EVALUATION OF CAPTIVE BREEDING AS A METHOD TO CONSERVE THREATENED GREAT BUSTARD (Otis tarda) POPULATIONS

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SUMMARY.- *Evaluation of captive breeding as a method to conserve threatened Great Bustard populations.* The recent Great Bustard Action Plan summarizes the main recommended lines of action to preserve current populations and their habitats in Europe. Among others, captive breeding is mentioned as a method to save clutches found in the field whose hatching success probability is suspected to be low for any reason. Birds hatched from these clutches have been used to either build up small captive-breeding flocks that ensure preservation of the genetic pool of seriously threatened populations once these may be extinct, or to be released into the natural populations as juveniles. In this paper we evaluate the viability of captive breeding in the light of new results of a recent study of juvenile Great Bustards during their maternal dependence period, family break-up and dispersal. The few data available on survival of captive-bred young after being released suggest that they suffer a high mortality, probably due to the lack of the experience acquired in natural conditions from their mothers. The negative effects of imprinting by their human keepers, particularly in relation with display and mating, has not been sufficiently investigated. These and other aspects make captive breeding questionable as an effective method, as compared with habitat protection measures.

Key words: captive breeding, Great Bustard, reintroduction.

RESUMEN.- *Evaluación de la cría en cautividad como método para conservar las poblaciones de Avutardas amenazadas.* El recientemente elaborado plan de acción de la avutarda establece las líneas prioritarias de actuación para conservar y mejorar las poblaciones de avutardas y sus hábitats en el continente europeo. Entre dichas medidas se contempla la cría en cautividad de las puestas que, por diversas razones, se presumen sin posibilidades de éxito en libertad. Los individuos nacidos de tales huevos se han utilizado para formar pequeños grupos reproductores cautivos que garanticen la pervivencia de poblaciones en situaciones extremas de peligro de extinción, o bien para ser reintroducidos de nuevo a la población natural como jóvenes. En el presente artículo se evalúa la viabilidad de dichas campañas de cría en cautividad a la luz de los resultados de un reciente estudio del comportamiento de los jóvenes durante su período de dependencia materna y posterior emancipación y dispersión. Los escasos datos disponibles sobre supervivencia de los jóvenes criados en cautividad y posteriormente liberados sugieren una elevada tasa de mortalidad que podría deberse fundamentalemente a la falta de la experiencia adquirida en condiciones naturales por el joven durante la dependencia materna. No se han investigado suficientemente los posibles efectos negativos del troquelado de los individuos cautivos por su relación con cuidadores humanos, especialmente durante el complejo proceso de apareamiento. Estos y otros aspectos hacen de la cría en cautividad un método cuestionable frente a medidas más eficaces de protección del hábitat.

Palabras clave: Avutarda, cría en cautividad, reintroducción.

INTRODUCTION. A BRIEF HISTORY OF GREAT BUSTARD CAPTIVE BREEDING

Captive breeding has traditionally been regarded as a suitable method for the recovery of threatened wild Great Bustard populations. First attemps to breed Great Bustards in captivity were carried out in Hungary (Chernel, 1904), although first successful reintroductions to the wild took place in Dobrudsha (Romania), where four individuals hatched by a turkey in 1919, were freed after being kept in semi-wild conditions for several years (Rayner, 1942). In later years, similar programs were undertaken in different central European countries, urged by the alarming decrease of Great Bustard populations due to agricultural intensification. The aim of these captive breeding stations is, on one hand, to reintroduce young reared from artificially incubated eggs into the wild and, on the other hand, to create captive groups of breeding individuals that assure the survival of extremely threatened populations. Among those pursuing the former objective, the main stations were Buckow and Steckby in Germany, and Dévaványa in Hungary (Fodor *et al.*, 1981; Dornbusch, 1983a; Litzbarsky & Litzbarsky, 1983; Sterbetz, 1986; Farago, 1990). Other attempts were carried out in Portugal (Pinto, 1981), Russia (Ponomareva, 1983), and Slovakia (Randik & Kirner, 1983). Attemps to establish a captive-breeding flock have been made in Spain (Hellmich, 1991), Poland (Graczyk, 1980; 1983; Graczyk *et al.*, 1980), and the United Kingdom (Goriup, 1985; Collar & Goriup, 1980; Osborne, 1985).

Birdlife International has recently set up an action plan for the Great Bustard in Europe that includes, among its main points, the study and evaluation of the current captive breeding programs, focusing on the survival and reproductive success of released individuals (Kollar, 1995).

This paper evaluates the viability of such programs in the light of the results obtained during a recent study of the behaviour of juvenile Great Bustards during their maternal dependence period and their later emancipation and dispersal.

RESULTS OF CAPTIVE BREEDING PROGRAMS

The main results of captive breeding programs are summarized in the following table:

Reference	Station, country	Working period	Period results reported	No. eggs collected	No. hatched (and % eggs collected)	No. chicks survived before release (and/or % hatched)	No. young survived after release (and/or % released)
Dornbusch, 1983a,b	Steckby, Germany	1973-present	1973-81	ca. 500	ca. 350 (70%)	190 (55%)	?
Graczyk et al., 1980	Agriculture Academy, Poznan,	1974-89	1974-79	24	16 (67%)	10 (62%)	not released

	Poland						
in Hellmich, 1991	Las Seguras, Spain	1975-90	1975-82	116 *	?	11 (9%)	?
Litzbarski & Litzbarski, 1983	Buckow, Germany	1979-present	1979-83	438	238 (54%)	137 (58%)	?
Block, 1995			1979-94	?	?	255 (?)	45 (18%)**
Farago, 1990	Dévaványa, Hungary	1978-present	1979-88	?	688 (?)	190 (28%)	?
Collar & Goriup, 1980	Porton Down U.K.	1970-82	1979	1	0 (0%)	0	-
Goriup, 1985			1980	3	3 (100%)	0 (0%)	-
Osborne, 1985			1982	9	4 (45%)	4 (100%)	?
Pinto, 1981	ICN, Portugal	1981	1981	7	7 (100%)	2 (29%)	0 (0%)***
Ponomareva, 1983	Saratov, Russia	1982-present	1982	?	81 (?)	?	?
Radnik & Kiner, 1983	Zlatná na Ostrove, Slovakia	1983-present	1983	5-10	1-2 (20%)	?	?

* This is the number of chicks collected, the total number of eggs collected is unknown, although a minimum of 43 eggs were sent to the station (Hellmich, 1991).
** This is a minimum, since it means the number of individuals resighted after release, but does not include other birds possibly survived and not resighted.
*** The 2 individuals were sent to a zoo because they wouldn't survive in nature due to imprinting.

Releases are carried out in late August, that is, when young are about 90 days old, having previously remained in fenced areas under semi-wild conditions.

Considering each of the above experiments as one data, the mean percentage of eggs hatched from those collected was 57%, and the mean survival of chicks hatched until release, 43%. Thus the mean chick survival before release was ca. 24% of the eggs collected.

However, the most important factor to be considered in a reintroduction program is the survival rate of released young, and this data is in most occasions not given in the literature. We only know of two authors that give precise information in this respect, their results varying between 0% and 18% success (Pinto, 1981, Block, 1995). Although the 18% success at Buckow station must be considered a minimum (see note below the Table), we do not think that many more individuals would have survived without having been sighted, given the long time considered in their report (15 years, 1979-94, see Block, 1995).

Moreover, in several instances the authors mention that a number of individuals return or do not disperse from the release stations or come very close to farms under hard weather conditions (e.g after snowfalls), which obviously denotes that these birds had been imprinted during their rearing period in the stations.

MATERNAL DEPENDENCE PERIOD IN A WILD POPULATION

During a study on maternal dependence and juvenile dispersal of radiotagged young Great Bustards we gathered some data that help understanding the low success of Great Bustard breeding programs (Alonso *et al.*, 1994 and pers. obs.). Although there are large individual and sex-biased differences in maternal investment in young, the average duration of this dependence period has been found to be extremely long. Maternal dependence period ends on average earlier in males than in females.

The independence of radio-tagged male juveniles took place between January and May of the year after the birds' hatching (mean date, March 15th, at a mean age of 275 days). For female juveniles, independence dates varied between March and June (mean date, May 5th, at a mean age of 330 days). Mean male independence dates were, therefore, almost two months earlier than female ones, this difference being statistically significant ($z=2.50$, $p=0.013$, Mann-Whitney U-test).

Independence date frequency distributions are apparently truncated to the right, since the independence is determined by the beginning of the mother's reproductive activities, while young solicit maternal attention until the end of their dependence period. The truncated pattern is particularly marked in female youngs, while it does not exist in male juveniles because their emancipation generally occurs long before the beginning of the breeding season. In relation to the integration process of juveniles in flocks, which include other families and non-breeding and failing females, this is a slow process, not necessarily linked to their independence from adult females. Although there are some sparse cases in which a young is seen forming part of a flock at an early age, families usually remain solitary until chicks are about 200 days old.

For male youngs, integration of families in flocks may not take place until November. For females, integration in September and October is higher than for males, although most of it also occurs in November. Until then, interactions of families with other individuals are scarce or accidental. After becoming independent from their mothers, juveniles integrated flocks in which most individuals were of the same sex and age. These independent juveniles suffer then increased aggression rates from other individuals in the flock.

Sex-differences in dispersal from nest site are significant. Male dispersal distances are significantly higher than female ones (more than 20 km in average at the end of their first year of life for males and less than 5 km for females). Females usually return to their natal areas, remainig close to them during their adult life. On the contrary, males are more erratic and not so tied to their natal sites (Alonso & Alonso, 1992; Alonso *et al*., 1994).

CONCLUSIONS

Although parental investment and mother-young relationship may vary with environmental conditions, our results show that the high and prolonged maternal dependence of Great Bustard young may probably be one of the main causes of the low survival rate of young released from a captive breeding station. Several studies have shown that the degree of dependence affects the physical condition of juveniles even at their adult age and, therefore, the reproductive success of those individuals that have not reached the required size and strength before becoming independent from their mothers will be at a disadvantage when competing for food resources and mates (reviewed in Clutton-Brock, 1991). Moreover, the fact that most families in the wild do not integrate in flocks until a much later date than that when most releases are carried out, suggests that interindividual competition for resources in the flock is probably still high for young birds under natural conditions, and surely too high for released juveniles to garantee their optimal development. Therefore, mere integration in flocks does not garantee young survival, contrary to what was suggested by Fodor *et al*. (1981).

Dispersal patterns seem to be similar in wild and captive-bred juveniles (see Alonso *et al* 1995; Block, 1995), for recolonization of pre-determined zones is highly difficult because many birds will establish in areas far away from the release point. It would be wise to shift conservationist efforts towards the improvement of environmental conditions in breeding and wintering areas, in order to garantee the settlement of healthy populations that allow genetic interchanges. It is also important to emphasize that post-dispersive returns of captive-reared juveniles may not follow natural patterns, since they have not stayed at their natal sites long enough to recognise them as natal areas. Reproductive behavioural mechanisms of these birds may not as well follow natural patterns as a consequence of human influenced imprinting, a fact that has been stated in other bird species (e.g. Marshall & Black, 1992).

As a consequence of long-range dispersal movements and the lack of knowledge about the degree of fitness of freed young Great Bustards, it is necessary to undertake scientifically planned radiotracking studies after releases that allow an evaluation of the real effectiveness of captive-breeding programs. This would allow to obtain a true measure of the reintroduction succes, which is ultimately given by the breeding success of reintroduced individuals. Also, the marking of some wild individuals of those populations where the captive-reared birds are intended to be released would yield valuable information on the natural processes of maternal dependence and dispersal of juveniles (see, for example, James *et al*., 1983; Smith, 1986; Panek, 1987; Combreau *et al*.,1995).

Finally, the setting-up of a captive-breeding station could promote that farmers actively search for eggs or do not care so much about trying not to disturb nests found during farming operations. The existence of a station where they can bring any eggs found in the fields could lead them to interpret that many nests that are in fact still attended by the female would be abandoned and their eggs should be taken to be bred artificially.

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