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MARSH DEER (*BLASTOCERUS DICHOTOMUS*) RANGING PATTERNS IN THE PARANÁ RIVER VALLEY, BRAZIL

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ABSTRACT

Twenty-two marsh deer (Blastocerus dichotomus) *were captured and radio-collared four different sites along the Paraná River, Brazil, to verify their seasonal movements and home range size. Five of these animals were transported 50 Km away from their capture site to provide data on the effects of translocation on their survival and ranging patterns. Marsh deer were monitored from October 1993 to December 1994, and core areas and home-range sizes were determined by the harmonic mean method. Males had larger home ranges than females, and individual ranges were larger during the flood than during the rest of the year. However, core areas did not differ in size between males and females or between flood and dry seasons for individual marsh deer. Translocated individuals did not differ in survival or ranging patterns from native marsh deer.*

Keywords: conservation, habitat use, marsh deer, radiotelemetry, translocation

INTRODUCTION

The marsh deer, *Blastocerus dichotomus*, is the largest of the living native South American herbivores, weighing up to 150 Kg (Pinder and Grosse, 1991). This cervid is typical of the South American tropical and sub-tropical wetlands to the south of the Amazon river. The species is highly dependent on aquatic

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vegetation to meet its food and shelter requirements. Within seasonally flooded plains, the fluctuation on water level is probably a limiting factor and may determine the extension of seasonal movements performed by these animals (Schaller and Vasconcelos, 1978).

The recent construction of a dam in the Brazilian Paraná river encouraged studies to protect one of the largest populations of this endangered cervid, which is threatened due to the loss of habitat (Fonseca *et al.*, 1994; Pinder, 1996). The present study aimed to test two hypotheses related to the marsh deer's ranging patterns in the Paraná river: 1) marsh deer move up the Paraná tributaries during the flood; 2) translocation does not significantly affects the survival of marsh deer.

The assumption that marsh deer use Paraná river tributaries during large flood suggests that they will escape from the flooding of Porto Primavera's reservoir by moving along the flood fringes into the tributaries. However, so far no formal study has been conducted to verify the suitability of these habitats for marsh deer. In addition, in a recent survey, the author has not confirmed the presence of the species in the Paraná river tributaries (Pinder, *op. cit.*). Therefore, testing the first hypothesis one may answer whether or not marsh deer will have a natural escape route from the permanent flood caused by the reservoir.

The second hypothesis tries to answer whether or not translocation of a number of individuals to other areas might help to preserve part of the gene pool of this population, if there is no natural escape route to the marsh deer in Porto Primavera. Such effort was already done in 1991, after the construction of a dam in a large tributary (Tietê) of the Paraná river (Moraes et al, 1993). However, no marsh deer was radiocollared to verify the survival and dispersal of the individuals removed.

Besides testing hypotheses that bring forth a pragmatic management insight, this work is relevant to enhance knowledge on this rare and little known herbivore, whose ranging habits had remained speculative up to date. Due to the logistic difficulties in studying this species, previous fieldwork had only focused on surveying the marsh deer geographic distribution and conservation status (Schaller, 1976; Schaller and Vasconcelos, 1978). More recently, a few site-specific population estimates were conducted (Beccaceci, 1994; Mauro, 1993, Moraes et al, 1993, Pinder, 1996).

Study Area

The study area is located in the Paraná River valley, just above the Capricorn parallel, in southwestern Brazil. It extends from S20°46'54" to S22°31'38", encompassing over 250 Km of a 10 Km wide seasonally flooded wetland, along

the right Paraná river bank. The river flows southward from the central plateaus of Brazil into Paraguay and Argentina to the Atlantic Ocean.

Altitude ranges from 240 to 450 m above sea level. The climate is tropical with one wet and one dry season. Average annual rainfall is 1,395 mm, with the rainy season occurring from October to March. Most of the rainfall takes place in December, January and February, and the flood in the later two months. Annual average temperatures range between 20° and 24°C. Maximum absolute temperatures reach 41°C in November and minimum of -1°C in July.

The valley soil can be classified into three age categories of the sediment: 1) the lowland floodplain (255m), a 2 Km wide fringe of recent deposits along the river, and 2) a higher (265 m) and wider (8 Km) strip of older sedimentary terrain called terrace, that borders the hilly landscape beyond the valley. Lowland floodplain is completely flooded in January and February, with exception of a narrow strip (50 m) of gallery forest on rich alluvial soils along the river. This wetland consists mostly of marshes and grasslands. Several narrow semi-deciduous forest patches on sandy soil, of a few hundred meters long each, are interspersed with seasonally flooded marshlands. Vegetation on the terrace follows the same pattern described above, differing in the marshes that are less diverse in species composition and *Thypha dominguensis* often dominates. Terrace may be subject to severe droughts, after long lasting rainless seasons. The tropical forest (Cerradão) on the slopes surrounding the floodplain has been almost completely clear-cut for cattle ranching. On the other hand, the river valley has been little affected by agricultural activities, and still harbors several species of large birds and mammals. The fauna includes rare species such as spoon bills (*Ajaja ajaja*), jabiru storks (*Micteria jabiru*), tapirs (*Tapirus terrestris*), and jaguars (*Panthera onca paraguaiensis*). The average density of marsh deer in the study area is 0.52 ind./Km≤, with a total population estimated ranging from 741 to 1,194 individuals (Pinder, 1996).

Material and Methods

Four distinct areas along 100 Km of the Paraná river valley were selected to capture 22 marsh deer in the first two weeks of July 1993: Santana ranch to the left bank of the Pardo river (P.R.), a tributary of the Paraná (S21°41'22", W52°10'17"); São Luis ranch (S.L.), 10 Km to the south of Pardo river (S21°49'09", W52°13'20"); Santa Clara ranch (S.C.) (S22°01'31", W52°21'53"); and Santo Antônio ranch (S.A.) (S22°19'13", W52°47'49").

Pardo river is the largest tributary in the area and was selected for this study to test the hypothesis of migration during the flood season at the Santana

ranch. Santo Antônio was selected for the capture of animals for the translocation experiment to Santa Marta ranch (S22°06'14", W52°27'27"). São Luis and Santa Clara, in between the two previous ranches, were chosen as control for the experiments.

A total of 14 females and 8 males were captured with the aid of a CODA net-gun and a Bell Jet Ranger helicopter from 02 to 12 July (winter) of 1993: 2 males and 2 females at P.R.; 1 male and 3 females at S.L.; 3 males and 6 females at S.C.; 2 males and 3 females at S.A. One to five animals were captured daily in early morning or late afternoon hours. Pursuit time averaged less than 2 minutes and processing lasted less than 20 minutes, including measurements and ear-tagging. One of the females was captured by CESP personnel, using the drive net method, at Pardo river. The same method was used for the rescue at the Tietê river. Another previous trial, using the drive-net, caused the death of a two-year old male at P.R. A comparison between net-gun and drive-net methods of capture was discussed by Pinder and Audi (1994).

The animals were fitted with MOD-500 activity (Telonics Inc.) radio-transmitters and immediately released, with the exception of S.A. group that was translocated to Santa Marta ranch. A mixture of Xylazin (0.5mg/Kg) and Ketamine (1mg/kg) was used to tranquilize marsh deer during transportation. Yohimbine (0.4 mg/kg) was used to revert the effects of Xylazin. It took from 20 to 30 minutes to transport each marsh deer using a hanging cage attached to the helicopter. All translocated marsh deer were released on terrace within an area of 1.6 Km2 at Santa Marta ranch. The habitat is dominated by *Thypha sp.*, interspersed with marsh and grassland spots. The distance between released individuals ranged from 0.7 to 1.3 Km. Less than 10% of the area is covered by narrow or rounded tree islands that range in size from a single tree to 40 meters wide.

The releasing area was 12 Km to the Sw of the marsh deer population monitored at S.C. This area encompasses 56 Km2 of terrace swamps limited by semi-deciduous forest (Cerrado) to the east, pasture to the west, and tree swamps to the north and south.

Systematic locations started in October 1993, after the translocated marsh deer had already dispersed from the releasing area and settled a new home range. Each animal was found and observed a minimum of five and a maximum of nine times monthly during the study. The locations were scheduled to cover all periods of daylight. A Cessna 180 was used to locate and observe each individual. Fixes were registered with the aid of a Garmin GPS.

Survival rate is calculated using Kaplan and Meier (1958) method. Home range size is calculated through the harmonic mean using McPaal computer package. The 95% contour was used to estimate total area, and 50% contour estimated core areas. Location interval distances were compared between sexes,

native and translocated marsh deer, and among the four groups of deer using Kruskall-Wallis test. Kruskall-Wallis test is used to compare home range size between sexes, home range between translocated and native marsh deer, and home range among the four study sites. Dry season home range sizes of consecutive years (1993/1994) were compared by the Wilcoxon sign test.

Results

The number of locations per animal varied from 51 to 118 between July 1993 and December 1994, a variation due to the mortality of six marsh deer. In addition, a few locations were excluded because of human or equipment failure, and bad flying conditions. Three marsh deer died in consequence of illegal hunting (two males and one female), two females suffered natural death, and one male probably died in consequence of the capture effort.

Daily Movements of Native and Translocated Marsh Deer

Average distances between consecutive locations are not significantly different when compared between sexes, native and translocated individuals, or among study sites ($X2._{05}$). From October to December of 1993, marsh deer of the groups located in the extreme north of the study area (Santana and São Luis ranches) have the smallest movement medians, 1.55 Km (range 1.36-1.95 Km), and 1.40 Km (range 1.30-1.84 Km) respectively. Santa Clara's marsh deer moved 1.80 Km (range 1.51-2.79 Km), whereas translocated deer at Santa Marta moved 2.10 Km (range 1.33-2.50 Km).

Total Home Range Size

Male marsh deer used areas twice as large as females ($X2._{05}$). Translocated and native female's home range size ranged from 16.47 to 33.17 Km2 (n=13; x=23.57 ± 6.39 Km2), whereas males used 25.35 to 63.77 Km2 (n=7; x=47.69 ± 11.94 Km2). Males' core areas were also larger (6.61 ± 3.29 Km2) compared to those of females (3.16 ± 0.94 Km2).

Although all groups were in the same general area, site specific characteristics in habitat availability may have influenced the total home range size. A comparison among females of the four study sites showed significant range size differences ($X2.$). Home ranges increased in size from the South to the North. Female marsh deer located in the left bank of the Pardo river had an average home range size larger than São Luis, Santa Clara, and Santa Marta groups Rio

Pardo females used 33.12 ± 0.06 Km2 (n=2), whereas females of S.L., S.C. and S.M.occupied respectively 25.24 ± 1.12 Km2 (n=2), 22.01 ± 6.37 Km2 (n=6), 19.19 ± 3.60 Km2 (n=3). Such trend was less evident among males, but the two largest male ranges were located at the extreme North of the study area. At R.P. males used 58.18 ± 7.91 Km2 (n=2), whereas S.C. males occupied 43.02 ± 15.31 Km2 (n=3).

To minimize bias in home range size due to sex and site variables, females of neighboring S.C. and S.M are compared to assess possible differences between translocated and native marsh deer. This comparison does not show any significant difference between the two groups.

Home Range Size Between Seasons and Years

The number of locations for each marsh deer ranged from 16 to 24 locations for the 1993's dry season (July/December) and 8 to 10 for the 1994's flood season (January/February). During the dry season most of the marsh deer monitored used the lowland floodplain. During the flood season (January/February) these marshlands became almost completely submerged, pushing marsh deer towards the terrace. Marsh deer returned to lowland floodplain when water retreated, although they continue to use terrace to some extent. The complete exclusion of terrace areas only occurs if terrace dries out completely, as in the drought of 1994's spring, after the harshest dry season of the last years.

The observation of R.P. marsh deer movements demonstrated that marsh deer in the study area do not use Paraná river tributaries during the flood season. Instead, they moved away from the Pardo river into the higher lands of the Paraná river terraces. The distances covered between core areas for dry and flood seasons vary locally according to the area flooded, and the availability and homogeneity of suitable habitat in the region. The largest distances occurred in R.P., reaching up to 5.2 Km in a straight line from the dry season core areas to the flood season core areas on terrace. In R.P. the marshes located on terrace are much more fragmented by a mosaic of forest and short grass habitats than other study sites. Suitable marshes on terrace occur 5 km away from the Pardo river marshes. The smallest distances between dry and wet seasons core areas where 2.7 Km at S.C. This seasonal migration does not occur in areas of terrace, where the water source is continuous and homogeneous, as it was observed for two females at S.L., and one female at S.M.

There are no significant differences between the years of 1993 and 1994 for the boundaries of the areas used by individual marsh deer from June to December. Although sample sizes varied between years, the estimates suggest that the total home range size between years has not significantly differed also.

On the other hand, core areas differed somewhat in location. This behavior was more evident at São Luis ranch, where in 1994 marsh deer moved their core areas closer to the river banks relatively to 1993. This observation suggests the proportion of use of areas within the home range varied according to the water level.

Survival

Translocation did not cause differential mortality among translocated and native marsh deer, except for one male that might have died in consequence of the capture effort. This animal had difficulties in recovering from the anesthetics after the release and died between three and four weeks after the capture. Additionally, two males and one female were killed by hunters, and two females died from natural causes. The large variance in survival estimates for males and females did not allow a conclusive comparison, but suggests no differential mortality rate. After 18 month of study, marsh deer had a survival expectancy of 76.19%. If considered separately males expectancy of survival was 71.43 (95% CI: 37.96-100.00%), whereas females had an estimated survival of 78.57% (95% CI: 57.99-99.15%).

Adult mortality was approximately 16% per year. However, this percentage does not represent total mortality because fawn and yearling's mortalities are unknown. Hunting alone eliminated 9,5% of the studied marsh deer in a 12 month period. At the current levels, hunting does not endanger the whole population, estimated in 950 individuals (Pinder, 1996), but will contribute to the extinction of the species in the study area after the Porto Primavera's reservoir submerges the only marsh deer habitat available.

Discussion

Ranging Patterns

The present research indicates that marsh deer movements depend on the fluctuations of water level. Within the study area, home range sizes increased as the local amplitude of flood also increased. Additionally, the distance between seasonal core areas within home ranges increased as the flood covered larger areas. Therefore, it is hypothesized that populations located in areas subject to larger amplitudes of flooding, such as the Pantanal, will show larger ranging patterns and home range sizes, compared to the ones found in Porto Primavera region. Other variables such as food resources distribution and population density do also interact with flood regime to determine the quality of the habitat, which can be directly correlated with home range size.

Although, the marsh deer are dependent on wetlands, they also survive away from the major marshes, as long as there are permanent wet areas where they can forage. A few remaining populations survive within protected areas in the Cerrado, the Brazilian tropical savanna (Pinder, 1994). In the Cerrado ecosystem, the marsh deer occupy the narrow swamps formed along the rivers watersheds, locally called "veredas". Thus, in the Cerrado, the marsh deer ranging patterns may be determined not by the flood regime, but by the environmental changes caused by local drought patterns. In December of 1994, a couple of marsh deer was observed foraging in the ditches along of the major interstate highway crossing the study area, some 15 Km away from the river. This was the last wet spot available in that site away from the river valley.

The hypothesis of proportional range size according to the extension of the flooding shall plays an important role in the conservation and management of the marsh deer in the wild. Marsh deer populations located in wetlands subject to large areas of periodical flooding may be more vulnerable to habitat loss. For example, marsh deer at the Parque Nacional do Pantanal Matogrossense have to leave the protected area during the flood, moving into neighboring private lands (Mauro, 1993). Thus, conservation recommendations such as minimum areas to preserve a viable population should consider local characteristics of habitat instead of extrapolating from different biomes or study sites.

Seasonal Movements

The study of the marsh deer at the Rio Pardo left bank allows the demonstration that marsh deer at Porto Primavera do not use Paraná river tributaries during the flood season. This occurs because flood reaches the tributaries' floodplains before it reaches the Paraná rivers' terrace.

Away from the tributaries, marsh deer follows the pulse of flood going up the terrace and returning to the lower floodplains as they become less flooded. With the creation of the Porto Primavera reservoir this cycle will be broken forever and marsh deer will be pushed beyond the terrace into pasture lands. With the elimination of the only suitable habitat, most of the marsh deer population in Porto Primavera region will perish because there is little remaining native marshes where they could move to. A few individuals may survive in marginal habitats along the fringes of the lake, but without the vastness of the marshes as protection, poaching will probably eliminate them. Also, population modelling shows that small populations, of less than 500 individuals, are at risk of extinction due to catastrophic events and demographic stochasticity. If the species is vulnerable to inbreeding depression, the risk of extinction is further increased (Seal, 1994).

Translocation

Failures and difficulties in successfully translocating cervids have been discussed in the literature (Jones and Witham, 1990; O'Bryan and McCullough, 1985). Most of the deaths reported in these instances were caused by other factors than the capture and removal technique itself. Regarding this particular aspect, the present study did not differ from the others. Therefore, the translocation technique using the net-gun method could be successfully used to found new populations if suitable habitat is available.

However, before supporting translocation as a viable alternative for the survival of the Porto Primavera marsh deer population, complementary studies should be performed, because rescue operations frequently move animals to marginal and less suitable remaining habitats. Rescues are expensive, and their results are questionable. For example, population estimates periodically conducted in a releasing site, after the construction of a dam in the Tietê river, demonstrated the resident marsh deer population was momentarily increased by the introduction of individuals, but decreased to their original numbers one year after the translocation effort (Moraes *et al.*, 1993). These results suggest the local carrying capacity was exceeded, causing the decline of the population after a few months.

Furthermore, translocation of marsh deer from Porto Primavera to other populations in Brazil is not recommended since they will not significantly contribute to these populations. Also, introduction of deer to these populations may represent a significant risk of introducing new diseases (Seal, 1994).

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References

Beccaceci, M.D. 1994. A census of marsh deer in Iberá Natural Reserve, its Argentine stronghold. *Oryx* 28(2):131-134.

Fonseca, G.A.B., A.B. Rylands, C.M.R. Costa, R.B. Machado, and Y.L.R. Leite. 1994. *Livro Vermelho dos Mamíferos Brasileiros Ameaçados de Extinção.* Fundação Biodiversitas, Belo Horizonte, Brazil. 479 p.

Jones, J.M. and Witham, J.H. 1990. Post-translocation survival and movements of metropolitan white-tailed deer. *Wildl. Soc. Bull.* 18:434-441.

Kaplan, E.L., and P. Meier. 1958. Nonparametric estimation from incomplete observations. *J. Am. Stat. Assoc.* 53:457-481.

Mauro, R.A. 1993. Abundância e padrão de distribuição de cervo-do-pantanal *Blastocerus dichotomus* no Pantanal Mato-Grossense. Ms thesis, UFMG, Belo Horizonte, Brazil.

Moraes, W., G.M. Mourão, and R.L. Gasparini. 1993. Avaliação da população de cervos-do-pantanal *Blastocerus dichotomus* na área do rio do Pântano, Mato Grosso do Sul. Report to CESP, 7 pp.

O'Bryan, M.K. and McCullough, D.R. 1985. Survival of black-tailed deer following relocation in California. *J. Wildl. Manage.* 49:115-119.

Pinder, L. 1994. Marsh deer wild population status in Brazil. Pp 105-112 in (Pinder, L. and U.S. Seal eds.) *Cervo-do-Pantanal* Blastocerus dichotomus *análise de viabilidade da população e habitat* (PHVA). IUCN/SSC Captive Breeding Specialist Group, Apple Valley, MN, USA, 172 pp.

Pinder, L. 1996. Marsh deer *Blastocerus dichotomus* population estimate in the Paraná River, Brazil. *Biological Conservation 75:87-91.*

Pinder, L., and A. Audi. 1994. Capture and handling of marsh deer in the wild. Pp 131-138 in (Pinder, L. and U.S. Seal eds.) *Cervo-do-Pantanal* Blastocerus dichotomus *análise de viabilidade da população e habitat* (PHVA). IUCN/SSC Captive Breeding Specialist Group, Apple Valley, MN, USA, 172 pp.

Pinder, L., and A.P. Grosse. 1991. *Blastocerus dichotomus. Mammalian Species* 380:1-4.

Schaller, G. 1976. Report on a wildlife survey in northern Argentina and in the Emas National Park, Brasil. Mimeographed report to World Wildlife Fund, Morges, 17pp.

Schaller, G., and J.M.C. Vasconcelos. 1978. A marsh deer census in Brazil. *Oryx* 14(4):345-351.

Seal, U.s. 1994. Population biology and modeling. Pp 39-63 in (Pinder, L. and U.S. Seal eds.) *Cervo-do-Pantanal* Blastocerus dichotomus *análise de viabilidade da população e habitat* (PHVA). IUCN/SSC Captive Breeding Specialist Group, Apple Valley, MN, USA, 172 pp.

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