafayettei</i>	18,28,10 (12)	9,12,0 (7)
<i>Gallus sonneratii</i>	15,16,8 (11)	11,16,10 (9)
<i>Gallus varius</i>	12,18,10 (10)	2,1,0 (2)
<i>Lophophorus impeyanus</i>	72,82,18 (48)	72,71,30 (51)
<i>Lophura diardi</i>	20,23,5 (21)	12,15,4 (14)
<i>Lophura edwardsi</i>	78,76,8 (39)	80,54,10 (39)
<i>Lophura e. erythrophthalma</i>	4,4 (3)	7,6,0 (6)
<i>Lophura hatinhensis</i>	11,6,0 (7)	37,25,5 (16)
<i>Lophura ignita ssp</i>	16,20,0 (10)	6,9,1 (9)
<i>Lophura i. rufa</i>	3,3,0 (3)	13,13,0 (10)
<i>Lophura inornata</i>	12,7,0 (5)	2,3,0 (3)
<i>Lophura leucomelanos ssp,</i>	38,29,6 (19)	22,22,26 (18)
<i>Lophura swinhoii</i>	59,76,11 (39)	38,43,22 (29)
<i>Pavo muticus ssp,</i>	15,21,7 (16)	19,21,13 (17)
<i>Polyplectron bicalcaratum</i>	50,42,15 (31)	33,25,9 (27)
<i>Polyplectron chalcurum</i>	2,1,0 (2)	1,0,0 (1)
<i>Polyplectron emphanum</i>	62,55,9 (41)	49,33,10 (36)
<i>Polyplectron germaini</i>	3,2 (4)	12,13,5 (8)
<i>Polyplectron inopinatum</i>	11,12,0 (7)	7,11,5 (9)
<i>Polyplectron malacense</i>	3,6,0 (2)	6,5,0 (5)
<i>Pucrasia macrolopha</i>	15,8,0 (7)	0,1,0 (1)
<i>Syrmaticus ellioti</i>	27,27,0 (19)	23,26,7 (16)
<i>Syrmaticus humiae</i>	16,19,22 (7)	10,7,2 (9)
<i>Syrmaticus mikado</i>	41,37,0 (30)	10,7,0 (7)
<i>Syrmaticus reevesii</i>	52,90,6 (39)	34,50,35 (33)
<i>Tragopan blythii</i>	9,5,0 (6)	3,0,0 (2)
<i>Tragopan caboti</i>	5,5,0 (4)	9,7,0 (4)
<i>Tragopan satyra</i>	60,59,1 (47)	32,31,7 (30)
<i>Margaroperdix madagascarensis</i>	4,1,0 (3)	8,9,12 (6)
<i>Perdix perdix</i>	35,26,29 (17)	11,9,12 (15)
<i>Rollulus rouloul</i>	75,70,23 (36)	179,181,62 (69)
<i>Acryllium vulturinum</i>	58,62,19 (36)	41,37,41 (31)

Galliformes in the wild are of conservation concern as around 27% of species are globally threatened and a variety of *in situ* conservation action activities have been instigated to address this. If undertaken correctly, active *ex situ* management, such as conservation breeding, can also be used to supplement this. Conservation breeding, as part of cooperative programmes, education and research are the main aims of EAZA (EAZA Constitution, article 11 – EAZA Code of Ethics). For this reason, plus the fact that Galliformes are colourful, beautiful birds, with spectacular displays that are very useful for educational purposes and highlighting habitat loss and *ex situ* conservation, they will always be kept in captivity. What will change is the species that are kept. As space at zoos becomes limited, as the size of exhibits increases in an attempt to display whole ecosystems, the number of galliform species will continue to decrease. In the future, European zoos will probably hold only endangered galliform species held as part of conservation programmes. Only the private sector will maintain captive stocks of unthreatened species.

The choice of species for conservation breeding programmes in zoos is important. It is highly dependent upon the TAG that publishes its Regional Collection Plan, using many criteria, for example status in the wild and IUCN status, size of the population in captivity, number of founders, experience with the species, educational value and taxonomic uniqueness. The recommendations of the TAG should play an important role in the choice of the species kept by EAZA institutions, because many of them (65%) define their collection management according to the annual EAZA Yearbook (EAZA 2007). TABLE 3 gives the galliform species recommended by the EAZA TAG that will probably constitute the EAZA galliform captive stock in the future.

The intensive management of captive bird populations, such as an EEP, requires maintenance of 90% of the genetic diversity over a long period, between 90 and 200 years. In large mammal species or in parrot species, when the founder population is large, this is easy to achieve. For galliform species, for which the reproductive life is short and where there are few founders, this will be difficult to attain without the use of biotechnologies. For some years, European zoos have conducted research into developing and using DNA analyses (Hennache, 1999; Hennache et al., 1999), artificial insemination and cryo-preservation of

semen (Saint Jalme et al., 1999a; 1999b), especially for Edwards's pheasant, Blyth's and Cabot's tragopan. In the future, DNA analysis will provide accurate knowledge of the population structure of captive threatened species that are part of conservation breeding programmes. Cryo-preservation of semen and artificial insemination will allow the re-injection of genes into captive populations long after the death of the founders. This technology will also allow semen of genetically important males to be sent out of Europe, without having to transfer living birds.

TABLE 3 Galliform species recommended by the EAZA TAG (2007). EEP = European Endangered Species Programme, ESB = European Studbook, MON-P = monitoring by a person, MON-T = Monitoring by TAG, RES = research needed.

Species	Management category
<i>Alectura lathamii</i>	MON-T
<i>Aepyodius arfakianus</i>	MON-T
<i>Guttera pucherani</i>	MON-T
<i>Acryllium vulturinum</i>	MON-T
<i>Perdix perdix</i>	MON-T
<i>Coturnix coturnix</i>	MON-T
<i>Rollulus rouloul</i>	MON-T
<i>Tragopan satyra</i>	MON-T
<i>Tragopan blythii</i>	ESB
<i>Tragopan caboti</i>	ESB
<i>Lophophorus impejanus</i>	MON-T
<i>Gallus gallus gallus</i>	MON-P
<i>Lophura edwardsi</i>	EEP
<i>Lophura hatinhensis</i>	RES
<i>Lophura inornata</i>	MON-T
<i>Lophura e. erythroptalma</i>	ESB
<i>Lophura ignita macartneyi</i>	RES
<i>Lophura ignita rufa</i>	MON-P
<i>Lophura diardi</i>	MON-P
<i>Crossoptilon c. drouyni</i>	MON-T
<i>Crossoptilon mantchuricum</i>	MON-T
<i>Catreus wallichi</i>	EEP
<i>Syrmaticus ellioti</i>	ESB
<i>Syrmaticus humiae</i>	MON-T
<i>Syrmaticus mikado</i>	MON-T
<i>Syrmaticus reevesii</i>	MON-P
<i>Polyplectron inopinatum</i>	ESB
<i>Polyplectron germaini</i>	MON-T
<i>Polyplectron malacense</i>	ESB
<i>Polyplectron emphanum</i>	EEP
<i>Argusianus argus</i>	ESB
<i>Afropavo congensis</i>	EEP
<i>Pavo muticus muticus</i>	ESB
<i>Tetrao tetrix</i>	MON-T
<i>Tetrao urogallus</i>	MON-T
<i>Meleagris ocellata</i>	MON-T

In the zoo world, organisational structures for management of *ex situ* populations have been built over 20 years. Therefore zoos have good experience for management and population analysis thanks to accurate databases (ISIS

and detailed studbooks) and powerful software (PM2000). They are able to minimize the genetic drift and genetic diversity loss for any captive stock and to give annual recommendations to be followed by the participants in conservation breeding programmes. However, with Galliformes, their rearing experience and breeding success are often limited by a lack of experienced staff. In contrast, in the private sector, where bird keeping is a hobby, there is a great knowledge of husbandry and housing requirements, and there is better experience of breeding Galliformes in captivity. However, many private breeders are unable to properly manage their captive population, and problems with inaccurate data, no ringing, no registering, and no checking of relationships is frequently experienced. The private sector can devote space, time and money to the conservation breeding of Galliformes and this is why if European zoos and private breeders cooperate to keep threatened galliform species, it will enhance not only the breeding capacity but also the quality of conservation breeding. In 2004, the European Conservation Breeding Group (ECBG) was created to act as an umbrella for European private breeders willing to participate in conservation action. A close co-operation between EAZA TAG and ECBG is essential to the conservation breeding of threatened galliform species in Europe.

To achieve galliform conservation it will be important in the future that *ex situ* and *in situ* projects must work in partnership. European zoos can help *in situ* conservation by providing funds and supporting teams in the field. Nevertheless, CITES legislation, welfare legislation and world health problems reduce the possibilities of animal transfers between Europe and other countries. The world management of threatened galliform populations will require an enhanced breeding capacity of zoos and conservation centres within the native range countries. European zoos can help to develop such structures not only by funding support but also by staff training and transfer of their technologies to these countries.

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Biographical sketches

ALAIN HENNACHE worked for the National Museum of Natural History in Paris, Department of Botanical and Zoological Gardens, since the beginning of the seventies. He joined the Zoological Park of Clères in 1979, where he met Jean Delacour. Then he dedicated his life to *ex situ* conservation of birds and especially to the Galliformes. He was a pioneer of using DNA analyses for the management of Galliformes

captive populations and spent a lot of time for the conservation of the Edwards's pheasants and Vietnamese related species. Chair of WPA France, Chair of the EAZA Galliforme TAG, he is also the world coordinator of several studbooks for Galliformes and at the origin of the European Conservation Breeding Group. More recently, he wrote an important book *Monographie des Faisans* which is a comprehensive update of our knowledge of this group.