Mastozoología Neotropical, 18(2):217-225, Mendoza, 2011

ISSN 0327-9383
Versión on-line ISSN 1666-0536
http://www.sarem.org.ar

EVALUATION OF POPULATION PARAMETERS OF COYPU *Myocastor coypus* (RODENTIA, MYOCASTORIDAE) DURING AND OUTSIDE THE AUTHORISED HUNTING SEASON IN THE FLOODPLAIN OF THE PARANÁ RIVER, ARGENTINA

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ABSTRACT: We studied a *Myocastor coypus* (Molina, 1782) population during the authorised hunting season (AHS) and outside the hunting season (OHS) in the floodplain of the Paraná River (Argentina), a representative area for this species within its original geographic range. The aims of this work were to describe and compare fluctuations in population parameters (relative abundance, sex ratio, age structure) and in the physical condition between these two periods. Additionally, we discussed the possible occurrence of simultaneous influence of environmental factors (particularly the hydroperiod) and hunting pressure on these parameters. The absolute density during the AHS was 2.78 individuals/ha. No differences in the trapping success index were found between AHS and OHS. Throughout the study period the sex ratio remained 1:1. Adults predominated at the beginning of the AHS. There was no predominance of any age class during the OHS. The physical condition index (PCI) decreased during the AHS for both sexes, while in OHS only for females increased in December. No differences were found in the PCI between AHS and OHS for both sexes. The hydroperiod of the Paraná River showed a decrease during AHS and more stable but lower values during OHS. We hypothesise that these results could be related to a compensatory favourable effect of the habitat conditions (particularly the hydrological regime) over the negative effect of hunting pressure.

RESUMEN: Evaluación de parámetros poblacionales de *Myocastor coypus* (Rodentia, Myocastoridae) durante la temporada de caza autorizada y fuera de ella en la planicie aluvial del Río Paraná (Argentina). Se estudió una población silvestre de *Myocastor coypus* (Molina, 1782) dentro de la temporada de caza autorizada (TCA) y fuera de ella (FCA) en la planicie aluvial del Río Paraná (Argentina), un área representativa dentro de su rango original de distribución. Los objetivos de este estudio fueron describir y comparar las fluctuaciones observadas en algunos parámetros poblacionales (abundancia relativa, proporción de sexos, estructura de edades) y en la condición física entre ambos períodos, y discutir el posible efecto simultáneo de factores ambientales (hidroperíodo) y de la presión de caza sobre ellos. La densidad absoluta en TCA fue de 2,78 individuos/ha. No se observaron diferencias significativas entre TCA y FCA en los los índices de éxito de trampeo estimados. Durante todo el período estudiado la proporción de sexos fue 1: 1. Los adultos

Recibido 15 noviembre 2010. Aceptado 5 agosto 2011. Editor asociado: L Guichón

fueron la clase de edad predominante y estuvieron más representados al inicio que al final de la TCA. No predominó niguna clase de edad durante la FCA. El índice de condición física (ICF) decreció a lo largo de TCA para ambos sexos mientras que sólo las hembras alcanzaron un pico relativo en diciembre (FCA). No obstante, no existieron diferencias en IFC entre TCA y FCA. El hidroperíodo del Río Paraná mostró un decrecimiento durante la TCA mientras que en la FCA se observaron valores más bajos y estables. Los resultados observados podrían estar relacionados con un efecto compensatorio de las condiciones de hábitat (particularmente del régimen hidrológico) sobre el efecto negativo de la presión de caza.

Key words. Argentina. Hunting pressure. *Myocastor coypus*. Paraná River Delta. Population ecology

Palabras clave. Argentina. Delta del Río Paraná. Ecología poblacional. *Myocastor coypus*. Presión de caza.

INTRODUCTION

The coypu or nutria *Myocastor coypus* (Molina, 1782; Rodentia, Myocastoridae) is an hystricomorph rodent native to southern South America (Parera, 2002). This herbivore rodent has semi-aquatic, nocturnal and gregarious habits, and a polygynous mating system (Doncaster and Micol, 1989; Gosling and Baker, 1991; Bó et al., 2006). In each group, the mean number of individuals and their sex and age composition may differ markedly in response to environmental conditions (Guichón et al., 2003b). Coypus are found along the shore of lakes, ponds, marshes and slow-flowing rivers and streams; their survival and reproduction are highly influenced by water level fluctuation in these habitats (Bó et al., 2008).

The coypu has invaded vast areas of Europe, Asia and North-America, where it became successfully established since 1930 (Carter and Leonard, 2002). In these regions, the coypu is considered a pest because it causes important economic losses in agriculture (Abbas, 1988) and damages to drainage systems (Veerheyden and Abbas, 1996). In contrast, in Argentina, the species is traditionally hunted for its fur, and has emerged over the past decades as a valuable wildlife resource due to the number of people involved in the commercial chain (Bertonatti and Corcuera, 2000; Porini et al., 2002). Currently, only 2% of the coypu furs on the market come from breeding farms while the rest come from wild populations. The official hunting season, which lasts from June to September, was chosen according to commercial rather than ecological criteria (Bó et al., 2006). This extractive activity is mainly carried out in northeast and central-east provinces of Argentina, being the floodplain of the Paraná River the most important hunting area (Porini et al., 2002).

In recent years, knowledge of the population ecology of coypu in its original habitat has increased (Colantoni, 1993; Courtalon et al., 1993; D'Adamo et al., 2000; Guichón, 2003; Corriale, 2004; Nazar Anchorena, 2004; Bó et al., 2008; Spina, 2008). However, it is still relatively scarce and fragmented in wetlands. On this basis, this is the first work dealing with a continuous and systematic follow-up of a feral coypu population throughout a one-year period during and outside the authorised hunting season in representative wetlands of its original geographic range.

The aims of this work were to describe and compare fluctuations in population parameters (relative abundance, sex ratio, age structure) and in the physical condition during and outside the authorised hunting season. Additionally, we discuss possible simultaneous effects of environmental factors (particularly the hydroperiod) and hunting pressure on these parameters.

MATERIALS AND METHODS

The study was conducted in a representative area of the Middle Delta of the Paraná River (located in the

Islands Zone of the Victoria Department, Entre Ríos Province, Argentina; **Fig. 1**). The Middle Delta has extensive wetlands with particular biogeographical and ecological features (Malvárez, 1997). From a hydrological point of view, this area is affected by the regime of the Paraná River with the water level rising from early autumn (March-April) to mid-winter (July) and falling from early spring (September-October) to mid-summer (February) (Bó et al., 2008). The richness of mammals was estimated in 36 species, among which the coypu is one of the most typical species and the main wildlife income for local residents (Bó and Malvárez, 1999).

The landscape pattern is characterised by ridges dominated by *Cyperus giganteus* and *Panicum prionitis*. Towards the mid and low portions of the topographical gradient, plant species are substituted according to flooding conditions. At mid slopes a prairie of short hydrophitic plants prevails, with *Polygonum* spp. and *Ludwigia* spp. as dominant species. The most depressed portion, which is flooded permanently or for long periods, is dominated by *Schoenoplectus californicus* and *Eichhornia azurea*. Deep water bodies may be found in the central zones. The particular flooding conditions and many of the available plant species fulfil the main habitat requirements of coypus (food, cover and reproduction; Bó et al., 2006).

Coypus were caught monthly throughout one year (between June 2007 and May 2008) in a hunting area of 105 ha, with the help of a local hunter using the capture-removal method (Krebs, 1989). Coypus were captured daily with 20 leg-hold traps according to the Agreement on International Humane Trapping System (AIHTS), approved by the Wildlife Department of Argentina. Traps were set for 12 days in 20-ha hunting subareas close to coypu tracks (nests, trails and feeding areas). The capture method may not affect males and females differentially. The hunter was authorised by the Wildlife Department of Entre Ríos to capture coypus during the authorised hunting season (AHS: June, July, August and September, 2007) and outside the hunting season (OHS: November and December, 2007; March, April and May, 2008). No data were collected in October 2007, January and February 2008 due to limited access to the area caused by adverse climatic conditions.

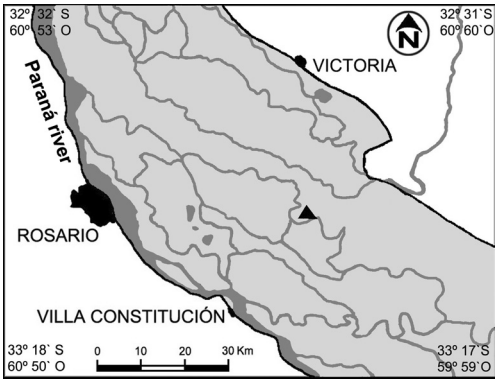

Fig. 1. The Islands Zone of the Victoria Department, Entre Ríos Province, in the Middle Delta of the Paraná River, Argentina. The triangle indicates the study area.

We estimated the absolute density of coypus in the study area by a capture-removal method (Zippin, 1958) using the Removal Sampling Program (Pisces Conservation Ltd., 1992). The capture-removal method assumes that heavy hunting pressure leads to population declines. In the AHS, we considered a constant capture probability (Zippin, 1956). In the OHS, the increased number of captures recorded over time prevented us from using this method.

We calculated a trapping success index (TSI) (Mills et al., 1991) to estimate relative abundance for each month using the equation:

TSI=(Number of individuals captured monthly/Number of traps *Number of nights)*100 (1)

We used the Kolmogorov - Smirnov test (Siegel and Castellan, 1998) for two independent samples to compare differences in monthly TSI between the AHS and OHS. We estimated the monthly sex ratio, and followed the procedure proposed by Caughley (1977) to test whether the sex ratio of the studied population deviated significantly from 1:1 using the Chi-square test with the Bonferroni´s correction (Keppel, 1991).

We assigned the captured coypus to five age-classes based on their weight following the methodology of Norris (1967) and Crespo (1974) (**Table 1**). We determined the monthly age structure of the population and compared the proportion of each age class at the beginning and at the end of the hunting season using the Chi-square test (Sokal and Rohlf, 1981) as suggested by Bodmer et al. (1997).

We determined the monthly physical condition of males and females using the physical condition index (PCI) proposed by Bailey (1968), which was previously used for coypus by Willner et al. (1979) according to the equation:

PCI=body weight (kg)* 10^5 / cephalocaudal length (cm) (2)

Table 1

Age categories of *Myocastor coypus* used in this study (based in: Norris, 1967 and Crespo, 1974).

Age category	Weight (g)	Estimated age (months)	Reproductive condition
Sub-young (SY I)	1000 – 1999	2 - 4	Immature
Young (Y II)	2000 – 2999	4 - 6	Mature
III. Sub-adult (SA III)	3000 – 3999	6 - 8	Active
IV. Sub-adult (SA IV)	4000 – 4999	8 - 12	Active
V. Adult (A V)	>5000	> 12	Active

We compared the monthly PCI values calculated for the AHS and the OHS with the Mann-Whitney test for two independent samples (Siegel and Castellan, 1998).

We built the hydroperiod of the Paraná River between June 2007 and May 2008 using monthly data of water height from the Victoria River provided by the Dirección de Fiscalización y Puerto de la Municipalidad de Victoria, Entre Ríos. The relationship between the trapping success index in the N months (used as an estimator of relative abundance) and the water level of the N-1 months, was tested by a Spearman rank correlation (Rp) (Siegel and Castellan, 1998). We used a delayed relationship due to the time needed by the water to flow from the river to the marsh areas inhabited by coypus. Spearman rank correlation was also used to assess whether the PCI (calculated by sex) was related to the hydroperiod.

All statistical analyses were performed with the software STATISTICA (Statsoft Inc., 1999).

RESULTS

The absolute density of coypus estimated for the AHS by the capture-removal method was 2.78 individuals ha^{-1} (1.11-5.42 individuals ha^{-1}). This method also allowed us to estimate that 76% of the population was removed by the hunter, which indicated the occurrence of a strong hunting pressure during the AHS.

There was a slight decrease in TSI during the first four months of the year (June-September) corresponding to the AHS and to the period of high water level (**Fig. 2**). The values of TSI were highest during the last three months (March-May), period of relatively low water level. Given the high internal variability in OHS no significant differences in TSI were found between the AHS and OHS (medians of 8.41 and 17.25, respectively; $U = 3.5$; $p = 0.11$).

Water height was positively correlated with TSI ($Rp = 0.70$; $p = 0.03$). It was also positively correlated with PCI for males ($Rp = 0.86$; $p < 0.01$) but there was no significant correlation between water height and PCI for females ($Rp = 0.55$; $p = 0.12$).

The sex ratio remained 1:1 throughout the AHS and OHS (**Table 2**). Age structure observed throughout the study period showed a predominance of adults during the AHS, though they were more represented at the beginning than at the end of this season ($\chi^2 = 99$, $df = 1$, $p < 0.01$) (**Fig. 3**). In contrast, the juveniles and subadults III were significantly more represented at the end than at the beginning of the AHS ($\chi^2 = 8.69$, $df = 1$, $p < 0.01$

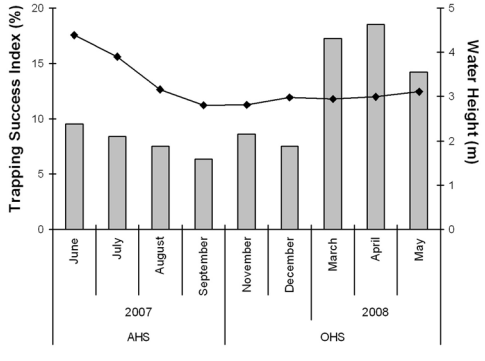

Fig. 2. The hydroperiod (monthly water height, line) and the trapping success index (bars) obtained for the *Myocastor coypus* population during the authorised hunting season (AHS) and outside the hunting season (OHS).

Table 2

Number of males and females captured monthly during the study period. Chi square tests with Bonferroni´s correction were used to evaluate predominance of one sex assuming 1:1 sex ratio. df =1 in all cases. AHS: authorised hunting season; OHS: outside hunting season.

α (with Bonferroni´s correction) = 0,005

Year	Month	Hunting season	Males	Females	X^2	*P*
2007	Jun	AHS	21	17	0.421	0.516
	Jul	AHS	20	17	0.243	0.622
	Aug	AHS	9	15	1.500	0.221
	Sep	AHS	15	4	6.368	0.012
	Nov	OHS	10	2	5.333	0.021
	Dec	OHS	7	2	2.777	0.096
2008	Mar	OHS	35	34	0.014	0.904
	Apr	OHS	48	41	0.551	0.458
	May	OHS	34	34	-	-

and $\chi^2 = 81$, $df = 1$, $p < 0.01$, respectively). There was no predominance of any age class during the OHS, with subadults III, IV and adults being the most represented. Subadults III were significantly more represented at the beginning of this season ($\chi^2 = 7.50$, $df = 1$, $p < 0.01$) and subadults IV at its end ($\chi^2 = 10.30$, $df = 1$, $p < 0.01$).

Minor fluctuations in the PCI were observed for females and males throughout the year and within the AHS and OHS (**Fig. 4**). This index decreased during the AHS for both sexes, while in females it increased in December during the OHS. We found no significant differences in the PCI of females and males between the AHS and OHS (females: AHS median = 3.99, OHS median = 4.23, $U = 8$; $p = 0.62$; males: AHS median = 3.98, OHS median = 4.04, $U = 8$; $p = 0.62$).

DISCUSSION

We described parameters of a coypu population throughout one year in one of the main hunting sites of Argentina and interpreted our results within a context of hunting pressure coupled with hydrological-climatic factors. Environmental stochasticity associated to hydrological-climatic factors may affect population parameters not only as disturbances but also as bonanzas (Morris and Doack, 2002). In the case of a highly fluctuating system like the floodplain of the Paraná River, the observed variation in the hydrological regime could affect coypu population structure.

The absolute density of coypus during the AHS (2.78 individuals ha^{-1}) was higher than the median value reported for similar areas of Argentina (1.67 individuals ha^{-1}; Bó et al., 2006). Taking into account that the study site is located in one of the two main hunting areas of coypu in the country (Bó et al., 2006), these results may suggest that habitat conditions were particularly favourable for the survival and reproduction of coypus.

Trapping success index of males was positively associated with water level, though the slight decrease during the AHS could also be explained by hunting pressure. The absence of hunting in surrounding areas may account for the increase in the TSI during the autumn months of the OHS, however, high variability of TSI within OHS prevented the detection of differences between hunting seasons. The

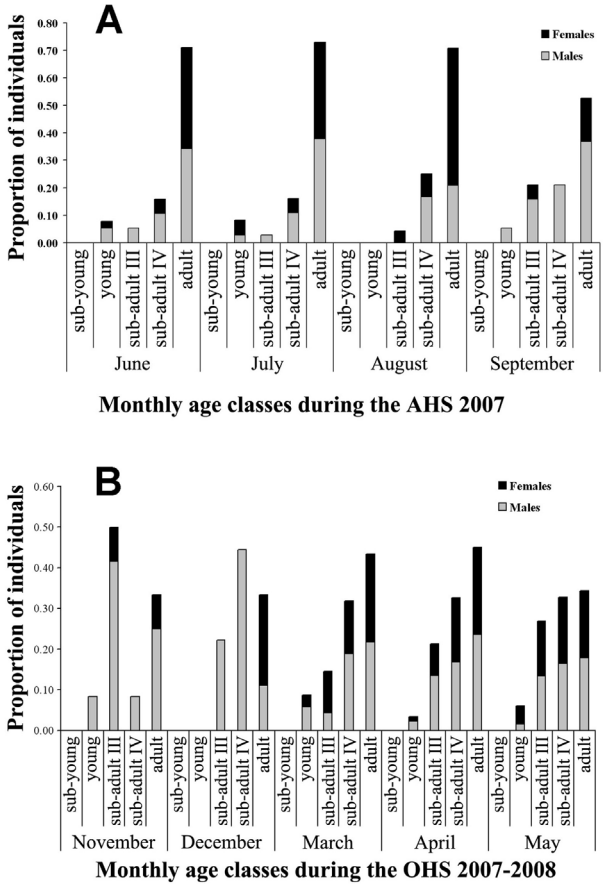

Fig. 3. Monthly age structure of the *Myocastor coypus* population (A) during the authorised hunting season (AHS) and (B) outside the hunting season (OHS).

increase of TSI in autumn would be related to the recruitment observed after a birth peak in October (Spina, 2008) rather than to immigration through water (Bó et al., 2008), since the water level remained constant and relatively low during the OHS. These results were in accordance with those reported for the Buenos Aires Province, where coypu density remained relatively constant throughout the year mainly due to climate stability in the area (D'Adamo, 1996; Guichón, 2003; Guichón et al., 2003a). However, they differed from those obtained in Europe, where harsh winters lead to high mortality rates (Doncaster and Micol, 1990).

In this study, hunting pressure did not seem to affect the 1:1 sex ratio, in agreement with previous reports (Crespo, 1974; Bó et al., 2006). A trend in a larger number of males captured in spring as compared with females was probably due to their greater movement and active search of new social groups (Ryszkowski, 1966; Guichón et al., 2003b). The absence of a predominant age group during OHS could be related to the skill of hunters, who captured many large individuals during the previous AHS, and also to the birth peak in October previously mentioned. The higher number of young coypus at the beginning than at the end of the OHS may be explained by the development of young individuals into adults.

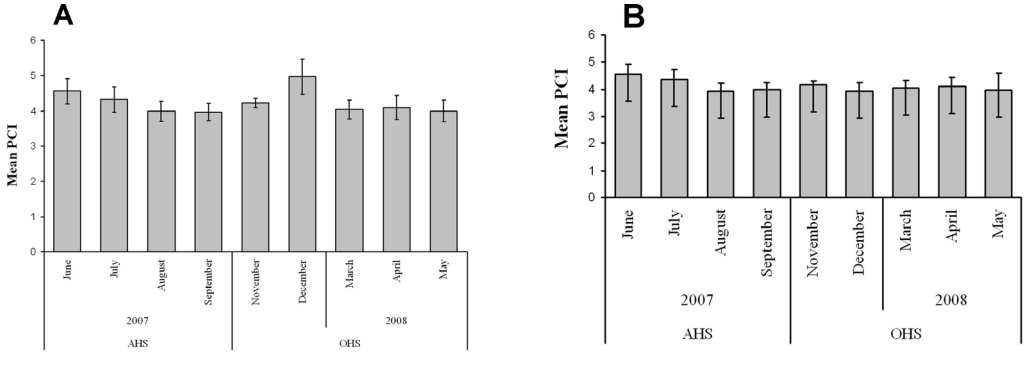

Fig. 4. Monthly mean values of the physical condition index (PCI) for (A) females and (B) males *Myocastor coypus* individuals throughout the study period. AHS: authorised hunting season; OHS: outside the hunting season.

Variation in the number of individuals among age classes would be related to the hunting pressure rather than to environmental factors (e.g. hydrological changes), as evidenced by a reduction of adults in the population during the AHS. The proportion of different age classes was similar to previous studies (Crespo, 1974; Colantoni, 1993; Corriale, 2004; Nazar Anchorena, 2004; Bó et al., 2006). However, in this study the trapping method could have biased the age structure of the population given the differential catchability of individuals according to the depth at which the trap was set in the water (quoting the hunter, "larger coypus are caught by deep traps"). This would explain the almost permanent lack of captures of sub-young and young individuals throughout the study period. Nevertheless, the resulting age structure indicated the most frequently captured age group and, therefore, it was used to evaluate the influence of these captures on the population.

The slight fluctuations in PCI observed for males were positively associated with water level, though no correlation was found for females. Pregnancy rates could explain the slight increase in PCI in June and December for females (Spina, 2008). PCI values in June suggested good physical condition for individuals of both sexes, probably as a result of the relatively high availability of aquatic vegetation (Malvárez, 1997) and favourable hydrological conditions in the previous months. An influence of the seasonal variation of precipitations on the physical condition of individuals has also been suggested for other rodent species (Makundi et al., 2006). The median PCI values of the entire coypu population during AHS (3.98) and OHS (4.13) were comparable to those obtained for similar areas of Argentina (median=3.61, range=2.34-5.59) by Bó et al. (2006), with lowest PCI values in areas with high hunting pressure. In comparison, our study area had an intermediate level of hunting pressure, which was compatible with resource conservation. PCI was relatively higher in a coypu population that had not been exposed to heavy hunting pressure for a long time (median=5.18, range=4.69-6.63) (Corriale, 2004).

The particular hydrological regime in the study area during the study period resulted in periods of extreme drought (2006 and 2008) and flood (2007) and, therefore, did not allow us to carry out a continuous monitoring of the coypu population for a longer period. However, we postulate the occurrence of a compensatory and favourable effect of habitat conditions (particularly the hydrological regime) over the negative effect of hunting pressure. In the AHS, such situation was likely to be associated with higher water levels contributing to the peaks of births and immigration in autumn, just at the beginning of the hunting season (Bó et al., 2006, 2008). During the OHS, it would be related to more stable hydrological, climatic and habitat conditions, which could have contributed to a second peak of births in spring (Spina, 2008) and to the maintenance of other population parameters during the following months, as observed in this study. Studying a feral population of coypus throughout one year in native wetlands represents a first valuable approach. However, this kind of studies should be continued at larger spatial and temporal scales to obtain information needed for developing management programs to ensure species' sustainability.

ACKNOWLEDGEMENTS

We are grateful to Carlos Hevia for his hospitality and help during the field work. This study was conducted in the frame of "Nutria Project: Basic Ecological Studies for the Sustainable Management of *Myocastor coypus* in Argentina". This project is part of a cooperation agreement between the Secretaría de Ambiente y Desarrollo Sustentable de Argentina and the Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina, financed by Dirección de Fauna Silvestre de la Nación.

LITERATURE CITED

ABBAS A. 1988. Impact du ragodin (*Myocastor coypus* Molina) sur une culture du mais (*Zea mays L.*) dans le marais Poitevin. Acta Oecologica 9:173-189.

BAILEY JA. 1968. A weight-length relationship for evaluating physical condition of cottontail. Journal of Wildlife Management 32(4):835-841.

BERTONATTI C and J CORCUERA. 2000. Situación Ambiental Argentina 2000. Fundación Vida Silvestre Argentina, Buenos Aires.

BÓ RF and AI MALVÁREZ. 1999. Las inundaciones y la biodiversidad en humedales. Un análisis del

efecto de eventos extremos sobre la fauna silvestre. Pp: 147-168, *in:* Tópicos sobre humedales subtropicales y templados de Sudamérica (AI Malvárez, ed.). Oficina Regional de Ciencia y Tecnología de la UNESCO para America Latina y el Caribe (ORCyT), Montevideo, Uruguay.

BÓ RF, GM PORINI, MJ CORRIALE, and SM ARIAS. 2006. Proyecto Nutria. Estudios ecológicos básicos para el manejo sustentable de *Myocastor coypus* en Argentina. Pp. 93-104, *in*: Manejo de Fauna Silvestre en Argentina. Programas de uso sustentable (ML Bolkovic and D Ramadori, eds.). Dirección de Fauna Silvestre, Secretaría de Ambiente y Desarrollo Sustentable de la Nación Buenos Aires.

BÓ RF, P COURTALON, F SPINA, R FERNÁNDEZ, and G PORINI. 2008. Los eventos extremos de sequía e inundación y sus consecuencias sobre el coipo o nutria (*Myocastor coypus* Molina, 1782) y la actividad de caza en el Delta Medio del Río Paraná. Pp. 167-192, *in*: Efecto de cambios globales sobre la biodiversidad - Efecto de cambios globales sobre los humedales de Iberoamérica (AV Volpedo and LF. Reyes, eds.). RED CYTED. Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo.

BODMER RE, R AQUINO, PE PUERTAS, CJ REYES, TG FANG y NL GOTTDENKER. 1997. Manejo y uso sustentable de pecaríes en la Amazonía Peruana. Occasional Paper of the UICN Species Survival Commission Nro. 18. UICN-Sur, Quito.

CARTER J and BP LEONARD. 2002. A review of the literature on the worldwide distribution, spread of, and efforts to eradicate the coypu (*Myocastor coypus*). Wildlife Society Bulletin 30:162-175.

CAUGHLEY G. 1977. Analysis of vertebrate populations. John Wiley & Sons Ltd. New York. 234 pp.

COLANTONI LO. 1993. Ecología poblacional de la nutria (*Myocastor coypus*) en la provincia de Buenos Aires. Fauna y Flora Silvestres. Año 1, 1:1-25.

CORRIALE MJ. 2004. Evaluación del estado poblacional y patrón de uso de hábitat del coipo (*Myocastor coypus*) en humedales urbanos. Tesis de licenciatura inédita, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina.

COURTALON P, C BENTHAM, A CROJETHOVICH, and L RAFFO. 1993. Estudio de selección de hábitat y estimación de la densidad del coipo *Myocastor coypus* en el Parque Natural Costanera Sur, Capital Federal. Actas de las 1ras. Jornadas Nacionales y 6tas. Regionales de Medio Ambiente. Universidad Nacional de La Plata, La Plata. 1-42.

CRESPO JA. 1974. Observaciones sobre la reproducción de la nutria en estado silvestre. Primer Congreso Argentino de Producción Nutriera, Provincia de Santa Fe, Argentina 1:60-73.

D'ADAMO P. 1996. Uso del hábitat del coipo (*Myocastor coypus*) en un agroecosistema del sur de la provincia de Buenos Aires. Tesis de licenciatura inédita, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina.

D'ADAMO P, ML GUICHÓN, RF BÓ, and M CASSINI. 2000. Habitat use of coypu (*Myocastor coypus*) in agrosystems of the Argentinean pampas. Acta Theriologica 45(1):25-33.

DONCASTER CP and T MICOL. 1989. Annual cycle of coypu (*Myocastor coypus*) population: male and female strategies. J. Zool. London 217:227-240.

DONCASTER CP and T MICOL. 1990. Response by coypus to catastrophic events of cold and flooding. Holartic Ecology 13:98-104.

GOSLING LM and SJ BAKER. 1991. Coypu. Pp. 267-275, *en*: Handbook of British Mammals (GB Corbet and S Harris, eds.), 3ra ed., Blackwell Scientific Publications, Oxford.

GUICHÓN ML. 2003. Distribución espacial, comportamiento y estructura de poblaciones del coipo *Myocastor coypus* en la cuenca del Río Luján (Buenos Aires, Argentina). Tesis de Doctorado, Universidad de Buenos Aires, Buenos Aires, Argentina.

GUICHÓN ML, CP DONCASTER, and MH CASSINI. 2003a. Population structure of coypus (*Myocastor coypus*) in their region of origin and comparison with introduced populations. Journal of Zoology 261:265-272.

GUICHÓN ML, M BORGNIA, C FERNÁNDEZ RIGHI, G CASSINI, and MH CASSINI. 2003b. Social behaviour and group formation in the coypus (*Myocastor coypus*) in the Argentinean pampas. Journal of Mammalogy 84:254-262.

KEPPEL G. 1991. Design and analysis. A researchers's handbook. Prentice Hall, New York

KREBS CJ. 1989. Ecological methodology. Harper Collins Publisher, Inc., New York.

MAKUNDI RH, AW MASSAWE, and LS MULUNGU. 2006. Breeding seasonality and population dynamics of three rodent species in the Magamba Forest Reserve, Western Usambara Mountains, north-east Tanzania. African Journal of Ecology 45:17–21.

MALVÁREZ AI. 1997. Las comunidades vegetales del Delta del Río Paraná. Su relación con factores ambientales y patrones de paisaje. Tesis de Doctorado, Universidad de Buenos Aires, Buenos Aires, Argentina.

MILLS JN, B ELLIS, KT MECKER, J MAIZTEGUI, and JE CHILDS. 1991. Habitat associations and relative densities of rodent populations in cultivate areas of central Argentina. Journal of Mammalogy 72(3):470-479.

MORRIS WF and DF DOACK. 2002. Quantitative conservation biology: Theory and practice of population viability analysis. Sianuer Associates, Sunderland, MA. 480 pp.

NAZAR ANCHORENA S. 2004. Estimación de la edad en *Myocastor coypus* (Molina, 1782) y sus implicancias en la ecología y el manejo sustentable de la especie. Tesis de licenciatura inédita, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina.

NORRIS JD. 1967. A campaing against feral coypus (*Myocastor coypus* Molina) in Great Britain. Journal of Applied Ecology 4:191-199.

PARERA A. 2002. Los mamíferos de la Argentina y la región austral de Sudamérica. 1ra. Ed. El Ateneo. Buenos Aires.

PORINI G, M ELISETCH, and C SEEFELD. 2002. Manual de identificación de especies de interés peletero. International Fur Trade Federation y Federación Argentina de Comercio e Industria de la Fauna, Buenos Aires.

REMOVAL SAMPLING PROGRAM. PISCES CONSERVATION LTD. 1992. Pennington, Lymington U.K..

RYSZKOWSKI L.1966. The space organization of nutria (*Myocastor coypus*) populations. Symposia of the Zoological Society of London 18:259-266.

SIEGEL S and NJ CASTELLAN. 1998. Estadística no Paramétrica. Editorial Trillos. Buenos Aires.

SOKAL RR and F J ROHLF. 1981. Biometry. The principles and practice of statistics in biological research. W. H. Freedman and Co. New York.

SPINA F. 2008. Ecología reproductiva y parámetros poblacionales del coipo (*Myocastor coypus*) en el valle de inundación del río Paraná (Departamento Victoria, Provincia de Entre Ríos, Argentina). Tesis de licenciatura inédita, Facultad de Ciencia Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina.

STATSOFT INC. 1999. Statistica for Windows (Computer Program Manual). Statsoft Inc. East 14th Street, Tulsa OK 74104.

VERHEYDEN C and A ABBAS. 1996. Impact du ragodin sur le milieu. Pp. 44-54, *in*: Le ragodin: biologie et méthodes de limitation des populations. (P Jouventin, T Micol, C Verheyden, and G Guédon, eds.). Association de Coordination Technique Agricole, Paris.

WILLNER GR, JA CHAPMAN, and D PURSLEY. 1979. Reproduction, physiological responses, food habits, and abundance of nutria on Maryland marshes. Wildlife Monographs 65:1-43.

ZIPPIN C. 1956. An evaluation of the removal method of estimating animal populations. Biometrics 12:163–189.

ZIPPIN C. 1958. The removal method of population estimation. Journal of Wildlife Management 22: 82–90.