J. Field Ornithol., 69(1):117–120

FERTILITY OF GREATER RHEA ORPHAN EGGS: CONSERVATION AND MANAGEMENT IMPLICATIONS

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Abstract.—Greater Rheas (*Rhea americana*) lay unattended (orphan) eggs far from active nests. The objective of this study was to test the fertility of orphan eggs. Eggs were harvested and kept in storage for 1–7 d and then transported to incubation facilities. Fifteen (38%) of 40 artificially incubated orphan eggs were fertile, and eight of them hatched. Orphan eggs found in mid- to late spring had higher fertility than those collected in summer. These results provide the first evidence for fertility of rhea orphan eggs. Systematic harvesting and artificial incubation of Greater Rhea orphan eggs could increase productivity of wild populations, using eggs which normally would have no chance of development and without disturbing the breeding birds.

FERTILIDAD DE LOS HUEVOS ABANDONADOS DE *RHEA AMERICANA*: IMPLICASIONES PARA EL MANEJO Y CONSERVACIÓN DE LA ESPECIE

Sinopsis.—Los ñandues (*Rhea americana*) depositan huevos aislados (huachos) lejos de nidos activos. El objetivo de este trabajo fue probar la fertilidad de estos huevos. Se recogieron los huevos y se almacenaron entre 1–7 días, para luego ser transportados al laboratorio de incubación. Quince (38%) de los huevos abandonados e incubados resultaron fértiles y ocho eclosionaron. Los huevos hallados a mediados y fines de la primavera tuvieron mayor fertilidad que los recogidos en verano. Estos resultados proveen la primera evidencia de que los huevos huachos de ñandú son fértiles. La cosecha sistemática e incubación artificial de estos huevos, prodría aumentar la productividad de las poblaciones silvestres de esta especie.

The Greater Rhea (*Rhea americana*) inhabits grasslands and open shrub areas throughout its range in South America. Currently, this ratite primarily occurs in agro-ecosystems in which the native vegetation has been replaced with pastures and crops. Wild populations of Greater Rheas have been adversely affected by a combination of habitat modification and fragmentation, floods, and widespread egg gathering and hunting (Bucher and Nores 1988; Carman 1988; M. B. Martella and M. A. Castaño, unpubl. data).

Throughout the breeding season, but especially at the start of it, female Greater Rheas lay isolated eggs far from active nests. These unattended eggs have been called "orphans" ("guachos" or "huachos"; Dabbene 1920, Dani 1993, Santos 1952) and can be found in large quantities scattered in the field (Bruning 1971, 1973, 1974; Felce and Benarós 1943; Hudson 1927; pers. obs.). Orphan eggs appear to be the consequence of active nests being unavailable to the females. This may occur either before the nest scrape is constructed by the male (Felce and Benarós 1943, Santos 1952) or after the nest is already full of eggs (mean clutch size = 28 eggs; M. B. Martella and J. L. Navarro, unpubl. data) and the incubating male has aggressively rejected the female (Bruning 1973, Dabbene 1920, Hudson 1927). Some females may also fail to locate a nest when they are ready to lay (Bruning 1973).

Although orphan eggs are widely believed to be infertile, Martella and Navarro (1993) did not find significant differences in size between orphan eggs and eggs in active nests (mean volume = 548 cm^3). This is indirect evidence of orphan eggs being of similar quality to non-orphans and, thus, potentially viable.

The purpose of this paper was to test the fertility of rhea orphan eggs and consider the relevance of the results for the management and conservation of this ratite.

STUDY AREA AND METHODS

This research was part of a long-term study on the breeding biology of Greater Rheas conducted at El Refugio ranch (33°44′S, 64°58′W), located 350 km south of the city of Córdoba, Argentina. This 1400-ha ranch is a flat area with some isolated sand dunes and patches of xerophylous shrubland. It is used to raise cattle and for agriculture (mainly maize and sunflower). Mean annual rainfall is 750 mm (75% occurring in mid-spring and summer); monthly average temperature during the breeding season ranges from 14–24 C. In September 1995, the population of free-ranging Greater Rheas was approximately 130 individuals.

From the pre-laying period in October 1995 to the end of the breeding season in March 1996, we searched intensively (at 1–7-d intervals) for active nests and orphan eggs of Greater Rheas throughout the study area. Orphan eggs were defined as solitary eggs found in locations other than nest scrapes and far (>50 m) from any active nest. Rhea eggs were collected immediately upon being found, although sometimes this was several days after laying (based on color, which changes progressively from golden yellow-green to cream-white in about 5 d; Brito 1949, Dabbene 1920, Hudson 1927, Mendes 1986, pers. obs.). Eggs were stored in a cool room (approximately 20 C) for 1–7 d, until transported to incubation facilities at Córdoba city. During transit they were wrapped with newspaper and packed in a strong cardboard or isoprene box.

On arrival, the eggs were brushed to remove mud and debris, individually numbered, and laid on their side in a forced draft incubator. The incubator temperature was set to 36.5 C (Stewart 1994:1318), with relative humidity and ventilation maintained to achieve an average loss of 14% of preincubation mass (Ar 1996) of control eggs during the course of incubation up to external piping (37 days). Eggs were automatically turned every 4 h at a 90° angle.

All eggs were periodically candled to determine fertility and the progress of embryonic development through hatching was monitored. Eggs that showed no visible sign of embryonic development at candling after

13 d were considered infertile. Thus viable eggs were not removed prematurely. Infertile or contaminated eggs (with either or both bacteria and fungi; see Deeming 1996) and eggs with dead embryos were recorded and discarded. Two or three days before the hatching date, eggs were transferred to a hatcher (also at 36.5 C) and turning was ceased.

RESULTS AND DISCUSSION

We collected 45 orphan eggs of the Greater Rhea. Four were discarded upon arrival: one was broken, one was contaminated and two were accidentally stored for >19 d. Another contaminated egg was discarded during the first week of incubation.

Fifteen (38%) out of the 40 incubated orphan eggs showed evidence of embryo development at candling. Eight eggs (20%) hatched.

Eggs harvested earlier than the median date of collection (28 November) showed greater fertility (55%) than eggs harvested after this date (16%) (Fisher's Exact Test, $P = 0.05$). This is despite the fact that preincubation periods were significantly longer at the beginning of the experiment (median = 7 d) than at the end of it (4 d) (Mann-Whitney test, $Z = 2.83$, $P < 0.01$).

We believe that the 38% fertility obtained in this study is in fact an underestimation. Fertile eggs with early dead embryos (<7 d of incubation) could have been mistaken as infertile. Furthermore, the precarious pre-incubation storage environment may not have provided the range of temperature and relative humidity recommended for ratite egg storage (13–18 C and 75%, respectively; Stewart 1994), and such a situation has been found to decrease the viability of fertile eggs of other ratites (Ar 1996). Some of the eggs were collected several days after being laid, which could have led to a weather-worn effect and an excessively long preincubation period (>10 d), thus diminishing fertility and hatchability (Bruning 1973). Finally, the temperature, humidity, and vibration suffered by the eggs during transit could have been detrimental to embryo development.

The higher fertility found in eggs harvested in mid- and late spring, could be related to the lower temperatures and rainfall to which eggs were exposed in the field during that season (monthly average minimum and maximum temperatures range from 10–12 C and 24–27 C, while monthly average rainfall is 96 mm), compared with temperatures and rainfall in summer (15–16 C, 29–30 C, and 123 mm, respectively).

Our study provides the first evidence that a large proportion of orphan eggs of Greater Rheas are fertile and viable. In particular, those laid early in the breeding season are probably as fertile as those laid in nests (overall fertility rate = 57%; J. L. Navarro and M. B. Martella, unpubl. data.). We conclude that the harvesting of Greater Rhea orphan eggs for artificial incubation could be important for the management and conservation of rheas. Using these eggs (that normally would have no chance of development) one could enhance the natural productivity of rhea populations and supply chicks for farming and ranching projects. More regular egg harvesting schedules (i.e., daily or on alternate days) and better egg storage and transit conditions will probably ensure a higher success in chick production than that obtained in the present study. In contrast to the collection of eggs from active nests, which is a common management practice for several species, the use of orphan eggs does not disturb reproductive birds and does not affect the reproductive potential of wild rhea populations.

ACKNOWLEDGMENTS

We are grateful to the Bocco family for allowing us to use the fieldwork area and for providing housing; and to the Ponzo family for their hospitality and help in the field. P. Abate, M. C. Masciocchi, and A. Muñoz assisted us at the laboratory. C. R. Chandler and two anonymous referees made comments on the manuscript. The study was supported by grants from the Consejo de Investigaciones Científicas y Technológicas de la Provincia de Córdoba (CONICOR) and the Secretaría de Ciencia y Técnica de la Universidad Nacional de Córdoba (SECYT-UNC). The Ministerio de Agricultura, Ganadería y Recursos Naturales Renovables de la Provincia de Córdoba assisted us to purchase and import the forced draft incubator.

LITERATURE CITED

AR, A. 1996. Requirements for successful artificial incubation of ostrich eggs. Pp. 131–144, *in* D. C. Deeming, ed. Proc. Intern. Conference, Improving our understanding of ratites in a farming environment, Manchester, United Kingdom.

BRITO, P. M. 1949. Observações sobre o comportamento e a reprodução da Ema, *Rhea americana americana* (Linaeus, 1758) em cativeiro. Boletim do Museu Nacional, série Zoologia 89:1–9.

BRUNING, D. F. 1971. Rheas in Argentina. Animal Kingdom 74:22–27.

———. 1973. The Greater Rhea chick and egg delivery route. Nat. Hist. 82:68–75.

———. 1974. Social structure and reproductive behavior in the Greater Rhea. Living Bird 13:251–294.

BUCHER, E. H., AND M. NORES. 1988. Present status of birds in steppes and savannas of northern and central Argentina. Pp. 71–79, *in* P. D. Goriup, ed. Ecology and conservation of grassland birds. ICBP Tech. Publ. No. 7.

CARMAN, R. L. 1988. Apuntes sobre fauna Argentina. Vazques Mazzini Eds. Buenos Aires. 125 pp.

DABBENE, R. 1920. Los ñandúes de la República Argentina. El Hornero 2:81–84.

DANI, S. 1993. A Ema (*Rhea americana*): biologia, manejo e conservação. Fundacão Acangaú, Belo Horizonte. 136 pp.

DEEMING, D. C. 1996. Microbial spoilage of ostrich (*Struthio camelus*) eggs. British Poultry Science 37:689–693.

FELCE, E., AND L. BENARÓS. 1943. El Ñandú o Avestruz Americano. Su vida - Sus costumbres. Colección Flor, Editorial Dovile, Bs. As. 145 pp.

HUDSON, W. H. 1927. Los ñandúes de la Argentina. El Hornero 4:52–59.

MARTELLA, M. B., AND J. L. NAVARRO. 1993. Formación de harenes en el ñandú: una aproximación. Resúmenes de la XVI Reunión Argentina de Ecologia: 192.

MENDES, B. V. 1986. Criaçâo de animais nativos no semi-árido do nordeste brasileiro. Silvicultura (Sâo Paulo, Brasil) 41:17–22.

SANTOS, E. 1952. Da Ema ao Beija-flor. 2nd Ed., F. Briquet, Rio de Janeiro. 334 pp.

STEWART, J. S. 1994. Ratites. Pp. 1284–1326, *in* B. W. Ritchie, G. J. Harrison and L. R. Harrison, eds. Avian medicine: principles and application. Wingers Publ. Inc., Lake Worth, Florida.

Received 10 Sep 1996; accepted 12 Feb. 1997.