Acta Theriologica 39 (1): 83–88, 1994.
PL ISSN 0001 – 7051

Winter circadian activity pattern of free-ranging coypus in the Paraná River Delta, eastern Argentina

Francisco PALOMARES, Roberto BÓ, Juan F. BELTRÁN,
Gloria VILLAFAÑE and Sacramento MORENO

Palomares F., Bó R., Beltrán J. F., Villafañe G. and Moreno S. 1994. Winter circadian activity pattern of free-ranging coypus in the Paraná River Delta, eastern Argentina. Acta theriol. 39: 83–88.

During August 1990, 3 male and 3 female coypus *Myocastor coypus* (Molina, 1782) were radiotracked for 42 24-h periods at the Delta of Paraná River, Argentina. Coypus were mainly nocturnal, with activity peaks around one hour after sunset and two hours before sunrise. Movement rate peaked between 02.00 and 04.00 o'clock. This pattern is similar to that observed in captive individuals and introduced feral populations. Among 7 environmental factors (day period, temperature, wind, cloud cover, and presence or absence of moon, fog, and rain) only period of day and rainfall during daylight were found significantly related to coypu activity, but no environmental factor influenced coypu nocturnal rate of movement.

Estación Biológica Doñana, CSIC, Apartado 1056, 41080 Sevilla, Spain (FP, JFB, SM); G.E.S.E.R. Fac. de Cs. Ex. y Naturales, University of Buenos Aires, Ciudad Universitaria, Pab. II- Dpto. de Cs. Biológicas, 1423 Buenos Aires, Argentina (RB, GV)

Key words: *Myocastor coypus*, activity pattern, distance travelled, Argentina

Introduction

The coypu or nutria *Myocastor coypus* (Molina, 1782) is a rodent indigenous to South America and an appreciated economic resource as furbearer (FAO-PNUMA 1985, Kinler *et al*. 1987). Paradoxically, most of the ecological and behavioural information on this species has been collected from feral or captive animals in North America and Europe, where coypus were intentionally or accidentally introduced (e.g. Hillbricht and Ryszkowski 1961, Gosling 1981, 1986, Doncaster and Micol 1989). In this paper, we report winter activity of free-ranging coypus inhabiting the Delta of Paraná River (eastern Argentina) as determined by radio-tracking. This region is considered the typical location of the species (Ximénez *et al*. 1972).

In mammals, daily patterns of activity have been related to an endogenous activity rhythm (Aschoff 1966, Ashby 1972) and environmental determinants, particularly in rodents (Ashby 1972, Vickery and Bider 1981). Previous information on coypu activity indicates that the coypu is mainly nocturnal (Łomnicki

1957, Chabreck 1962, Gosling 1979), with higher levels of locomotor activity around dusk and dawn (Chabreck 1962). Diurnal activity may occur during cold winters (Gosling *et al.* 1980). However, this information has been obtained in captive animals or feral populations of introduced individuals far away from the coypu natural range. Whether the patterns described in these studies are shared or not by coypus in their original habitats is not known because no comparable data are available from natural South American coypu populations. We test the hypothesis of an endogenous nocturnal activity rhythm in this rodent and evaluate the effects of some environmental determinants on coypu activity.

Study area and methods

The study area was a natural freshwater marsh situated 5 km east of Puerto Constanza (Delta of the Paraná River, Entre Rios, Argentina; 34°S, 58–60°W). Water depth was 50–90 cm. Emergent vegetation in the marsh was mainly by giant bulrush *Scirpus* sp., which was distributed in patches of variable density, sometimes accompanied by arrowhead *Sagittaria* sp., water hyacinth *Pontederia* sp. and *Eichrornia* sp. Submergent vegetation included water fern and milfoil (*Myriophyllum* sp., *Salvinia* sp. and *Hidrocotile* sp.), as well as *Alternanthera* sp. The area is managed for grazing by cattle; revenue from wildlife, particularly coypus, is also important in the study area. The climate is characterized by mild winters and hot summers (mean annual temperature = 17°C); annual rainfall is about 1100 mm.

Each of six coypus (3 subadult males; 1 young, 1 subadult and 1 adult females) were tracked for seven 24-h periods in August 1990. Age and reproductive condition was estimated from body mass (Crespo 1974). Coypus were equipped with radiocollars that incorporated motion sensors (Biotrack, Wareham, U.K.). The signal was received by a portable La-12 receiver (AVM, Livermore, California) via a 3-element Yagi antenna. During each 24-h period of radiotracking, the activity of each animal was checked every hour, and its position determined by triangulation every 2-h. Activity and inactivity were distinguished after one minute listening to tip switches of the radiocollar motion sensor (Knowlton *et al.* 1968). Animals were considered active when the radio signal indicated movement. Coypu positions were determined at distances observer-animal ranging from 50 to 300 m. Activity patterns were described using the percentage of bearings with activity for each hourly interval, and by determining the mean of the shortest distance travelled in each 2-h interval. The total percentage of bearings with activity (an estimate of the daily time spent active) and the minimum distance travelled per 24-h period were also estimated.

For each hourly record of activity, 6 environmental variables were measured: air temperature (°C), wind conditions (6 categories following Beaufort scale; Peterson 1968), cloud cover (4 categories: 0–25%, 25–50%, 50–75%, and 75–100%), and presence or absence of visible moon, fog, and rain, respectively. Day was subdivided into 3 periods: twilight (07.00–08.00 h and 18.00–19.00 h), daylight (09.00–17.00 h), and nightime (20.00–06.00 h). Moon was only scored at night and cloud cover during daylight.

Individual differences in activity patterns (analyzed only from percentage of bearings with activity; see Palomares and Delibes 1991) were tested by Spearman rank correlation coefficient (r_s). Differences in daily activity time and distance travelled were tested using the Kruskall-Wallis test (H). The dependence of activity on environmental variables was examined using an unsaturated linear model based on logistic regression and maximum likelihood estimation (procedure CATMOD in SAS; SAS 1988). The response variable (activity) was considered to have just two levels (active or inactive), and the independent variables included both qualitative (wind speed, cloud cover, moon, fog, rain, and time of day) and quantitative (temperature) factors. To account for possible nonlinear responses of activity to temperature, the square of this variable was added to the other independent variables. The effect of environmental factors on the rate of movement was analyzed using a general linear model (procedure GLM; SAS 1988). Distances were log-transformed for the analysis. As distance travelled was estimated from each 2-h interval and 3 records of each environmental factors were obtained for each one of them, we considered the intermediate value for the model.

Results

Coypu activity was mainly nocturnal, with two activity peaks: one around 20.00–21.00 h, approximately one hour after sunset, and the other between 04.00 and 06.00 h, approximately two hours before sunrise (Fig. 1). Daily activity patterns were similar among all individuals (all $r_S > 0.50$, all $p < 0.015$). The mean proportion of daily bearings with activity was 54.2% (n = 42, SD = 11.5, range = 29.2–79.2). Although some individual variation was observed (individual means ranged from 47.9 to 63.0%), it was not statistically significant (H = 10.86, p = 0.054).

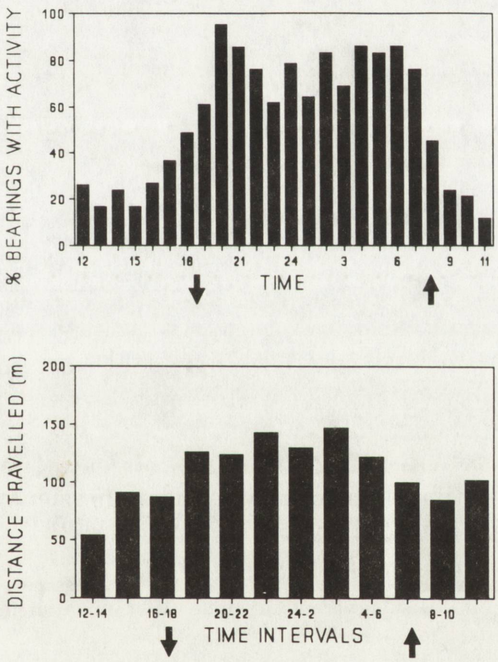

Fig. 1. Winter activity patterns of radiotracked free-ranging coypus in the Paraná River Delta (Argentina) as estimated by percentage of bearings with activity and rate of movements. Arrows show sunset and sunrise during the study.

Two environmental factors were found significantly related to coypu activity: period of day and rainfall (Table 1). Coypus were active on 78.8% of all bearings made during the night (n = 444), compared to only 22.6% during daylight (n = 376). Intermediate values were obtained for twilight (57.8%, n = 166). On the other hand, coypus were more active during rain (58.3%, n = 24) than without it (53.3%, n = 980). Removing twilight periods from the analyses to prevent the possible influence of a period of transition in coypu activity, resulted in similar findings (Table 1). A separated analysis of the influence of environmental factors on coypu activity during the night and the day, revealed that rain only affected it to some extent during daylight, and no factors at nighttime (Table 1).

Coypu locomotor activity was also higher at night than during daylight (Fig. 1). Mean distance travelled peaked between 02.00 and 04.00 h (Fig. 1). Mean minimum daily distance travelled was 1.25 km (n = 42, SD = 0.60,

Table 1. Influence of environmental factors on coypu activity. [2)] Temperature × temperature, a – the factor was not scored for some of the day periods included in the analysis, b – the factor was not scored for this period, c – the factor was not present during this period.

Independent variables	General analysis			Daylight and night only			Daylight			Night		
	χ^2	(df)	p	χ^2	(df)	p	χ^2	(df)	p	χ^2	(df)	p
Temperature	0.14	(1)	0.710	0.03	(1)	0.863	1.04	(1)	0.309	0.03	(1)	0.873
Temperature[2)]	0.16	(1)	0.688	0.01	(1)	0.942	1.11	(1)	0.292	0.04	(1)	0.834
Wind	7.02	(5)	0.219	5.05	(4)	0.282	4.08	(4)	0.395	3.03	(3)	0.387
Moon	a			a			b			1.38	(3)	0.240
Fog	0.15	(1)	0.674	0.17	(1)	0.679	c			0.07	(1)	0.790
Day period	88.90	(2)	0.000	77.76	(1)	0.000	–			–		
Cloudiness	a			a			1.58	(3)	0.663	b		
Rain	7.66	(1)	0.006	6.78	(1)	0.009	3.47	(1)	0.063	c		

Table 2. The lack of influence of some environmental factors on nocturnal 2-hour movements of coypus (from 20.00 to 06.00). [2)] Temperature × temperature.

Independent variable	df	F value	p
Temperature	1	2.86	0.093
Temperature[2)]	1	2.93	0.089
Moon	1	0.01	0.913
Fog	1	0.12	0.726
Wind	3	1.39	0.247

range = 0.41–2.59). Individual mean minimum daily distances ranged from 0.93 to 2.00 km, but the differences were not statistically significant (H = 9.78, p = 0.082).

We only analyzed the influence of environmental factors on coypus locomotor activity during night. No environmental factor was significantly related to coypu nocturnal movement rate (Table 2).

Discussion

Winter activity of free-ranging coypu living in its natural environment is mainly nocturnal. Onset of activity occurs shortly after sunset; high levels of locomotor activity are maintained during the night. These results agree with those reported for captive and feral introduced coypus elsewhere (Łomnicki 1957, Chabreck 1962, Gosling 1979). The activity pattern suggests that the end of activity is more variable (with the peak less pronounced) than the onset. Temperature did not seem to influence coypu activity, as it had been previously observed by Gosling (1979). Chabreck (1962) also detected no changes in coypu activity due to temperature. This difference may be a result of colder night temperatures in Britain where Gosling carried out his observations; the mild minimum air temperatures reached during our study (range: 9–15°C) did not seem to be critical to coypus. The only environmental factor that we detected influencing coypu activity was the occurrence of rainfall during the day. Movements to avoid adverse weather conditions could explain this result.

The two methods used in this study to assess the patterns of daily activity coincide to reveal the nocturnal habits of this species; however, activity peaks were in different times with each method. This result may be explained in relation to the expected predominant behaviour that coypus exibited at those intervals. In captive animals, Gosling (1979) observed that feeding was more intense in the early evening, and that other activities such as nest building and autogrooming, increased around sunrise. Since these activities may be accomplished with short or without displacements, they would be detected only throughout recording activity as revealed by the motion sensor of the transmitters. On the other hand, captive coypus performed swimming activities with greater intensity after midnight (Gosling 1979), in coincidence with the observed peak in coypu movements in this study. Because coypus at the study area presented large home range overlapping (authors, unpub.), this behaviour could be. also related with their spatial organization and social interactions which seem complex in this species (Ryszkowski 1966, Doncaster and Micol 1989).

It can be considered that only light conditions (period of the day) accounted for significant variation in the activity of coypus. The similarity between the circadian rhythms observed in our study area and those obtained in captive and feral coypus in areas where the species was introduced, suggest that the nocturnal pattern observed reflects an endogenous activity pattern which has evolved in the nature range (Aschoff 1966, Daan and Aschoff 1975, Gosling 1979).

Acknowledgements: The research was partially supported by the Spanish Ministerio de Educación y Ciencia and the Junta de Andalucía. A. Pulenta provided housing and logistic support during the fieldwork. We thank to O. Maglione for trapping animals and for allowing us to carry out this study on his property. R. Quintana and J. Merler helped with the fieldwork. C. M. Herrera performed part of the statistical analysis and made useful comments during the preparation of the manuscript. L. M. Gosling kindly reviewed an earlier version of the manuscript.

References

Aschoff J. 1966. Circadian activity pattern with two peaks. Ecology 47: 657–662.

Ashby K. R. 1972. Patterns of daily activity in mammals. Mammal Rev. 1: 171–185.

Chabreck R. H. 1962. Daily activity of nutria in Louisiana. J. Mammal. 43: 337–344.

Crespo J. A. 1974. Observaciones sobre la reproducción de la nutria en estado silvestre. Primer Congreso Argentino de Producción nutriera. Santa Fe 1: 60–73.

Daan S. and Aschoff J. 1975. Circadian rhythms of locomotor activity in captive birds and mammals: Their variations with season and latitude. Oecologia 18: 269–316.

Doncaster C. P. and Micol T. 1989. Anual cycle of a coypu (*Myocastor coypu*) population: male and female strategies. J. Zool, Lond. 217: 227–240.

FAO-PNUMA. 1985. Manejo de fauna silvestre y desarrollo rural. Información sobre siete especies de America Latina y el Caribe. INF. Of. Reg. FAO para A. Latina y el Caribe: 1–161.

Gosling L. M. 1979. The twenty-four hour activity cycle of captive coypus (*Myocastor coypus*). J. Zool., Lond. 187: 341–367.

Gosling L. M. 1981. Climatic determinants of spring littering by feral coypus, *Myocastor coypus*. J. Zool., Lond. 195: 281–288.

Gosling L. M. 1986. Selective abortion of entire litters in the coypu: adaptive control of offspring production in relation to quality and sex. Am. Nat. 127: 772–795.

Gosling L. M., Guyon G. E. and Wright K. M. H. 1980. Diurnal activity of feral coypus (*Myocastor coypus*) during the cold winter of 1978–9. J. Zool., Lond. 192: 143–146.

Hillbricht A. and Ryszkowski L. 1961. Investigation of the utilization and destruction of its habitat by a population of coypu, *Myocastor coypus* Molina, bred in semi-captivity. Ekol. pol. A 9: 505–524.

Kinler N. E., Linscombe G. and Ramsey P. R. 1987. Nutria. [In: Wildfurbearer management and conservation in Nort America. M. Novak, J. A. Baker, M. E. Obbard and B. Malloch, eds]. Ministry of Natural Resources, Ontario, Canada: 325–343.

Knowlton F. F., Martin P. E. and Haug J. C. 1968. A telemetry monitor for determining animal activity. J. Wildl. Manage. 32: 943–948.

Łomnicki A. 1957. The daily rhythms of activity in the nutria (*Myocastor coypus* Molina). Folia biologica, Kraków 5: 293–306.

Palomares F. and Delibes M. 1991. Assessing three methods to estimate daily activity pattern in radio-tracked mongooses. J. Wildl. Manage. 55: 698–700.

Peterson F. 1968. Introducción a la meteorología. Espasa Calpe, Madrid: 1–469.

Ryszkowski L. 1966. The space organization of nutria (*Myocastor coypus*) populations. Symp. zool. Soc. Lond. 18: 259–265.

SAS Institute. 1988. SAS/STAT User's guide. Release 6.03 Edition. SAS Institute Inc., Cary, North Carolina, USA: 1–1028.

Vickery W. L. and Bider J. R. 1981. The influence of weather on rodent activity. J. Mammal. 62: 140–145.

Ximénez A., Langguth A. and Praderi R. 1972. Lista sistemática de los mamíferos del Uruguay. Anales Museo Nacional Historia Natural de Montevideo, 2nd ser., 7: 1–49.

Received 13 January 1993, accepted 2 November 1993.