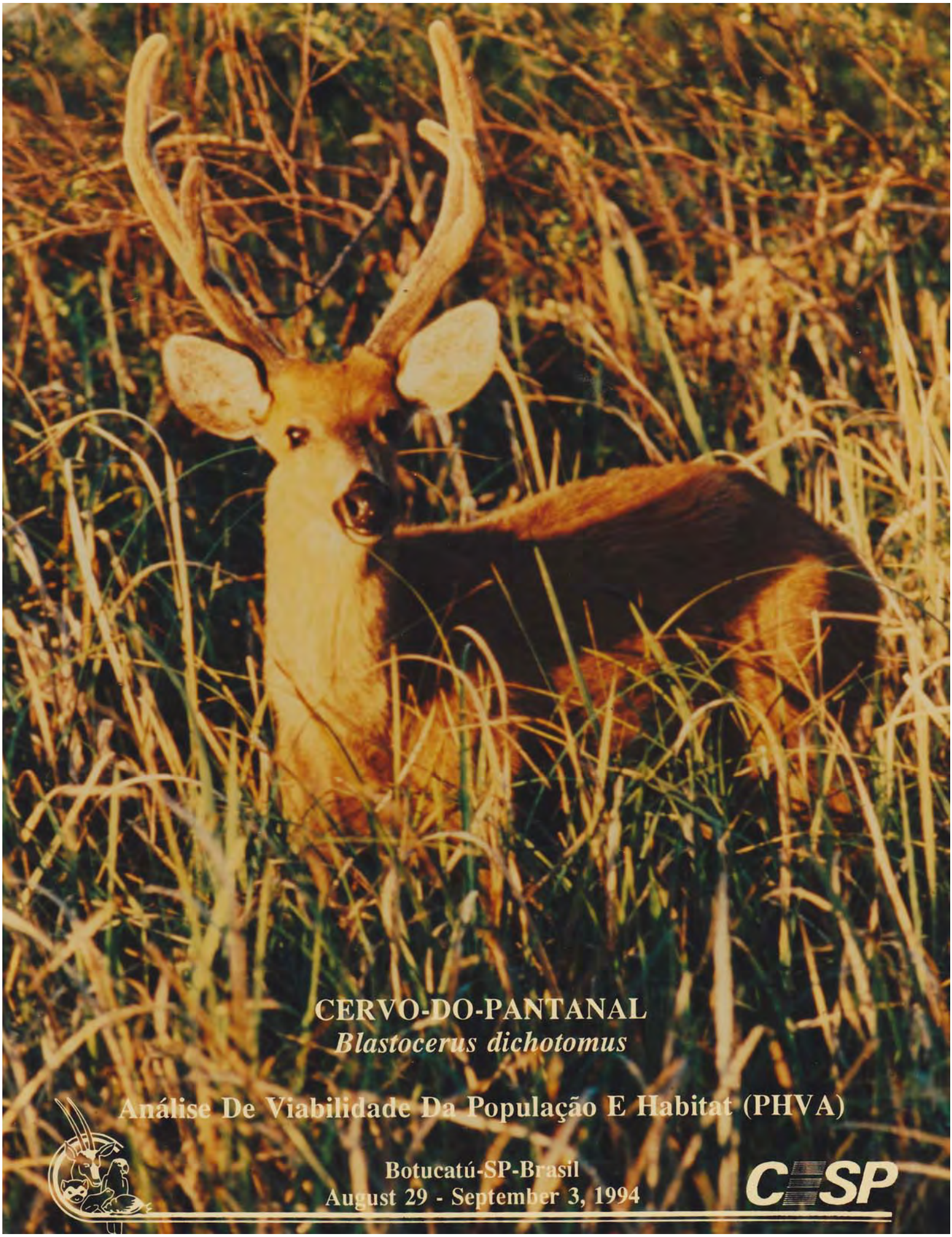

CERVO-DO-PANTANAL
Blastocerus dichotomus

Análise De Viabilidade Da População E Habitat (PHVA)

Botucatú-SP-Brasil
August 29 - September 3, 1994

CESP

CERVO-DO-PANTANAL

Blastocerus dichotomus

ANÁLISE DE VIABILIDADE DE POPULAÇÃO E HABITAT (PHVA).

BOTUCATÚ - SP - BRASIL
AUGUST 29 - SEPTEMBER 03

Report

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3 March 1995

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EXECUTIVE SUMMARY

Introduction

The marsh deer (*Blastocerus dichotomus*), largest of the South American cervids, is threatened in the wild. Similarly to many other large game mammals in the tropics, marsh deer populations are at risk due to habitat destruction and hunting. Their historical habitat, swamps and marshes, has been fragmented by agriculture and by dam construction in large rivers in Argentina, Brazil, and Paraguay. Poaching probably caused the extinction of the species in Perú and Uruguay and endangers isolated populations in Brazil, even though anti-poaching laws in this country are more rigorous relative to the neighboring countries. Current surveys estimate that marsh deer numbers 40.000 in Brasil, with 25,000 in the Pantanal and the remaining animals divided between five main populations. In Argentina, less than 2,000 are segregated into at least three populations. The status of the populations in Bolivia and Paraguay is unknown.

Although population sizes seem impressive, habitat destruction is occurring at a striking rate, drastically reducing wild populations. Approximately 1,000 marsh deer will perish within the next four years, with the creation of a single hydroelectric reservoir in the Brazilian Paraná river. A number of other dams and large scale agricultural projects are planned for this country, further accelerating habitat reduction and fragmentation in the next decades. Demographic catastrophes like this allied to the current rate of poaching, may eliminate wild populations, even before genetic drift problems come to play a role in reducing the viability of the species.

Presently, there is one national park with enough habitat available to maintain a marsh deer viable population in Brazil. However, the park exists primarily on paper, meaning no effective protection against poaching and future human encroachment. In Argentina the species is preserved in Iberá Natural Reserve, which thanks to its difficult access maintains a population of 1,100 individuals. Sizable national parks also exist in Bolívia and Paraguay, but the marsh deer situation in these areas is obscure.

The scenario of the species in captivity is similarly fragile. There are four populations in captivity: the Berlin Zoo keeps 5 females descendants of Paraguayan marsh deer, Ilha Solteira Zoo (Brazil) has 12 and Promissão Conservation Center (Brazil) has 21 individuals, all originating from Tietê river in Brazil. In Argentina there are 12 marsh deer in captivity at Guaycolec Breeding Center in Formosa Province. Reproduction in captivity occurs normally, but high rates of mortality have hindered the increase of the *ex situ* population.

This workshop was established to associate updated information from several experts in field biology, veterinary and captive breeding with population modeling techniques to evaluate possible conservation implications, and alternative management actions. The modeling procedures focused on the probability of extinction of wild populations given different demographic parameters, and helped understanding the relative importance of each variable contributing to the decline of isolated populations. For the captive population, the assemblage of different areas of expertise allowed for an overview of the current problems facing captive

breeding, and the design of a new strategy for the species propagation in captivity.

The main purpose of this workshop was to generate a conservation strategy that will increase the probabilities for the continuous adaptive evolution of *Blastocerus dichotomus* in the wild, as well as to guarantee a sound and integrated captive breeding management. The conservation strategy consists of recommendations for management procedures and basic research on wild and captive populations. The plan also assumes a combined international effort, rather than isolated endeavors to accomplish some of the conservation strategy goals.

The main steps to maintain viable populations in the wild are: 1) take actions to protect habitat and populations; 2) monitor periodically population numbers; 3) determine the genetic relationship among the main isolated populations to conduct proper conservation actions; 4) reintroduce founder populations into suitable habitat for self sustaining populations.

Objectives

The specific purposes of this workshop were:

1) To evaluate the current status and threats to the known marsh deer populations in the wild;

2) To indicate areas of knowledge where basic information on the species is missing.

3) To analyze short and long term alternative strategies to protect the marsh deer and its habitat in the wild.

4) To discuss alternative destinies for marsh deer located in areas doomed to disappear with the creation of reservoirs, in particular the Pôrto Primavera dam in the Paraná River, Brazil.

5) To discuss the role of the marsh deer captive breeding program in the conservation strategy context.

6) To address current management practices in the captive breeding program.

7) To generate specific recommendations for marsh deer conservation in the wild and its management in captivity.

Recommendations

Population status and habitat assessment

1) To conduct a study across the main marsh deer areas of occurrence to verify genetic variation between and within populations.

2) To monitor habitat changes through remote sensing within the range of marsh deer.

3) To select specific areas throughout the distribution of marsh deer to monitor changes in population size.

Protected areas, translocation and reintroduction

1) To create new protected areas in Argentina, Brasil, and Paraguay to ensure the survival of representative populations of the species.

2) To translocate a founder population into the Parque Nacional Pilcomayo, Argentina.

3) To start a program for the reintroduction of marsh deer in Uruguay.

4) To conduct experiments on translocation as means for future supplementation of small isolated populations.

Field Research

1) To verify density, sex ratio, social organization, and population dynamics of the population below Pôrto Primavera dam.

2) To determine reproductive parameters in the wild.

3) To evaluate marsh deer disease status, reproduction, and diet by periodically collecting individuals in the area to be flooded by Pôrto Primavera dam.

4) To develop criteria for the evaluation of habitat quality.

5) To conduct phenological and nutritional studies in parallel with a survey on diet.

6) To verify disease interactions and food overlap with cattle.

Management and research in captivity

1) To maintain a population of 50-100 individuals distributed among several institutions.

2) To create a central quarantine in Brazil to receive and distribute marsh deer captured in the wild.

3) To develop a studbook and a management plan for the species in captivity.

4) To deactivate the marsh deer Conservation Center in Promissão due to its inadequacy for the purposes of breeding and research.

5) To create a conservation center to coordinate an inter-institutional management plan for the species in captivity and to concentrate research efforts.

6) Research priorities are: neonatal mortality causes; disease monitoring and experimentation; parasitological surveys; veterinary treatments; physical and chemical restraint; reproductive parameters (hormonal cycles, behavior, parturition, lactation, etc); assisted reproduction; genetics and genome banking.

7) To establish an environmental education program as support to species conservation in the wild, selecting the research center, zoos, and selected areas for future reintroduction as well as native populations as targets of the campaign.

CERVO-DO-PANTANAL

Blastocerus dichotomus

ANÁLISE DE VIABILIDADE DA POPULAÇÃO E HABITAT (PHVA).

Wild Populations of Marsh Deer

DISTRIBUIÇÃO E HISTÓRIA NATURAL

Introdução

Atualmente não existe informações completas e atualizadas sobre a situação do cervo-do-pantanal nos distintos países de sua distribuição. Entretanto as informações disponíveis indicam:

Brasil

	Indivíduos
1) Pantanal (Levantamento aéreo, 1993) Superfície: 140.000 Km^2 (Mourão et al. com. pess.)	25.000
2) Rio Paraná (Levantamento aéreo, 1992) Superfície: 5.000 Km^2 (Pinder, com.pess.)	2.000
3) Bacia do Araguaia (Extrapolação, 1994) Superfície: 10.000 Km^2	5.000
4) Bacia do Xingu (Extrapolação, 1994) Superfície: 8.800 Km^2	4.400
5) Rio Guaporé (Extrapolação, 1994) Superfície: 6.000 Km^2	3.000
6) Rio Tocantins (Extrapolação, 1994) Superfície: 1.500 Km^2	750
7) Rio Juruena Superfície: 1.000 Km^2	500
	40.650

Argentina

1) Iberá (Levantamento aéreo, 1992) Superfície: 1.200 Km^2 (Beccaceci 1994)	1.100
2) Delta do Rio Paraná (Sem metodologia) Superfície: ?	100

3) Formosa ?
Superfície: ?

Paraguai

1) Dept. Concepcion ?
Superfície: ?

2) Dept. Neembucu ?
Superfície?

3) Dept. Central ?
Superfície:?

4) Dept. Paraguarí ?
Superfície:?

5) Dept. San Pedro ?
Superfície:?

6) Dept. Itapúa ?
Superficie:?

7) Dept. Misiones ?
Superfície:?

8) Dept. Presidente Hayes ?
Superfície:?

Bolívia:

1) Dept. Beni ?
Superfície:?

2) Dept. Santa Cruz ?
Superfície:?

3) Dept. La Paz ?
Superfície:?

Peru:

1) Dept. Madre de Dios ?

Uruguai:

1) Dept. Soriano Extinto ?

RECOMENDAÇÕES

1 - Status da espécie

Levantar a situação do habitat através de imagens de satélite, e com base nestas informação selecionar áreas de amostra para estimar o tamanho populacional em cada uma desta áreas.

Brasil:
Verificar a situação da espécie nas bacias do Tocantins, Xingu, Guaporé, e especialmente São Francisco . Comprovar a existencia da espécie na Bacia de Juruena.

Argentina:
Verificar a situação da espécie da Província de Formosa (Rio Pilcomayo), Delta do Rio Paraná, Rio Bermejo, e banhados da Provincia de Corrientes.

Paraguai:
Verificar a situação da espécie ao longo do Rio Paraguai e na área de Neembucú.

Bolivia:
Verificar a situação da espécia nos três Dept. onde ocorram a espécie.

Perú:
Verificar se a espécie ainda existe no Santuário Nacional Pampas del Heath

Uruguai:
Verificar se a espécie ainda existe ao longo do Rio Uruguai e nos banhados do Leste do país.

UNIDADES DE CONSERVAÇÃO

Brasil:

A ocorrência do cervo-do-pantanal está associada às Bacias Amazônica, do Prata e provavelmente na do Rio São Francisco, sugerindo a existência de três sub-espécies. Nas regiões mencionadas encontram-se áreas legalmente protegidas e que podem conservar populações da espécie:

Bacia Amazônica:	Reserva Biológica do Guaporé	6.000 Km^2
	Parque Nacional do Araguáia	5.200 Km^2
Bacia do Prata:	Parq Nac. do Pantanal Matogrossense	1.350 Km^2
	Estação Ecológica do Taiamã	143 Km^2
Bacia Rio São Francisco	Grande Sertão Veredas	840 Km^2

No P. N. do Pantana Matogrossense a proteção não é efetiva, pois no período de cheias a população de cervos é obrigada a se deslocar para fora destas áreas.

Ao longo do Rio Araguáia e seus tributários existe uma série de reservas indígenas de etnia Xavante e Carajás, cujas áreas são totalmente protegidas contra a agricultura e outras atividades como mineiração. Os próprios indígenas mantêm seu sistema de agricultura em regime de subsistência, apesar de diversas tentativas da FUNAI (Fundação Nacional do Índio) de implantar projetos modernos de agricultura intensiva. Os Xavantes culturalmente não comercializam os produtos da fauna e flora, embora existam pressões externas para que tal comercialização ocorra.

Peru	Bacia Amazonica - Pampas del Heath	1.021 Km^2
Bolívia	Bacia Amazônica - Beni	1.350 Km^2
Argentina	Bacia do Prata - Iberá	12.000 Km^2
	Otamendi	26 Km^2
Paraguai	Bacia do Prata - Tinfunqué	2.800 Km^2
Uruguai	El Potrerillo	715 ha.

PRINCIPAIS AMEAÇAS

Bacia Amazônica:

Brasil e Bolívia

Rio Guaporé e Beni - Com o rápido crescimento populacional na região nas décadas de 1980 e 1990, uma forte pressão de caça tem sido causada por madeireiros é seringueiros Brasileiros. Considera-se que a maior pressão de caça seja causada por camponeses Bolivianos que atravessam a fronteira para caçar em território Brasileiro. Outro provável problema é a presença de búfalos indianos ferais que podem representar elementos intermediários para a transmissão de doenças e competir pelo uso do habitat.

Com respeito à região do Beni existe uma alta pressão de caça somada a modificação do habitat consequente aos projetos de desenvolvimento agrícolas financiados pelo Banco Mundial.

Rio Araguáia - Parte do habitat secundário (campos úmidos de cerrado) para o cervo-do-pantanal foi parcialmente transformado em pastagens artificiais para a pecuária. O restante da área natural-foi também ocupada pela pecuária extensiva. Como consequência, o único habitat contínuo disponível ocorre ao longo do vale do Araguáia e Ilha do Bananal. Existem planos de grandes empreendimentos de drenagem das várzeas para o plantio de arroz nas planícies de inundação. Na Ilha do Bananal os índios Carajás, devido a degeneração cultural estão causando problemas ao Parque do Araguáia através da caça e comercialização de produtos faunísticos, que possívelmente incluam produtos do cervo-do-pantanal. Tanto a fiscalização do IBAMA quanto da FUNAI não garantem a proteção da fauna local.

Bacia do Prata:

BRASIL

Supreção de habitats devido à intensificação das atividades antrópicas nas áreas de ocorrência da espécie.

Redução de populações remanescentes de cervo-do-pantanal devido ao aproveitamento hidrelétrico.

Rio Paraná - Após a formação do reservatório da Hidrelétrica de Porto Primavera previsto para 1998, que tera superfície de 2.500 Km2, restarão apenas cerca de 1.000 cervos à jusante de sua barragem. Nesta área remanescente, localizada entre o remanso do reservatório da UHE Itaipu Binacional e a região do Pontal do Paranapanema, existe previsão para construção da Usina Hidrelétrica de Ilha Grande Alta.

BRASIL-PARAGUAI-ARGENTINA

Rio Paraguai - Existe plano para a construção da Hidrovia Paraná/Paraguai na próxima década. Isto afetará populações de cervos ao longo destes rios e de seus afluentes, como o Taquarí, Rio Negro e São Lourenço entre outros. Esta alteração ambiental afetará entre 10% e 20% do habitat útil do cervo-do-pantanal .

Considera-se grave ameaça, o endemismo de brucelose e febre aftosa na região do Pantanal. Uma grave epidemia abateu inúmeros indivíduos nos anos 1977/1978. Não existem registros anteriores ou posteriores de outras epidemias de semelhantes proporções.

Reduções populacionais significativas podem ocorrer ciclicamente entre 10 e 15 anos em consequência de grandes cheias, que causam uma redução na disponibilidade de habitat .

ARGENTINA

Banhados de Iberá - Não existem planos de manejo para a reserva, onde falta controle contra caça furtiva. No seu entorno existem projetos agrícolas de cultivo de arroz com retirada de água do sistema .

RECOMENDAÇÕES

1 - Status da espécie

Levantar a situação do habitat através de imagens de satélite e com base nesta informação selecionar áreas de amostragem para estimar o tamanho populacional em cada uma desta áreas.

Brasil:

Verificar a situação da espécie nas bacias do Tocantins, Xingu, Guaporé e especialmente São Francisco . Comprovar a existência da espécie na Bacia do Juruena.

Peru:

Verificar se a espécie ainda existe no Santuário Nacional Pampas del Heath.

Argentina:

Verificar a situação da espécie da Província de Formosa (Rio Pilcomayo), Delta do Rio Paraná, Rio Bermejo, e banhados da Província de Corrientes.

Paraguai:

Verificar a situação da espécie ao longo do Rio Paraguai e na área de Neembucú.

Bolívia:

Verificar a situação da espécia nos três Deptos. onde a espécie possibelmente ocorre.

Uruguai:

Verificar se a espécie ainda existe ao longo do Rio Uruguai e nos banhados do Leste do país.

2 - Criação de Novas Áreas Protegidas

Brasil:

No caso da existência de Cervos no Rio São Francisco, pesquisar a viabilidade para o estabelecimento de uma Unidade de Conservação. Criação de novas Unidades de Conservação no Pantanal do Mato Grosso do Sul e Mato Grosso, especialmente na região do Rio Negro e lago uberaba respúctivamente. Em relação ao Parque Nacional do Pantanal faz-se necessária a proteção da área de seu entorno em consequência da migração sazonal de sua população de cervos-do-pantanal. É prioritária a criação de uma área protegida no remanescente de áreas úmidas à jusante da barragem de porto primavera.

Paraguai:

Criar as seguintes áreas protegidas:

Parque Nacional Rio Negro
Parque Nacional Lago Ypoá
Parque Nacional Laguna Inmákata
E outras onde se verificarem a presença do Cervo do Pantanal.

Argentina:

Criar áreas protegidas no Rio Pilcomayo (Formosa), Delta do Rio Paraná e Banhados da Província de Corrientes.

3 - Translocação e Reintrodução da Espécie

Em consequência das populações brasileiras de cervo do pantanal apresentarem ainda números considerados suficientes para a preservação da espécie, não se vê a necessidade momentânea de serem efetuadas reintroduções.

Propomos que para o programa de reintrodução da espécie no Uruguai, sejam enviados animais brasileiros provenientes de cativeiro. O Uruguai deverá contar com um sistema

de aclimatação, antes se serem realizadas as reintroduções na área protegida El Potrerillo.

Existe um programa de reintrodução da espécie no Parque Nacional Rio Pilcomayo, Argentina. Neste parque a espécie conta com um ambiente ideal, que já abrigou uma população de cervos do pantanal, anteriormente à proteção da área.

Sugere-se a realização de um projeto binacional Brasil/Argentina, destinado a estudar a capacidade de adaptação e colonização dos ambientes por cervos do pantanal reintroduzidos. A informação científica obtida poderá subsidiar futuros projetos de translocação da espécie em território brasileiro. Devido à proximidade com a população que será afetada pelo enchimento do reservatório de Porto Primavera, sugerimos que animais na região de influência desta barragem sejam utilizados no programa de reintrodução na Argentina.

4. Realização de Estudos Sobre a Espécie em Vida Livre

A) Levantamentos populacionais que permitam estimar:

Estrutura sexual, organização social, densidade e dinâmica populacionais

B) Avaliação de habitats e fenologia.

C) Avaliação das pressões humanas (caça e agropecuária).

D) Interação com espécies exóticas.

E) Avaliações dos hábitos alimentares da espécie.

F) Estudos genéticos entre as populações brasileiras (Bacia Amazônica, Prata e São Francisco) e entre estas e a dos outros países.

G) Estudos reprodutivos e eco-etológicos da espécie em áreas protegidas ou não.

H) Monitorar a fragmentaçao dos habitats na regiao de ocorrência atual da espécie.

5. Prioridades de Pesquisa:

1. Ecologia populacional do cervo do pantanal - iniciar uma pesquisa a respeito do cervo-do-pantanal na reserva a ser proposta à jusante da barragem de Porto Primavera em 1995.

A. Justificativa: Existem poucos dados sobre a dinâmica populacional do CP. Tais informações são extremamente necessárias para direcionar qualquer programa de manejo para conservação do CP na América so Sul. Concensualmente este projeto é prioritário para a conservação do CP.

B. Objetivos: Documentar parâmetros populacionais que incluem densidade, taxas de mortalidade e sobrevivência, distribuição espacial, uso de habitat e se possível taxas de recrutamento.

C. Metodologia: Capturar, instalar rádio-colares e monitorar uma população de 40 a 50 CP equitativamente distribuídos entre classes de idade e sexo, por um período de 3 anos. Observação: após o primeiro ano a manutenção da amostra de 40 a 50 CP poderia requerer uma captura adicional de 10 a 15 animais anualmente.

2. Reintrodução do CP no Parque Nacional de Pilcomayo, Argentina - o CP foi exterminado da área do Parque Nacional de Pilcomayo há aproximadamente 20 anos, antes da criação deste parque. A população de CP à montante da barragem de Porto Primavera, a qual será perdida com o enchimento de seu reservatório em 1998, fornece uma fonte de CP excedente. Estes animals podem ser transportados para Pilcomayo na tentativa de se estabelecer uma população viável desta espécie na área protegida.

A. Justificativa: A população de CP de Porto Primavera representa uma oportunidade ímpar para pesquisa biológica sobre uma espécie ameaçada de extinção. Independentemente do resultado, este experimento produzirá considerável quantidade de informações para a elaboração de futuras estratégias de manejo.

B. Objetivos: Estabelecer uma população viável de CP.

C. Metodologia: Capturar 30 CP da população de Porto Primavera anualmente, durante 3 anos, e translocar para o Parque Naccional de Pilcomayo. Os cervos translocados serão monitorados através de radiotelemetria, para facilitar a availiação do sucesso da reintrodução. Esta operação de translocação dependerá da seleção prévia de locais dentro do Parque Nacional de Pilcomayo, avaliação de seu habitat, avaliação sanitária da população de gado ao redor do parque e pressão de caça. Os animais serão submetidos a um periodo de quarentena anterior a translocação.

3. Suplementação populacional - Varias populações de CP no Brasil foram isolados devido a transformação de seu habitat. O tamanho de algumas destas pequenas populações parecem estar declinando a despeito da disponibilidade de habitat, possivemente como resultado da caca. Estas pequenas populações podem ser acrescidas pela suplementação de CP translocados. A fonte destes animais está disponível em Porto Primavera.

A. Justificativa: O habitat para o CP na America do Sul continuará a ser degradado e fragmentado nos próximos anos. A avaliação da translocação como uma técnica para a suplementação de pequenas populações é necessária para o estabelecimento de estratégias de conservação futuras.

B. Objetivo: Suplementar pequenas populações (20 a 30 cervos), para implementar a abundância e a viabilidade populacional.

C. Metodologia: O primeiro passo será selecionar uma pequena população de CP habitando uma área cuja capacidade de suporte ainda não foi atingida, na qual a caça pode ser controlada. O segundo passo será a translocação de 10 cervos com radio-colares anualmente nesta população, durante 3 anos. Os animais serão submetidos a um período de quarentena anterior a translocação.

4. Variabilidade genética entre populações - comparar a variabilidade genética das diferentes populações de CP existentes no Brasil.

A. Justificativa: Existem populações de CP associadas a bacais hidrográficas diferentes, e possivelmente distintas geneticamente.

B. Objetivo: A hipótese da existência de três sub-espécies localizadas na bacias Amazônica, do Prata e do Rio São Franscisco deve ser testada através de estudos genéticos, para forncer subsídios para elaboração de estratégias para conservação da espécie.

C. Metodologia: Obtenção de amostras de material biológico nas três bacias, extração de DNA e realização de estudos para caracterização molecular. Observação: A coleta de amostras e dados morfométricos e marcação deve ser realizada em todas as oportunidades de manuseio de cervos em vida silvestre.

DISTRIBUTION AND STATUS IN THE WILD

INTRODUCTION

Currently, there are little information on the status of several of the marsh deer populations in the wild. Most of the knowledge is concentrated in the populations located in the Pantanal and Paraná River, including the Brazilian and Argentinian/Paraguayan region. Virtually nothing is known about the populations situated in the Amazon basin. Also, it is not known whether or not marsh deer still occurs along the São Francisco River and tributaries.

POPULATION ESTIMATES AND EXTRAPOLATIONS

The marsh deer historically occurred in Argentina, Bolivia, Brazil, Paraguay, Peru, and Uruguay. The current estimates for known wild populations are cited for Argentina and Brazil. Extrapolations for other areas were made based on crude estimates of habitat availability and average density of 0.5 individuals/Km^2 found in the Paraná River.

	No of individuals
ARGENTINA:	
1) Iberá (aerial survey, 1992) (Beccaceci, 1994) Surface: 1,200 Km^2	1,100
2) Paraná River Delta (without methodology) Surface: ?	100
BRASIL:	
1) Pantanal region (aerial survey, 1993) (Mourão, pers. comm.) Surface: 140.000 Km^2	25,000
2) Paraná River, above Pôrto Primavera dam (aerial survey, 1992) (Pinder, in prep.) Surface: 2,500 Km^2	720 - 1,140
3) Paraná River, below Pôrto Primavera dam (extrapolated from the estimates above) Surface: 2,500 Km^2	1,000
4) Araguaia River Basin (extrapolated) Surface: 10,000 Km^2	5,000

5) Xingú River Basin (extrapolated) Surface: 8,800 Km^2	4,400
6) Guaporé River (extrapolated) Surface: 6,000 Km^2	3,000
7) Tocantins River (extrapolated) Surface: 1,500 Km^2	750
8) Juruena River? (extrapolated) Surface: 1,000 Km^2	500

Other areas where marsh deer occurs include:

ARGENTINA: Province of Formosa. Other areas of Corrientes province (apart) from Iberia)

BOLIVIA: Departments of Beni, La Paz, and Santa Cruz.

PARAGUAY: Departments of Concepcion, Neembucu, Central, Paraguai, San Pedro, Itapúa, Misiones, Presidente Hayes.

PERU: Department of Madre de Dios. Currently considered extinct.

URUGUAY: Department of Soriano. Considered extinct, but some dispersing marsh deer may be seasonally crossing the Uruguay river from Argentina.

PROTECTED AREAS

Marsh deer are found in a number of protected areas, including all of the countries within its range. However, the single estimation ever done into a protected area was conducted at Iberá Natural Reserve in Argentina, where 1,100 individuals were found (Beccaceci, 1994). Due to its difficult access, the park is reasonably safe from poaching. Besides this reserve, marsh deer sizable populations may occur only at the Pantanal and Araguaia National Parks in Brazil. Nevertheless, the Pantanal National Park becomes unsuitable for most of its population during the flood season. Many marsh deer may leave the park during that time of the year. The other area, the Araguaia National Park, is barely protected against encroachment and poaching.

In Brazil, the reserves created for the indigenous people, another category of federal protected land, may help in the conservation of marsh deer. Although subsistence hunting is allowed for the native people in these areas, there are ongoing plans to create hunting management guidelines to the benefit of the wildlife and the natives. There is a number of indigenous people reserves (Xavante and Carajás) along the Araguaia river and its tributaries, which are totally protected by the natives against agricultural development and mining operations. The natives maintain the agriculture on their own subsistence system, nonetheless several attempts by the Brazilian government in implanting commercial agriculture. Additionally,

the Xavantes do not traditionally commercialize wildlife products, resisting the continuous persuasion of illegal dealers.

The marsh deer is found in the following protected areas with the relative inferred populations, not including the indigenous reserves.

	No of individuals
ARGENTINA:	
1) Iberá Natural Reserve (aerial survey, 1992) (Beccaceci, 1994) Surface: 1,200 Km^2	1,100
2) Otamendi Natural Reserve Surface: 26 Km^2	?
BOLIVIA:	
1) Beni Biosphere Reserve Surface: 1,350 Km^2	?
BRAZIL:	
1) Reserves within the Amazonic Basin:	
- Guaporé Biological Reserve (inferred) Surface: 6,000 Km^2	150
- Araguaia National Park (inferred) Surface: 5,200 Km^2	500
2) Reserves within the Prata Basin:	
- Pantanal National Park (inferred) Surface: 1,350 Km^2	500
- Taiamã Biological Reserve (inferred) Surface: 143 Km^2	50
3) Reserves located away from major rivers and within the Cerrado:	
- Emas National Park (inferred) Surface: 1,300 Km^2	<20

- Grande Sertão Veredas National Park (inferred) < 10
  Surface: 840 Km^2

The presence of marsh deer in Iquê (2,000 Km^2) and Côco-Javaés (370 Km^2) Biological Reserves at the Amazonic Basin needs to be checked, but marsh deer probably number no more than a few individuals. Marsh deer may also have occurred in Mirador State Park in Maranhão State (Cerrado), and Lagoa do Peixe and Taim National Parks in Rio Grande do Sul State (coastal marshland system), but are now extinct.

PARAGUAY:

1) Tifunqué ?
   Surface: 2,800 Km^2

PERU:

1) Pampas Del Heath 15-20 animals
   Surface: 1,021 Km^2

URUGUAY:

1) El Potrerillo
   Surface: 715 ha.

MAIN THREATS

AMAZONIC BASIN:

Bolívia and Brazil:

Beni and Guaporé Rivers - One of the threats to marsh deer populations in this region is poaching. This region has suffered a rapid population increase as from the last decade, with the exploitation of timber and rubber-tapping. As a consequence of this human swamping in the region basically living off extraction, subsistence hunting sometimes is the only means that pioneers can supplement their diet. The major hunting pressure seems to be caused by Bolivian countryside people, that frequently cross the Brazilian border to hunt. Another possible threat is the presence of feral Indian buffalos that may be intermediary disease transmitters and food competitors with marsh deer. Additionally, for the Beni region in particular, there is a quick modification of the habitat caused by large scale agricultural projects financed by the World Bank.

Araguaia River - Marsh deer habitat in this region, the wet grasslands within the Cerrado, has been increasingly transformed into cattle pastures through the drainage and introduction of exotic grasses. The remaining natural habitat has already been occupied by extensive ranching. Consequently, the only habitat now available for marsh deer is the valley of the Araguaia River, including Bananal Island, where the Araguaia National Park and an Indigenous people reserve is located. Vast surfaces of soy bean plantations are covering the region around the lowlands and there are plans for marshlands draining to cultivate rice at large scale in the valley. At the Bananal Island, the Carajá Indians are invading the neighboring Araguaia National Park to hunt for food and to merchandise wildlife products that may include marsh deer harvests. Neither the Park Service Agency (IBAMA) nor the Indigenous people Agency (FUNAI) have been able to repress these activities.

PRATA BASIN:

Argentina:

Iberá marshlands - There are no management plans for the reserve, where poaching control is absent. Water is drained from its marshlands because of adjacent rice plantations.

Argentina, Brazil, and Paraguay:

Paraguay River - There are plans for the construction of a series of dams along Paraguay river, creating a new waterway within the next decade. Besides eliminating habitat for thousands of marsh deer along Paraguay river floodplains, the damming will affect other important rivers in the Pantanal, such as Taquarí, Rio Negro and São Lourenço. It is considered that with this construction between 10% and 20% of marsh deer habitat in the entire Pantanal will be destroyed.

Brazil

Pantanal - The negative effects on marsh deer populations, caused by the waterway, may be severely strengthened due to periodic outbreaks of cattle transmitted diseases and cyclic extreme floods. A great epidemic in 1977/1978 killed many marsh deer in the Pantanal, and every 10 to 15 years an extreme flood significantly reduces marsh deer habitat, facilitating disease transmission and starvation.

Paraná River - The remaining habitat for marsh deer in the Brazilian Paraná river is endangered by the operation of the two last hydroelectric dams in this river: Pôrto Primavera and Ilha Grande. Pôrto Primavera dam is completed and approximately 1,000 marsh deer will perish with the creation of its reservoir (2,500 Km^2) in 1998. Plans for the conclusion of the Paraná/Paraguay waterway include the construction of Ilha Grande dam, eliminating the remaining habitat for marsh deer below Pôrto Primavera (2,500 Km^2). However, there are local political resistance against the project, allied to ongoing projects for the establishment of natural preserves in that area.

Other major rivers - Governmental plans foresee the construction of additional hydroelectric plants in the major rivers of Brazil to further expand the energetic potential of the country. Therefore, the last strongholds of marsh deer in the wild will be critically reduced during the next decades.

Cerrado - The continuous grain production development for exportation, especially soy bean, is irreversibly eliminating secondary marsh deer habitat in the cerrado. It is predictable that marsh deer will disappear from this biome in a few decades, since numbers within its national parks are extremely low. Given proper management, some may remain in Indigenous lands.

RECOMMENDATIONS FOR *IN SITU* CONSERVATION

To properly conserve marsh deer in the wild, steps should be taken in the following lines of action: 1) to improve knowledge on the marsh deer status in the wild, including distribution, taxonomic possible differences, and threats towards currently isolated populations; 2) to improve the protected areas structure; 3) to conduct basic research in the species ecology and population dynamics; 4) to improve management tolls through experimentation with techniques such as translocation and reintroduction; 5) to reestablish populations in areas where marsh deer has become extinct.

Status in the Wild

1) Conduct a thorough investigation on the current marsh deer distribution and status within its range.

Argentina

Survey Formosa Province (Pilcomayo River), Parana River Delta, Bermejo River and marshlands of Corrientes Province for relictual populations.

Bolivia

Verify the situation of the species in the following areas: Beni, Santa Cruz, and La Paz.

Brazil

Update the information on marsh deer distribution and status in the Guapore, Tocantins, and Xingu basins. Verify whether or not marsh deer still occurs in the Sao Francisco River and the Tapajos River tributaries, such as Juruena River in Brazil. Estimate population sizes and evaluate threats to marsh deer within protected areas, especially: Araguaia and Pantanal National Parks, and Guapore Biological Reserve.

Paraguay

Verify the status of the populations across the Paraguay River and Neembucu region.

Peru

Verify whether marsh deer still occurs at Pampas Del Heath National Sanctuary.

Uruguay

Search for remaining individuals across the Uruguay river

flood plains and marshlands along the coast.

2) Monitor marsh deer habitat loss every five years through satellite images.

3) Monitor population changes through time by surveying selected areas throughout the marsh deer range, every five years.

Creation of Protected Areas

Marsh deer requires large areas of suitable habitats to maintain long term viable populations. Currently, two protected areas preserve sizable populations of marsh deer: Araguaia National Park (Amazonic Basin), and Ibera Natural Reserve (Prata Basin). However, none of the two areas represent assurance for the species maintenance, due to lack of law enforcement and conservationist land use policies. The following recommendations are given to improve marsh deer habitat protection.

Argentina

1) Implement a management plan for Ibera National Park and regulate land use around the park.

2) Create protected areas in the regions of Pilcomayo River, Parana River Delta, and marshlands of the Corrientes Province. Adequate protected areas should be established at the following sites: Rio Negro, Lago Ypoa, and Laguna Inmakata.

Brazil

1) Implement management plans and enforce poaching control in Araguaia and Pantanal National Parks. These results are better attained through the creation of long term research projects, conducted by resident field researchers.

2) Enlarge the Pantanal National Park boundaries or else guarantee full protection against habitat degradation and poaching around the park by decreeing it an Environmental Protection Area, another category of protected area in Brazil, consisting of land use regulation.

3) Create new protected areas to exclusively preserve large proportions of marshlands along rivers, which are barely represented in the Brazilian National Parks system. Areas of interest are: the region below Porto Primavera dam, to preserve the last population of marsh deer in the Brazilian Parana River; Rio Negro and Uberaba lake, as areas of high densities of marsh deer in the Pantanal; and an appropriate protected area in the Sao Francisco River valley, if a genetically distinguished population is found in that region.

RESEARCH AND MANAGEMENT NEEDS

Genetic Variability

Sample marsh deer biological material from each of the major rivers where the species occurs, to evaluate possible taxonomic differences among isolated populations.

Rational: Marsh deer is associated with three distinct river basins (Amazonic, Prata, and Sao Francisco), in which different marsh deer subspecies could have evolved during the series of isolations, caused by the Pleistocene dry periods (glaciations).

Objectives: The hypothesis formulated above should be tested through genetical studies. The results of this research will help establishing conservation priorities and strategies for the species.

Methods: Biological samples should be collected in at least one site for each river basin mentioned above. Molecular characterization should be done following DNA analysis.

Population Ecology

Rational: There are little data on marsh deer population parameters. These information are extremely necessary to direct any future management plan for the species in the wild.

Objectives: Documenting population parameters including density, mortality, survival, and recruitment rates. Ecological data should also be collected such as reproductive seasonality, dispersal, habitat use and preference.

Methods: Monitoring 50 radio-instrumented marsh deer for three consecutive years. The 50 animals should be equally segregated into sex and age and classes. The total of 50 animals monitored should be maintained at the beginning of each year, meaning the capture of additional individuals to substitute losses in the study group. This research should be conducted below the Porto Primavera dam to continue with studies already started in the area (Pinder, 1994).

Ecology

Rational: It is estimated that approximately one thousand marsh deer will perish with the operation of Porto Primavera hydroelectric. The sacrifice of a portion of these animals can however, provide useful information on reproduction, nutrition, diet, and interactions with domestic stock (food overlap, sharing of endo- and ectoparasites, etc).

Objectives: Verify reproductive seasonality, collect samples for genetic analysis, collect and

preserve germplasm (sperm, ova, and embryos), collect blood for serological analysis, collect digestive contents for diet evaluation, identify and quantify endo- and ecto-parasite loads.

Methods: Ten individuals should be monthly collected to provide information on seasonal variation in nutrition, diet, reproduction, and disease infestation during a whole year.

Reintroduction

Although reintroduction programs are not critical to the conservation of marsh deer in the wild at the moment, Argentina and Uruguay are interested in reestablishing wild populations in areas where the species has become extinct. Such initiatives could be useful in gaining experience towards the use of such procedure, and could help increase public education regarding environmental issues.

Argentina

Rational: Marsh deer was eliminated from Pilcomayo National Park region some 20 years ago. The area might be suitable for receiving marsh deer from the area affected by Porto Primavera dam. This area will produce a surplus of individuals that will otherwise perish with the flooding. Additionally, the animals could be safely transported to the releasing area since it is not geographically distant from Porto Primavera.

Objective: Reestablish a self sustaining marsh deer population in the Pilcomayo National Park.

Methods: The first steps in this attempt would be a complete investigation to determine the feasibility of the operation. Preliminary studies would need to determine the carrying capacity of the area, the absence of exotic fauna as potential competitors and intermediary facilitator for disease and parasite transmission. Also, poaching should be completely eliminated and a epidemiological study should be performed to verify disease compatibilities between the donor and receiving areas. The second step should be the capture and translocation of 30 marsh deer annually from Porto Primavera to Pilcomayo during three years. At least ten of the translocate marsh deer should be monitored so the success of the operation could be evaluated. All animals should suffer a quarantine in Brazil before the release in Argentina.

Uruguay

A proportion of the current marsh deer surplus generated in captivity in Brazil should be used to initiate new colonies in captivity within and outside the country. The foundation of a conservation and research center in Uruguay for marsh deer should be the prerequisite for a future reintroduction of the species into the wild. No translocations are recommended at this

moment since there are no protected areas in that country able to sustain a marsh deer population.

Supplementation

Several marsh deer populations in Brazil have been isolated in consequence of habitat transformation. Data form Porto Primavera suggest that some of these populations may be declining despite of habitat availability, probably due to excessive hunting. These populations may be increased by the supplementation of translocated marsh deer. Currently, the ideal source of these animals is Porto Primavera.

Rational: Marsh deer habitat will continue to decrease and fragment in the next decades. An evaluation of the translocation for supplementing small populations may be necessary as an strategy of future conservation of the species. One should take the opportunity of having expendable marsh deer in Porto Primavera to conduct such experiments.

Objective: Supplement a small population (20 to 30 individuals) to increase its probability of survival.

Methods: The first step will be to select an area where a known population is well below carrying capacity, and where poaching can be controlled. The second step will be to translocate 10 radio-instrumented marsh deer from Porto Primavera annually for three years, after a quarantine period.

Dam Impact

Thirty marsh deer should be radio-instrumented in the area to be flooded by Porto Primavera to document the fate of the population impacted by the dam. Mitigatory measures could thus be taken in similar future occasions.

Priorities for action

1) Conduct a thorough investigation on the current marsh deer distribution and status within its range.

2) Implement management plans and enforce poaching control within Araguaia, Pantanal, and Ibera National Parks.

3) Continue the current study on marsh deer population at Porto Primavera, extending population and ecological studies to the area below the dam, to gather basic information for future management of the species in the wild.

4) Control poaching in the study area.

CERVO-DO-PANTANAL

Blastocerus dichotomus

ANÁLISE DE VIABILIDADE DE POPULAÇÃO E HABITAT (PHVA).

Population Biology of Marsh Deer

POPULATION BIOLOGY AND MODELING

Wild marsh deer populations modeled included five in Brazil with N>1000 and two with sizes less than 1000. The largest population in the Pantanal estimated at 25,000 animals was not simulated, but the impact of present and potential threats was evaluated. Information on basic life history parameters was drawn from studies on 2 wild populations and the captive population.

Life History

The female marsh deer produces 1 fawn, with no reports of twins in the wild populations. The age of first reproduction is typically 1.5 to 2 years in the female with no data on possible delays under adverse conditions. The does breed every year. Males can breed at 2 years but are thought to be delayed 1 or 2 years in the wild because of dominance relationships or delays in maturation. However, all males were considered to have an equal opportunity to breed each year. Males appear to have a higher adult mortality since the adult sex ratio is about 1 male to 3 females in 2 wild populations. The species is polygynous. The life expectancy of the species may range up to 12 years but is thought to be about 10 years in the wild populations.

Brazilian Populations

This information is presented in the section on 'Wild Populations' and in the accompanying papers. Six of the 7 populations in Brazil appear to be stable in size with the upper limit for the Pantanal population at about 25,000 animals. The Rio Parana population of about 2,000 animals is expected to decline to 1,000 with closure of the dam. Census data are available for both populations with estimates of adult sex structure and numbers of fawns.

The fawn counts are at 2-12 weeks of age and indicate that 40-50% of the adult does have surviving fawns (unknown sexes) of that age. The counts for the females in the census need to be adjusted down for the number of immature females (perhaps 10-15% of the total) to estimate the proportion of adult females with fawns in a given year. The 1993 census then yields an estimate of 50% of adults with fawns surviving to 1-3 months of age.

The sex ratio of 'adults' in the Parana River population in Brazil (Pinder 1994) and the Ibera Natural Reserve population in Argentina (Beccaceci 1994) favors females with about 30-35% of adults counted as males. The skewed sex ratio has no certain mechanism, since the birth ratio is assumed to be 1:1. There may be differential adult male mortality in the wild populations as the result of selective hunting. Males may also be lost from the population because of dispersal and loss of juveniles. Adult males may die earlier on average as a result of the stresses of rut. Differential early male fawn mortality will be

important to determine, especially if it reflects inbreeding, because of the implications for management of gene flow and population size.

Threats To Brazilian Populations

Threats to the populations are multiple, but the primary concerns are illegal removals (poaching), abrupt habitat loss as a result of dam construction, gradual habitat loss, disease, and inbreeding depression in the smaller populations. The relative role of each of these factors differs between populations thus the model needs to be adjusted to the conditions prevailing in each population. This needs to be done as part of the process for developing a management plan for the species in each country.

During the capture of 22 marsh deer in Rio Paraná for a radio-telemetry study, blood samples revealed the occurrence of blue tongue disease in that population (M. Barbanti pers. comm.). Blue tongue is a serious problem for the reproduction of cervids in captivity (M. Barbanti, pers. comm.), and may have undermined previous attempts at breeding and keeping marsh deer in captivity in the tropics (Nogueira-Neto, 1973). Two great outbreaks of wild cervid mortalities were registered by Pinder (1992, unpublished report to FUNATURA), and Oliveira (1993) for the regions of Grande Sertão Veredas National Park and Mirador State Park respectively. These two independent epidemic catastrophes arose after the passage of cattle, transported from ranches to market areas. In the Pantanal and other remote areas of the interior without roads, it is still frequent to move cattle across large distances to sell them. In consequence, diseases can be easily spread within the wild population.

Increased parasite loads and exposure to diseases may occur as the distribution and numbers of domestic animals in deer habitat areas increase. Hunting pressure on the one herd that has been studied is severe enough to assure the eventual extinction of this population. There is an urgent need for diagnosis of the possible disease events and vectors since an endemic continuing disease process may provide a sustained reduction in reproduction and fawn survival. Similar events have been described in white-tail deer enclosures with high stocking rates and when managed with livestock. A die-off event was included in the catastrophe module of the model at a 10% frequency and a 0.5 severity on reproduction and 0.8 severity on survival (20% reduction in survival across all age groups).

Hunting contributes as significant decimating factor in those areas where marsh deer populations are already severely reduced by habitat transformation. Marsh deer also receives legal protection from the Brazilian government which has forbid its hunting since 1967. The species is listed in Appendix I of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Inbreeding and loss of genetic heterozygosity may result from years of low population numbers, skewed adult sex ratios, and a social structure that favors breeding by relatively few males in a given season. Given the 1) current size of the Brazilian marsh deer populations with the smallest estimated at 500 animals, 2) a generation time of about 5 years,

3) an estimated effective population size of 0.2 of the census population size (Ne/N = 0.2), and 4) a likely period of fragmentation of no more than 100 years, the rate of loss of heterozygosity due to drift would be 0.5% per generation or less with no correction for new variation acquired by mutation. This rate of loss is unlikely to have resulted in detectable inbreeding depression effects in these populations.

Marsh Deer Population Modelling

Simulation models were constructed to examine the interaction of:

(1) annual fawn mortality of 60, 50, and 40%;
(2) annual adult female mortality of 5, 10, and 15%;
(3) life expectancy of 10 years;
(4) proportion of does breeding annually at 90%;
(5) carrying capacities of 100, 200, 500 and 1500; and
(6) a catastrophe with a severity of 0.5 on reproduction and 0.8 on survival occurring at a probability of occurrence of either 10% or 5%.

on the population dynamics and risk of extinction of the wild marsh deer populations in Brazil and Argentina.

Each scenario was run 200 times for 100 years. Selected scenarios were run 500 times for better statistics. Version 6.23 of VORTEX was used to prepare the models. The simulations were run on a Toshiba T4600C computer with 33 MHz 486SLX processor with math coprocessor under MSDOS 6.22.

Constant values for the species used in all of the scenarios were (see the sample input file for further details, Table 5):

(1) age of first reproduction as 2 years for females and 3 years for males,
(2) polygynous,
(3) a litter size of 1 produced annually,
(4) no correlation of EV in survival with EV in reproduction,
(5) no change in carrying capacity (K) over time and SD=0 for K,
(6) initiating the runs with a stable age and sex distribution calculated with a Leslie matrix for the starting population of either 50, 200, 500 or 900 animals,
(7) no harvest or supplements to the population,
(8) all of the adult males were in the breeding pool.
(9) adult male mortality of 28% to yield an adult sex ratio of 1 male to 3 females.

Results

Approximately 140 scenarios were examined to encompass the interactions of ranges of values presented for the different wild populations and to provide sensitivity analyses for each of the variables and their interactions. The results are tabulated in Tables 1-4 and presented graphically in Figures 1-16. The tables identify each output file and the conditions varied (input) in that series of scenarios.

Results presented in order across the tables include:

(1) the file number of the run,
(2) mortality values for fawns and adult females as %, used in the runs,
(3) the deterministic 'r' value calculated with a Leslie matrix algorithm, (other deterministic values calculated, but not presented in the Table, were the generation time for each sex, the Ro, the lambda, the adult sex ratio, and the stable age distribution by sex),
(4) the mean stochastic 'r' value and its standard deviation calculated over the 200 (or 500) runs,
(5) the probability of extinction (Pe),
(6) the mean population size (N) of the surviving populations, and the standard deviation of the population size projections (SD) at 100 years,
(7) the proportion of heterozygosity (H) remaining at 100 years in the surviving populations, and
(8) the mean time to extinction, in years, for the populations that went extinct.

General Observations

If the deterministic '*r*' is negative the population cannot survive under the conditions specified in the simulation scenario. If the stochastic '*r*' is negative, even if the deterministic '*r*' is positive, the population will have a significant risk of extinction during the 100 year time period and the mean surviving population size will decline. Populations with both '*r*' values positive can have a significant risk of extinction (depending upon population size and the occurrence of catastrophes) and the population sizes can be less than the carrying capacity because of the effects of environmental variance and catastrophes. Slow population declines may take 10-20 years or more to become evident and may be difficult to detect in the wild populations, especially in annual censuses, because of the wide confidence limits of current census methodologies.

We examined the matrix of values for the combinations of variables which would yield an approximately stable population size for carrying capacities of 100, 200, 500, 1500 corresponding to several of the Brazilian populations.

Stochastic Growth Rate: The growth rate of real populations varies from year to year as a function of varying environmental and habitat conditions affecting mortality, reproduction,

and animal dispersal. These stochastic variations in the demographic parameters are incorporated into the model as standard deviations in the estimates of mean values for the individual populations. Such multiple year data is not available for any of the populations so very conservative (low) estimates were used in the simulations. If this variance, due to environmental variation is greater than our estimates, then the risk of extinction will be increased.

Population Size: The population sizes modeled were selected to encompass the low range of values for actual populations in Brazil and Argentina. However, the largest size modeled (900 animals and K=1500) gives a reasonable guide for what might be expected in the larger populations. The problem faced by these populations will be the interaction of step-wise reduction in habitat with additional development, continuing pressure from unregulated take, and the potential for disease epidemics. Only a comprehensive management plan with agreed population and habitat goals can provide the needed long term protection.

Carrying Capacity: The population of 50 with K=100 was at a higher risk of extinction than any of the larger populations in all combinations values that led to any extinctions in the 100 year time period of the models, Figures 8, 10, & 12. The small populations lost 30% or more of their heterozygosity even under the best of conditions (no extinctions in 100 years) as compared to a loss of 5% or less in the population of 900, Figures 13-16. This is a loss of heterozygosity of 1-2% or more per generation. This may be a minimum estimate of the rate of loss of heterozygosity since unequal family sizes for females were not estimated. A loss of 1% per generation corresponds to an average effective population size of 50 and a loss of 2% to an Ne = 25. The effective population size could be further reduced by 50% by the skewed adult sex ratio observed in this population. The population of 25,000 is large enough for replacement by new mutation of variation lost by drift so would experience no net loss of genetic variation except under selection.

Adult Mortality: Adult female mortalities were examined at 5, 10, and 15%. The value of 10% is considered a minimum value and would include about 5% losses to poaching - although this might be selective for males for their antlers as trophies. Populations with alternate year reproduction could not survive with fawn mortalities of 40% (survival rates of 60%) even without including catastrophes in the model. Given current estimates population stability and of fawn mortality it is probable that the does are reproducing each year. Fawn survival rates need to be 50% or more depending upon whether catastrophes are included in the model.

Fawn Mortality: Mortality of fawns (by the age of one year) may be 60-80% in the Brazilian and Argentinian populations since only about 50% of does have accompanying fawns when censuses were conducted. With annual reproduction and at a 10% adult mortality rate, the populations can sustain a 60% mortality only if the life expectancy is about 10 years and there are no catastrophes. If there is a density dependent increase in fawn survival to about 60% (40% mortality) for several years after a population decline or catastrophe then the population could recover. It will be valuable to follow several

populations, to determine the variation in these rates and to detect the occurrence of abrupt declines in reproduction or increases in mortality of the major age groups.

Differential Male Mortality: Selective adult male mortality was adjusted to achieve the adult sex ratio of 1 male to 2-3 females observed in the wild populations. This biased sex ratio will increase the rates of genetic heterozygosity loss by its effect on the effective population size. Rates of heterozygosity loss could be increased as much as 3-fold if the effective ratio of breeding males to females is 1:5 rather than 1:1.

Proportion of Does Reproducing: We only examined annual interbirth intervals (90% of does reproducing in a given year) based upon available data. The consensus is that the does breed annually and that the differences in recruitment are due to fawn mortality. However no data are available to estimate the annual variation in reproduction that might occur with fluctuations in nutritional resources or diseases that do not produce substantial mortality in adults. It is likely that most fawn mortality will occur in the first weeks after birth. For most of the scenarios tested, annual reproduction is necessary to sustain a stable or growing population combined with the mortality rates suggested for adults and fawns. This issue could be resolved with radiotelemetry studies of does over several years (to estimate annual variance).

Catastrophes: The only catastrophe modelled in this series was an event occurring at approximately 10 or 20 year intervals. A die off that occurred in the late 1970s in one population that may have been due to disease. Recently deer have been observed with diseases that may have come from local cattle herds. Droughts may also affect reproduction and fawn mortality.

The results indicate a reduction in '*r*' of about 0.030 with the addition of a catastrophe at 10% probability and a reduction of 0.015 at 5% probability of occurrence to any of the scenarios. The deterministic value is also decreased since the effects of the catastrophe are averaged over the time period for this model. This reduction in population growth rates requires lower average fawn (or adult) mortalities for the population to remain approximately stable unless there is a positive density dependent response. The smaller population sizes are even more susceptible to extinction with a catastrophic event imposed upon the other sources of year to year environmental variation.

Inbreeding Depression: The smallest population experienced a loss of 1.5 - 3% of heterozygosity per generation at the population size of 50-100. The amount of variation which has already been lost will be a function of the duration of isolation from other populations, the size during this period of isolation, and the fluctuations in population size that have occurred during this time. It is likely that some sibling and parent-offspring

(father-daughter) breeding has already occurred. Insight into possible consequences can only be inferred from studies on other cervid species since there has been little breeding in the captive population. It will also be of interest to compare molecular measures of heterozygosity between the small and larger populations in Brazil and with the Argentinean populations. Inclusion of inbreeding depression in the models would increase the rate of extinction as has been shown with the pampas deer simulation analyses.

Research Recommendations

There is an urgent need to determine if reproductive failure or fawn mortality or their interaction is the basis for the relatively low fawn/doe ratios observed in the wild populations. It is also essential to determine the growth potential of the population and the growth response to sustained removals whether by poaching or legal hunting. Research programs (there are no legal hunting programs since the marsh deer is protected throughout its range) need to include collection of animals to evaluate age structure, sex, and condition of the herds. A corollary of this study would also determine if early fawn mortality is primarily of males. These demographic studies would allow a partial resolution of the contributions of nutrition, disease, predation, and genetics to the demographic dynamics of these marsh deer populations.

This information would provide a basis for specific management actions. Thus the growth potential of the populations would allow estimation of the numbers, frequency, ages, and sex of animal removals that could be allowed while retaining a stable population. The potential for inbreeding depression in the smallest population could be reduced by the introduction of animals (or genetic material) from the nearest larger population. It will be important that proper attention be given to the possible transfer of disease in the process.

Much of the information needed could be obtained by radiotelemetry studies of at least 50 does in each population, followed over 2-3 years, with replacement of animals lost each year to maintain about 50 marked animals in the study population. This technique would assist in habitat usage studies, partial validation of census methodology, description of social structure, measurement of hunting losses, detection of possible disease events, as well as providing information on reproduction and mortality.

Summary

Several patterns have emerged from this array of simulation models built upon estimates of parameter values from the several wild populations. Small populations, of less 500 animals, are highest risk of extinction and will be rapidly vulnerable to a catastrophic event. If the species is vulnerable to inbreeding depression, the risk of extinction is further increased in these small populations.

The closing of the dam will result in loss of about 1000 of the 2000 animals.

Translocation of these animals to add to the other populations in Brazil is not recommended since they will not make a significant genetic or demographic contribution to these populations. If these other populations are below average carrying capacity then the reasons for low levels need to be removed. Addition of deer to these populations will be disruptive for the local population and may be a significant risk for introducing new diseases. These animals might be useful as founders for new populations if suitable habitat is available.

The demographic simulations indicate the need for data on adult female mortality and fawn mortality as keys to understanding the dynamics of these populations. Losses of adult animals to unregulated hunting will keep these populations from expanding to carrying capacity and could lead to population extinction if they continue. The impact of diseases and parasites on these populations is uncertain but the presence of viral and bacterial diseases has been suggested from tests on samples collected from the live captured animals. It is likely that diseases and parasites contribute to increased mortality during periods of environmental stress.

This information will provide the needed base for establishing firm conservation and management goals for this species in each population in Brasil and in each of the range countries. Each population will require a management plan adjusted to local habitat conditions and threats.

Legends

Constant conditions in all of the scenarios presented in these figures include: 1) age of first reproduction as 2 years for females and 3 years for males, 2) polygynous breeding, 3) an annual litter size of 1, 4) 90% of adult females producing a fawn each year, 5) all of the adult males in the breeding pool each year, 6) 100 year projections, 7) carrying capacity constant over the 100 years of the simulations, 7) no harvest or supplements of the populations, 8) 1000 runs of the basic scenarios and 200 iterations of the other scenarios, and 9) the Environmental Variation of reproduction and survival not correlated, 10) no density dependence of reproduction, 11) yearling mortality of 20% for both sexes, 12) adult male mortality set at double the adult female mortality to produce the 1:3 sex ratio observed in the wild populations, and 13) standard deviations set at 1/3 of the mean as a conservative estimate of environmental variation effects.

Interactions between annual fawn mortality (at 40, 50, or 60%), annual adult mortality (at 5, 10, or 15%), carrying capacity at 100, 200, 500, and 1500 deer, and presence (CAT) or absence (NC) of a catastrophe (probability of occurrence either 5% or 10% with severity on reproduction of 0.5 and on survival of 0.8) were examined for their effects on population growth rate (deterministic *r*, Tables 1-4; stochastic *r*, Figures 3-4), mean population size (at 100 years or at 10 year intervals to 100 years, Figures 5, 7, 9, 11), probability of population extinction (over time and at 100 years, Figures 6, 8, 10, 12), and mean heterozygosity remaining in the surviving populations at 100 years, Figures 13-16).

Each of the histogram figures (Figures 3-16) presents the results from 18 simulation scenarios based upon the interaction of fawn and adult female mortality in the without and with one added catastrophe. There are 6 scenarios for each level of fawn mortality indicated on the x-axis. The first 3 are for the scenarios without a catastrophe and with adult female mortality of 5, 10, and 15%. The second 3 scenarios show the effects of adding a 5% probability of a catastrophe with a severity effect of 0.5 on reproduction and 0.8 on survival (i.e. a 20% reduction in survival in the year of occurrence of the event). This pattern of 3+3 is repeated for each level of fawn mortality. The population size and carrying capacity are indicated in the figure titles. The variable for which calculated results are presented is on the y-axis. All values are means at 100 years.

Figure 1. Mean population sizes at 10 year intervals for combinations of 10 and 15% adult female and 50 & 60% fawn mortality rates with no catastrophes and no inbreeding effects. The initial population size was 900 and the carrying capacity was set at 1500 animals. The only viable population, under these conditions, was with the combination of 10% adult and 50% fawn mortality which had a positive growth rate with an $r = 0.014$. A near zero growth rate would occur with an average fawn mortality rate = 55% and adult female mortality = 10%. Adult female mortality of 15% would require fawn mortality to be about 45%. Each further 5% increment in adult female mortality would require a 10% decrease in fawn mortality to achieve about zero population growth. Thus a 25% adult female mortality would require a 75% fawn survival rate for population stability.

Figure 2. Cumulative probability of extinction (Pe) at 10 year intervals for combinations of 10 and 15% adult female and 50 & 60% fawn mortality rates with no catastrophes and no inbreeding effects. These extinction probabilities are for the same scenarios as in Figure 1.

Figure 3. Effects of 5, 10 & 15% adult female and 40, 50 & 60% fawn mortality rates on the simulated stochastic population growth rate (mean *r*) with K = 1500 and a starting population of 900. This a relatively large population size and carrying capacity. Persistent mean negative values of *r* will always lead to extinction. Compare with Figure 1 which shows the decline in population size over time.

Figure 4. Effects of a small population size and carrying capacity under the same mortality and catastrophe conditions as in Figure 3. The K = 100 and starting population size was 50. The mean stochastic values of *r* are lower than for the large populations. The deterministic r values were the same for as for the larger populations. Compare with figure 3. The risk of extinction is greater for these small populations, Table 2. Indeed few of the small populations survived except under the lowest conditions of adult and fawn mortality, even with positive growth rates, reflecting their vulnerability to fluctuating environmental conditions from year to year.

Figure 5. Effects of 5, 10 & 15% adult female and 40, 50 & 60% fawn mortality rates on mean population size (N) with K = 1500 and a starting population of 900. The patterns for larger populations will be similar to that with this relatively large population size and carrying capacity. Surviving populations are well below the carrying capacity for the scenarios with the mortality rates near those recorded for several of the wild populations reflecting the negative growth rates probably produced by poaching. Compare with Figure 1 which shows the decline in population sizes over time.

Figure 6. Effects of 5, 10 & 15% adult female and 40, 50 & 60% fawn mortality rates on probability of extinction at 100 years with mean population size (N) with K = 1500 and a starting population of 900. The Pe is high in all scenarios with fawn mortality of 60% except at adult mortality of 5% and no catastrophes. Surviving populations are below the carrying capacity reflecting the negative growth rates. Compare with Figure 1 which shows the decline in population size over time.

Figure 7. Effects of a small population size and carrying capacity under the same mortality and catastrophe conditions as in Figure 3. The K = 100 and starting population was 50. This is a small population size and carrying capacity. Surviving populations are below the carrying capacity reflecting the negative growth rates. Compare with Figure 5.

Figure 8. Cumulative projected probabilities of extinction, as percents, under the same conditions as in Figure 7. A higher proportion of these small populations, even at the lowest fawn mortality rates, is extinct by 100 years in comparison with the populations of 1000 in Figure 6. The inclusion of inbreeding depression would further increase the probability of extinction in these small populations.

Figure 9. Effects of a doubling of carrying capacity from 100 to 200 under the same mortality and catastrophe conditions as in Figure 3. The K = 200 and starting population was 200. This is still a small population size and carrying capacity. Surviving populations are below the carrying capacity reflecting the negative growth rates. Compare with Figures 5 and 7.

Figure 10. Cumulative projected probabilities of extinction, as percents, under the same conditions as in Figure 9. A higher proportion of these small populations, even at the lowest fawn mortality rates, are extinct by 100 years in comparison with the populations of 1000 in Figure 6. However, the probability of extinction is significantly reduced by this doubling of carrying capacity. The inclusion of inbreeding depression would further increase the probability of extinction in these small populations.

Figure 11. Effects of a further increase in population size and carrying capacity under the same mortality and catastrophe conditions as in Figure 3. The K = 500 and starting population was 500. Surviving populations are below the carrying capacity in many scenarios reflecting the negative growth rates and effects of catastrophes. Compare with Figures 5, 7, and 9.

Figure 12. Cumulative projected probabilities of extinction, as percents, under the same conditions as in Figure 9. The proportion of these populations extinct by 100 years is close to those in comparison with the populations of 1000 in Figure 6. However, the probability of extinction is significantly reduced by this further increase in carrying capacity. The inclusion of inbreeding depression would have little additional effect on probability of extinction in these populations.

Figure 13. Effects of 5, 10 & 15% adult female and 40, 50 & 60% fawn mortality rates on mean heterozygosity remaining with K = 1500 and a starting population of 900. All population with a positive growth rate retained more than 90% of their starting heterozygosity. The losses in declining populations is related to the rate of decline. Catastrophes increase the loss under most conditions reflecting the fact that oscillating populations will lose heterozygosity in proportion to the harmonic mean of the population sizes. The patterns for larger populations will be similar to that with this relatively large population size and carrying capacity.

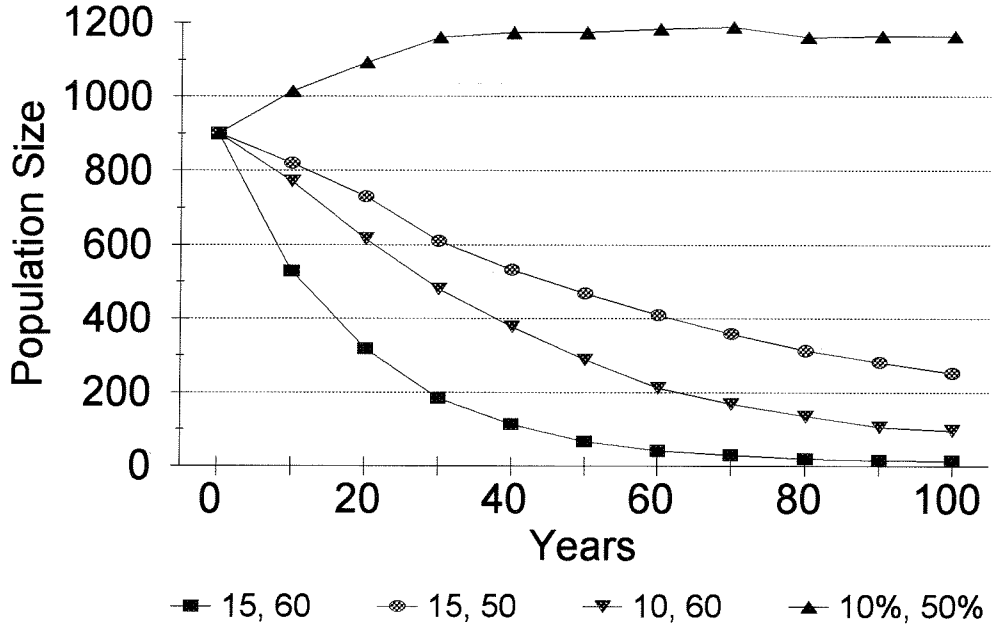
Figure 14. Effects of 5, 10 & 15% adult female and 40, 50 & 60% fawn mortality rates on mean heterozygosity remaining with K = 100 and a starting population of 50. None of the populations, even with a positive growth rate, retained as much as 65% of their starting heterozygosity. The generation time of approximately 5 years means that about 20 generations were encompassed in these simulations. Surviving populations lost between 1.5 and 3.0+ % of their heterozygosity per generation during this time. These small populations lose heterozygosity primarily by random drift and are vulnerable to inbreeding depression. They also are less able to adapt to changing selection pressures in their environment over time.

Figure 15. Effects of 5, 10 & 15% adult female and 40, 50 & 60% fawn mortality rates on mean heterozygosity remaining with K = 200 and a starting population of 200. The populations, retained 60 to 90% of their starting heterozygosity depending upon growth rates and mean population sizes during the 100 years of the simulations. The generation time of approximately 5 years means that about 20 generations were encompassed in these simulations. Surviving populations lost between 0.5 and 3.0+ % of their heterozygosity per generation during this time. These populations lose heterozygosity primarily by random drift and are vulnerable to inbreeding depression. They also are less able to adapt to changing selection pressures in their environment over time.

Figure 16. Effects of 5, 10 & 15% adult female and 40, 50 & 60% fawn mortality rates on mean heterozygosity remaining with K = 500 and a starting population of 500. The populations, retained 70 to 95% of their starting heterozygosity depending upon growth rates and mean population sizes during the 100 years of the simulations. The generation time of approximately 5 years means that about 20 generations were encompassed in these simulations. Surviving populations lost between approximately 0.2 and 1.0 % of their heterozygosity per generation during this time.

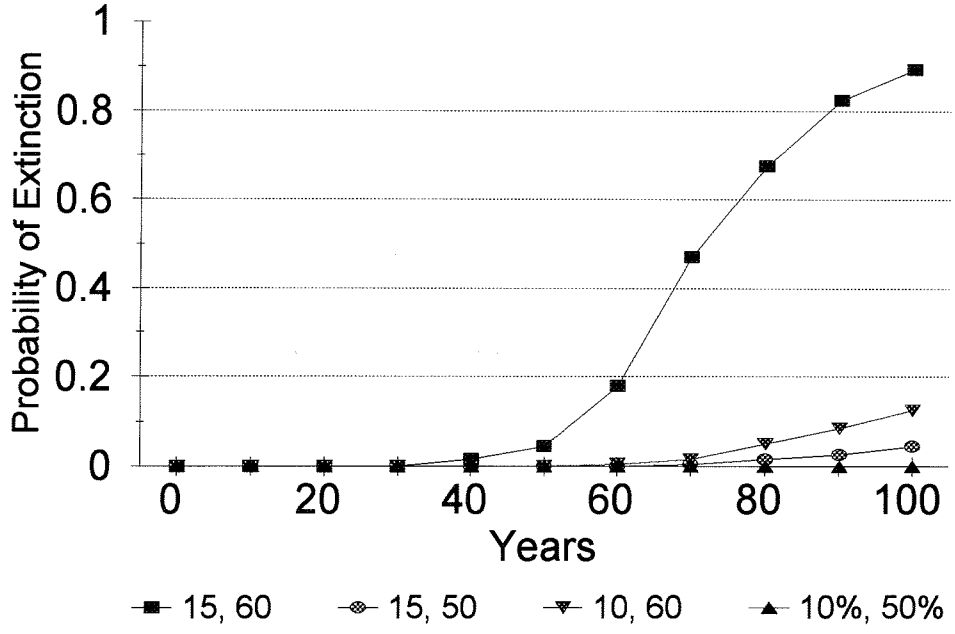
MARSH DEER DEMOGRAPHY

Female & Fawn Mortality



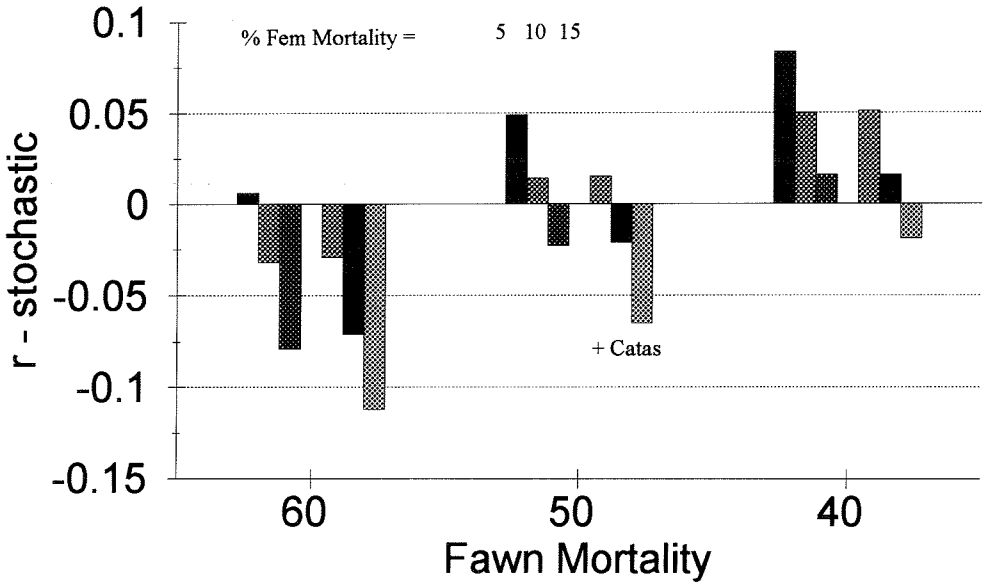
MARSH DEER DEMOGRAPHY

Mortality & Pe, K=1500



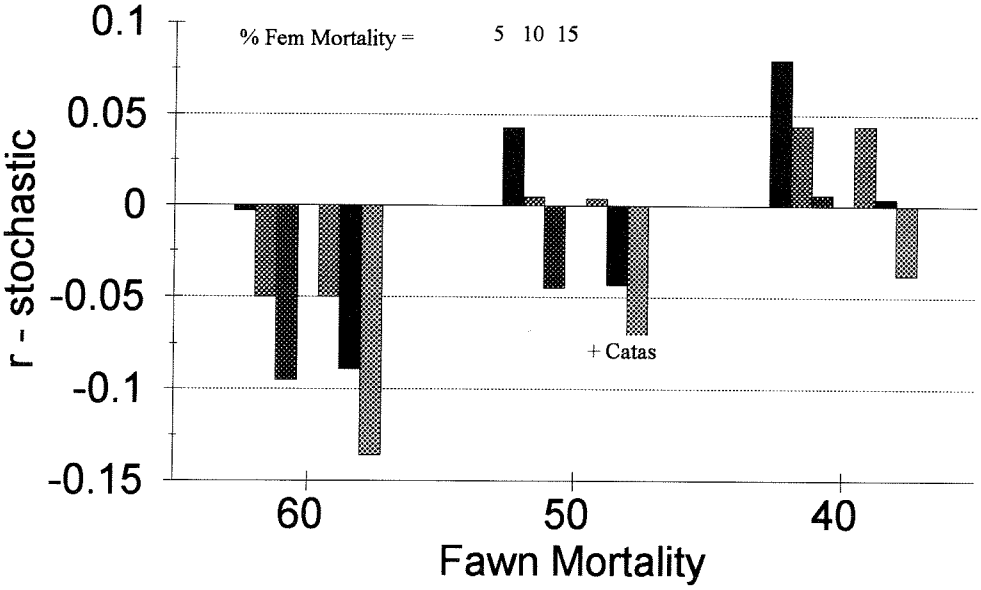
MARSH DEER DEMOGRAPHY

N=900, K=1500



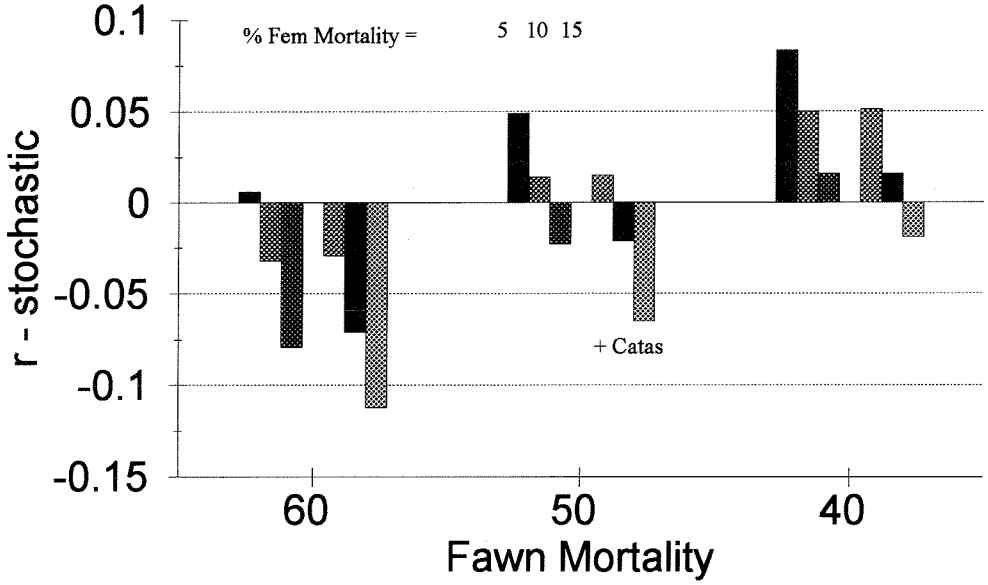
MARSH DEER DEMOGRAPHY

N=50, K=100



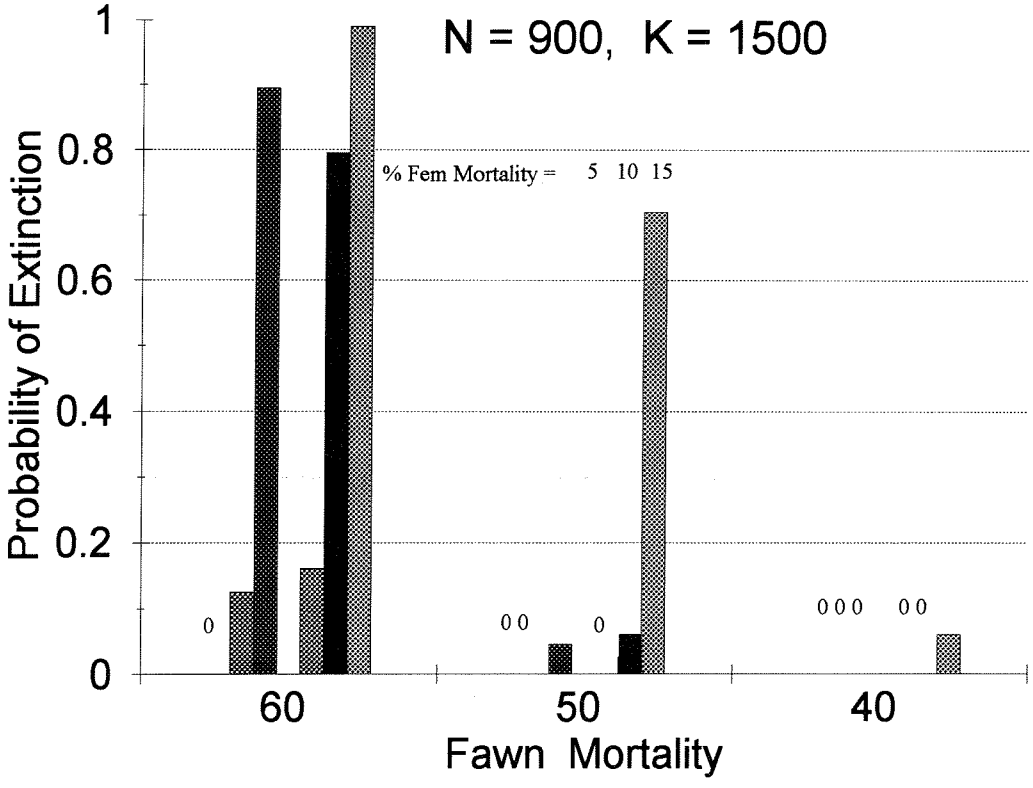
MARSH DEER DEMOGRAPHY

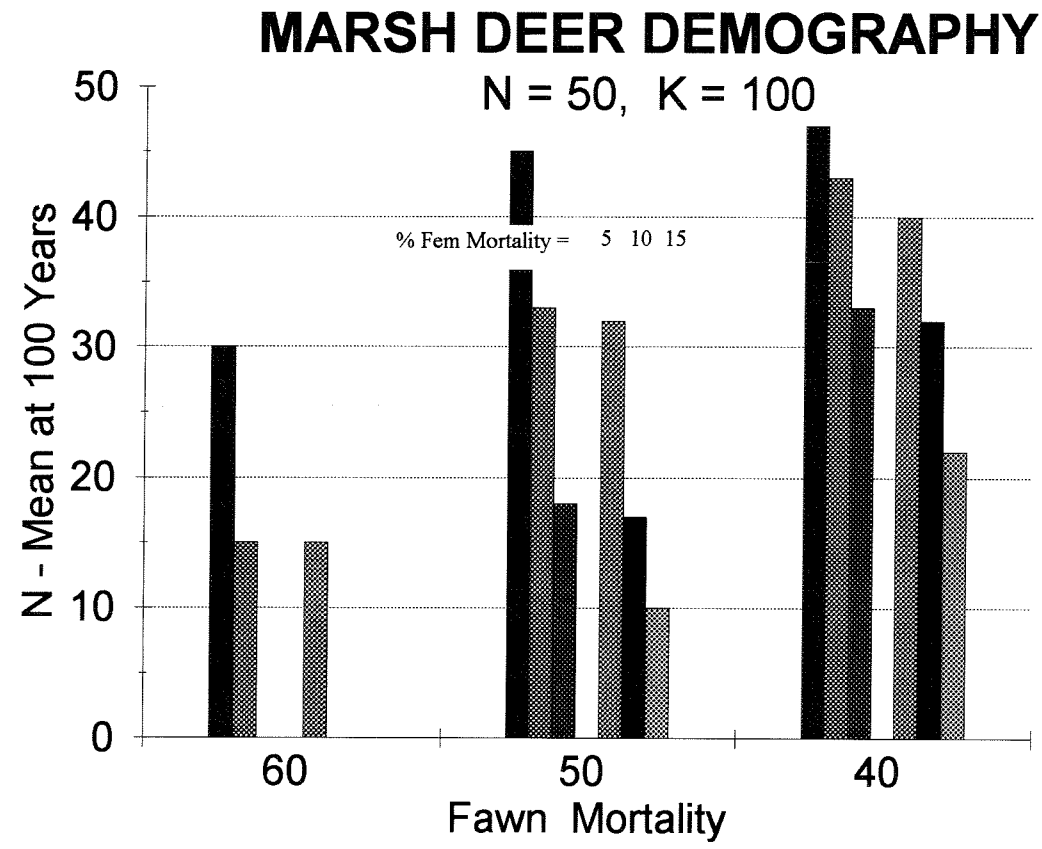
N=900, K=1500

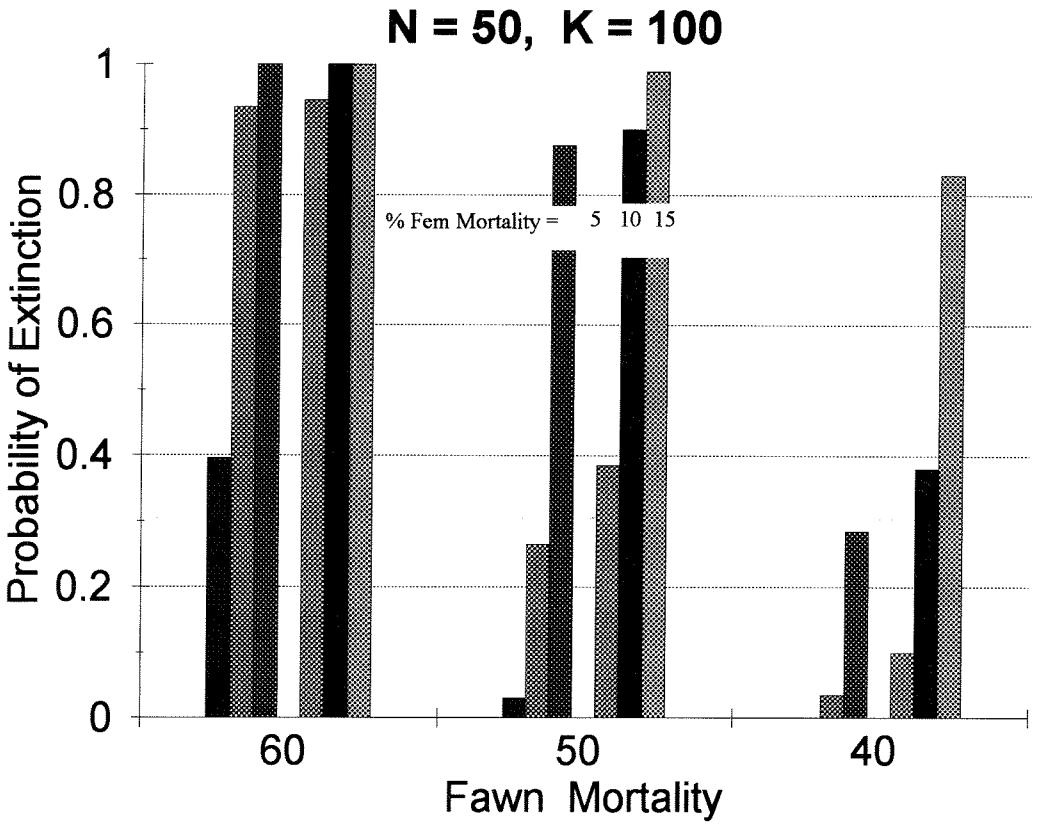


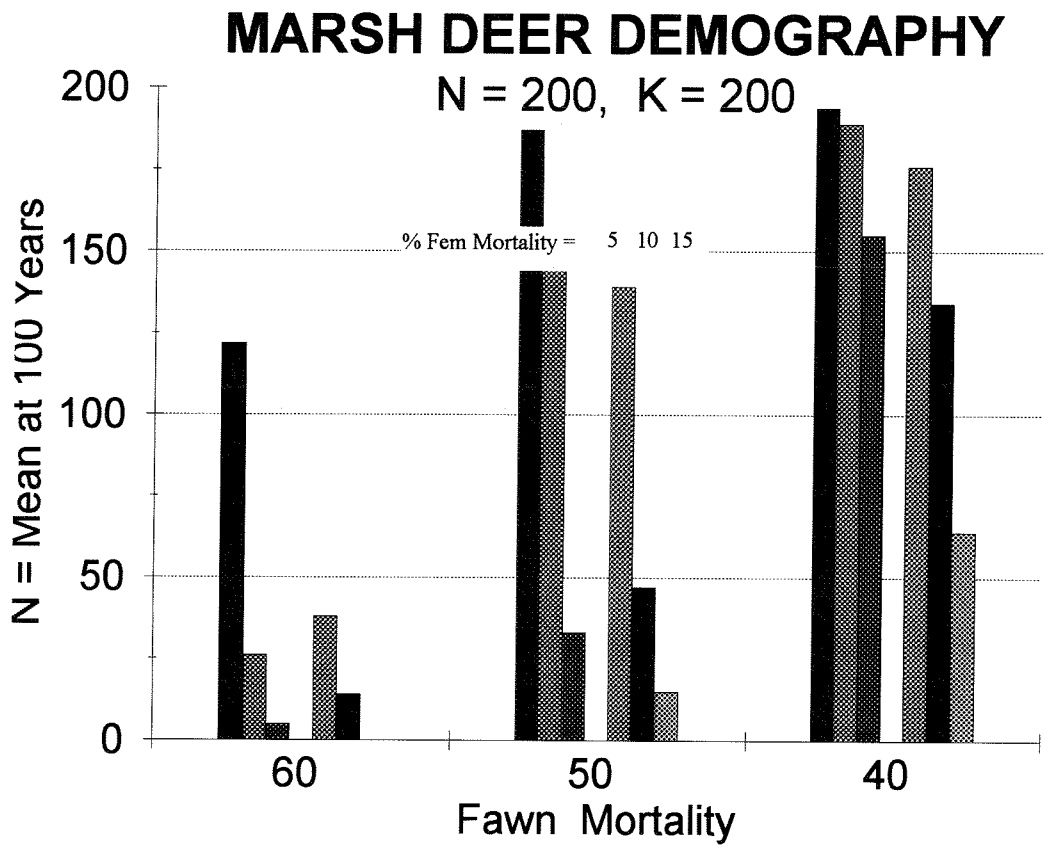
MARSH DEER DEMOGRAPHY

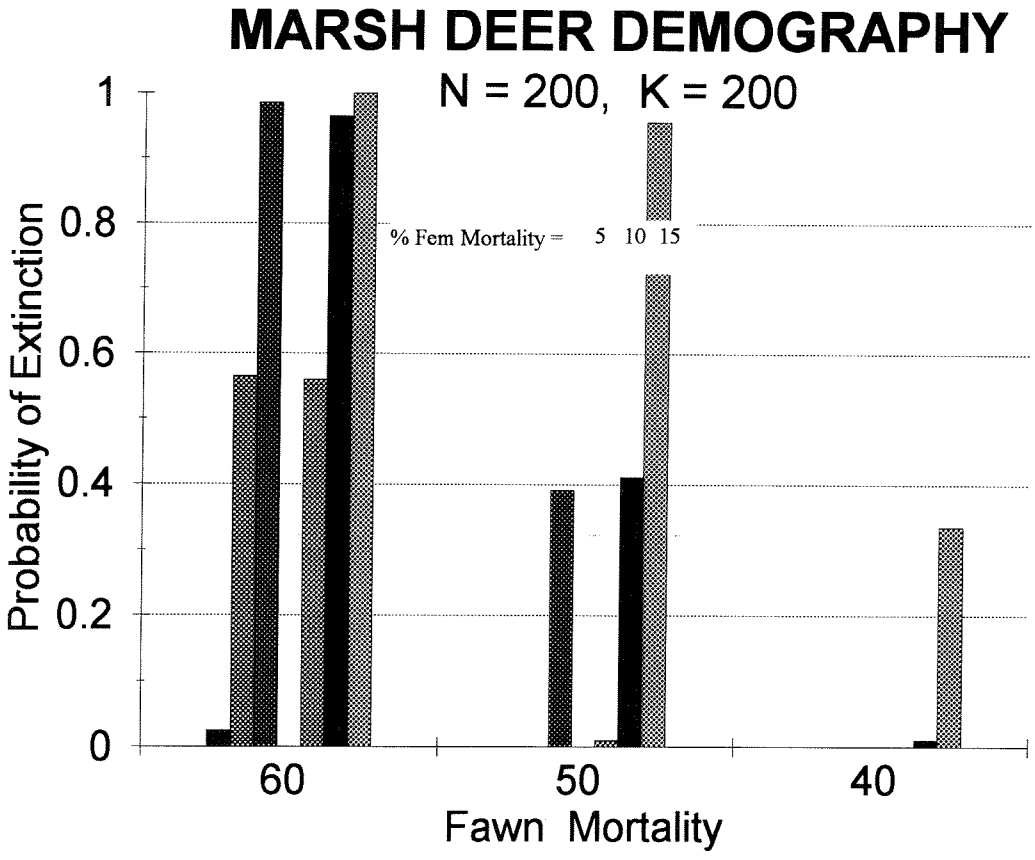
N = 900, K = 1500

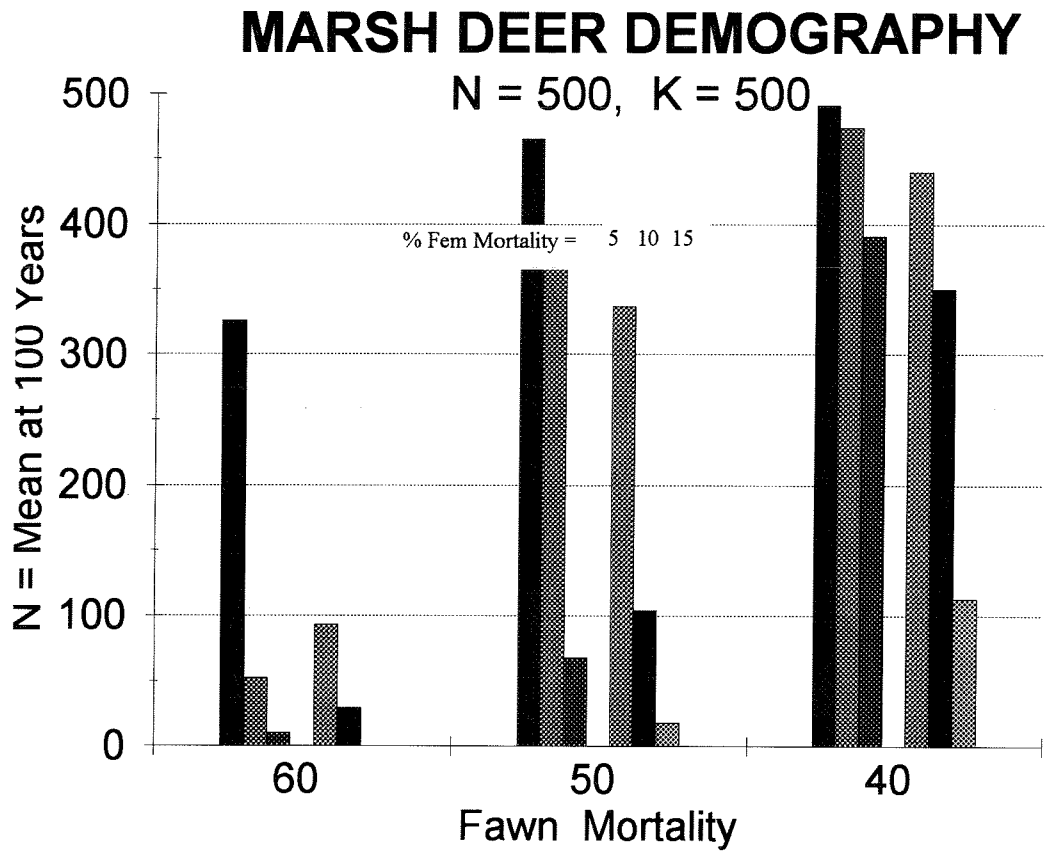


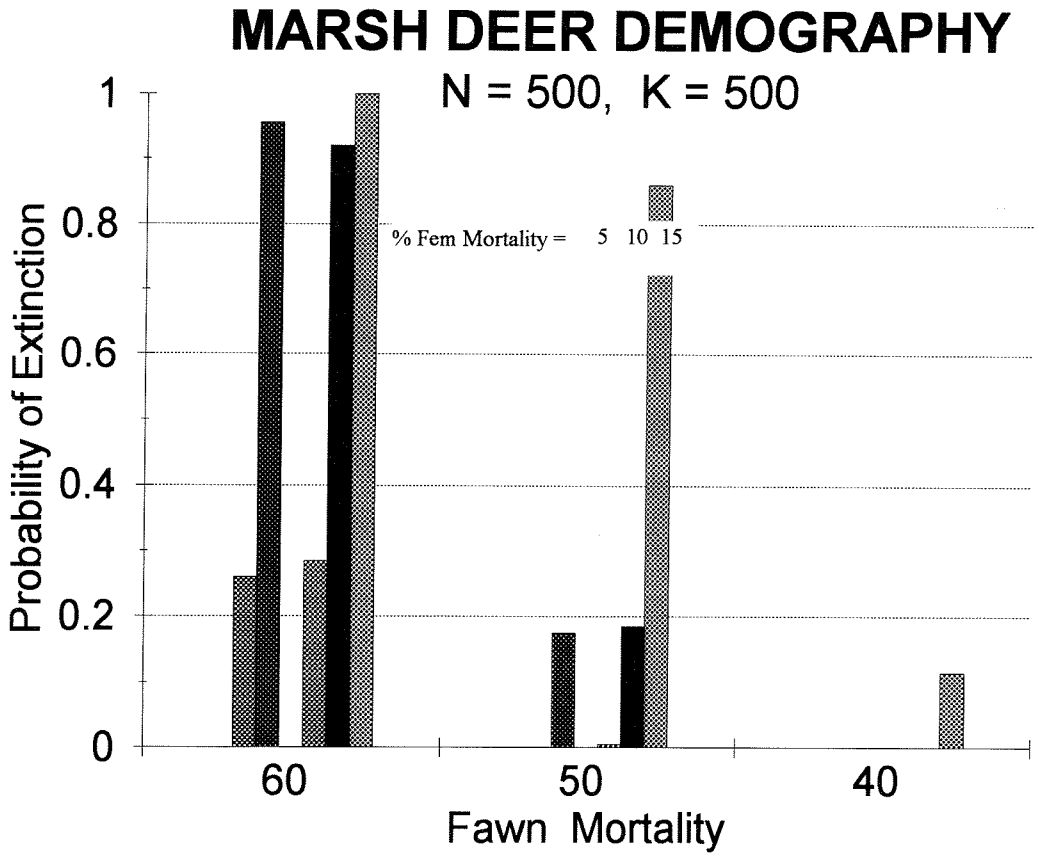

MARSH DEER DEMOGRAPHY
N = 50, K = 100
% Fem Mortality = 5 10 15
N - Mean at 100 Years
0
10
20
30
40
50
60
50
40
Fawn Mortality

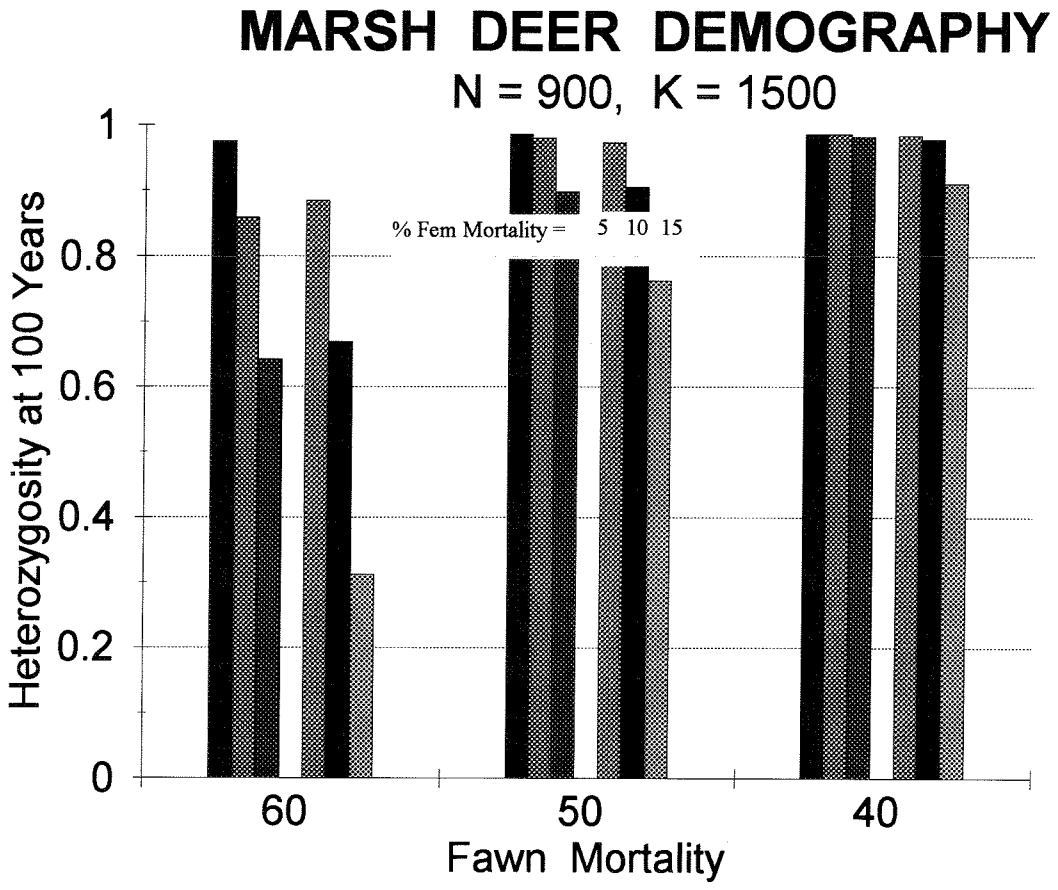

N = 50, K = 100
% Fem Mortality = 5 10 15
Probability of Extinction
0
0.2
0.4
0.6
0.8
1
60
50
40
Fawn Mortality

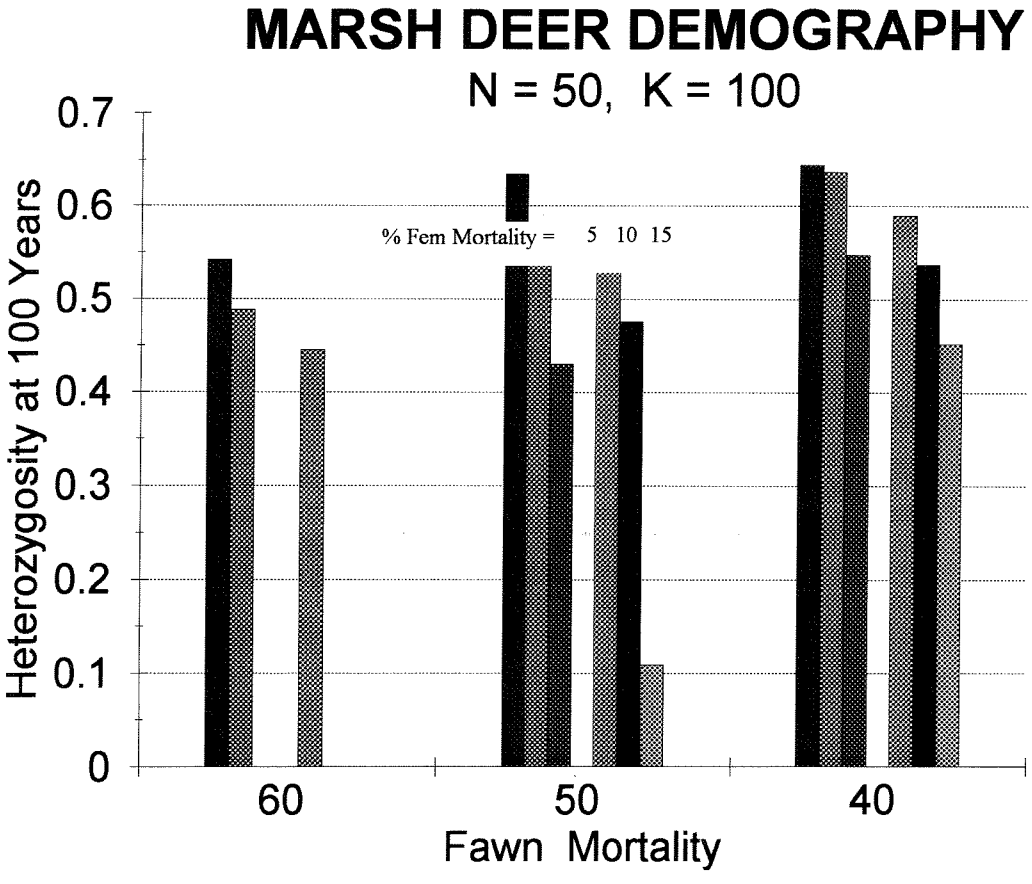

MARSH DEER DEMOGRAPHY
N = 200, K = 200
% Fem Mortality = 5 10 15
N = Mean at 100 Years
200
150
100
50
0
60
50
40
Fawn Mortality

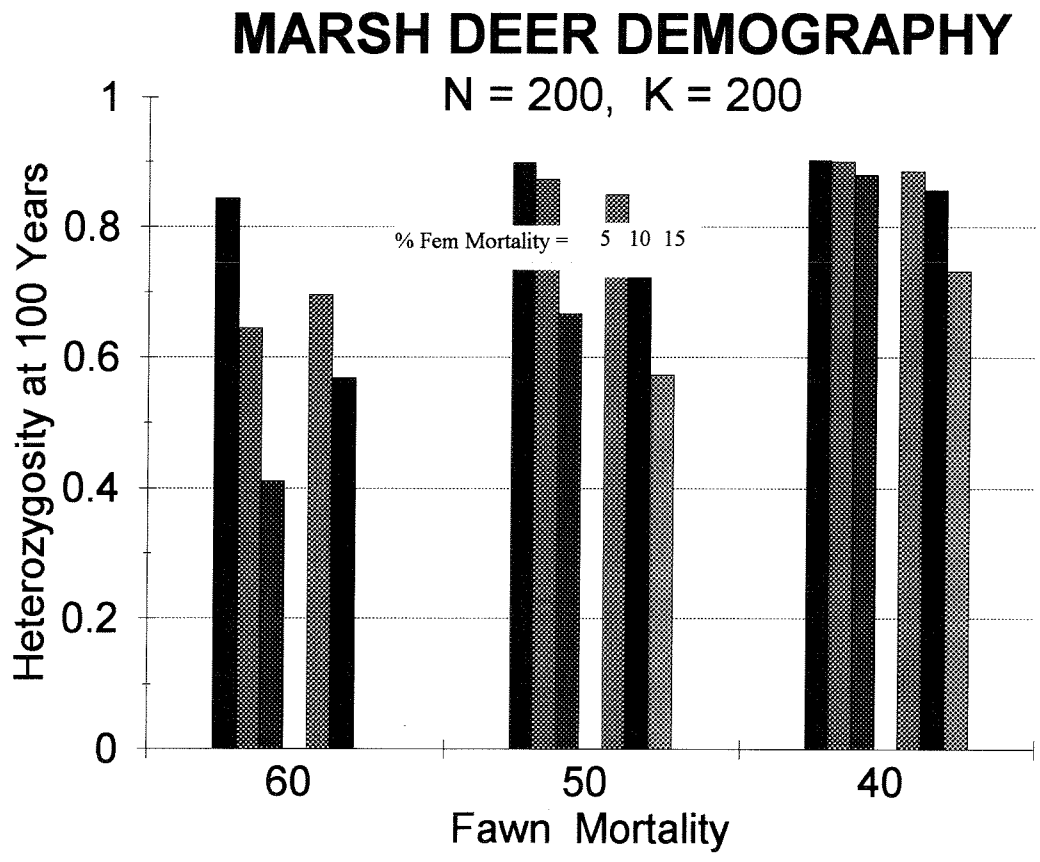

MARSH DEER DEMOGRAPHY
N = 200, K = 200
% Fem Mortality = 5 10 15
Probability of Extinction
1
0.8
0.6
0.4
0.2
0
60
50
40
Fawn Mortality


MARSH DEER DEMOGRAPHY
N = 500, K = 500
% Fem Mortality = 5 10 15
N = Mean at 100 Years
500
400
300
200
100
0
60
50
40
Fawn Mortality


MARSH DEER DEMOGRAPHY
N = 500, K = 500
% Fem Mortality = 5 10 15
Probability of Extinction
1
0.8
0.6
0.4
0.2
0
60
50
40
Fawn Mortality


MARSH DEER DEMOGRAPHY
N = 900, K = 1500
Heterozygosity at 100 Years
1
0.8
0.6
0.4
0.2
0
% Fem Mortality = 5 10 15
60
50
40
Fawn Mortality


MARSH DEER DEMOGRAPHY
N = 50, K = 100
Heterozygosity at 100 Years
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
% Fem Mortality = 5 10 15
60
50
40
Fawn Mortality


MARSH DEER DEMOGRAPHY
N = 200, K = 200
Heterozygosity at 100 Years
1
0.8
0.6
0.4
0.2
0
% Fem Mortality = 5 10 15
60
50
40
Fawn Mortality

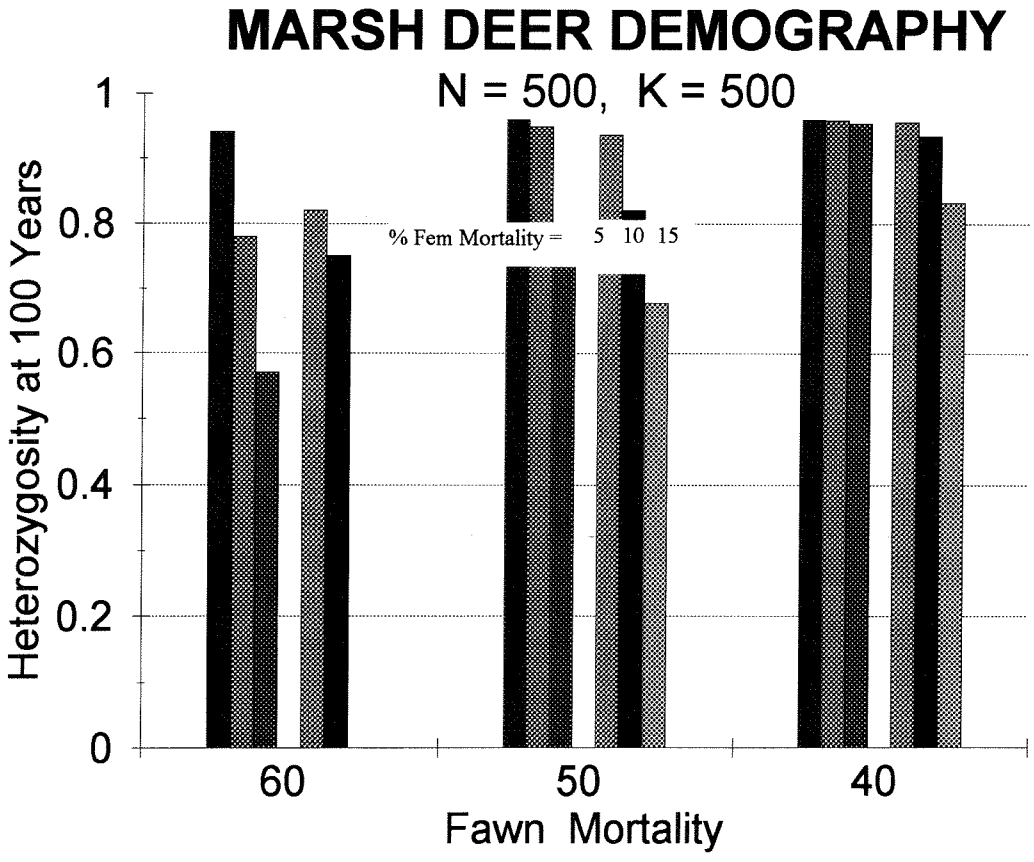

MARSH DEER DEMOGRAPHY
N = 500, K = 500
Heterozygosity at 100 Years
1
0.8
0.6
0.4
0.2
0
% Fem Mortality = 5 10 15
60
50
40
Fawn Mortality

Table 1. MARSH DEER DEMOGRAPHY - N = 900, K = 1500

File	Mortality		Results							
			Population Growth			100 Years				Te
	0-1 %	Adl Fem %	Deter r	Stochastic r	SD	Pe	N	SD	He	
No catastrophes										
605.001	60	5	.011	.006	.117	0	918	402	.976	-
505.001	50		.052	.049	.110	0	1418	118	.986	-
405.001	40		.087	.083	.106	0	1468	68	.986	-
610.001	60	10	-.023	-.032	.132	.125	89	111	.859	84
510.001	50		.019	.014	.113	0	1138	310	.981	-
410.001	40		.055	.050	.106	0	1424	114	.986	-
615.001	60	15	-.059	-.079	.177	.895	19	16	.643	71
515.001	50		-.016	-.023	.130	.045	175	189	.898	86
415.001	40		.021	.016	.108	0	1223	298	.983	-
Catastrophe at 10%: 0.5 on reprod., 0.8 on survival										
605.005	60	5	-.018	-.029	.161	.160	156	186	.885	83
505.	50		.022	.015	.151	0	1025	397	.974	-
405.	40		.057	.051	.149	0	1364	197	.984	-
610.	60	10	-.053	-.071	.191	.795	20	18	.669	72
510.	50		-.011	-.021	.159	.060	266	312	.905	83
410.	40		.024	.016	.153	0	1046	404	.978	-
615.	60	15	-.089	-.112	.212	.990	7	4	.312	52
515.	50		-.047	-.065	.195	.705	36	64	.763	75
415.	40		-.010	-.019	.158	.060	280	297	.911	89
Catastrophe at 5%: 0.5 on reprod., 0.8 on survival										
605.009	60	5	-.003	-.010	.138	0	393	345	.940	-
505.	50		.037	.031	.134	0	1296	247	.984	-
405.	40		.072	.066	.132	0	1409	155	.986	-
610.	60	10	-.038	-.053	.168	.485	35	42	.767	79
510.	50		.004	-.004	.137	0	614	441	.958	-
410.	40		.039	.034	.132	0	1309	242	.984	-
615.	60	15	-.074	-.094	.200	.980	11	6	.597	64
515.	50		-.031	-.046	.167	.370	49	55	.805	81
415.	40		.005	-.001	.134	0	661	441	.962	-

Table 2. MARSH DEER DEMOGRAPHY - N = 50, K = 100

File	Mortality		Results							
			Population Growth			100 Years				Te
	0-1 %	Adl Fem %	Deter r	Stochastic r	SD	Pe	N	SD	He	
No catastrophes										
605.002	60	5	.011	-.003	.010	.395	30	14	.542	62
505.	50		.052	.043	.141	.030	45	8	.634	77
405.	40		.087	.080	.129	0	47	5	.644	-
610.	60	10	-.023	-.050	.201	.935	15	10	.488	49
510.	50		.019	.005	.161	.265	33	15	.539	60
410.	40		.055	.044	.139	.035	43	9	.637	69
615.	60	15	-.059	-.095	.230	1.00	-	-	-	33
515.	50		-.016	-.045	.206	.875	18	10	.430	50
415.	40		.021	.006	.158	.285	33	13	.547	61
Catastrophe at 10%: 0.5 on reprod., 0.8 on survival										
605.006	60	5	-.018	-.050	.218	.945	15	11	.445	45
505.	50		.022	.004	.192	.385	32	15	.529	60
405.	40		.057	.044	.179	.100	40	11	.590	60
610.	60	10	-.053	-.089	.242	1.00	-	-	-	33
510.	50		-.011	-.043	.223	.900	17	11	.475	50
410.	40		.024	.004	.196	.380	32	15	.537	62
615.	60	15	-.089	-.136	.265	1.00	-	-	-	23
515.	50		-.047	-.084	.250	.990	10	8	.109	35
415.	40		-.010	-.038	.221	.830	22	15	.452	50
Catastrophe at 5%: 0.5 on reprod., 0.8 on survival										
605.010	60	5	-.003	-.028	.195	.790	26	15	.501	55
505.	50		.037	.022	.170	.165	38	13	.582	60
405.	40		.072	.062	.156	.010	45	7	.632	66
610.	60	10	-.038	-.071	.222	.990	14	6	.438	39
510.	50		.004	-.024	.201	.700	26	14	.505	55
410.	40		.039	-.0256	.169	.165	39	12	.590	65
615.	60	15	-.074	-.117	.247	1.00	-	-	-	26
515.	50		-.031	-.062	.226	.950	22	16	.363	42
415.	40		.005	-.015	.192	.565	26	13	.504	55

Table 3. MARSH DEER DEMOGRAPHY - N = 200, K = 200

File	Mortality-Age		Results							
	0-1 %	Adl Fem %	Population Growth			100 Years				Te
			Deter r	Stochastic r	SD	Pe	N	SD	He	
No catastrophes										
605.003	60	5	.011	.003	.128	.025	122	58	.843	79
505.	50		.052	.046	.118	0	187	20	.899	-
405.	40		.087	.082	.111	0	194	11	.902	-
610.	60	10	-.023	-.038	.164	.565	26	22	.644	74
510.	50		.019	.013	.122	0	145	48	.873	-
410.	40		.055	.050	.113	0	189	19	.901	-
615.	60	15	-.059	-.088	.203	.985	5	1	.411	51
515.	50		-.016	-.032	.163	.390	33	28	.666	74
415.	40		.021	.015	.116	0	155	45	.880	-
Catastrophe at 10%: 0.5 on reprod., 0.8 on survival										
605.007	60	5	-.018	-.035	.184	.560	38	31	.696	72
505.	50		.022	.014	.159	.010	139	54	.849	57
405.	40		.057	.049	.156	0	176	30	.886	-
610.	60	10	-.053	-.079	.213	.965	14	9	.568	53
510.	50		-.011	-.028	.184	.410	47	40	.727	75
410.	40		.024	.016	.160	.010	134	51	.857	74
615.	60	15	-.089	-.122	.234	1.00	-	-	-	38
515.	50		-.047	-.074	.222	.955	15	9	.573	56
415.	40		-.010	-.023	.180	.335	64	52	.732	71
Catastrophe at 5%: 0.5 on reprod., 0.8 on survival										
605.011	60	5	-.003	-.014	.157	.225	78	56	.773	80
505.	50		.037	.032	.140	0	168	34	.884	-
405.	40		.072	.068	.136	0	189	19		-
610.	60	10	-.038	-.061	.191	.885	28	22	.643	63
510.	50		.004	-.005	.150	.095	92	55	.816	81
410.	40		.039	.032	.138	0	169	38	.886	-
615.	60	15	-.074	-.103	.215	.990	6	4	.534	43
515.	50		-.031	-.054	.196	.770	24	24	.614	64
415.	40		.005	-.005	.152	.100	97	58	.814	84

Table 4. MARSH DEER DEMOGRAPHY - N = 500, K = 500

File	Mortality		Results							
			Population Growth			100 Years				Te
	0-1 %	Adl Fem %	Deter r	Stochastic r	SD	Pe	N	SD	He	
No catastrophes										
605.004	60	5	.011	.005	.119	0	326	128	.941	-
505.	50		.052	.048	.113	0	465	45	.960	-
405.	40		.087	.083	.106	0	491	21	.960	-
610.	60	10	-.023	-.033	.142	.260	52	52	.780	81
510.	50		.019	.013	.116	0	381	113	.949	-
410.	40		.055	.049	.109	0	474	41	.959	-
615.	60	15	-.059	-.081	.185	.955	10	8	.571	64
515.	50		-.016	-.028	.144	.175	68	69	.801	84
415.	40		.021	.015	.110	0	391	98	.954	-
Catastrophe at 10%: 0.5 on reprod., 0.8 on survival										
605.008	60	5	-.018	-.029	.169	.285	93	98	.821	79
505.	50		.022	.014	.155	.005	337	136	.936	83
405.	40		.057	.050	.151	0	440	77	.955	-
610.	60	10	-.053	-.075	.203	.920	29	38	.751	66
510.	50		-.011	-.023	.169	.185	104	99	.821	79
410.	40		.024	.016	.154	0	350	135	.934	-
615.	60	15	-.089	-.118	.222	1.00	-	-	-	47
515.	50		-.047	-.069	.205	.860	18	15	.678	70
415.	40		-.010	-.020	.163	.115	113	112	.833	83
Catastrophe at 5%: 0.5 on reprod., 0.8 on survival										
605.012	60	5	-.003	-.010	.143	.030	169	130	.889	78
505.	50		.037	.032	.134	0	418	92	.954	-
405.	40		.072	.067	.132	0	477	45	.958	-
610.	60	10	-.038	-.056	.178	.695	23	21	.698	77
510.	50		.004	-.002	.141	.015	247	250	.915	80
410.	40		.039	.034	.134	0	434	77	.955	-
615.	60	15	-.074	-.104	.210	1.00	-	-	-	53
515.	50		-.031	-.047	.177	.560	47	60	.742	78
415.	40		.005	-.002	.139	.015	245	152	.913	97

Table 5. Sample data input file for the marsh deer population simulations.

```
MARSH605.001     ***Output Filename***
Y     ***Graphing Files?***
N     ***Each Iteration?***
200     ***Simulations***
100     ***Years***
10     ***Reporting Interval***
1     ***Populations***
N     ***Inbreeding Depression?***
N     ***EV correlation?***
2     ***Types Of Catastrophes***
P     ***Monogamous Or Polygynous***
2     ***Female Breeding Age***
3     ***Male Breeding Age***
10     ***Maximum Age***
0.500000     ***Sex Ratio***
1     ***Maximum Litter Size***
N     ***Density Dependent Breeding?***
10.000000     ***Population 1: Percent Litter Size 0***
90.000000     ***Population 1: Percent Litter Size 1***
5.000000     ***EV--Reproduction***
60.000000     ***Female Mortality At Age 0***
14.770979     ***EV--FemaleMortality***
20.000000     ***Female Mortality At Age 1***
10.000000     ***EV--FemaleMortality***
5.000000     ***Adult Female Mortality***
3.000000     ***EV--AdultFemaleMortality***
60.000000     ***Male Mortality At Age 0***
14.770979     ***EV--MaleMortality***
30.000000     ***Male Mortality At Age 1***
10.000000     ***EV--MaleMortality***
15.000000     ***Male Mortality At Age 2***
5.000000     ***EV--MaleMortality***
28.6000000     ***Adult Male Mortality***
5.000000     ***EV--AdultMaleMortality***
10.000000     ***Probability Of Catastrophe 1***
1.000000     ***Severity--Reproduction***
1.000000     ***Severity--Survival***
1.000000     ***Probability Of Catastrophe 2***
1.000000     ***Severity--Reproduction***
1.000000     ***Severity--Survival***
Y     ***All Males Breeders?***
Y     ***Start At Stable Age Distribution?***
900     ***Initial Population Size***
1500     ***K***
0.000000     ***EV--K***
N     ***Trend In K?***
N     ***Harvest?***
N     ***Supplement?***
Y     ***AnotherSimulation?***
```

CERVO-DO-PANTANAL

Blastocerus dichotomus

ANÁLISE DE VIABILIDADE DE POPULAÇÃO E HABITAT (PHVA).

Captive Population of Marsh Deer

Criação do Cervo do Pantanal (*Blastocerus dichotomus*) em Cativeiro

HISTÓRICO

Apresenta-se um breve relato dos conhecimentos adquiridos sobre o cervo do pantanal, desde o programa de captura em Três Irmãos (1990), e os dados obtidos com a experiência em cativeiro no Centro de Conservação do Cervo do Pantanal (Promissão) e no Zoológico de Ilha Solteira, São Paulo.

1. Conservação:

Dos 60 animais fundadores capturados na natureza, há quatro anos, existem hoje apenas 18 deles, associados a 16 de seus descendentes, totalizando 34 animais (13 em Ilha Solteira e 21 em Promissão). Não há programa de análise genética da população, e dos 80 machos que foram capturados, não se colheu nenhuma amostra de sêmen.

Assim sendo, em termos de conservação de material genético, o objetivo não foi atingido.

2. Educação Ambiental:

Existiu um programa de informação da população de Promissão, com vista à reintrodução de alguns animais. No Zoológico de Ilha Solteira, há um programa de educação ambiental que enfoca o cervo como espécie principal, e na cidade de Promissão, o programa existente não enfoca especificamente a problemática do cervo do pantanal.

3. Pesquisa:

Houve aquisição de conhecimentos básicos referentes à manutenção e criação do cervo do pantanal em cativeiro, em Promissão e Ilha Solteira. Em Três Irmãos, juntamente com a captura de animais e sua transferência para cativeiro, foi colhido material biológico, destinado a pesquisas nas áreas de genética, enfermidades e fisiologia.

Apresenta-se a seguir um resumo dos dados referentes a questões de patologia animal.

3.1. Doenças Virais:

3.1.1. Doenças Virais de Ocorrência Confirmada:

3.1.1.1. Doença Hemorrágica (*Blue Tongue*) - Diagnóstico sorológico positivo em cerca de 50% dos animais testados em Ilha Solteira. Adicionalmente, a população de gado bovino da

região, testada por amostragem, apresentou positividade de 100%.

3.1.2. Doenças Virais Com Maior Potencial de Ocorrência:

3.1.2.1. Febre Aftosa: Ocorrência ainda não confirmada, porém com possibilidade de provocar graves problemas, especialmente no pantanal matogrossense. Obs: Levantamento sorológico levado a efeito em 119 cervos capturados em Três Irmãos revelou ausência de Febre Aftosa e IBR (Rinotraqueíte Infecciosa Bovina) naquela amostra populacional.

3.1.2.2. Febre Catarral Maligna: Ocorrência em bovinos no estado de São Paulo, e portanto potencialmente problemática para cervídeos em geral.

3.1.2.3. Listagem de Doenças Virais de Ocorrência Possível em Cervídeos:
- BVD (Diarréia Viral Bovina)
- IBR (Rinotraqueíte Infecciosa Bovina)
- Raiva
- Papilomatose

3.2. Doenças Bacterianas:

3.2.1. Leptospirose: De 112 amostras de soro provenientes de animais capturados em Três Irmãos, houve positividade em 33,92%, abrangendo 12 diferentes sorotipos. Não se observou, até o momento, porém, quadro compatível com a ocorrência da enfermidade em sua forma clínica.

3.2.2. Brucelose: De 116 amostras de soro provenientes de animais capturados em Três Irmãos, observou-se um caso positivo. Não se observou, até o momento, porém, quadro clínico compatível com a ocorrência da enfermidade em sua forma clínica.

3.2.3. Tuberculose: Considerada como enfermidade de alta problemática na criação de cervídeos em cativeiro, porém até o momento, não diagnosticada em cervo do pantanal.

3.2.4. Listagem de Doenças Bacterianas de Ocorrência Possível em Cervídeos:
- Pasteurelose
- Necrobacilose e Actinomicose
- Tétano e Botulismo
- Carbúnculo Sintomático
- Carbúnculo Hemático
- Enterites Bacterianas

3.3. Doenças Parasitárias:

3.3.1. Ectoparasitas:

3.3.1.1. Carrapatos: Em animais de vida livre, existem relatos da ocorrência do gênero *Amblyoma*. Em cativeiro, porém, considera-se como um dos principais problemas a altíssima infestação pelo gênero Boophilus, observada em Ilha Solteira e Promissão. Tais carrapatos, além do potencial indutor de anemias e, portanto, indutor de queda na resistência orgânica geral, são ainda os transmissores dos protozoários do gênero *Babesia* e das ricketsias do gênero *Anasplasma*.

3.3.1.2. Listagem dos Ectoparasitas de Ocorrência Possível em Cervídeos:
- Larvas de dípteros (miíases furunculóides e cavitárias)
- Pulgas e Piolhos
- Dípteros sugadores
- Sarnas

3.3.2. Endoparasitas:

3.3.2.1. Metazoários: Os problemas mais comumente observados à necropsia de exemplares de cervo do pantanal são relacionados com alta incidência de *Paramphistomun spp.* e ocorrência de nematóides do grupo *Strogyloidea* (*Trichostrongylus, Haemonchus, Cooperia* e *Trichuris*).

3.3.2.2. Protozoários: É possível a ocorrência de infecção pelo gênero *Babesia*, especialmente em função da alta incidência de carrapatos citada ao item 3.3.1.1.

OBJETIVOS

Objetivos Básicos do Trabalho de Criação em Cativeiro:

1. Manutenção de uma população em cativeiro, para obtenção do máximo possível de conhecimento científico, que auxilie o manejo e conservação da espécie.

2. Promover mecanismos (formais e não formais) de conscientização da população acerca da conservação da espécie.

1. Considerações Sobre O Manejo Do Cervo Do Pantanal Em Cativeiro

Considerando o status do cervo do pantanal em vida livre, não seria necessaria a manutenção de grandes populações em cativeiro.

Sugere-se que 50-100 indivíduos seriam suficientes para prover animais para educação e pesquisa. Se necessario, poderiam ser buscados animais na natureza para complementar populações em cativeiro.

As sub-especies conhecidas ou que venham a ser identificadas deverão ter representantes mantidos em cativeiro, sendo necessário priorizar as sub-espécies mais ameaçadas. O centro de pesquisa e conservação deverá localizar-se na área de ocorrência da sub-espécie em questão.

Origem:

Os locais de coleta devem ser perfeitamente identificados. Os animais devem ser marcados de uma maneira segura, atraves dos meios de identificação conhecidos. Deverão ser colhidas todas as informações referentes aos animais mortos durante a captura.

Faixa Etária:

Somente os animais jovens capturados deverão ser destinados ao cativeiro.

Quarentena:

Os animais seriam enviados a uma área de quarentena, com todas as instalações necessárias para o manejo do animal, conservação e envio de amostras para análise. Neste quarentenário seriam feitos todos os exames necessarios para determinação do status sanitario em vida silvestre, e Iniciar o trabalho de adaptação ao cativeiro (dieta, manejo, etc.). Todos os indivíduos portadores de enfermidades que forem identificados durante a quarentena deverão receber o tratamento médico adequado. Os animais que apresentarem positividade para qualquer doença que ponha em risco as populações cativas deverão ser rejeitados.

Os registros de quarentena deverão ter o máximo de precisão, incluindo dados referentes a captura, dados de ficha biológica (nutrição, comportamento e reprodução) e dados médicos gerais (incluindo informações necroscópicas).

Após a passagem pela quarentena, os animais deveriam ser enviados a diversas instituições, conforme citado abaixo:

- Centro de conservação: no mínimo 10 machos e 40 fêmeas.
- Parques zoológicos: no minimo um macho e duas fêmeas.
  (Atualmente existem 14 zoológicos interessados em receber animais,
  o que indica uma demanda inicial de 30 indivíduos.)
- Criadouros: no minimo um macho e uma fêmea.
  (Sugere-se um levantamento de entidades interessadas em receber animais.)
- Reintrodução na natureza.

Centro de Pesquisa e Conservação:

Deverá ser implantado um centro de pesquisa e conservação do cervo do pantanal, citado adiante com maior detalhamento, cujas instalações deverão ser adequadas ao manejo intensivo de pesquisa, incluindo alojamento para pesquisadores, laboratorios adequados às linhas de pesquisa propostas, e localizando-se geograficamento em área adequada para seus propósitos, sendo conectado à rede *Internet*. Suas finalidades principais são a manutenção de exemplares de cervo do pantanal em condições de higidez, a colheita, armazenamento e difusão de dados necessarios sobrevivencia da espécie, a colheita e estoque de material genetico e o treinamento de pessoal técnico.

Os animais destinados a formar o grupo inicial serão provenientes de captura na natureza e/ou cativeiro. O plantel inicial será de 50 indivíduos, sendo que é previsto um plantel de 100-150 animais cinco anos após a implantação do centro.

Todo e qualquer material ou subsídio informativo obtido no centro de pesquisa ou em outras instituições para onde cervos do pantanal tenham sido tranferidos, deverá ser mantido no centro de pesquisa e conservação. Animais que venham a ser descartados pelo centro poderão ser transferidos para outros locais, com finalidades educativas.

Manual de Manejo:

Deverá ser produzido um manual de manejo do cervo do pantanal em cativeiro, com base nos conhecimento já existentes e nos dados obtidos através das atividades de pesquisa intensiva desenvolvidas no centro de pesquisa e conservação. Até que tais pesquisas sejam levadas a efeito, as recomendações gerais iniciais para o manejo dos animais do centro são as seguintes:

* Instalações:
- Cerca de alambrado com 2,5 m de altura, com postes do lado de fora. Nos zoológicos, a área de visitação deverá ser delimitada, e as outras áreas dos recintos deverão ser protegidas com barreiras visuais.
- Local ao ar livre, destinado a exercicio, com 200 m² de área para cada cervo adulto.
- Duas áreas separadas, destinadas ao manejo intensivo de cativeiro, com uma área livre de 4x10 (40 m²) e uma baia de 3x3 m (9 m²).
- Portas de correr operadas por fora, com 1 m de largura.
- Bebedouros e comedouros cobertos.
- Os diferentes recintos devem ser inter-comunicáveis, por meio de corredores.
- Acesso adequado a eletricidade, água, e transporte.
- Area de maternidade.
- Area de recria de filhotes.

* Assistencia técnica de pessoal treinado: Veterinarios, Biólogos e Tratadores.

* Nutrição de adultos:
- Fornecimento de ração peletizada com 16 a 18% de proteína bruta e 13 a 15% de fibra bruta. A administração da ração deve ser feita com base no cálculo de 1 Kg de ração para 100 Kg de peso, sendo esta quantidade dividida em duas refeições diárias.

- Fornecimento de sal mineral, à vontade.
- Fornecimento de alimentos verdes de boa qualidade; leguminosas e gramineas tenras.

* Nutrição de Neonatos:
- Considera-se como ideal o leite caprino, e como segunda opção o leite bovino.
- Manter posição adequada durante amamentação.
- Intervalo de mamadas:
    - 1° semana: 8 por dia 100gr/mamada.
    - 2° semana: 6 por dia 172gr/mamada.
    - 3° semana: 4 por dia 313gr/mamada.
    - 4° semana: 3 por dia 473gr/mamada.
    - 2° mês: 2/dia - 670gr/mamada.
    - 3° mês: 2/dia - 680gr/mamada.
    - 4° mês: 2/dia - 660gr/mamada.
    - Desmame: 5° mês.
- A partir da 2° semana, administrar ração e volumoso, à disposição todo dia.

* Reprodução:
- Para os animais mantidos em zoológicos, macho e femeas devem ser mantidos permanentemente juntos.
- As fêmeas gestantes devem ser mantidas isoladas na maternidade.
- Os neonatos deverão sofrer os cuidados médicos usuais, incluindo exame físico, desinfecção do umbigo e colheita de sangue para exames laboratoriais.
- Um dia após o nascimento, os filhotes deverão ser isolados, e criados artificialmente.
- Após o parto a fêmea deve retornar ao convívio com o macho tão logo seja possivel.

* Protocolos de Captura e Contenção:
- Fisica: Contenção manual, Redes.
- Quimica: Tranquilizantes, neurolépticos de longa duração, associação de cloridrato de tiletamina e zolazepam, associação de cloridrato de xilazina, cloridrato de cetamina, cloridrato de detomidina e cloridrato de medetomidina.
* Cuidado Médico Geral:
- Os animais devem passar por exame físico e avaliação clínica no mínimo anualmente.
- O controle de ecto e endo parasitas deve ser rigoroso, incluindo a realização de exames copro-parasitológicos e a implementação de medidas profiláticas periódicas.

* Considerações Gerais:
- Deve ser instituído um *Stud Book* e um plano de manejo para a espécie em cativeiro. Um comitê especialmente formado decidirá sobre a escolha dos locais de envio dos animais, gerenciando o crescimento da população cativa.
- Todas as instituições que receberão os cervos deverão aceitar as recomendações e critérios explícitos para o manejo dos animais, formulados num termo de compromisso a ser assinado por ambas as partes. Os animais serão cedidos às instituições, podendo ser manejados e retirados a qualquer tempo, a critério do comitê.

- Considera-se que as instalações atualmente em uso em Promissão são inadequadas para os fins de cativeiro definidos neste documento.

2. Considerações Sobre a Implantação Do Centro De Pesquisa E Conservação Do Cervo Do Pantanal Em Cativeiro

Em termos históricos, o plantel de cervo do pantanal em cativeiro iniciou-se a partir de 60 animais fundadores capturados na natureza, há quatro anos. Compondo este plantel, existem atualmente apenas 18 daqueles indivíduos fundadores, associados a 16 de seus descendentes, totalizando 34 animais (13 em Ilha Solteira e 21 em Promissão). Tais resultados mostram claramente a inadequação do atual programa de criação em cativeiro .

A criação em cativeiro desempenha papel crucial de medida preventiva em relação ao futuro das espécies vulneráveis, como o cervo do pantanal, ameaçado pela perda de seus habitats e pela fragmentação populacional.

A recomendação básica do grupo de trabalho é a constituição de um centro independente de pesquisa e conservação, destinado a gerar o conhecimento necessário à criação, manutenção e desenvolvimento da espécie em cativeiro.

Os esforços iniciais de pesquisa deverão enfatizar o desenvolvimento de protocolos de manejo que permitam a propagação e a manutenção bem sucedidas de uma população cativa auto-sustentável.

O centro de conservação e pesquisa deverá seguir as seguintes linhas gerais:

- Albergar o plantel principal de cervos do pantanal.
- Centralizar, em um banco de dados geral, todas as informações referentes à espécie, bem como estabelecer um banco de pesquisa genética, sendo toda a troca de informações realizada via *Internet.*
- Coordenar as atividades realizadas em núcleos satélites (criadouros, zoológicos, etc.), que manterão outros plantéis e contribuirão com seu banco de dados. É necessário enfatizar que o centro de pesquisa deverá controlar todas as ações das demais instituições que vierem a fazer parte do programa de pesquisa, as quais serão obrigadas legalmente a cumprir as determinações e normas de trabalho estabelecidas pelo centro.
- Coordenar as atividades de pesquisa realizadas por seu pessoal técnico e por pesquisadores de outras instituições, tais como universidades, zoológicos, etc.
- Criar e manter atualizado o *Stud Book* Internacional da espécie.

Objetivo Geral das Atividades de Pesquisa: Obtenção de conhecimento científico sobre a espécie com a finalidade de auxiliar o manejo e otimizar a sobrevivência das populações cativas e de vida livre.

ÁREAS DE PESQUISA:

1. Manejo:

- Avaliação de diferentes meios de manutenção da espécie em cativeiro, com a finalidade de obtenção do sistema mais adequado. A estratégia de manejo adotada deve permitir a manipulação segura dos animais, a fim de possibilitar atividades intensivas de pesquisa. Todos os dados obtidos nas pesquisas deverão ser compilados, na forma de um manual de manejo do cervo do pantanal.
- Determinação do protocolo dietético mais adequado aos vários estágios de desenvolvimento do animal (os animais estão sendo alimentados com concentrado básico composto por 20% de proteína, 15% de fibra e 2500 Kcal/kg de energia, além de frutos). A partir de trabalhos já realizados na natureza, recomenda-se a necessidade de estudos nutricionais, referentes, por exemplo, à substituição dos frutos por leguminosas, etc. A definição das necessidades nutricionais mínimas para a espécie deverá ser embasada em estudos realizados com os animais cativos.
- Determinação do sistema adequado de aleitamento para os filhotes. O programa de aleitamento artificial conduzido pelo Zoo de Ilha Solteira, apesar de empírico, tem permitido sucesso na manutenção de filhotes vindos de Promissão. O produto utilizado inicialmente foi o leite caprino, sendo que atualmente está sendo empregado o leite bovino. Dados iniciais obtidos em fêmeas de cervo do pantanal capturadas em Três Irmãos demonstram, porém, que a porcentagem de gordura do leite da espécie é bastante superior àquela encontrada nos sucedâneos citados. Assim sendo, são necessários estudos que definam a composição do leite da espécie. Da mesma forma, é imperioso que se conduzam estudos referentes à duração da lactação no cervo do pantanal.

2. MEDICINA VETERINÁRIA:

- Introdução:

Em termos gerais, as enfermidades infecciosas já detectadas nas poucas avaliações pregressas, tanto em cativeiro quanto em amostras provenientes da natureza, foram a Doença Hemorrágica (*Blue Tongue*), causadora de mortalidade em cativeiro, a Leptospirose e a Brucelose. Com respeito às enfermidades parasitárias, observou-se altíssima infestação por carrapatos do gênero *Boophilus*, na população cativa de Ilha Solteira e Promissão, sendo que em termos de endoparasitismo, os problemas mais comumente observados à necropsia de exemplares de cervo do pantanal são relacionados com alta incidência de *Paramphistomun spp.* e ocorrência de nematóides do grupo *Strogyloidea* (*Trichostrongylus, Haemonchus, Cooperia* e *Trichuris*).

- Recomendações:

- Devem ser realizados estudos referentes a causas de mortalidade neonatal, e métodos de

prevenção.
- Análises sorológicas deverão ser realizadas para todos os animais do centro de pesquisa, bem como para amostras da população de vida livre, para as enfermidades anteriormente citadas, e para aquelas que têm potencial mórbido em cervídeos, tais como Febre Catarral Maligna, Febre Aftosa, Diarréia Viral Bovina, Rinotraqueíte Infecciosa Bovina e Raiva, entre outras enfermidades virais.
- Deve ser pesquisada a ocorrência de Tuberculose, Pasteurelose, Necrobacilose, Actinomicose, Tétano, Botulismo, Carbúnculo Sintomático e Carbúnculo Hemático, entre outras enfermidades bacterianas.
- Deve ser realizado completo e constante levantamento parasitológico.
- Algumas enfermidades devem ser avaliadas quanto ao potencial patogênico através do emprego de técnicas de desafio, especialmente a Febre Aftosa.
- Os procedimentos de quarentena destinam-se à avaliação de animais recém chegados ao centro de pesquisa, possibilitando portanto a realização de uma série de pesquisas médicas e biológicas em indivíduos cuja situação física é muito semelhante à encontrada na natureza, pois sua captura ocorreu recentemente. A quarentena cumpre, além de fornecer dados de pesquisa, o importantíssimo papel de impedir a entrada, nas áreas de criação, de enfermidades oriundas da natureza. Em termos gerais, durante a quarentena, além dos procedimentos usuais de identificação, marcação, biometria e exame médico, deverá ser realizada a colheita de material para a realização de exames laboratoriais. Tais exames serão destinados à avaliação do estado clínico dos animais, ao levantamento de dados parasitológicos e referentes aos parâmetros normais de patologia clínica para a espécie (hemograma, provas bioquímicas, urinálise, etc.), e à obtenção de dados referentes às situações mórbidas ocorrentes na natureza, principalmente através de provas sorológicas para prevalência de enfermidades e da realização de exames necroscópicos nos cadáveres de indivíduos que morrerem durante o período. Os recintos destinados à quarentena deverão estar localizados a uma distância adequada das instalações de criação, e deverão possibilitar que a manipulação dos animais e a realização dos procedimentos citados ocorram com plena segurança, visto tratar-se de animais capturados diretamente da natureza, e, portanto, não adaptados ao cativeiro.
- Pesquisa médica aprofundada deverá ser realizada no que tange aos procedimentos profiláticos e terapêuticos, com o objetivo de formular protocolos de imunização e tratamento eficientes e adequados às necessidades das populações cativas de cervo do pantanal (medicamentos e produtos biológicos em geral).
- Devem ser realizados estudos referentes à metodologia de contenção física e química dos animais, incluindo equipamentos especiais e testes de anestésicos, tranquilizantes de longa duração, etc.

Para que as citadas atividades de pesquisa na área de medicina veterinária possam ser realizadas de maneira frutífera, é necessária a implantação, no centro de pesquisa, de uma infra-estrutura mínima composta por uma sala de atendimento capacitada à realização até mesmo de atos cirúrgicos, um laboratório de análises e uma área de enfermaria, para isolamento de animais doentes.

3. REPRODUÇÃO:

O conhecimento sobre a biologia reprodutiva do cervo do pantanal é ainda insuficiente. As poucas informações reprodutivas obtidas em cativeiro sugerem que os nascimentos podem ocorrer em todos os meses do ano. O período de gestação é de cerca de 8 meses, sendo que as fêmeas geram apenas um filhote. Tanto machos quanto fêmeas assumem a maturidade reprodutiva por volta de dois anos de idade. Apesar de os machos apresentarem ciclos anuais de crescimento dos chifres, tais ciclos não são sincrônicos, sugerindo que a espécie não apresenta estacionalidade reprodutiva. Ainda não se realizaram estudos reprodutivos detalhados sobre a espécie, com a finalidade de definir as características específicas de ciclo estral nas fêmeas ou de ciclo testicular anual nos machos.

- Recomendações para pesquisa:

Primeira Fase:

a) Fêmeas:
- Existência ou ausência de estacionalidade reprodutiva.
- Idade de maturidade sexual e idade à primeira reprodução.
- Características endócrinas básicas do ciclo estral.
- Comportamento reprodutivo.
- Período de gestação e diagnóstico de gestação.
- Parto, lactação, e cuidados com os neonatos.

b) Machos:
- Existência ou ausência de estacionalidade reprodutiva.
- Avaliação do grau de sincronia entre chifres e ciclo testicular.
- Idade de maturidade sexual e idade à primeira reprodução.
- Perfis endócrinos reprodutivos anuais e sua relação com o ciclo testículos/chifres.
- Características básicas do ciclo dos chifres, incluindo morfometria e alterações no tamanho testicular.
- Comportamento reprodutivo em relação ao ciclo chifres/testículos.
- Alterações anuais nas características seminais.

Segunda Fase:

Após a obtenção de conhecimento básico sobre reprodução, os esforços de pesquisa deverão enfocar o desenvolvimento de técnicas de reprodução assistida, que poderiam ser usadas em combinação com o banco de recursos genéticos, para otimizar o manejo reprodutivo das populações de cativeiro e vida livre.

a) Fêmeas:
- Sincronização do ciclo estral.
- Inseminação artificial.
- Indução de ovulação.
- Produção de embriões *in vivo* e *in vitro*.

- Resgate *post-mortem* de gametas.
- Criopreservação de embriões.

b) Machos:
- Colheita de sêmen.
- Criopreservação de sêmen.
- Resgate *post-mortem* de esperma.

4. GENÉTICA:

As pesquisas em genética permitirão a avaliação da variabilidade genética e caracterização das populações. Propõe-se a criação de um banco de recursos genéticos que organizará a colheita, estoque e utilização dos bio-materiais. O banco tem potencial de auxiliar no manejo da conservação das espécies raras e ameaçadas *in situ* e *ex situ,* podendo prover material para a proteção das populações em caso de epidemias e catástrofes naturais. Também proverá um meio de intercâmbio de material genético entre populações de vida livre e cativeiro para maximizar a diversidade genética.

As pesquisas em genética gerarão conhecimentos básicos que permitirão analisar e interpretar a evolução e filogenia dos cervídeos, bem como trarão conhecimentos que serão aplicados para o manejo das populações.

Metodologia:

Serão colhidas amostras de sangue e tecidos dos indivíduos de cativeiro para realizar os seguintes estudos:
- Citogenética.
- Eletroforese de proteinas e isoenzimas.
- DNA mitocondrial e marcadores nucleares (microsatélites).

As análises citogenéticas e eletroforéticas estão sendo desenvolvidas pela UNESP (Campi de Jaboticabal e Botucatu) e outras instituições correlatas, para fins de utilização em citotaxonomia.

Os estudos de genética molecular terão de ser implementados por se tratarem de ferramenta efetiva e poderosa para avaliar a variabilidade genética das populações em cativeiro, permitindo realizar análises comparadas com as populações de vida livre.

Os marcadores nucleares microsatélites compreendem uma nova técnica que permite determinar relações de parentesco. Estes resultados permitirão conhecer o grau de endogamia das populações mantidas em cativeiro e evitar os efeitos da mesma realizando cruzamentos dirigidos.

3. CONSIDERAÇÕES SOBRE PROGRAMS DE EDUCAÇÃO AMBIENTAL

JUSTIFICATIVA

Tendo em vista que a conservação de espécies vulneráveis como o cervo-do-pantanal depende de ações de todos os seguimentos da sociedade e em especial das comunidades de entorno das áreas de ocorrência da espécie, bem como dos centros de pesquisa e conservação, faz-se necessário um trabalho amplo e contínuo de educação e conscientização ambiental. Torna-se, portanto, necessário envolver esse público num processo participativo e abrangente, procurando atrair ao máximo a sua atenção, de maneira tal que sentir-se-ão propensos a conservarem e a exigirem a conservação.

OBJETIVOS

- Desenvolver uma campanha de educação e conscientização ambiental com as comunidades adjacentes aos locais de ocorrência da espécie, naqueles onde se implantarem centros de pesquisa e conservação e áreas de reintrodução, conscientizando a população sobre os problemas atuais de degradação do meio ambiente, a situação crítica desta espécie e a necessidade e importância da conservação do cervo-do-pantanal e de seu habitat, envolvendo essas comunidades de tal forma que sintam-se responsáveis pela preservação e evitem a degradação ambiental através de queimadas, caça e destruição ambiental.

- Elaborar e desenvolver programas de treinamento para profissionais envolvidos no manejo da espécie (curadores de zoológicos, biólogos, veterinários, zootecnistas, estudantes, profissionais especializados e tratadores) e profissionais afins.

POPULAÇÃO ALVO

O público a ser envolvido pelo Programa de Educação Ambiental compreende as pessoas que vivem nas áreas de ocorrência da espécie e/ou de instalação dos centros de pesquisa e conservação. Incluem:
- comunidades de entorno
- lideranças comunitárias
- comunidade escolar (estudantes e professores)
- Organizações Governamentais
- ONG's ambientalistas

Além destes seguimentos, serão envolvidos pelo Programa de Educação Ambiental os profissionais de zoológicos, instituições de pesquisa e criadouros que vierem a manter cervos-do-pantanal em sistema de cativeiro.

ESTRATÉGIAS

O Programa de Educação Ambiental constará de duas linhas de atuação. A primeira direcionada aos zoológicos e criadouros que receberem cervos para criação em cativeiro e a segunda, destinada as comunidades de entorno da área de distribuição da espécie , de instalação de Centros de pesquisa e conservação ou de reintrodução da espécie.

1. Zoológico.

As estratégias definidas para o Programa de Educação Ambiental em Zoológico compreendem:

1.1 Levantamento dos zoológicos do Brasil e exterior, com capacidade para receber os indivíduos, do ponto de vista de condições de instalação, profissionais capacitados e manutenção dos indivíduos.

Deste levantamento será definido o número de indivíduos necessários para atender as solicitações, considerando-se a disponibilidade do plantel do centro de Pesquisa. Como premissa básica, os zoológicos deverão ter condições de receber no mínimo um macho e duas fêmeas, e os criadouros no mínimo um casal de cervos a fim de manter o Programa de reprodução.

Para os zoológicos de interesse, localizados nas áreas de ocorrência da espécie, mas sem condições financeiras de abrigar os animais, serão desenvolvidos mecanismos tais como patrocínio e apoio institucional que facilitem a inclusão dos cervos ao plantel do zoológico.

1.2 Programa de Treinamento dos Profissionais de zoológico.

Previamente ao envio dos animais será desenvolvido no Centro de Pesquisa um programa de treinamento com os profissionais dos zoológicos interessados em receber cervo-do-pantanal. Este treinamento buscará prover os técnicos com as noções básicas de manejo da espécie incluindo os seguintes temas:
- reprodução
- nutrição
- sanidade
- adequação de recintos e equipamentos
- contenção

Para difusão dos princípios de conservação da espécie e de seu habitat, será fornecido material contendo impressos (cartazes, cartilhas, folders), audio-visual (vídeo e slides) e demais informações para embasar o trabalho de educação ambiental a ser desenvolvido com a espécie no zoológico.

2. População Local

O trabalho com as comunidades das áreas de ocorrência de cervo-do-pantanal, próximas a Centros de pesquisa e conservação ou de reintrodução da espécie envolverá as seguintes estratégias:

2.1 Diagnóstico Ambiental

Compreende uma pesquisa junto a população sobre o grau de conhecimento da espécie, conservação, hábitos conservacionistas e predatórios, dentre outros, procurando traçar o perfil ambiental da população.

Com estes dados definir-se-ão linhas de ação prioritárias para cada região abrangendo os aspectos de maior ênfase para a campanha de educação, como por exemplo conservação de hábitat (florestas, cerrados, várzeas), perigo das queimadas, consequencia da caça ilegal, dentre outros.

2.2 Opções de Campanhas Educativas

2.2.1 Em Zoológicos e Centros de pesquisa e conservação

Promover cursos, palestras, produção de textos para agentes multiplicadores e visitantes, visitas orientadas e programas especias (colônia de férias, eventos, datas comemorativas).

Possibilitar a participação de estudantes universitários e pesquisadores em atividades de estágios e desenvolvimento de pesquisas em cativeiro.

Integrar as ONG´s às ações de educação e pesquisa do zoológico, bem como a iniciativa privada.

2.2.2 Nas comunidades

Desenvolver ações de conscientização através de :
-cursos para estudantes, professores e lideranças (zona rural e urbana),
-produção de material informativo e de divulgação (cartazes e outros)
-campanhas informativas junto aos meios de comunicação (rádio, televisão, jornal)
-reuniões com produtores rurais e agricultores,

Em caso de comunidades que culturalmente dependem da caça do cervo-do-pantanal para sua sobrevivência, deverão ser desenvolvidos estudos de sustentabilidade da caça na população, conscientizando sobre a necessidade de não se esgotar o recurso informando sobre a capacidade de extração tolerável da espécie. Deverão ser ainda propostas alternativas de outras fontes de subsistência.

MONITORAMENTO E AVALIAÇÃO

- Os programas de educação ambiental deverão ter seu desenvolvimento monitorado com a finalidade de averiguar os resultados obtidos e, se necessário, promover alterações nas estratégias utilizadas para alcançar os objetivos inicialmente propostos.

Formas de avaliação dos resultados serão necessárias para medir o sucesso dos programas, como, por exemplo, diminuição da caça em determinada região.

CAPTIVE BREEDING, RESEARCH, AND ENVIRONMENTAL EDUCATION

INTRODUCTION

HISTORY OF MARSH DEER IN CAPTIVITY IN BRAZIL

Below it is reported the knowledge acquired on marsh deer since the rescue operation at Três Irmãos dam (1990), and the data obtained at the Marsh Deer Conservation Center (Promissão) and at the Ilha Solteira Zoo, São Paulo.

1. Conservation

Four years ago 60 marsh deer were captured at Três Irmãos to found a captive population. Today, 18 of these individuals are still alive with 16 descendants, totaling 34 marsh deer (13 at Ilha Solteira and 21 at Promissão).

2. Environmental Education

In Promissão, there was a local education program with the objective of reintroducing some of the animals into the wild. At Ilha Solteira Zoo, there is an education program focusing on marsh deer.

3. Research

Knowledge on the management and breeding of marsh deer was gained during the last four years in Promissão and Ilha Solteira. Zoo. Biological material was collected from the animals at Três Irmãos for research on genetics, physiology and diseases.

Below is a summary of data related to diseases found in this population.

3.1. Viral Diseases

3.1.1. Viral disease confirmed:

Blue Tongue - Approximately 50 % of the individuals tested were positive for this disease at Ilha Solteira. Additionally, 100 % of the cattle tested in the region were equally positive.

3.1.2. Viral diseases with probability of occurrence:

Foot and Mouth Disease - Not confirmed, but potentially dangerous for the species, especially in the Pantanal. Marsh deer population in Tietê River was negative for this disease at the time of the rescue in Três Irmãos. None of the 119 individuals tested were positive for foot and mouth disease or infectious bovine rhinotracheitis (IBR).

Febre Catarral Maligna - It occurs in bovines in São Paulo State, and may be transmitted to cervids in general.

Other diseases possibly occurring in cervids:
- BVD (Bovine viral diarrhea)
- IBR (Infectious bovine rhinotracheitis)
- Rabies
- Papillomatoses

3.2. Bacterial diseases

3.2.1. Leptospiroses - Of the 112 individuals tested from Três Irmãos, 33.92% were positive, encompassing 12 different serum types. However, none of the marsh deer showed any disease symptoms.

3.2.2. Brucelloses - One out of 116 tested marsh deer was positive. However, the animal did not showed external signs of the disease.

3.2.3. Tuberculosis - Not diagnosed in marsh deer so far. It is considered problematic for captive breeding in captivity.

3.2.4. Bacterial diseases with probability of occurrence:

- Pasteurelloses
- Necrobacilloses and Actinomycoses
- Tetanus and botulism
- Symptomatic carbunculosis
- Hematic carbunculosis
- Bacterial enteritis

3.3. Parasitic diseases

3.3.1. Ectoparasites

Ticks - In the wild marsh deer is associated with *Amblyoma sp.*. In captivity however (Promissão and Ilha Solteira), there is high infestation by *Boophilus sp.*. Besides causing anemia, such parasites transmit protozoa of the genus *Babesia* and rickettsias of the genus *Anaplasma*.

3.3.2. Endoparasites

Metazoa - Most commonly, high loads of *Paramphistomum spp.* are associated with marsh deer mortalities. Nematodes of the group *Strogyloidea* (*Trichostrongylus, Haemonchus, Cooperia*, and *Trichuris*) area also common.

Protozoa - Because of the high infestation by ticks, it is possible the occurrence of infection by *Babesia.*

OBJECTIVES

The main objectives for the marsh deer captive breeding are:

1. Accumulate scientific knowledge to better manage and conserve the species.

2. Promote environmental consciousness in the general public, in especial for the conservation of the species.

CONSIDERATIONS ON MARSH DEER CAPTIVE MANAGEMENT

Taking into consideration the current abundance of marsh deer in the wild, there is no need for the maintenance of a great number of marsh deer in captivity. It is suggested that between 50 and 100 individuals would be enough to promote basic research and public education. If necessary, some animals could be captured in Pôrto Primavera to supplement the current captive population.

If genetic analysis define subspecific differences among the wild populations, the most endangered subspecies should deserve more attention.

PROCEDURES FOR ANIMALS CAPTURED IN THE WILD

ANIMALS RECORDS

The wild marsh deer capture sites must be correctly and accurately recorded. Each animal must receive a permanent marking. As much as possible information should be collected from marsh deer dying during the capture process.

AGE CLASS

Only young animals captured in the wild should be included in the captive population.

QUARANTINE

All of the marsh deer captured in the wild should be sent to a quarantine with the necessary facilities for the management of the animals, and preservation of biological samples before proper analysis are conducted. This facility should provide means for the execution of sanitary exams, besides having the structure to start the captive adaptation process. All of the animals carrying diseases should be able to receive proper treatment on site. Marsh deer showing positive tests that might endangered captive populations should be discharged.

Quarantine records should be most accurate and detailed as possible, including capture references, biological information (nutrition, behavior, and reproduction), and medical data.

After the quarantine, the animals would be ready for distribution among the following institutions:

- Conservation center: minimum of 10 males and 40 females.
- Zoos: minimum of 1 male and 2 females (currently there are 14 zoos able to receive up to 30 marsh deer).
- Private breeders: minimum of 1 male and 1 female (a survey on candidate breeders needs to be done).

MANAGEMENT IN CAPTIVITY

CONSERVATION AND RESEARCH CENTER

There is need for a marsh deer conservation and research center. Its facilities should allow for: intensive management of the animals, lodging for researchers, and laboratories. This center should be connected to *Internet* network. The main conservation center purposes are the maintenance of a healthy population for research, genetic materials collection and preservation, and training of professionals.

This population will consist of animals captured in the wild and captive born individuals. The initial group should contain 50 marsh deer, that after five years should have reached a total of 100-150 individuals.

All of the material and information collected in this center or its affiliated institutions, should be kept in the conservation and research center. Marsh deer discarded from the center may be transferred to other institutions and used for educational purposes.

MANAGEMENT GUIDE

A marsh deer management guide should be produced, based on the experience acquired in the future conservation center. Preliminary recommendations include:

Facilities

- Wire fence 2.5 m high. Poles should be set facing the external side of the fence. In zoos, an area for visitors should be established. The remaining marsh deer enclosures should contain visual obstacles.
- Enclosures should contain open areas of 200 m^2 for each adult marsh deer.
- Two separate areas dedicated for intensive management should include an open area of 4x10 m^2 and a tamer of 3x3 m^2.
- Sliding doors opened from outside with length of 1 m.
- Covered feeding and drinking area.
- Different enclosures must be connected by corridors.
- Adequate access to electricity, water, and transportation.
- Maternity area.
- Nursing area.

Technical assistance

- Veterinarians, Biologists, and keepers.

Adult Nutrition

- Pellet ration with 16% to 18% of crude protein and 13% to 15% of crude fiber. Ration should be calculated as 1 Kg of ration for 100 Kg of body weight, and divided into two meals.
- Mineral salt at will.
- Greens, legumes, and tender grasses.

Neonatal Nutrition

- Goat milk as first option, and cattle milk secondarily.
- Maintain adequate position during nursing.
- Nursing intervals:
  - 1st week: 8/day, 100g/nursing.
  - 2nd week: 6/day, 172g/nursing.
  - 3rd week: 4/day, 313g/nursing.
  - 4th week: 3/day, 473g/nursing.
  - 2nd month: 2/day, 670g/nursing.
  - 3rd month: 2/day, 680g/nursing.
  - 4th month: 2/day, 660g/nursing.

5th month: weaning.

- Provide ration and forage as from the second week.

Reproduction

- Maintain males and females permanently together in zoos.
- Pregnant females must be kept apart.
- Neonates must receive medical attention including umbilical disinfection, and blood sampling for sanitary exams.
- One day after the birth, fawns should be taken from their mothers for hand raising.
- As soon as possible females should return from isolation after parturition.

Capture and restrain

- Mechanical: nets and manual contention.
- Chemical: tranquilizers, long lasting neuroleptics, tiletamine chloride and zolazepam associations, xylazine chloride, ketamine chloride, detomidine chloride and medetomidine chloride associations.

General medical care

- Annual physical and clinical examinations.
- Prophylactic measures, and periodical parasite control including fecal examinations.

General considerations

- There must be created a stud book and a management plan for the species in captivity. A committee should be appointed to decide on the selection of institutions to where surplus marsh deer should be sent. This committee should also coordinate the destiny of the captive population.
- An agreement between the institutions receiving the marsh deer and the research center should be signed stating their compromise in following recommendations and criteria determined for the management of the species. The committee will have the opportunity to manage and request any animal from the receiving institutions at any time.

- The current facilities created for marsh deer at Promissão are considered inadequate for the purposes defined in this document.

MARSH DEER CONSERVATION AND RESEARCH CENTER

Captive breeding plays a crucial role to the conservation of vulnerable species, which habitat is been lost and populations area been fragmented. The current program of captive breeding in Brazil is not fulfilling this objective. After 4 years of functioning, of the 60 marsh deer initiating the captive population only 34 individuals constitute, showing the inadequacy of this program. It is suggested that a new research and conservation center be created. This center should generate the necessary knowledge to maintain and breed the species in captivity. Initial efforts should emphasize the development of management protocols, which allow for the propagation and maintenance of a self-sustaining captive population.

The conservation and research center should obey the following guidelines:

- Encompass the marsh deer core group in captivity.
- Centralize all the information pertinent to the species, as well as to establish a nucleus of genetics research base. All of the information exchange should be conducted through *Internet*.
- Coordinate all activities carried on in satellite nucleus (private breeders, zoos, etc), which will maintain the remaining marsh deer population in captivity, and will contribute to the data base. All of the institutions taking part in the program should be legally committed to accomplish with the norms and determinations ruled by the center.
- Coordinate research lines conducted by its technical personnel as well as researchers of other institutions, such as universities, zoos, etc.
- Develop an international Stud Book for the species.

General objective of the research lines:

Obtain scientific knowledge on the species with the aim of managing and optimize the captive populations survival and in the wild.

RESEARCH LINES

1. Management:

- Evaluate different alternatives for the species management in captivity. The selected strategy must permit a safe handling of the animals, allowing for intensive research. All of the guidelines, should be compiled into a management manual for the species.
- Determine the most appropriate diet for all development stages of marsh deer (currently marsh deer at Promissão receive a ration consisting of 20% protein, 15% fiber and 2500 Kcal/Kg, and fruits). Based on studies conducted in the wild, it is recommended the need for nutritional research, e.g. substituting fruits by legumes.
- Determine an adequate nursing protocol for the fawns. The current nursing system used in

Ilha Solteira has produced effective results. Initially, it was used goat milk, but currently cattle milk has been provided. Preliminary data however, show that marsh deer milk has a higher content of fat compared to cattle and goat milk. Thus, studies should be conducted to define the marsh deer milk composition, and duration of the lactating interval.

VETERINARY MEDICINE

Introduction

In general, three infectious diseases were detected in marsh deer: Blue Tongue, Leptospiroses, and Brucelloses. Regarding ectoparasites, high loads of ticks (*Boophilus*) have occurred in Ilha Solteira and Promissão. The most common endoparasites are *Paramphistomum spp.* and nematodes of the *Strogyloidea* group.

Recommendations

- Conduct studies to prevent neonatal mortality.
- Perform serological analyses in all captive marsh deer and samples of wild individuals for those viral diseases mentioned previously.
- Survey the occurrence of bacterial diseases.
- Periodical checking for parasitological diseases.
- Utilize individuals recently caught in the wild as source of information on the sanitary state of the wild population, as well as basis for clinical parameters such as hemogram, urinalysis, etc.
- Produce protocols for immunization and treatment.
- Research chemical and physical restrain methods, including special equipment, anesthetics, etc.

To conduct the recommendations above, the center needs to include a surgery room, a laboratory for clinical analysis, and an infirmary for isolation of sick animals.

REPRODUCTION

Little is known on marsh deer reproductive biology. Information collected in captivity and wild suggest that reproduction may occur at any month of the year. Gestation is approximately 8 month long, with a single fawn been born. Male and female reach reproductive maturity at approximately two years of age. Antler growth is seasonal. Studies on estral and testicular cycles are lacking.

Research recommendations:

First Step:

a) Females:
- Verify reproductive seasonality.
- Age of reproductive maturity and age of first reproduction.
- Estral cycle endocrine characteristics.
- Reproductive behavior.
- Gestation period and pregnancy diagnose.
- Parturition, lactation, and neonatal care.

b) Males:
- Verify reproductive seasonality.
- Evaluate relationship between antler growth and testicular activity.
- Age of reproductive maturity and age of first reproduction.
- Reproductive cycle related to antler growth and testicular activity.
- Morphometry of the antler and testes growth.
- Reproductive behavior relative to antler and testes growth.
- Annual alterations in seminal characteristics.

Second Step:

Develop techniques of assisted reproduction that could be used in association with the genetic sources stocked by the center. Conduct the following research lines and activities:

a) Females:
- Synchronize estral cycle.
- Artificial insemination.
- Induced ovulation.
- Embryo production *in vitro* and *in vivo*.
- *Post-mortem* rescue of gametes.
- Embryo cryopreservation.

b) Males:
- Sperm collection.
- Semen cryopreservation.
- *Post-mortem* semen rescue.

GENETICS

Genetic research will enable genetic variability analyses and characterization of wild populations. It is suggested the creation of a genetic resource banking responsible for collection, preservation and its utilization. This bank will provide sources for genetic interchange between captive and wild populations. Furthermore, genetic research will allow for analyses and interpretation of phylogeny and evolution of cervids.

Methods:

Blood samples and tissues will be collected of captive marsh deer to conduct the following studies:

- Cytogenetics.
- Protein and Isozymes electrophoreses.
- Mitochondrial DNA and nuclear markers.

PUBLIC EDUCATION

RATIONAL

Given the importance of local communities as well as all of the segments of the society, it is necessary that a thorough program of public education be conducted.

OBJECTIVES

- Develop an environmental campaign in the critical areas for the conservation of the species.

- Develop training programs for professionals involved in the species management (zoos curators, biologists, veterinarians, students, keepers and other related professionals).

TARGET PUBLIC

Target public include:

- Community leadership.
- Local public in contact with the species.
- Schools.
- Governmental Agencies.
- NGOs.
- Zoo professionals
- Research Institutions.
- Private breeders.

TRAINING PROGRAM

Previously to the remittance of marsh deer to any institution, a training program should be developed with the local professionals receiving the animals. This training will provide technicians with basic notions on the management of the species including subjects as:

- reproduction.
- nutrition.
- hygienics.
- Adaptation of enclosures and equipments.

Educational material (posters, folders, videos, etc) will be provided for public education.

PUBLIC EDUCATION

Environmental diagnose

It is necessary to conduct a research to learn the degree of knowledge that the target population has regarding the species, and human impacts on the environment and the species. These data will be used to focus future actions of the campaign.

Education campaign actions

Areas of marsh deer captive breeding

Promote courses, speeches, produce graphic material for visitors, oriented visits and especial events.

General Public

Develop environmental consciousness through:

- courses for students, professors and local leadership.
- produce educational material.
- divulge through the media.
- meetings with land owners.

Especial programs should be developed to those communities that rely on subsistence hunting, based on the results of the studies on sustainable use of wildlife.

Monitoring and evaluation

Monitoring of the results attained by the educational program should be constantly conducted to improve the methodology employed and reformulate objectives.

MARSH DEER CONSERVATION AND RESEARCH CENTER FINAL CONSIDERATIONS

It is proposed the termination of the marsh deer center in Promissão and the transfer of its individuals to other facilities. A new center should be created taking into account the following reasons:

- The center at Promissão does not comply with the necessary requirements for the research and management objectives proposed in this document.
- Profound alterations would be necessary to prepare the center at Promissão to attend the requirements.
- Most of this center is resting on flooded soil.
- The environment characteristics cited above, make difficult controlling endo- and ectoparasites.
- There are already captive born individuals capable of being used in intensive research.

The creation of a marsh deer conservation and research center should follow the following recommendations:

- The Brazilian Zoological Society will contact zoos interested in receiving marsh deer, and will evaluate the adequacy of their facilities to maintain the species according to the recommendations above.

- Ilha Solteira zoo should be improved with the construction of a quarantine area, and the adaptation of their enclosures.

- Smaller enclosures connected by corridors should be build to accommodate 20 captive born marsh deer. Ilha Solteira would constitute a research satellite nucleus, where immediate research could start according to the recommendations in this document.

- A committee should be formed by one representative of each society or governmental agency as follows: IBAMA, the Brazilian Zoological Society, the Deer specialist group (IUCN), the group of interest in cervids (SZB), and a NGO acting in the area of interest. This committee would be responsible for evaluating the sending of marsh deer to zoos. private breeders, etc, and it would take additional decisions regarding the captive population as a whole. All of the marsh deer would belong to the conservation and research program, initially centered at Ilha Solteira.

- The core conservation and research center should be created near the new reservoir of Pôrto Primavera. This center would be strategically located near the area of occurrence of the species, and close to possible areas for future reintroduction in Brazil and abroad.

CERVO-DO-PANTANAL

Blastocerus dichotomus

ANÁLISE DE VIABILIDADE DE POPULAÇÃO E HABITAT (PHVA).

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CERVO-DO-PANTANAL

Blastocerus dichotomus

ANÁLISE DE VIABILIDADE DE POPULAÇÃO E HABITAT (PHVA).

PRESENTATIONS

MARSH DEER WILD POPULATION STATUS IN BRAZIL

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1 - DISTRIBUTION

Marsh deer historic geographic distribution in Brazil is known from reports of pioneering naturalist expeditions and specimens collected for museums (Hensel, 1879; Ihering, 1892; Miranda Ribeiro, 1919; Rehn, 1934; Autuori, 1972). The limits of its range are assumed to overlap with the grassy and park savannas to the South of the Amazon river, and coincide with the grasslands of Southern Brazil (Fig. 01). The map prepared by Pinder (1991) perhaps is closest representation of the historic distribution for marsh deer in Brazil (Fig. 1).

Blastocerus dichotomus primary habitat are the large expanses of seasonally flooded grasslands along the major rivers, as well as the coastal marshes along lake systems. Away from the main water courses within the savanna, marsh deer habitats are the swamp and wet grassland corridors along the river watersheds, known as "veredas".

Currently, this range has shrunk and became fragmented by the replacement of savanna and marsh landscapes by cultivated lands in Central and South Brasil, and flooding of riverine habitats specially in the Southeast. The species is probably extinct in the South with the last specimens seen in the early 1980's (Voss and Konrad, 1981). Just a few specimens survive in the State of São Paulo after the construction of a series of dams that completely flooded the Tietê and Paranapanema rivers in the last twenty years. The remaining individuals are segregated in relictual habitats along Tietê and Paranapanema rivers, and Paraná's river smaller tributaries. A new reservoir will flood 250 Km of the Paraná river in the next two years. In addition, there are plans to build another dam downriver, destroying the remaining marsh deer habitat in the Paraná valley. Land use probably extinguished marsh deer from Rio São Francisco valley in Minas Gerais and Bahia, and may have endangered the species in the Tocantins floodplains. Human population increase, in addition to the acceleration in agriculture during the last 20 years, have probably extinguished marsh deer of all habitats away from riverine marshes, with exception of governmental protected areas. Little disturbed populations still occur in the Pantanal, and perhaps along a few large rivers: Araguaia, Guaporé, and main tributaries of Xingú and Juruena.

2 - STATUS IN PROTECTED AREAS

A few parks and reserves in central Brazil preserve marsh deer presently: Pantanal

(MT), Araguaia (TO), Emas (GO), and Grande Sertão Veredas (MG) National Parks; Guaporé (RO) Biological Reserve; and Taiamã (MT) Ecological Sanctuary. Marsh deer may occur at Côco-Javaés (TO) Ecological Sanctuary (Fonseca et al, 1994), but the species' available habitat is insignificant. The presence of marsh deer at Iquê (MT) Ecological Sanctuary needs to be verified. In Southeastern Brazil marsh deer may have inhabited the region of Lagoa do Peixe National Park, and Taim Ecological Sanctuary (Voss et al, 1981), and in the Northeast the Mirador State Park (Oliveira, 1993). A multidisciplinary analysis should be conducted to verify the feasibility of reintroducing the species in these areas.

There are no effective protective measures against poaching within protected areas, and no management plan for the species or even the parks have been enforced. The single wildlife survey encompassing marsh deer in a protected area was conducted by Schaller in Emas National Park (1976). Schaller could only find tracks of a single marsh deer during his survey, and considered the species rare in the park. Population estimates are lacking for all of the protected areas.

In the last few decades many reserves have been created for indigenous people throughout the country. Although the government allows the natives to hunt marsh deer in these areas, they might in fact represent additional refuges, if a sustainable use was enforced to the mutual benefict of natives and wildlife. Marsh deer occur in Pimentel Barbosa Indigenous Reserve (MT) (F. Leeuwenberg pers. comm.), and surveys should be conducted to confirm the presence of the species in several other such areas.

3 - **POPULATION SIZE**

Presently, five isolated strongholds contain the main populations of marsh deer in Brazil: the Pantanal, Xingú and Araguaia basin floodplains, Guaporé and Paraná valleys. Within the Pantanal, marsh deer are more abundant between the Paraguai and São Lourenço rivers, Uberaba Lake surroundings, and in a few areas of the Paiaguás region to the North. In the Southern region of Pantanal the largest concentrations are found along the Rio Negro (Fonseca et al, 1994).

Recent systematic aerial surveys have revealed estimates of marsh deer population numbers for the entire Pantanal region and 2,500 Km^2 of the Paraná river (Mauro, 1993; Pinder, 1993). In the Pantanal densities ranged from 0 to 1+ marsh deer/Km^2, with a total estimate of 36,314 $\pm$ 4,923 individuals (Mauro, 1993). Pinder (1993) surveying the area to be flooded by the reservoir of Pôrto Primavera hydroelectric plant found and average density of 0.5 marsh deer/Km^2, with a total of 977 individuals (range 760-1194) between the parallels 20°50' and 22°30' S. A few kilometers to the North, a tributary of the Paraná river, Rio do Pântano revealed an estimated population of 40 isolated individuals (Moraes, et al 1993). Absolute counts of marsh deer in the remaining marshes of Tietê river, after the flooding of the last native portion of this river showed a population of approximately 10 individuals.

Using density estimates according to habitat type obtained in these two studies, and getting a rough calculation of the remaining available habitat for marsh deer in Brazil, it is possible to infer densities on other populations not surveyed so far (Tables 1 & 2). From these numbers one may assume that marsh deer is not in immediate danger of extinction in Brazil. However, with the continuous human population growth, and the current policy of dam constructions in the major rivers, one can forecast a scenario where in the next century, marsh deer will disappear from all of its range but the Pantanal, Guaporé and Araguaia rivers, and their protected areas, if no measures of effective preservation are taken.

4 - THREATS AND LEGISLATION

Undoubtly, the main factor threatening marsh deer populations in Brazil is habitat loss. Hunting contributes as significant decimating factor only in those areas where marsh deer populations are already severely reduced by habitat transformation. Marsh deer also accounts with legal protection from the Brazilian government that forbid its hunting since 1967. The species is also listed in Apendix I of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora. Diseases transmitted by cattle are considered a hazard for marsh deer populations in the Pantanal during the flood season, especially brucellosis and foot and mouth disease (Coimbra-Filho, 1972; Fonseca et al, 1994). Nevertheless, there are no quantitative data on death caused by transmitted diseases. Due to the difficulties in capture and handling wild marsh deer, no serious attempt to study infectious diseases in marsh deer have been conducted. It is possible, that several other diseases besides brucellosis and foot and mouse disease are killing marsh deer in the wild. During the capture of 22 marsh deer in Rio Paraná for a radio-telemetry study, blood samples revealed the occurrence of blue tongue disease in that population (M. Barbanti pers. comm.). Blue tongue is also a serious problem for the reproduction of cervids in captivity (M. Barbanti, pers. comm.), and may have undermined previous attempts of breeding and keeping marsh deer in captivity in the tropics (Nogueira-Neto, 1973). Two great outbreaks of wild cervid mortalities were registered by Pinder (1992, unpublished report to FUNATURA), and Oliveira (1993) for the regions of Grande Sertão Veredas National Park and Mirador State Park respectively. These two independent epidemic catastrophes arose after the passage of cattle, transported from ranches to market areas. In the Pantanal and other remote areas of the interior without roads, it is still frequent to move cattle across large distances to sell them. In consequence, diseases can be easily spread within the wild population.

Table 1 - Estimate of marsh deer population within Brazilian protected areas, based on extrapolated density calculations and crude evaluation of habitat availability.

Conservation Unit	Area (Km^2)	Habitat (Km^2)	Density (ind./Km^2)	Total Population
Maranhão				
Mirador*	5,000	250	0.2	50
Rondônia				
Guaporé	6,000	300	0.5	150
Mato Grosso				
Pantanal	1,350	1,080	0.5	540
Taiamã	143	114	0.5	57
Iquê**	2,000	100	0.2	20
Tocantins				
Araguaia	5,200	2,600	0.2	520
Côco-Javaés**	370	18	0.2	4
Minas Gerais				
Grande Sertão Veredas	840	42	0.2	8
Rio Grande do Sul				
Taim*	338	135	0.5	67

* - Areas where marsh deer probably existed in the past, but has gone extinct.
** - Areas where the occurrence of the species needs to be confirmed.

Table 2 - Crude estimation of marsh deer population in Brazil, based on extrapolated density calculations and crude evaluation of habitat availability.

Region	Population Estimate
Pantanal*	36,300
Araguaia Basin	5,000
Xingú Basin	4,400
Guaporé River	3,000
Paraná River**	1,000[1]
Tocantins River	750
Juruena River	500

* - Source (Mauro 1993)
** - Source (Pinder, 1993)
1 - Estimate after the creation of Pôrto Primavera reservoir.

Table 3 - Statistics of, growth rate, and demographic density of Brazilians within marsh deer current range - 1991.

State	Population	Growth rate (%) 1970/1980	1980/1991	Demographic density (ind/Km^2)	
MA	4,929,029	2.93	1.91	12.33	15.12
RO	1,130,874	15.80	7.84	2.03	4.74
MT	2,022,524	6.63	5.34	1.30	2.24
MS	1,778,741	3.21	2.40	3.91	4.98
TO	920,116	-	2.02	-	3.32
GO	4,012,562	2.76	1.99	6.01	11.80
MG	15,731,961	1.54	1.48	22.99	27.00
SP	31,546,473	3.49	2.12	101.25	127.55
RS	9,135,479	1.55	1.47	29.06	32.55

Source: Fundação Instituto Brasileiro de Geografia e Estatística (IBGE)

5 - CONSERVATION MEASURES

Recently, the first steps towards the conservation of marsh deer have been taken in Brazil. In 1990 a joint effort by EMBRAPA (Centro de Pesquisa Agropecuária do Pantanal) and WWF-US launched a project to determine the status and ecology of marsh deer in the Pantanal. In 1991, 158 marsh deer were translocated by CESP (Companhia Energética de São Paulo) from the floodplains of Tietê river, in consequence of the creation of a reservoir for a new power plant (Três Irmãos) in that river. Sixty-five of these animals were relocated to Rio do Pântano, 14 to an area acquired by CESP near Promissão in the Rio Tietê margins, and the remaining were transported into fenced areas exclusively created by CESP to reproduce marsh deer in captivity. These captures also allowed for sperm collection and cryopreservation in a cervids germplasm bank, kept at the University of Jaboticabal. Continuing with its efforts to minimize the impact caused by dam construction on marsh deer's habitat, CESP started studies in Rio Paraná in 1992. After a survey to estimate population size (Pinder, 1993), twenty-two marsh deer where radio-collared in order to monitor their movements, and verify habitat use. The study also intends to verify the results of the translocation of five marsh deer on their survival and movements. This study is demonstrating that translocation can be successfully employed following some basic safety guidelines. However, caution has to be taken to the selection of the releasing area, and to the number of animals delivered in the same area. Moraes et al (1993) showed that one year after the translocation the population at Rio do Pântano, to where 65 individuals had been introduced, returned to its original numbers of 40 individuals. The same result seems to have happened to the area in Rio Tietê, where 14 individuals where introduced in addition to a native population of 10 individuals. Therefore, the number of individuals relocated to a given area should be low relative to the local density of marsh deer, in order to dilute these animals and avoiding trespass the local carrying capacity. Currently, there are plans to start a multidisciplinary long-term program that will benefit marsh deer and its habitat. This program conducted by a pool of Brazilian NGOs will include research on veterinary, genetics, ecology, biology, captive and wildlife management.

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Status of the Marsh Deer, *Blastocerus dichotomus*, in Argentina, Paraguay, Bolivia and Peru,
MARCELO D. BECCACECI

Summary:

The marsh deer occurs in or near marshy habitat, in Argentina, Brazil, Bolivia, Paraguay and Peru where only scattered populations survive throughout its range. In Argentina, the species is distributed along the following rivers: Pilcomayo (province of Formosa), Bermejo (province of Chaco), Parana (Correintes, Chaco, Santa Fe, Entre Rios and Buenos Aires provinces), Uruguay (Entre Rios province). Marsh deer is also recorded in a few isolated large marshes of these provinces. In Corrientes, Ibera Reserve protects at least 1,100 individuals, the largest population of the country. Federally protected by law. It was declared a Natural Monument by Corrientes province in 1992. Paraguay: Itapucumi, Puerto Rosario Marsh, Ypoa Lake Basin, Neembucu Marsh, Patino Marsh, Yacyreta Island, marshes along the upper Paraguay river. Total numbers are unknown. Protected by law. Bolivia: The species occurs throughout eastern Bolivia in seasonally flooded savannah in Beni, Santa Cruz and La Paz departments. Total numbers are unknown but the population is decreasing. Protected by law. Peru: Only reported from Pampas del Heath, south-east, Peru, near the Bolivian border. In 1976 about 30-40 individuals were recorded. Protected by law.

Marsh Deer in Uruguay

Susana Gonzalez

Summary

Marsh deer (*Blastocerus dichotomus*) is the largest South American cervids. Inhabits wetland areas, marsh, lakes selecting areas with standing water 30 - 60 cm depth (Pinder & Grosse, 1991). Historically occurred throughout the marshy habitats at south of the Amazon River into northern Argentina. Currently South American populations are small and isolated. Marsh deer occurred in the past in "Banados del Este" of Uruguay called by the local people as "ciervo bayo". Banados del Este is a wetland system of low lands, partial flooded part of the year, lakes, lagoons and marsh area of approximately 300.000 ha. (205.000 in Rocha Dpto. and the other square is Treinta y Tres dpto.) (Fig. 1). Part of this system is included in Ramsar Convention (ratified in 1984), also has been decreed reserve by UNESCO, MAB program (June, 1976). The weather of this region is warm-humid. Three phytogeographic zones we can distinguish: a) High plan close to the wetland cover by grassland such Paspalum genus, and occasionally other bush; b) Medium plan with grassland and "Pajonales"; c) low plan in the flooded zone with major vegetal diversity and with complex communities (Lagomarsino et al, 1986). The increases of agricultural activities in this area lead to begin drain building channels in Banados del Este. In 1985 the first great channel was done with the goal to drain Banados de Santa Teresa, Las Maravillas and San Miguel, but this channel drained less volume and without maintenance was obstructed in 1930. In 1978 the Government decided to amplify and build big channels. In 1980 also private landowners built small channels.

The decrease of this species seems to take place at the beginning of this century. Sanborn (1929) remarked that he was not able to see this deer in Rocha and Treinta y Tres dpto. Kraglievih (1932) remarked it wasn't identified remains of Blastocerus genus in Uruguayan fossil record. Cabrera & Yepes (1940) expressed that in the past marsh deer were common in Uruguayan wetland areas but now is apparently extinct. However in 1958 a male was hunted in Banado Los Indios, the skull is at Museo Nacional de Historia Natural in Montevideo. This author and the local people think that a small nucleus of individuals survives in this area. In 1991 a female was hunted close to Villa Soriano, Soriano Dpto. (Lombardi, comm. pers.) Habitat alteration, wetland drain by a net of channels, poaching, seems to be the main factors to lead the marsh deer decrease, we have to monitor these cited areas to confirm the presence of the last marsh deer in Uruguay.

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Genetic Variation in a Population of Marsh Deer, *Blastoceros dichotomus*: Preliminary Results.

Patricia de Oliveira

The present study access the genetic variability of the marsh deer, *Blastocerus dichotomus*, population that was translocated due to the damming of the Tres Irmaos Power Plant, at Sao Paulo State, 1990. The cytogenetics analysis of 36 animals from the same population revealed the absence of polymorphism, with exception of the NOR band, suggesting that the animals belonged to a single population in the past, isolated for decades, and genetically similar (Duarte & Giannoni 1994).

The general goals of population genetics are to characterize and account for the genetic variation, once it furnishes raw material for future evolutionary changes and provide evidence for past evolutionary events (Weir 1990).

Considering that the genetic structure is fundamental information for species management (Baverstock & Moritz, 1990), the molecular genetics provides data on demographic events and entitles the structure prevision in the long term, collaborating with captive management plans.

The blood samples were collected during the captures, centrifuged to separate out the white cells, and stored in liquid nitrogen. A research plan was submitted to Smithsonian Institution, the funding agency for the initial analyses, through a Short Term Visitor Fellowship. The DNA was extracted at Sao Paulo State University at Campinas - UNICAMP, the suitable permits obtained (CITES, SDSA, USDA) and the samples brought to the Genetics Laboratory at National Zoological Park, Smithsonian Institution, Washington DC.

Under supervision of Dr. Robert C. Fleischer, Laboratory Director, the nuclear and mitochondrial DNA analysis were carried out from December 1991 March 1992. It encompasses the nuclear DNA fingerprinting, amplification via PCR (Polymerase Chain Reaction), RFLP (Restriction Fragment Length Polymorphisms) and sequencing of the D-loop fragment of mitochondrial DNA. We found that DNA fingerprints exhibited relatively low to moderate levels of variability and RFLP and sequence analysis of mitochondrial D-loop regions revealed no variability.

The study was conducted in two levels: the first focusing the individual characterization, to yield help for captive management plans, and the second focusing the intra-specific diversity, comparing different populations. To access the individual variability there is a need of studying a large number of loci, and the most suitable methodology is DNA fingerprinting. The nuclear DNA is an inexhaustible source of genetic markers, once accessed. With the discovery of hypervariable sequences (Variable Number Tandem Repeat VNTR) and their use in DNA fingerprints, there was a revolution in the analyses of population-level variation (particularly parentage), contributing to the studies of sexual selection, mating behavior and population ecology (Dowling et all, 1990).

The VNTR revealed the existence of related DNA fragments, dispersed through the vertebrate genome. Variations of these loci is more extensive than the traditional polymorphisms (Gilbert et all, 1991), and the analysis are made by the digestion of the DNA with restriction enzymes and hybridization with synthetic oligonucleotides (probes). The probes binds to the multiple repeated sequences simultaneously, yielding a large number of hypervariable loci. As a result there is a array of bands unique for each individual, and very powerful for paternity tests and evaluation of kinship of natural populations.

The knowledge of paternity is valuable for rational management of reproductive populations in captivity, avoiding the inbreeding and it's deleterious effects (Ely and Ferrel, 1990). The pedigrees also allow the maximization of effective population size and the preservation of rare alleles. The recommendation is to implement breeding programs designed to preserve the genetic variability as soon as possible for any captive population of endangered species (Templeton et all, 1987).

The DNA fingerprint analysis of a sample of 36 animals reveled low to moderate variation. As there are no ecological data available to be used in the discussion of the results, we made an option to group the animals according to the capture site, recovering the original group composition before the translocation. To finalize the study there is a need for the maps with the locations, that was asked when the analysis were performed, and it's hoped to be available soon. The DNA fingerprint analysis of the actual captive population could supply valuable information to be used in reproductive management, minimizing the loss of genetic variability (Morin & Ryder, 1991).

To access the intra-specific diversity the mitochondrial DNA was studied, a circular molecule in the animals ranging from 14.000 and 39.000 bases The mitochondrial DNA has been used in evolutionary genetics due to it's economic and compact organization, where there is little space for regulatory regions (Gadaleta et all 1989). The DNA mitochondrial is considered a valuable genetic marker because of it's uniparental inheritance, describing the maternal lineage, and going through a recombination process during transmission. It's relatively rapid evolution makes the mitochondrial DNA a suitable marker for variability among and between populations, although it's significantly more variable between populations, due to the tendency to become homogeneous, being used to estimate phylogeny and biogeographic investigations (Dowling et all, 1990).

In order to access the variability between populations we studied the most variable region of the mtDNA, the D-loop. This region was in vitro amplified by PCR, using primers developed by Patton to study fossils of Odocoileus virginianus (Purdue & Patton, 1991).

Through PCR is possible to work with small initial amounts of DNA, and the selected sequences are amplified exponentially, producing enough material to conduct the analysis. This methodology also allow the study of museum specimens, allowing the comparison between populations.

Using PCR we obtained two sequences, of 700 and 1200 bases, the later representing the complete D-loop region.

The first methodology to access the variability level of D-loop was RFLP. Restriction enzymes are used to cut the DNA at known sequences, usually of 4 or 6 bases. As a result, the digestion yields an reproducible array of fragments, which are analyzed via electrophoresis in agarose gel. This method has low to moderate sensibility, but high efficiency (Dowling et all, 1990). In the present study we cut the DNA using 13 different enzymes, and found no variation.

We passed to the second methodology to study the D-loop, the base sequencing. This is one of the most utilized in phylogenetic studies, besides being expensive and very laborious. It yields the exact sequence of bases that compose the fragment, allowing comparisons of sequences and the study of individual relatedness, geographic variation and hybridization within the same species. The number and size of sequences to be aligned varies upon the comparison desired (Hillis et all, 1990).

We conducted the sequencing of a sample of 5 animals, and obtained 170 bases with no variability too. The next step would be to go through the same mtDNA analysis with material from different populations, including from museums specimens. A test with Odocoileus virginianus skin resulted positive for DNA extraction and amplification of the D-loop fragment.

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MARSH DEER SEASONAL MOVEMENTS AND HOME RANGE SIZE

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1 - INTRODUCTION

This study is part of a program to mitigate the environmental impact generated by Pôrto Primavera hydroelectric plant, which reservoir will cover an area of 2,500 Km^2 of the Paraná river in 1995 between the States of Mato Grosso do Sul and São Paulo. The aim of the investigation is to increase the knowledge on marsh deer's ecology, so the impact on the local population can be discussed, and feasible measures can be taken to minimize the effects of habitat loss on the species.

High costs and technical difficulties in capturing marsh deer (*Blastocerus dichotomus*) have restricted the study of this cervid in the wild. Most of the published information is related to population surveys (Schaller and Vasconcelos, 1978; Mauro, 1993; Beccaceci, 1994) with a few anecdotal data on other aspects of the species biology and ecology (Pinder and Grosse, 1991). No information was available regarding habitat requirements, such as home range size or seasonal movements.

In order to collect elements to discuss the impact of the dam on marsh deer and generate alternative measures, a study in two steps was devised: 1) a preliminary survey of the affected population, and 2) a remote sensing study to learn the habitat requirements of the species in the area.

During the first step 50 hours of aerial surveys were spent from July to December of 1992 to verify the distribution, and estimate densities of marsh deer in the area, as well as collecting data on group composition and habitat use. An average density of 0.524 deer/Km^2 was found, with an estimated total population of 700 to 1,200 individuals. Approximately 70% of the observed marsh deer were solitary, and 60% of all individuals were females. Only 25% of the marsh deer found were adult males, and 15% were juveniles and non-sexed individuals.

To the second step, it was planned the capture and radio monitoring of 22 marsh deer distributed into four different study sites (Fig. 1). The captures were conducted in July of 1993 and the methods are described in another paper by Pinder and Audi.

2 - OBJECTIVES

This research tried to elucidate practical problems for the management of the species

in the wild, as well as to enlighten unknown aspects of the species' nature. Specific objectives were:

2.1. To verify the effects of a programmed translocation on the movements and survival of individuals.

2.2. To document suggested marsh deer's seasonal movements and home range size.

2.3. To investigate potential marsh deer's seasonal use of some tributaries of the Paraná river.

3 - ACTION PLAN

To comply with the objectives above, this research was distributed into four study sites: Pardo river, São Luis ranch, Santa Clara ranch, and Santa Marta ranch. To comply the experiment of translocation two males and three females were captured at Santo Antônio ranch and transported 50 Km to the North and released at Santa Marta ranch. To test Hypothesis of seasonal utilization of tributaries, two males and two females were captured to the left margins of Pardo river, the largest of the Paraná river's tributaries in the study area. To study the seasonal movements and home range size of marsh deer, two additional sites were selected in comparison with the sites above: São Luis ranch and Santa Clara ranch. One male and three females were radio-collared at São Luis, whereas three males and six females were monitored at Santa Clara.

3 - METHODS

Marsh deer were fitted with radio-collars MOD 500 (Telonics Inc.) with mortality pulse accessory. A minimum of eight locations of each marsh deer systematically distributed along the day were planned to follow statistical requirements for the analytical methods of analysis (Swihart and Slade, 1985). The daily 12 hours of sunlight were divided into four three-hour periods, and each individual marsh deer was ideally sampled twice a month within each period. Locations were conducted with a CESNA 182 fitted with two H type antennas (Telonics Inc.), connected to a receiver TR-2 (Telonics Inc.). Geographic coordinates at each location were recorded through a GPS (Trimble) and data recorded to a field data sheet.

Survival rate was calculated using Kaplan Meier method (1958). Minimum convex polygon (MCP) was used to compare the home range size between dry and flood seasons. To calculate home range size for the entire period of study, Harmonic Mean (HM) estimator was employed in addition to MCP. To eliminate inflation in the home range size caused by outlyers, a curve of 95% of probability of use was utilized in the harmonic mean estimator. Core areas represented 50% of probability of use contours. Data locations spanned from July of 1993 to May 1994 and were segregated into dry (July-December) and flood season

(January/February).

4 - **RESULTS**

4.1. Survival rate

There were six fatalities during the period of study. One of the translocated males died in the first week of August. Due to the difficulties in its recovery from sedation after the translocation, and lack of evidences of predation, it is believed that this male perished in consequence of the capture. For this reason, this datum was eliminated from the survival calculations to avoid violating one of the assumptions of the method (Kaplan and Meier, 1958).

Four of the observed death were caused by poachers: one female at São Luis (November); one female (January) and one male (April) at Santa Clara; and one male (May) at Rio Pardo. The distribution of mortalities in time and space suggest that hunting pressure is constant throughout the year and across the region. A single event of natural death occurred in May on an adult translocated female of Santa Clara site, probably through jaguar predation. In the same day of the translocation, the jaguar was seen very close to the female, which mortality signal was found within a tree island in the following location opportunity.

After almost one year of study 27 % of the monitored deer died. Ignoring the mortality caused by translocation, 24 % of the marsh deer died form July of 1993 to May of 1994. Poachers were responsible for 19 % of this mortalities, whereas only 5 % were due to natural predation. No animal died in consequence of illness or aging.

Mortalities increased significantly at the end of the period of the study, causing a drastic decrease in the probability of survival for marsh deer. After 11 months of study, the probability of survival to the next month for an adult marsh deer was estimated in 62.5 %, with a confidence interval of 95 % ranging between 80.2 % to 44.9 %. Projecting the trend of survival probabilities to the following months, an average probability of zero survival would be reached between 14 and 20 months.

4.2. Intra-seasonal Movements

In this analysis were considered locations from July to December of 1993. In average marsh deer of the northern study sites (Pardo and São Luis) had the smallest median of movements at consecutive locations of 3 and 4 day intervals. Respectively marsh deer at Rio Pardo moved 1,550 m, whereas at São Luis they moved 1,400 m. Marsh deer at Santa Clara moved 1,800 m and the translocated deer at Santa Marta moved 2,100 m. There were no significant differences between males and females.

4.3. Inter-seasonal movements

Marsh deer's habitat use is significantly altered by the local water regime. During the dry season, the highest densities of marsh deer are found in the marshes nearest to the river banks, with lower densities in the alluvial terrace, a few kilometers to the interior. During the flood season (January/February) these marshes near the river are submersed, obligating marsh deer to move to the terraces. When the pulse of inundation ends, marsh deer return to their original ranges near the river, although many keep using both marshes in the terrace and near the river. They probably only abandon completely the terraces in extremely dry years, searching for the remaining wet areas. On the other hand, marsh deer inhabiting the wide and homogeneous marshes at the terraces are not affected by the raise of water, and do not need to move from their areas. Marsh deer using exclusively terraces were the females 2.114 and 2.394 of São Luis, and 2.194 of Santa Marta the rest used both terraces and floodplains near the river.

The knowledge on seasonal activities of marsh deer are of practical application in foreseeing their movements during the creation of the Pôrto Primavera's reservoir. It also, answers the hypothesis that marsh deer will move into the Paraná's tributaries such as Pardo river. In this respect, the locations taken in January and February demonstrated that during the flood, marsh deer at Pardo site moved to the North/Northeast into the alluvial terrace of the Paraná river (Fig 1). This observation suggests therefore, that marsh deer will proceed in the same fashion during the filling up of Pôrto Primavera's reservoir. Therefore, the hypothesis that marsh deer will move into the tributaries with the creation of the lake is falsified. In contrary, marsh deer will move even farther from the tributaries entrance, because these areas will be flooded first relatively to the terraces.

The distances moved between the marsh deer's centers of activity during the dry season and flood season varied according to the extension of land covered by water, availability of adequate habitat nearby and homogeneity of the available habitat. The largest distances were observed at Pardo site, where marsh deer moved in average 5.2 Km between core areas of dry and flood season. In this site, marshes at the terrace are greatly fragmented by forest patches, and the major portions of wet areas are far away from Pardo river. Smallest distances of migration were observed at Santa Clara site, where the average was 2.7 Km between core areas. The distances moved between core areas is proportional to the extensions covered by water during the flood in these sites.

4.4. Home Range Size

The number of locations for each marsh deer varied between 16 and 24 during the dry season (July/December), and 8 to 10 during the flood (January/February). The total number of locations taken during the study (July 1993/May 1994) were 54 to 63 for the surviving marsh deer.

Both methods, MCP and HM reached similar results for the average total marsh

deer's home range size. Home range size calculated by MCP for not translocated marsh deer varied from 1,446 to 7,418 ha with average of 3,475 ha (n=16). The harmonic mean estimator that reflects better the range use, obtained figures ranging from 1,563 to 6,377 ha with an average of 3,291 ha (N=16; t=0.05) (Table 3). Seasonal fluctuations in home range size were not consistent among individuals or sites. Equal number of animals had similar home range size in both dry and flood seasons, compared to individuals that showed increase or yet decrease in ranging area, between seasons.

4.4.1. Site Specific Comparisons

Some of the variation among the monitored marsh deer in total home range size can be explained by differences in habitat. Marsh deer at Rio Pardo showed the largest average home range size (4,578 ha), compared to São Luis (2,684 ha) and Santa Clara (3,922 ha). This results are a consequence of the distances that marsh deer have to migrate during the flood season to find suitable habitat.

Seasonal fluctuations in the water level affect the availability of suitable habitats and consequently influence the movements of marsh deer in the area. Thus, marsh deer at Rio Pardo, that during the dry season had the smallest home range sizes, at the onset of the flood had to move in average 5.2 Km, significantly increasing their home range size. Less affected by the flood, marsh deer at São Luis and Santa Clara had to move smaller distances (1.9 and 2.7 Km respectively), and therefore causing little expansion in their home range sizes. In other words, marsh deer at Rio Pardo displayed a smaller overlap between dry and flood season ranges relative to the other two sites.

4.4.2. Comparisons Between Sexes

Besides individual differences, the remaining variation in home range sizes among marsh deer is explained by dissimilarities between sexes. Males showed home ranges twice as large as the females. In average male's home ranges attained 4,839 $\pm$ 73 ha (n=6), whereas females achieved 2,362 $\pm$ 56 ha (n=10). Translocated marsh deer were not included in the above calculations since they were subject to an atypical situation. Nevertheless, they showed consistent results with the native marsh deer. The dissimilarities between males and females were consistent from site to site. Males at Santa Clara and Rio Pardo showed ranges 1.8 times larger than females. The single male at São Luis exhibited a range 3.2 times greater than the females. This result may reflect a possible dispersal migration of this male, that left completely the area of capture just a few days consecutive to it.

Although comprising a small sample, there was a trend of sub-adult individuals demonstrating differences in home range size relative to adult marsh deer. Sub-adult females exhibited home ranges slightly smaller than adult ones, whereas sub-adult males showed home ranges larger than adult males considering site specific differences. This observation suggests that males are the dispersing sex in this species, similar to other members of the

Cervidae family.

4.5. Contrasts Between Native and Translocated Marsh Deer

Translocated marsh deer survival and home range size did not differ from the native individuals. Home ranges varied from 1,649 to 4,176 ha, showing values for each sex, close to the averages for native deer. The translocated marsh deer also showed similar seasonal movements compared to the native deer. Two individuals that stayed in terraces did not show seasonal migration, whereas two individuals in the floodplains moved to the terrace during the flood.

The single difference between native and translocated marsh deer lies on the initial dispersal from the releasing site occurred with the translocated individuals. Exception was a sub-adult female that remained in the releasing area. All of the three remaining marsh deer dispersed from the area. This initial dispersal may be related to the fact that all animals were released in the terrace during the dry season, when the low water level makes this habitat less suitable to marsh deer during this period of the year. Thus, two individuals moved to the floodplains bordering the Paraná river some 5 Km away from the releasing site. The third individual, a female, swam across the Paraná river (1.5 Km wide), lodging itself in São Paulo's margin of the river for three months before returning back to Mato Grosso do Sul with its fawn. This female however continued moving to the South until finally establishing a new home range 17 km away from the releasing site.

5 - CONCLUSIONS

The information collected in this study allows for the formulation of a few conclusions:

1) The current technology of translocation of marsh deer is expensive and presents some risks of mortality to marsh deer due to the methods of capture and handling. However, it is a feasible technique to be used in the conservation of the species, as long as the methods of capture and transport are conducted with caution and the releasing area is of adequate size and habitat quality. Currently, close to the study area, such characteristics are only found in the Paraná river floodplains, downstream to Pôrto Primavera dam. Translocations to secondary habitats are not guaranteed based on present knowledge.

2) Seasonal migrations of marsh deer occur only in consequence of a local flooding regime. The extent of the migration will depend on the magnitude and duration of the flood. There are no evidences showing that marsh deer at Paraná's floodplains have a seasonal use of tributaries, nor that they will be used by marsh deer escaping from the permanent flood, generated by Pôrto Primavera dam.

3) Female marsh deer required a home range size of in average 2,400 ha, whereas

males required in average 4,800 ha in Paraná river floodplains. If marsh deer are not subject to seasonal migrations, their home range size may decrease to 2/3 of these values.

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Dieta del Cíervo de los Pantanos en la Reserva Iberá, Corrientes, Argentina.

Marcelo D. Beccacecí y Mariano L. Merino

INTRODUCCION.

El *ciervo de los santanos*, es el cérvido sudamericano de mayor tamaño. En la Argentina, habita zonas anegables o áreas cercanas a ellas, fundamentalmente en las costas y delta del rio Paraná, asi como también en los bañados cercanos a las riberas del rio Pilcomayo y los esteros del Iberá.

Esta clasificada como especie vulnerable por la IUCN y en peligro de extinción por la Dirección de Flora y Fauna Silvestre. La informaci6n existente sobre su dieta es escasa, W.M.Tomas (1986) analizó sus hábitos alimenticios en el Pantanal Matogrosense (Brasil).

OBJETIVO

El objetivo del presente trabajo fue determinar la composición botánica de la dieta del *ciervo de los Pantanos* en la Reserva Provincial "Iberá" y algunos aspectos nutricionales de la misma. Para esto se utilizaron dos metodologias: la observación directa y el análisis microhistológico de las heces.

DESCRIPCION DEL AREA DE ESTUDIO.

Los esteros del Iberá se hallan localizados en la zona central de la provincia de Corrientes. Los mismos componen una vasta cuenca de praderas ínundables, pantanos, lagunas e "islas flotantes" de vegetaciónt'. El Iberá puede considerarse un antiguo cauce del rio Paraná. Originariamente el Iberá constituia una cuenca lacustre con predominio de lagunas. La vegetación ha ido colonizando estos cuerpos de agua y hoy ocupan las 2/3 partes de los mismos. El limite de las lagunas como el caso de "LAGUNA IBERA" (area donde se realízó el estudio) está dado por un franja de vegetación sobre un suelo " flotante " formado por una acumulación de restos orgánicos, denominados vulgarmente "embalsados". A ellos están asociados principalmente los *ciervos de los Dantanos*.

METODOLOGIA.

Se realizaron inventarios botánicos y se detectaron las principales especies utilizadas por los ciervos para su alimentación a lo largo del año por medio de la observación directa. Asimismo se efectuaron análisis químicos en siete especies. Estos incluyeron la determinación del contenido de humedad y materia seca, proteina total, fibra total, fósforo, calcio y magnesio. Para el análisis microhistológico de heces, se elaboró una colección de referencia de las epidermis de las plantas presentes en los ambientes frecuentados por el ciervo de los pantanos, en la Laguna Iberá. Para la obtención de los preparados epidérmicos se utilizaron maceraciones en OHNa al 15% y raspado.

La colección de los pellets fecales (N=20), se efectuó en dos épocas del affo otoño/invierno y primavera, durante 1993, en la Laguna Iberá (ver mapa). Las heces se procesaron según la técnica de Willians (1969) adaptada por Latour & Pelliza Sbriller (1981), a la cual se le agregó una maceración con OHNa al 10 %. De cada una de las muestras, se

realizaron cinco "slides", observándose 50 campos a lOOX.

Los resultados se expresaron como porcentaje de frecuencia relativa (%oFR), ajustada al 100% (Holechek y Gross 1982).

Las especies vegetales, se agruparon según su tipo morfológico en los siguientes grupos: arbustos/ árboles, hierbas, gramineas/graminoideas y frutos.

La información se analizó en conjunto y por estaciones. Se estimó, mediante la fórmula de Levins (1968) estandarizada por Hurlbert (1978), la amplitud trófica para las dos estaciones consideradas.

RESULTADOS Y DISCUSION

De acuerdo a la observación directa se obtuvo que la dieta del ciervo de los pantanos en la laguna Iberá se halla compuesta por 22 especies, 14 de las cuales constituyen probablemente la base de la misma. De estas 22 especies, 72,7 % son herbáceas, 18,1 % arbustos y 9 % subfruticosas. Los análisis químicos realizados produjeron resultados que, comparados con otros rumiantes como Odocoileus y ganado indicarían lo siguiente:

Falta de suficiente calcio y especialmente fósforo. De acuerdo a los análisis microhistológicos se obtuvo que la dieta del ciervo de los nantanos esta compuesta por 21 especies vegetales, 21.8% de las especies identificadas para la Laguna Iberá. De ellas 15 son Dicotiledoneas:

Cephalantus glabratus, *Aeschynomene montevidensis*, *Senna bicapsularis*, *Sapium haemastospermum*, *Vernonia scorpioides*, *Pontederia cordata*, *Thalia genisulata*, *Saggitaria montevidensis*, *Mikania micrantha*, *Hydrocotyle* sp., *Begonia cusullata*, *Polygonum acuminatum*, *Ludwigia* sp., *Ludwigia hexapetala*, *Blechnum serrulatum*, y 5 Monocotyledoneas: *Luziola peruviana*, *Scirpus giganteus*, *Zizaniopsis bonariensis*, *Panisum grunosum*, *Junsus* sp. En las tablas N_ 1-3 y gráfico A se presenta la información sobre % FR de las distintas especies que integran la dieta del ciervo de los nantanos.

Si bien estos datos tienen un carácter preliminar, se puede consíderar que:

1) No hay una marcada diferencia en la composición, % FR y amplitud trófica de las dietas correspondientes a las dos épocas analizadas. Esto podria deberse a la estabilidad que presenta el ambiente a lo largo de las distintas estaciones del año. Posiblemente debido a que no existan fluctuaciones marcadas en la "oferta de forraje".

2) Las altas AFR que presentan las especies: *Pontederia cordata* y *Thalia genisulata*, evidencian la importancia que posee la vegetación acúatica y semi acúatica en la dieta del *ciervo de los pantanos*

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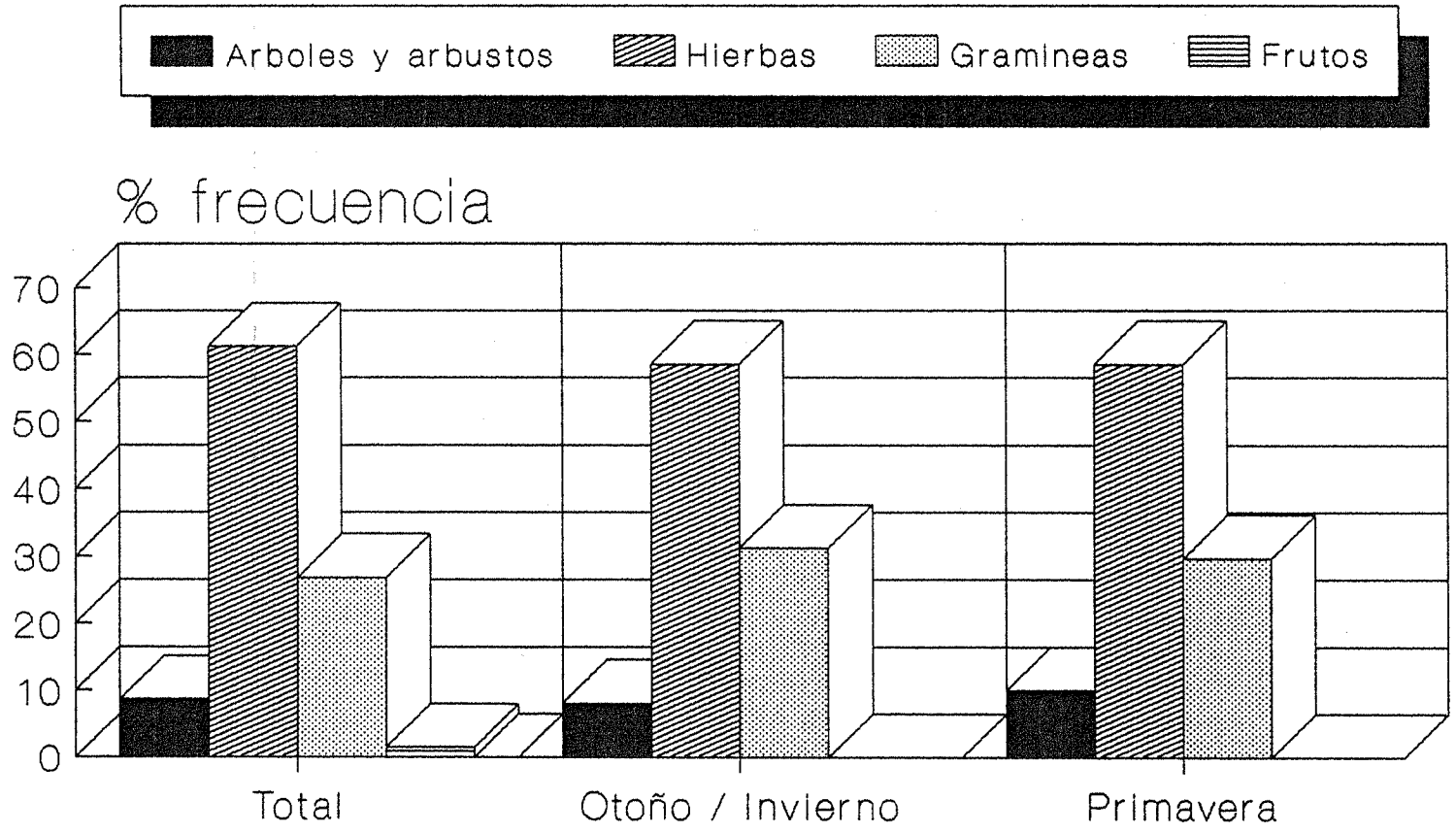

TABLA Nº 1

PERIODO OTOÑO/INVIERNO Y PRIMAVERA

(N=20)

Especie		% Frecuencia
Arboles y Arbustos		
Cephalantus glabratus		4
Aeschynomene montevidensis		2.71
Senna bicapsularis		1.93
Sapium haemastospermum		*
Vernomia scorpioides		*
	Total	8.64
Hierbas		
Pontederia cordata		13.3
Thalia geniculata		11.8
Saggitaria montevidensis		7.2
Mikania micrantha		7
Hydrocotyle sp.		6.65
Begonia cucullata		5.6
Polygonum acuminatum		4.65
Ludwigia sp.		3.50
Ludwigia hexapetala		1.5
Blechnum serrulatum		*
	Total	61.2
Gramineas y Graminoideas		
Gramineas No indentificadas		10.2
Luziola peruviana		5.2
Scirpus giganteus		4.8
Zizaniopsis bonariensis		3.6
Panicum grumosum		3
Juncus sp.		*
	Total	26.8
Frutos	Total	1.5

(*) menos del 1%.

TABLA Nº 2

PERIODO OTOÑO/INVIERNO

(N= 10)

Especie		% Frecuencia
Arboles y Arbustos		
Cephalantus glabratus		5.2
Aeschynomene montevidensis		2.9
Sapium haemastospermum		*
Vernonia scorpioides		*
	Total	**8.1**
Hierbas		
Pontederia cordata		16.7
Thalia geniculata		12.8
Mikania micrantha		10.9
Saggitaria montevidensis		6.
Ludwigia sp.		5.4
Hydrocotyle sp.		3.9
Polygonum acuminatum		1.5
Begonia cucullata		1.3
Ludwigia hexapetala		*
Blechnum serrulatum		*
	Total	**58.5**
Gramineas y Graminoideas		
Gramineas No indentificadas		12.7
Scirpus giganteus		8.19
Luziola peruviana		6.2
Panicum grumosum		3.1
Zizaniopsis bonariensis		1
Juncus sp.		*
	Total	**31.19**
Frutos		*

(*) menos del 1%.

AMPLITUD TROFICA = 0.551

TABLA Nº 3
PERIODO PRIMAVERA

(N = 10)

Especie		% Frecuencia
Arboles y Arbustos		
Cephalantus glabratus		3.35
Aeschynomene montevidensis		3.35
Senna bicapsularis		2
Vernonia scorpioides		1.3
Sapium haemastospermum		*
	Total	10
Hierbas		
Pontederia cordata		12.75
Thalia geniculata		11.40
Hydrocotyle sp.		6.7
Mikania micrantha		6.3
Polygonum acuminatum		6.
Begonia cucullata		5.36
Saggitaria montevidensis		4.69
Ludwigia sp.		4.02
Ludwigia hexapetala		1.32
Blechnum serrulatum		*
	Total	58.54
Gramineas y Graminoideas		
Gramineas No indentificadas		7.3
Zizaniopsis bonariensis		6.78
Luziola peruviana		6.4
Panicum grumosum		4.
Scirpus giganteus		2.6
Juncus sp.		2.6
	Total	29.68
Frutos		*

(*) menos del 1%.

AMPLITUD TROFICA = 0.666

CAPTURE AND HANDLING OF MARSH DEER IN THE WILD

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1 - INTRODUCTION

Studies through remote sensing or wildlife management practices require capture and frequently tranquilizing and transporting large animals (Hofmeyer and Bruine, 1973). Each one of these three steps involve risks and need specific safety measures inherent to the species being managed. These measures are necessary because capture and handling procedures frequently cause death to the animals (Rongstad and McCabe, 1984). Thus, the success of the process depends not only in the efficiency in catching the animal, but also in avoiding consequent mortality.

The success in the capture of a given species is a skill that depends on the knowledge of several information, such as the social habits of the species, the species' habitat preferences, behavior and anatomy of the animal. Each species has its own characteristics making every capture a challenge. A great deal of the capture success relies on the ingenuity of the researcher to adapt a technology used to other species, or to develop a new methodology based on his knowledge of the species. Rarely a given methodology can be applied with immediate success without preliminary tests. Often times, the simple change in capture site or habitat may cause difficulties. For example, the golden lion tamarin (*Leontopithecus rosalia*) were easily captured in Poço das Antas Biological Reserve in Rio de Janeiro State, using bananas as bait (Pinder, 1986). On the other hand, another species of lion tamarins (*Leontopithecus chrysopygus*) in São Paulo State, could not be captured as easily using the same bait (Pers. observ.). The reason was that banana trees grew naturally in the forest only in the first site, but not in the second.

When capture involves handling cervids, extra care has to be taken. Cervidae are particularly susceptible to stress and to capture myopathy (Conner et al, 1987). Capture myopathy is triggered by an excessive muscular effort during the capture, that ultimately degenerate the animals's tissues, and cause death up to 15 days after the process has started (Chalmers and Barrett, 1982). Anesthetic and tranquilizers are an additional risk of mortality, when applied in conjunction to a capture. Because drugs may interfere with the temperature regulation, and other processes of the physiology of the animal, the difference between death and a successful sedation rely on a number of variables such as environmental temperature, body temperature, dosage and type of drug used, physical and psychological condition of the animal (Seal and Bush, 1987). Also, for marsh deer there is a chance of mortality by drowning or predation if the animal does not fully recovers from the anesthesia. If transportation is necessary, the animal may die of stress or injuring himself within the container. Therefore, the design of the container, the methods of transportation, distances,

and life of sedation need to be well planned to avoid failures in a study or rescue procedure.

In 1990 CESP had the merit to develop for the first time a methodology to capture, sedate and translocate marsh deer previously to the flooding of a portion of Tietê river' course. Two methods were used, one developed by CESP's staff, and another applied with the help of one expert in the capture of large cervids using a net-gun. The first method is an adaptation of the drive netting currently used to catch different ungulates (De Young, 1988). The second method has been successfully used in United States (Firchow et al, 1986). These two methods were utilized again, during a study of marsh deer movements in Paraná river floodplains (Pinder, 1993). Both methods are described and compared below.

2 - OBJECTIVES AND STUDY SITE CHARACTERISTICS

The general aim of this study was to capture and fit radio-collars to 22 marsh deer to gather basic information on the movements of the species at the Rio Paraná's floodplain, as well as to test translocation as a method of management. As a sub-product of this study it was possible to compare the efficiency of two different methods of capture.

The study area is a seasonally flooded plain consisting of a mosaic of narrow strips of marshes and tree islands parallel to Rio Paraná banks. These flood plains reach up to 10 Km in width and are basically occupied by cattle ranches. Bordering the marshes and tree islands there is a zone of short grasses corresponding to the area covered by water only during the flood. Flood occurs in short pulses in January and February. Wildlife still maintains its original richness containing large predators as jaguars. Marsh deer surveyed in 1992 (Pinder, 1992) had an average density of 0.524 marsh deer/Km^2. Approximately 70% of the sightings of marsh deer were of solitary animals and 30% of groups. The captures were scheduled to the dry season (06/30 to 07/12) of 1993, when four different areas were selected to the captures. Distinct areas were selected to test hypothesis regarding the movements of marsh deer relative to the distance of tributaries and translocation site.

3 - METHODS USED IN THE CAPTURE

The main method chosen to capture marsh deer in this study was the net-gunning (Firchow et al, 1986). Alternatively, CESP technicians recommended the use of the method improved by them during the captures of marsh deer in the Tietê River in 1990 (Charity, 1990). This method is a variation of the drive netting method largely used in the capture of social ungulates (Day et al, 1980).

3.1. Net-Gun Method

Marsh deer were captured using a CODA net-gun model 82-2040 with removable cones. To capture males there were used two nets of 20 m^2, and mash of 20 cm resisting 600

pounds of tension. For females, we employed two nets of 12,5 m^2 and mash of 12 cm with 300 pounds of resistance in addition to the ones used for males. The capture team consisted of five people: the helicopter pilot, one net-gunner, one technician, one veterinarian, and one coordinator. The helicopter used was a five-place Bell Jet Ranger.

After a target animal was selected only three people were allowed to stay in the helicopter during the pursuit. With the animal in the net, the two remaining members of the team were transported to the animal by the same helicopter. Chemical contention of the animal was considered an unnecessary risk, and it was used only for the translocated animals. Biometrical information were collected by the team, previously to the marking with an ear-tag and radio-collar. When possible blood samples and ticks were collected. After the processing, the animals were released immediately. To tranquilize marsh deer for the translocation, it was used a combination of Ketamine (0.1 ml/kg) and Xylazine (0.05 ml/kg) applied directly to the blood stream. Yohimbine was injected to revert the effects of ketamine (0.13 ml/Kg).

3.1.1. **Translocation**

After the capture using the net-gun method, marsh deer were tranquilized, measured, fitted with radio-collars and ear-tags and transported in a box developed by CESP with the same helicopter used in the capture (CESP, 1990). The releasing area was approximately 50 Km to the North of the capturing area and took about 30 minutes of flight. Upon the arrival to the releasing site the animal was injected with antagonizers to the sedatives and monitored until its recover. The animal was allowed to recover still tied up and only released when able to run away.

3.2. **Drive Trapping**

This method utilizes a 200 m long net, placed in format of "V". The net is about 2 m high with mash of 20 cm. The net possess folds in its superior portion, so that the animal penetrates into the net completely before it is stopped. The net is mounted on eucalyptus tree poles, in the grasslands bordering the marshes. This method required a team of about 20 people among workman, drivers, and technicians. Two vehicles were employed to transport material and personnel besides the helicopter. The helicopter was used also in daily patrols over the mounted nets to verify accidental captures of cattle in the preceding days of the actual marsh deer's capture.

The method consist of driving a single marsh deer with the helicopter away from the marsh into the open area where the net is set. Two horseman are hidden beside each of the ends of the net to the final pursuit of the animal into the net. After the animal hits the net, a team including workman and veterinarians restrain the animal. The antagonist to the sedatives are applied at the end of the processing, and the animal is released. Due to the sedation, this method allows for a greater number of biological samples to be taken compared to net-gun.

4 - RESULTS

4.1. Drive Trapping Statistics

The drive trapping method was tried during two days of capture. A total of 467 minutes of helicopter were used during the trials (Table 1). There were five attempts of capture with two instances of success. One of the animals, a young male, died less than 24 hours later, not farther than 50 m away from the net. This male had been chased for 20 minutes making his body temperature raise to 42.3 ° C, measured during the processing. After the return from the sedation, which took more than one hour, the animal became prostrated and was left at a shade within the grassland, close to the area were it was found dead. The second animal, an adult female, was released without any damage.

Using the information collected during these trials, it was possible to calculate the efficiency of this method, and indicate some of the problems relate to the technique. The average time spent in locating each animal and taking it to the net was of 1 hour and 21 minutes. The average time consumed only with the pursuit itself was of 18 minutes, and the average time of processing was of 56 minutes. An additional of 60 minutes of helicopter use were estimated for the transportation of personnel and checking the nets. Taking into account the total number of hours of helicopter use, one may calculate the efficiency of the method (Table 2), that equals one marsh deer every 3 hours and 54 minutes. If one considers only the marsh deer that survived, this figure goes down to one marsh deer every 7 hours and 47 minutes of helicopter use. Translating this estimate in terms of costs, each marsh deer captured with this method would cost about US$ 8,000, considering only the expenditures of the helicopter.

Table 1 - Marsh deer capture statistics at Rio Paraná, 1993. m = morning; a = afternoon; T = Total time of helicopter operation.

DRIVE TRAPPING

	# of marsh deer		Time (minutes)		
Date	Pursued	Captured	T	Pursuit	Handling
07.02.93	1	0	101	39	0
07.03.93m	3	1	220	41	71
07.03.93a	1	1	86	12	42
Total	**5**	**2**	**407**	**92**	**113**

NET GUN (capture and release)

Date	Capt. trials	Shots	Capt.	Chase with capt.	Ineffect. pursuit	Handl	T
07.02.93	2	2	1	7	0	33	80
07.04.93	4	5	3	13	5	52	165
07.04.93	3	4	1	1	8	24	107
07.05.93	6	5	3	2	21	55	214
07.05.93	2	1	2	5	0	44	100
07.08.93	2	2	2	2	0	57	102
07.10.93	2	1	2	5	0	36	110
07.12.93	2	2	2	4	0	36	135
Total	**23**	**22**	**16**	**73**	**34**	**337**	**1013**

NET GUN (capture and translocation)

Date	Capt.	Shots	Chase (min)	Handl. (min)	Trans. (min)	Recov. (min)	T
07.09.	3	2	5	126	177	49	585
07.10	3	3	5	113	72	46	370
TOTAL	**6**	**5**	**10**	**239**	**249**	**95**	**955**

Table 2 - Efficiency of marsh deer capture in the floodplains of Paraná River in 1993.

Average Time	Drive Trapping	Net-gun	Translocation
Pursuit	18 min	2.4 min	1.7 min
Handling	56 min	21 min	40 min
Transport	---	---	42 min
Flight time/ capture	7h:47 min	1h:3 min	2h:39 min

4.2. **Net Gun Method Statistics**

A total of 1,013 minutes of helicopter flight were spent during six days of capture, excluding the time consumed with translocation of five additional marsh deer not considered in this analysis. Of the total time of helicopter work, including movement from the base to the capture site and vice-versa, in average 44 minutes were spent for each capture trial, and 63 minutes for an effective capture (Table 2). Thus, the individual cost of the capture equals approximately US$ 1,000.00 per animal.

4.3. **Translocation**

During two days of work six marsh deer were captured and five were translocated (Table 1). One young male was discarded from the translocation experiment because it was juvenile. Because the area of captures was the farthest in the range of work, the average capture success was one marsh deer every one hour and 39 minutes. The processing and preparation of the animal took in average 48 minutes, with a mean transportation time of 50 minutes. The recover of the animal required about 19 minutes upon the arrival at the releasing site. One adult male had difficulties in recovering from the drugs and died a few days later.

5 - CONCLUSIONS AND RECOMMENDATIONS

The main positive characteristics of the net-gun method are:

1) The economy of the method. The capture using net-gun was almost eight times faster than the drive netting method. Also, the net-gun method allows the researcher to reach the animal wherever it is, whereas in the drive netting method one has to wait to the chance of having the animals in the surroundings of the nets or else to waste a hole day transferring the nets of location. Therefore, using net-gun method, less helicopter hours are necessary to successfully capture a marsh deer. Capture success in this case meaning capture with consequent survival of the animal. In addition, the method does not require expenditures with

vehicles, horses, and all of the logistics necessary to prepare and monitor the drive nets. Finally, the net-gun method demand a crew of only five people compared to about 20 employed in the drive trapping method.

2) The method causes less risks to the survival of the marsh deer. The net-gun method produces less physical effort to the marsh deer, reducing the danger of triggering capture myopathy or fatal stress by overheating. In most of the instances deer were captured within less than 3 minutes of pursuit in the net-gun method, compared to more than 10 minutes in the drive trapping method. In the latter method marsh deer were driven to exhaustion due to their reluctance of leaving the marshes and moving distances larger than 500 m to the open grasslands, where the drive-nets are mounted.

3) The selectivity of the method. The net-gun method allows to the researcher to choose the animals being captured according to predetermined conditions, e.g. male adults, because the instrument of capture goes to the animals position. The drive-trapping method instead, is less selective, since the method is limited to the distance one can move the marsh deer to reach the net.

The use of anesthetics and tranquilizers are desirable only when the animal has to be transported for long distances. Otherwise, drugs should be avoided because they represent an additional factor of risk. Furthermore, drugs should not be applied to marsh deer captured with a net-gun, unless it occurs during translocations. Sedation greatly decreases the velocity of the method and therefore reduces one of its greatest advantages.

Biological samples should be collected always that a capture effort is done. However, the collection of material should not jeopardize the survival of the animal in ecological studies. On the other hand, if biological collection is the main purpose of the study, alternative less expensive methods of capture should be considered than net-gun or drive netting.

Considering the current elevated costs of capturing a living marsh deer, it is on ones interest to continue searching for methodologies that are less expensive and safer to the survival of the animal. At the moment, net-gun fulfills this prerequisites and is the best technology available to capture marsh deer in habitat conditions similar to the ones found in this study.

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The Condition of the Marsh Deer in Brazilian Zoos from 1985 to 1993.

The marsh deer population (*Blastocerus dichotomus*) in Brazilian Zoos has always been small. In the first census made by the Brazilian Zoos Society in 1981 only two animals were registered, a male in the Zoo of Goiania and a female in the Zoo of Sao Paulo, and in 1982 a female was registered in the Zoo of Sao Paulo. From 1985 to 1993, registers have shown that few changes occurred, with only two exceptions, that is, the years of 1990 and 1993, in which the existing individuals practically quintupled and the movement occurred over these years was also atypical. The year of 1991 is also out of the standards, but we may consider it a reflex of the previous year. (See Graphs 1 and 2).

By comparing the marsh deer individuals of the census of December 31, from 1985 to 1993 to the population of other Cervidae species in the same period, one verifies that the total of marsh deer follow a different path of the other three species, because the years of greater incidence in the amount of Cervidae are really the years in which the population of other species decreases in the Zoos. (See Graph - 3). Perhaps this may be explained by the type of entrance in each of the species, that is, the majority of individuals of pampas deer (*O. bezoarticus*), bororo deer (*M. rufina*) and brocket deer (*M. americana*) entered the Zoos through private donations, while the marsh deer entered the Zoos by means of capture due to the change of their habitats into artificial lakes intended for energy generation.

Death rate in relation to the totals on December 31, from 1985 to 1993, of marsh deer is 56%, while in the Family Cervidae is 40%. Taking into account only the years of 1990 and 1993 (years of capture) the death rate increases to 76% for the marsh deer and remains the same in the Family as a whole.

Considering 9 years of census only a birth was registered in 1993, in that only in the years of 1990, 1991 and 1993 there existed couples together in Zoos.

What one concludes is that the Cervidae population, in the Brazilian Zoos, was always small, mainly the male population (the few males that enter the Zoos through private donation are generally offspring or young animals); the number of individuals only increases when there is a deliberated capture (in this case the male and female ratio is the same); the death rate is very high and the birth rate does not exist or is very low (what proves the lack of knowledge in handling this species in the Brazilian Zoos).

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Cervo do Pantanal nos Zoos do Brasil ①

Blastocerus dichotomus

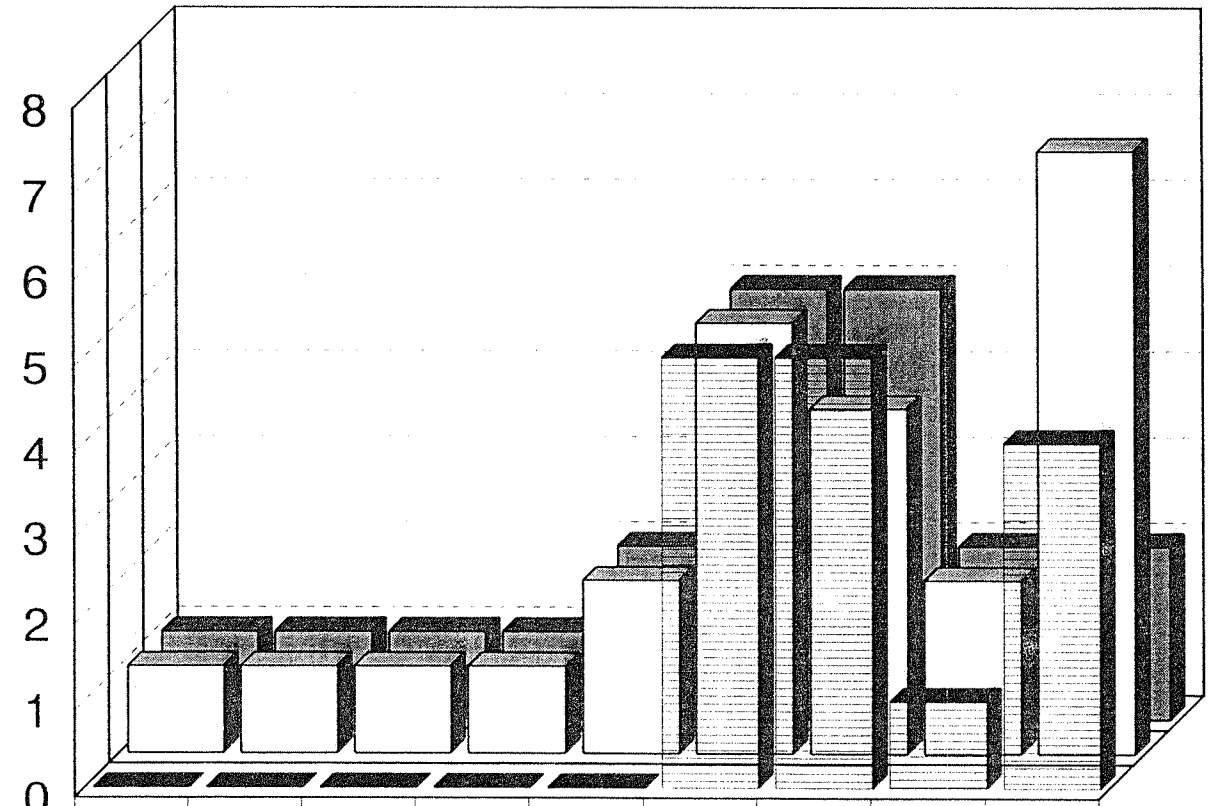


Gráfico - 1 ②

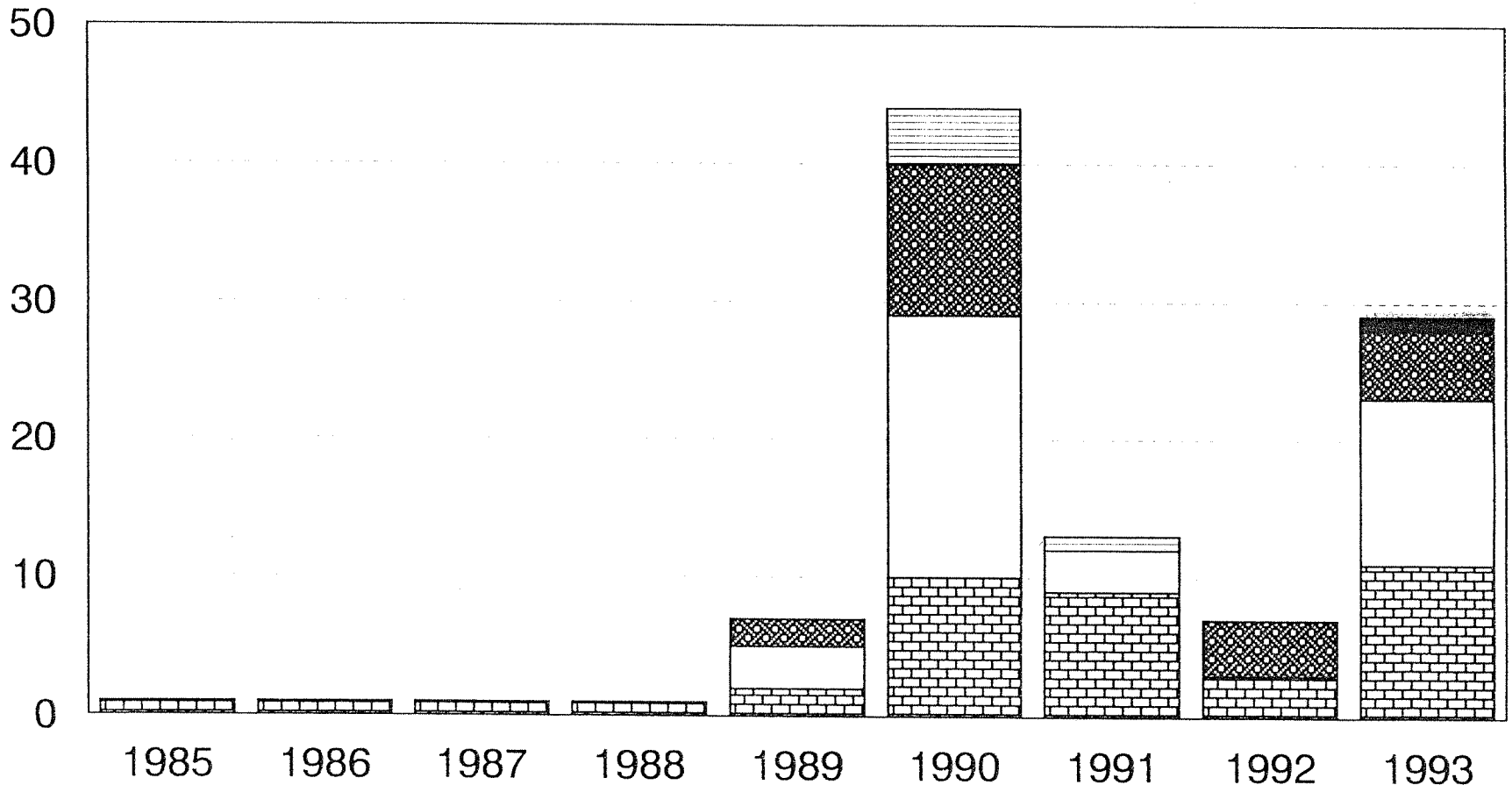
③

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Macho	0	0	0	0	0	5	5	1	4
Fêmea	1	1	1	1	2	5	4	2	7
Nº de Zoos	1	1	1	1	2	5	5	2	2

④

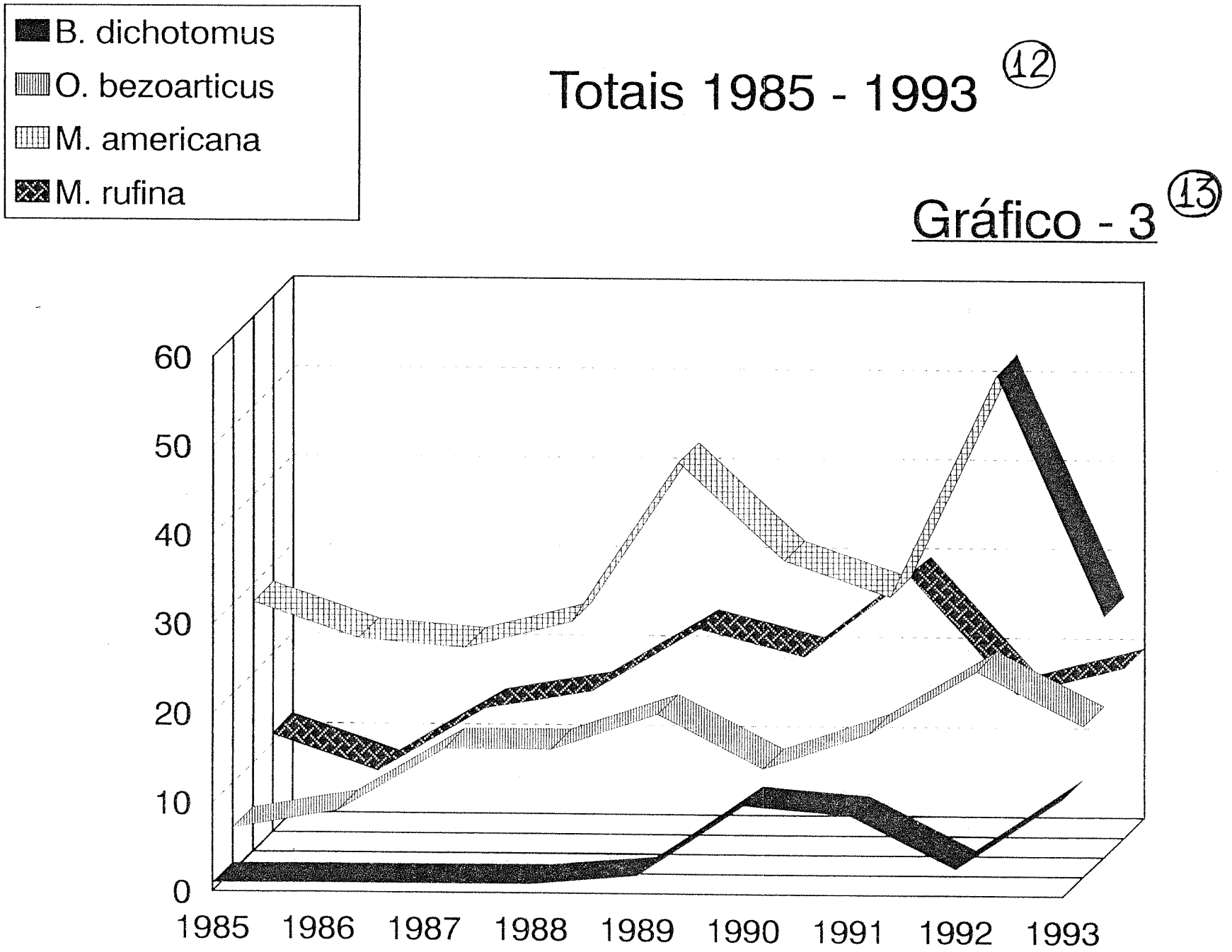
Movimento em Cervo do Pantanal ⑤

1985 - 1993



⑥ ⑦ ⑨ ⑩ ⑪

Gráfico - 2 ⑧


B. dichotomus
O. bezoarticus
M. americana
M. rufina
Totais 1985 - 1993
12
Gráfico - 3
13
60
50
40
30
20
10
0
1985
1986
1987
1988
1989
1990
1991
1992
1993

Totals of 1985 - 1993 (12)

Graph - 3 (13)

Movement of March Deer (5)

total on 12/31 (6)

entrances (7)

Death (9)

Birth (10)

take out (11)

Graph - 2 (8)

March Deer in Brazilian Zoos (1)

Graph - 1 (2)

Male Female nr. of Zoos (3)

Male Female nr. of Zoos (4)

Environmental Legislation

Daniel R. Fink

I. INTRODUCTION

First of all, we would like to thank the organizers of this workshop on marsh deer for the kind invitation we received to deal with matters related to the environmental legislation, congratulating them for the lucky initiative, wishing that their objectives be fully reached.

Since the theme we were proposed to talk about is extremely vast, it gave rise to an initial doubt on how we could focus it. Being the Brazilian legislation on environment equally vast and complex, we tried to make a summary compatible with this workshop, considering its several aspects, but we became frustrated and gave up.

As from a certain moment, we noticed that we were running a serious risk of becoming much generic, not dealing with specific situations that certainly should be more interesting.

So, we retook the subject from the central theme of this workshop, the marsh deer, and we chose it as a reference point to talk about the environmental legislation.

However, we were just concerned with the environmental legislation related to the fauna, realizing that it would be good enough to deal with.

This way, we will deal with environmental legislation on fauna, including the legal treatment of marsh deer in this context.

When dealing with environmental legislation it is important to start from the most important legislative tool at our disposal: the Brazilian Constitution, the national organization rule, and afterwards to analyze the hierarchically inferior legislation.

II. FAUNA PROTECTION UNDER THE BRAZILIAN CONSTITUTION

At first, the 1988 Constitution was concerned with the fauna in general, making no distinction among wild, exotic and domestic fauna, establishing in subsection VII of its article 23, that the Federal Government, the States, the Federal District and the Municipalities shall preserve the fauna. Such a rule shows that all units of the Brazilian federation, without exception, have the competence to protect the fauna and shall be concerned with it.

However, the major concern shall fall on the wild fauna protection, since it is made up of ecosystems that require the Brazilian State action.

Besides the generic obligation to preserve the fauna, the Brazilian Constitution itself imposes duties on the federation units as to the environment and, in its article 225 without obligatorily enumerating them, it specifies some of the duties applicable to fauna, as follows:

- to preserve and recover the essential ecological processes and to provide ecological handling to the species and ecosystems (subsection 1). It is worth mentioning that the Public Power, in Brazil, shall invest in the preservation of its fauna species, also promoting the ecosystems recovery;

- to preserve the diversity and integrity of the genetic patrimony of the Country... (subsection II), preserving, this way, the Biodiversity;

- to define the especially protected territory (subsection III), aiming at the species perpetuation;

- to protect the fauna and flora, forbidding, according to the Law, the practices that endanger their ecological function, provoke the species extinction or submit the animals to cruelty (subsection VII). More specifically, such a provision clearly states the concern of the constitutional legislator: risk of the fauna ecological function, its extinction and the cruelty practice to animals.

So, these are some of the obligations imposed by the Brazilian Constitution on the Public Power in every scope of the government, in that upon its fulfillment, one reaches the objective of preserving and recovering the ecosystems.

One should expect attitudes from the governors as to the fulfillment of these obligations, or they should be charged for such attitudes.

The Constitution also established the levels of the government that may issue rules on fauna (article 24, subsection VI). The Federal Government, the States and the Federal District may concurrently legislate. The Municipalities were excluded from the legislative competence and shall obey what the Federal Government and the State where they are based assert, and they may supplement their legislation without contradicting the Federal Government and the State legislation.

To avoid conflicts among Federal and State Laws, the Constitution established in paragraph I of its article 24 that the Federal Government will limit itself to issue general rules, being up to the States and the Federal District to delve deeply into the theme in its legislation.

III. THE INFRACONSTITUTIONAL LEGISLATION

Law nr. 5,197 of January 3, 1967, that provides for the fauna protection and other measures is the main law that deals with the fauna in Brazil. Such a law is also largely known in the

legal sphere as the "Hunting Code". Due to the fact that the majority of its provisions bring regulatory rules on hunting, what surely means the fauna protection. But it is not sufficient. The ecology evolution requires its up-to-dating.

However, it is an extremely important law to fauna protection, bringing important concepts and innovations in it.

In its article 1 we found out three concepts very important to its proper enforcement.

The first concept is the wild fauna definition, restricting its enforcement to this kind of fauna: animals living in the natural habitat, of any species and in any stage of their development. Every species is included, independently of being uncommon, fragile or threatened with extinction.

The second significant concept is the extension of the protection that is not limited to the animals, but also to their nests, shelters and natural breeding places as an habitat for the multiplication and perpetuation of species. The definition of the animal habitat extension belongs to the science and it is up to the law to respect its concepts.

Another news brought with the fauna protection law is to consider the wild animals and their habitat as "State-owned properties". The expression, "State-owned property" has to be well understood to avoid misinterpretation and to better direct the Public Power action.

When mentioning "State", the law refers to the Federal Government because it does not distinguish the geographical location of the animals and their habitat. All the species and their nests, shelters and breeding places found in the entire national territory are considered State-owned properties.

After establishing the "property" owner, it is necessary to understand the legal nature of the "State-owned property" term.

Property, in Brazilian law, presumes the right of its owner to freely use, enjoy and dispose of it (Civil C., article 524). Under the public right point of view, the State owned property constitutes the set of properties that form its patrimony, and it may dispose of its use according to the law.

Under the legal doctrine, it does not seem reasonable that the legislator has tried to include the wild fauna into the Federal Government patrimony, but to assign to it the responsibility for its protection.

According to Paulo Affonso Leme Machado wording, the Federal Government is officially in charge of the Brazilian wild fauna in the same terms it is in charge of the air and sea space, or still on the territorial sovereignty. It does not imply mentioning, under the internal point of view, that the Federal Government has as its patrimony the property of the national

territory, or of the territorial sea. For the fauna, the right of administration, including its preservation and recovery and the performance of the inspection power are attributes of "property" of Federal Government, but not the right of disposing of the species.

The correct understanding of legal nature of wild fauna property is not restricted to the academic and scientific scope, bringing about several consequences of practical order. The most important is the jurisdictional competence to sue and judge the unlawful acts to the fauna, whether civil or criminal.

Under the civil right, everyone who practices an unlawful act against wild fauna and its habitat is subject to recover the damage caused. The appropriate tool to force the infringer to recover the damage is the public civil action foreseen in Law nr. 7,347 of 1985.

The public civil action is the procedural remedy appropriate to look for recovering the damages caused to the environment (among other diffuse interests), in which the wild fauna is inserted.

Article 2 of Law nr. 7,347 of 1985 establishes that the competent forum to sue and judge public civil actions is the forum where the damage occurred, that is, the State courts of law. This article also enhances that the judge of the place where the damage has occurred has functional competence to know and judge the action. This implies stating that the judge is absolutely competent to sue and judge the action. Being absolute, the competence is not extended to another forum, implying invalidity of all the procedural acts practiced by an incompetent judge.

On the other hand, as stated above, the wild fauna is considered by the law that protects it a property of the Federal Government.

The Brazilian Constitution in its article 109, subsection I, states that the federal judges have the competence to sue and judge the causes in which the Federal Government is interested in, under the condition of plaintiff, defendant, assistant or intervenor. It is a matter of competence due to the subject and, therefore, is equally absolute.

The a priori interpretation of the constitutional provision could lead the one who interprets it to conclude that the public civil actions against damages to wild fauna would be under the competence of the federal judges.

This is not true.

It is not rare to find in the doctrine one who defends such an understanding.

To avoid this mistake, it is necessary to remember that public civil actions aim at protecting the environment, among other diffuse interests.

The environment is not property of the Federal Government, more over, it is not considered an individual property, since it belongs to the collectivity. So, the public civil action that aims at recovering the damage caused to the wild fauna, has not as an object to defend the Federal Government property, but defend the environment. So, the competence of the State courts of law prevails, which is foreseen in article 2 of Law nr. 7,347. This way, the Public Department of Sao Paulo has a number of public civil actions in courts in several counties of the State.

Under the criminal point of view the situation is different. Speaking of crimes defined in article 27, of Law nr. 5,197, and practiced against the wild fauna, the competence to sue the criminal action against the infringer will be under the responsibility of the federal judges. It is due to the fact that the article 109, subsection IV, of the Federal Constitution, provides that crimes practiced against the Federal Government properties will be sued and judged by federal judges. Although it is understood that the wild fauna does not belong to the Federal Government in terms of constituting an aggregate property to its patrimony, one cannot deny that the law has qualified it as a patrimony of the Federal Government.

It should also be affirmed here that one is not dealing with an environmental nature action, but with a criminal nature action to punish the infringer of the public interest damaged.

IV. THE MARSH DEER AND THE ENVIRONMENTAL LEGISLATION

By considering everything above discussed, much more could be added, and it is necessary to consider the marsh deer in the environmental legislation context.

The marsh deer is an animal species of the wild fauna and, therefore, protected by Law nr. 5,197.

Regulation nr. 1,622 of December 19, 1989, of Ministry of the Interior, included the Blastocerus dichotomus as a species of the Brazilian fauna threatened with extinction.

This classification, under the civil and criminal point of view does not give rise to any special effect. Maybe it could give a special treatment to this situation due to the risk of extinction of the species.

However, both the animals threatened with extinction and those that are not have the same treatment under the civil and criminal point of view.

Under the criminal aspect, it is worth mentioning that the crimes defined in article 27 of the fauna protection law are non-bailable, leading to prison the infringer during the whole criminal action, should he/she be arrested in "flagrante delicto".

Under the civil point of view, the fact of the animal being threatened with extinction will

certainly bring economic reflexes, because its environmental value will be very high and, once the animal is killed, this fact will result in an indemnification equally high. It is worth remembering that any undertaking that directly or indirectly affects the marsh deer will depend on the evidence of its environmental viability depending on the authorization by the qualified environmental agency.

More over, the wild fauna protection law itself foresees a number of prohibitions as to its hunting. For example: it prohibits the professional hunting; the marketing of species products and objects intended for its predation, the authorization to transport the species and related objects from legalized breeders; and finally a number of other provisions that restrict the possibility of damages to the wild fauna.

V. CONCLUSION

As already mentioned above, much more could be said about the environmental legislation on fauna or about the environmental legislation in general. There are several federal and state regulatory rules on environment that could deserve some comments.

However, such comments would demand a non-available time, and should be discussed in another opportunity, or even in more specific and specialized issues.

This way, to conclude, we reiterate the acknowledgement for your kind invitation and wish you all the success in this event.

Thank you very much.

Parasitological and Epidemiological Studies of Marsh Deer in Natural Habitat and Captivity: Consequences and Recommendations for the Conservation of the Species.

Jose Mauricio Barbanti Duarte (FCAVJ - UNESP/Jaboticabal)

1. INTRODUCTION

Diseases play an important role in the wild species conservation, especially when they are in contact with men or domestic animals. The Cervidae have been threatened by diseases of other domestic Artiodactyla such as bovine, caprine and ovine animals. Such threatens come from the physiological similarities among species that carry the same diseases. In Brazil this has been one of the main factors for the population decrease in areas such as the Pantanal, where bovine animals and cervids live strictly together

On the other hand, diseases proper to the species are balanced in wild populations, in that such balance is broken when environmental changes happen or when animals are kept in captivity.

This approach will be made intending to try identifying the sanitary problems significant to the species Blastoceros dichotomus and their reflexes in maintaining the populations healthy in captivity and in the natural habitat.

2. VIRAL DISEASES

2.1. FOOT AND MOUTH DISEASE

The foot and mouth disease is considered a significant mortality cause especially in the Pantanal. However, this is an empirical statement because cases with animals in the natural habitat have not yet been diagnosed. The only case confirmed in Brazil was with a brocket deer (Mazama americana) in which case the virus was isolated. In spite of this doubt, the foot and mouth disease seems to be a highly significant disease for the Brazilian Cervidae.

It is worth enhancing that many farmers blame the Cervidae as carriers and transmitters of the foot and mouth disease to the cattle. To solve such doubts, urgent surveys must be carried out, so as to evaluate the importance of the Cervidae in the epidemiological chain of this disease, through the detection of the anti-VIA antibody.

To date all serological tests carried out in animals in captivity resulted negative. It suggests that the Cervidae do not continue to be a carrier after the infection, because it is generally fatal.

All these inquiries shall be replied after the studies of experimental infection in individuals have been carried out.

2.2 - HEMORRHAGIC DISEASE

Presently, the Hemorrhagic Disease in which we include Blue Tongue and Hemorrhagic Epizootic Disease is probably the most significant disease affecting the Cervidae in Brazil. The disease is characterized by an hemorrhagic process resulting from virus injuries in the vascular endothelium. The hemorrhage mainly affects the gastrointestinal system, but it can be present in many organs such as heart, lungs and bladder. As it is transmitted by biting mosquitoes, the disease is seasonal, appearing in summer time, when it decimates most of the herd, at least in captivity.

The situation of this disease in marsh deer is uncertain, because an examination in the whole population in captivity and in a sample of the wild population has not yet been made. It is known that several animals in captivity died with the disease symptoms and others were serologically positive. This way, it is known that the disease is present in the population in captivity, so a special care must be taken in order to avoid contaminated animals in the herds. This is possible through serological tests when animals are in quarantine.

The presence of this disease in the herd is undesirable because it changes fertility, causes abortions, besides provoking new clinical cases with high mortality rate in hot seasons. It is worth noting that the cattle may be healthy carriers of Hemorrhagic Disease and transmit it to the Cervidae. A serological survey made in the cattle living in the surroundings of Ilha Solteira Zoo showed 100% of positive results, in that in such a Zoo some deer died after having presented symptomatology characteristic of the disease (MORATO, personal communication).

2.3 - MALIGNANT CATARRHAL FEVER

Such a disease has not yet been diagnosed in Cervidae in Brazil, however it is becoming common in the cattle. Historically, being a disease that frequently affects the Cervidae abroad, we should be attentive to its occurrence in our herds. There do not exist serological tests available in the national market.

3 - BACTERIOLOGICAL DISEASES

3.1 - BRUCELLOSIS

Brucellosis is a significant disease that affects the cattle in Brazil, but there does not exist any register as regards the Cervidae. All serological analyses carried out have presented negative results. This fact ranks this disease in second place in serological classifications. However, the facility to obtain the antigen and the testing makes it available to any Zoo or breeder.

3.2 - LEPTOSPIROSIS

Leptospirosis is highly related to aquatic environments because the Leptospira survives in water for a long time. This way, one should expect a high frequency rate of serologically positive animals. This fact happened with the population captured in Tres Irrnaos with a high number of serum positive animals.

This is not a reason for concern, because this disease is easily eliminated through the use of antibiotics. But for this purpose serology shall be made whenever possible and the results passed to the breeding center as soon as possible.

3.3 - TUBERCULOSIS

Tuberculosis besides being a great problem in every cattle herd in the world was not yet evaluated in marsh deer populations. It is a potential disease that shall be carefully analyzed by technicians responsible for the maintenance of such Cervidae.

4 - DISEASE CAUSED BY PROTOZOAN

4.1 - BABESIOSIS

Cervidae seem to be highly susceptible to babesiosis, however this disease is related to the breeding of the European cattle races In turn, such races are mainly located in more developed cattle raising areas, of which the Cervidae have disappeared for a long time, especially the marsh deer.

It is known that this disease is closely connected to ticks that are its transmitters, therefore in captivity the control of such parasites is directly related to the success in fighting against babesiosis. Some specimens of Cervidae serologically tested in UNESP/Jaboticabal did not present any positive result.

5 - PARASITIC DISEASES

5.1 - ECTOPARASITES

5.1.1 - TICKS

This has been one of the main problems of deer living in Promissao that present high levels of infestation with this arthropodous. The pathological result of this massive infestation is difficult to be evaluated, but certainly shall imply a substantial energy loss. The tick control

is very difficult under semi-captivity, conditions in which animals from Promissao are kept. Despite this fact, some attempts have been carried out by using pour-on parasiticide what has been relatively well succeeded, however in the long-run such methods will become inefficient.

There exists a varied degree of infestation in animals in the natural habitat that seems to be related to the sympatric level with the cattle.

5.2 - NEMATODES

Several nematode species were identified in the marsh deer of Promissao, such as the *Haemonchus contortus*, *H. similis* and *Trichostrongylus axei* in the abomasum, *Cooperia punctata* in the small intestine and *Trichuris* sp in the large intestine. None of the animals analyzed has shown high levels of infection, but it was due to the short stay in captivity (NASCIMENTO, personal communication). After a long period in captivity the environmental tension of contamination will increase to a certain extent that would cause infection levels incompatible with the animals survival.

Most species mentioned are cattle worms, proving that the contact between the two species may bring about serious consequences to the Cervidae.

5.3 - TREMATODES

There was a high frequency in the occurrence of *Paramphistomun liorchis* in the rumen of the animals analyzed in Promissao. This worm does not show high pathogenicity, however in a high number of animals it may lead to significant gastric disorders.

This trematode undergoes an indirect cycle, living in mollusca in order to have its cycle completed, so it is a problem that shall not occur in captivity without abundant water.

6. FINAL CONSIDERATIONS

The degree of knowledge of significant diseases affecting marsh deer is still incipient. Such a fact occurred due to the carelessness about those diseases for the maintenance of populations either in captivity or in the natural habitat. Thus, one expects both urgent measures to know the sanitary condition of the individuals in captivity and sampling of the populations in the natural habitat.

Concerning the knowledge until now, the importance of a quarantine efficient system is enhanced, so as to avoid the formation of herds carrying diseases that may, in the long run, decimate the populations living in captivity or even hinder efficient reintroduction processes.

Despite the apparent disease balance in animals in the natural habitat, the arrival in captivity causes a physiological unbalance with the consequent manifestation of the disease that may lead animals to death.

Considering the data presented, the following quarantine procedures to animals that just arrived in captivity are recommended:

a) Serology for Blue Tongue b) Serology for Leptospirosis c) Serology for brucellosis d) tuberculosis e) Feces examination (flotation and sedimentation) f) Hemogram

This way, the presence of main diseases in the herd may be avoided. It is important that the animal be not set free while it does not present negative results of the tests. Even considering the feces examination. animals that did not present negative results of at least five tests should not be set free. Remember that a minimum infection level today may bring about an unsolvable problem tomorrow.

Handling and Immobilization of Brazilian Cervidae: Experiences and Recommendations

Adauto Luis Veloso Nunes, M.V.

Introduction

Cervidae are animals that show a wide variety of handling difficulties, arising out of their sensitiveness to stress and their frightening behavior, frequently leading the animal to severe injuries or death Based on the practical experience acquired through the Brazilian Cervidae handling in captivity, plus the field experience in capture operations and translocation of the marsh deer, this summary also intends to gather the information gotten from several veterinarians from various zoos in Brazil, recommending that the Brazilian Cervidae handling operations, of which several species are under threat of extinction, be more safe either to the animal or to the capture team, whose recommendations may somehow help in the capture, immobilization, transportation and release of the animal.

The event of the animal being in captivity or in the natural habitat will define a number of different procedures. Some of them are perfectly applied to both or not.

1. CAPTURE OF CERVIDAE IN THE NATURAL HABITAT

The capture of Cervidae in the natural habitat is characterized by the fact of dealing with animals with little or no handling previous experience or human contact. This factor will lead us to an extra effort if we intend to keep the animal in captivity since it was captured, requiring a careful and progressive adaptation work that will be as successful as our knowledge about the animal behavior increases. The conditions that will determine the choice of the best method will depend on the time available, biology, ethology and habitat where the animal lives, besides the availability of material and human resources.

1.1 TRAP BAITED PLACES FOR THE CAPTURE OF ANIMALS

If we have enough time, we may use the spontaneous attracting system through food, salt, drinking water, attractive odors and sound signs. As known, the trap baited places are surveyed and prepared in advance where the animal will naturally go to. The animal may be captured through hanging nets, corrals or traps remotely controlled by ropes or by disarming automatic mechanisms, gun nets triggered by gunpowder or ground hidden nets that are lift by ropes or springs. The trap baited places method is cheap and does not involve many persons, but it requires patience and time presenting very different results. It is advantageous for not being much stressing and subject to fewer accidents, at least while conducting the animal as far as the net. This system has worked better in countries with severe winter, occasion in which the food demand is drastically reduced and the animals affected by hunger become less cautious.

1.2. NETS

Other ways to capture animals in the natural habitat require higher expenses with material and people, but they are more advantageous presenting higher efficiency in less time, as in the case of nylon or polypropylene nets.

1.3. WAITING OR GOAL NET

This net linearly or angularly arranged, put in places where the animal lives or uses to pass by requires a perfectly hidden team to make the manual immobilization soon after the animal is captured, and it works better if we can count on ways to force the Cervidae to go to it To conduct the animal as far as the net we may either singly or jointly use men on foot, on a horse, trained dogs or even very expensive equipment such as helicopters and planes. Leading the animal to the net in a very slowly way causes the stress, and may bring about serious problems and sometimes the immediate or later death because of cardiorespiratory arrest, hyperthermia, trauma and capture myopathy. The method used in 1990 to rescue 150 marsh deer from the area to be flooded by CESP's Três Irmåos HEP was that of using a large waiting net totally hidden (+-300 meters long) with a goal type net, where animals from the surrounding areas were led to by a helicopter and by horsemen. 20% of animal deaths occurred due to the referred to causes.

With a waiting net variation, Duarte (1992) reached a success of 42% in the capture of pampas deer, *Ozotocerus bezoarticus,* in Pantanal, where he took advantage of the topography favorable to surround the animal with a pickup truck keeping himself away from the limit of the animal runaway distance, releasing little by little a 100 m long x 1.8 m high net supported by civil construction iron bars fixed in the ground. When a semi-circle was completed the capture team was sequentially arranged, and by moving towards the animal pushed it against the net.

1.4 - NETS TRIGGERED BY FIREARMS

With a special firearm equipped with four guns one is possible to quickly launch a net over the Cervidae. The system efficiency largely depends on the habitat vegetation type and this system cannot be used in lands with compact and high bushes. Commonly one shoots from the helicopter at the animal in motion, making it to roll up in the net and be manually immobilized, in a quick operation with lesser exhausting risks because the Cervidae need not be conducted through large areas.

1.5. DART BLOW GUNS

They are considered efficient when chemically capturing animals in the natural habitat, but a good shot depends on many factors which tend to be little controlled, from the personal skill to the size, behavior and distance from the animal, the projectile speed, injection place, drug

type and many other factors. Notwithstanding, such a system has been successfully used for large African mammals in the natural habitat because of their habitat favorable conditions.

1.6 - STATIONARY CORRALS OR "BOMAS"

Those arrangements have been used successfully to capture African ungulates. A visual barrier arranged in a funnel shape is normally used which ends in a round area where the animals may be handled. Entire herds may be forced to enter in the "bomas" by the means already mentioned and be immobilized this way.

2. HANDLING OF CERVIDAE IN CAPTIVITY

Captivity is considered any situation where there exists any restriction to freedom characterized by fences, screens, trenches, comprising Zoos, breeders or farms.

2.1 - ENCLOSURES IN ZOOS

Our biggest problem is that the majority of the Brazilian Zoos do not have places proper to wild ungulates handling.

Generally, when constructing a Cervidae enclosure one thinks of a big screened area, besides a shelter fitted with feeding and drinking places, where the animals stay for days, months, years. Usually, one does not think of the need to treat or either capture such animals, and when it is necessary (and it occurs more frequently and rapidly than one can imagine...) the capture operation becomes an uproar, with unavoidable risks to animals and to the teams participating in the capture.

Then we come to the conclusion that it is more important to count on a PROPER PLACE FOR THE HANDLING OF ANIMALS than on our most skilled catcher or on the most efficient drug we should have at hand. So, ideally each enclosure should count on a closed place, with holes for the natural light close to the roof, and with gates (sliding or not) with no vents or gaps, easily operated by ropes or steel cable from outside. In such enclosures the animals would be fed and sheltered at night. The fact of sheltering the animals at night makes their behavior different, making them docile and better controlled. Such a more intensive handling requires a better supervision by the animal caretaker and when the animals need a medical assistance or a chemical immobilization the process is much easer, because the blowgun is used. With an animal frequently handled, the stress factor is highly reduced consequently diminishing risks of accidents to the team and animal.

The basic concept is that of not providing a large room which enables the animal to violently throw itself against obstacles nor jumping over them.

2.2 - LARGE FENCED AREAS (SEMI-CAPTIVITY)

In the same way, animals kept in large areas shall be fed in smaller corrals where they may be more properly handled. The entrance gates shall be located along the fence, operated either by ropes or springs. Inside those corrals the same principles shown above for the animals kept in Zoos are entirely applied.

2.3 - CAPTURE OF CERVIDAE IN CAPTIVITY

Being such a capture physical or chemical one should always bear in mind the following:

THE CAPTURE TIME IS THE MOST DANGEROUS ONE FOR THE ANIMAL AND TEAM. So, one should always be careful.

2.3.1- CAPTURE PLANNING

To ensure the entire success of any capture operation and reduce risks, a minimum planning is required and must be followed with a special attention to the following items:

a) COMMUNICATION: to inform people directly involved at least 15 days in advance, in writing, providing the list of animals to be handled;

b) IDENTIFICATION: accurate identification of each animal. Weight, age, sex, physical conditions, previous handling and temperament shall be taken into consideration. Please consult previous records; c) HANDLING TYPE: the type of handling and/or immobilization that will be more adequate to that species,

d) TRANSPORTATION CAGE: if the animal is to be transported the type of transportation cage that will be used. Previous inspect its condition and make eventual repairs. Leave the "bed" prepared;

e) ENCLOSURE CONDITIONS: enclosure conditions for capture. It is always preferable to attract the animal for the more restrict handling area already mentioned above. If necessary make remarkable changes, make them previously and let the animal get used to them;

f) RECORDS: it is convenient to have the details written down in proper cards for filing and future guidance purposes.

2.3.2 - PHYSICAL CAPTURE

2.3.2.1- USE OF VISUAL BARRIERS

Cervidae do not easily recognize screens or fences through which they can see as an obstacle in case of escaping. Therefore, visual or any other obstacles especially for captivity conditions are very important and largely used. Conducting the animal as far as the transportation cage, whether it is tranquilized or not, may be made with the use of funnel-like paths, since they also reduce the stress. Such structures may be made with various materials such as wooden planks, "madeirit" plates, opaque plastic canvas, dark pieces of cloths. Whatever the material is, it is ESSENTIAL that the animal does not see either through the structure or over it. The plastic canvas (Polifilm), or the "Sombrite" are very well fitted for this purpose because it is easily and rapidly installed over the screen, wire or wood, fastened with wire or Scotch tape.

If there is enough time for the capture it is desirable to induce the animal to enter the transporting cage without forcing it. The transporting cage must be taken to the enclosure some days before and placed where it is going to be used. Food shall be put in the cage for several days, with the gates open because the animal will not be afraid of being transported and leading it to the cage will calmly happen. Putting some deer feces in the cage helps to create a familiar atmosphere to it. 2.3.2.2 - USE OF NETS

These can be either waiting nets, manually launched, or fishing net type. Such nets must be resistant (white polypropylene), wide and long enough to cover (wrap) the animal. The net is usually placed close to the exit where the animal uses to pass by or along the enclosure fence. With small Cervidae as the Brocket Deer the use of this fishing net type handled by an agile animal caretaker is frequent and efficient and seeks giving the animal the impression of a free access way, but as the deer tries to escape the net is rapidly put in front of it. This method involves risks for everybody because it implies a manual immobilization. Putting the animal not tranquilized/sedated in a transportation cage is critical and involves risks to the team when the animal is going to be released.

2.3.2.3 - CAPTURE WITH ROPES

Although this system is often used, it is not recommended due to the risks to the animals and team. This kind of capture system involves one or more persons skilled in the rope handling, placed in sites near the animal passages, whose animals are normally conducted to the capture site by other persons. The hanging risk is always present besides more serious injuries such as neck fractures.

2.3.2.4 - MANUAL CAPTURE

This system shall only be used by persons with previous experience because it involves evident injury risks. However, in some occasions it is very efficient especially for rapid captures.

Small Cervidae such as the brocket, "bororo", and pampas deer, when being transported in cages or when relatively docile, may be easily caught in every hind legs, tarsus-tibial

articulation and lift from the ground while another person completes the immobilization of the front legs. Keep the animal stretched out to avoid sudden movements of hind legs. Care must be taken with the hooves that are extremely sharp.

The manual immobilization shall not be tried with Brocket Deer, *Mazama americana,* because they are very strong.

Bigger Cervidae such as the marsh deer (*Blastocerus dichotomus*) may also be immobilized, except for the big and vigorous males, by a person who holds its body by the scapula or neck, while one or two persons hold the groin skin fold and immobilize the animal among themselves or against an obstacle.

Either in captivity or in the natural habitat a blindfold should be put on the animal's eyes soon after it is captured.

2.3.2.5- IMMOBILIZATION THROUGH MECHANICAL SYSTEMS

Especially developed for wild ungulates, these systems have been used in breeding farms in the United States. Such systems are very efficient because they permit the handling of several animals in a short period of time without the need of chemically immobilizing it. The animals are sent to ever smaller corrals, passing through corridors up to entering an apparatus that fastens their thorax and abdomen with a grasping movement, in that the floor as a scaffold is also open, and the animal has no chance to hurt itself or the team.

3. TRANSPORTATION CAGE

It must be made of wood, with a guillotine type gate, floor with crossed lath and with dry straw or sawdust bed. Air holes are extremely important and must be in the upper third of the cage. Mobile tow curtain on the holes may be used and shall be rolled down if the animal is stressed, providing a darker room that is beneficial to the Cervidae. As a general guidance, the transportation cage shall be 20% longer, 15% wider and 10% higher than the measures of the animal to be transported, including the antlers.

4. TRANSPORTATION

The animal transportation must be made as rapid as possible preferably at high speed (in compatible roads), because the animal tends to seat and be calmer if it feels it cannot be standing up. This also helps cooling the transportation cage. When stopping for a quick inspection do not turn the engine off, because this hides other unexpected noises. In hot seasons you should prefer travelling at night or early in the morning. The cage must be transported transversely to the body of the truck, because it minimizes the stop and start

effects that may provoke injuries to the animal.

S. RELEASE OF ANIMALS

Releasing the animal must be made in rooms offering safety and privacy. Rooms totally fenced with screens are not good, because the animals do not recognize the screen as an obstacle. In this case, the covering with wood, clothing, plastic canvas or "Sombrite" mitigates this problem. As the animal gets used to the environment, the covering pieces may be gradually removed. If the use of this system is not possible, one should at least place the cage with the animal inside the new room or at the gate of it and let the animal be calmer for some time; it should also be ideal if the animal could see the room before being released. Then, after some time, one may tenderly open the cage gate and silently leave, letting the animal go out by itself. The cage may be taken out in another occasion. Another efficient way is to release the animal in small rooms that are protected by wood or canvas as the Sheltering or Exchanging Area instead of in the main room.

6. CHEMICAL CAPTURE OF CERVIDAE

During the capture, transportation and release of the animal a number of drugs that facilitates the work and enables a more safe handling may be used.

6.1- TRANQUILIZERS

Such drugs cause a calming effect by reducing the anxiety without causing serious relaxation and sensorial loss.

6.1.1 - "DIAZEPAM"

(Diempax, Usafarma. Valium, Roche. Diazepam, several).

Presentation: tablets of 2.5 and 1 0 mg. Vials of 10 mg/2 ml each.

Prescriptions: Used as pre-anesthetic and to calm down animals before the transportation to diminish the stress and fatigue during the capture, or to facilitate the adaptation to new environments.

Pharmacological Action: The product works on the Limbic System and produces tranquilizing effects, as well as sedation and an areflexia condition depending on the dose and the individual sensitiveness. It largely diminishes the aggressiveness not interfering too much in the motor activity; it is also used as a anticonvulsant. After getting the injection the effect

starts within 15 minutes and may last for 10 hours. Orally the effects generally start within 45 minutes and may last up to 24 hours. The product is highly safe. Frequently overdoses do not cause death.

Doses: Intramuscular/Venous: 0.5 to 1.5 mg/kg
Oral: 1.0 to 10 mg/kg
Antagonist: "Flumazenil"

6.1.2- "ACEPROMAZINA" (Acepran, Univet)

Presentation: Vials of 10 ml at 1% (10 mg/ml) each.

Pharmacological Action: This drug is the most powerful derivative from the "promazinas" and acts as a tranquilizer that depresses the cerebral cortical activity. High doses in Cervidae may cause sleepiness and muscle relaxation, especially in those very docile animals. They show antiemetic, hypotensive and hypothermal activities.

Prescription: They are usually used as a pre-anesthetic together with other drugs to optimize the immobilization particularly if the muscular relaxation is desirable. If it is used alone it allows small clinical procedures in especially anxious animals.

Cautions: Toxic reactions may occur if animals show hyperthermia, due to the interruption of heating dissipation mechanisms. Do not use intravenous injection in excited animals because it may cause a sudden death.

Doses: Intramuscular/Venous: 0. 1 to 0.5 mg/kg

Antagonists: There is none specific.

6.2 - IMMOBILIZERS

6.2.1- "XILAZINA" HYDROCHLORIDE (Rompum, Bayer)

Presentation: Vials of 10 ml with 20 mg/ml (2%) each.

Prescription: Used as a sedative agent, analgesic, anesthetic and muscular relaxant.

Pharmacological action: This drug has a strong sedative and analgesic effect due to its action in the C.N.S. (stimulant 2 adrenergic), causing muscular relaxation by inhibiting the nervous impulse transmission; the bradypnea, tachypnea and hypotension occur. A mild sialorrhea, lowering of the head, falling down of lips and eyelids, penis relaxation may also occur. After getting the injection the animal must be left quiet until the drug is completely absorbed, what generally occurs within 15 to 20 minutes, lasting about 2 hours.

Cautions: Overdose may cause deep cardiorespiratory depression and death. Tympanism may occur if ruminants are left in the lateral position.

Doses: Intramuscular/Venous: 0.5 to 3 mg/kg

Antagonists: The Yohimbine Hydrochloride provokes a rapid and frequent recuperation of the complete sedation by the "Xilazina".

Average dose: from 0.3 to 0.5 mg/kg

6.2.2- "DETOMIDINA" (Domosedan, Ciba-Geigy)

Presentation: Vials of 5 ml with 10 mg/ml each.

Prescriptions: Normally used in domestic equines as pre-anesthetic and for small surgeries, it has also been used for sedation and to facilitate the transportation of some wild ungulates.

Pharmacological actions: It provokes sedation, analgesia, and muscular relaxation. Although it acts in the same receptors of the "Xilazina" it is ten times more powerful. The "Detomidina" apparently interferes less in the physiological parameters then the "Xilazina". The effect begins between 1 - 5 minutes and lasts I hour in average.

Cautions: The occurrence of hyperthermia in wild ungulates is related to the "Detomidina" .

Doses: Intramuscular/Venous: 100-250 mgr/kg
Antagonists: Yohimbine hydrochloride, "Idazoxan", "Tolazolina"

6.2.3 - "KETAMINA" HYDROCHLORIDE (Ketalar, Park-Davis)

Presentation: Vials of 10 ml with 50 mg/ml each.

Prescriptions: Used for anesthesia and immobilization purposes with short period induction and effects, being highly safe.

Effects: The product leads to the so-called dissociative anesthesia in which the reflexes are present with an apparent consciousness, however with loss of the normal and aggressive reactions. Salivation that may be controlled by "Atropina" may occur; no remarkable respiratory or cardiac frequency alteration happen. After the intramuscular injection the effects are observed within 3-4 minutes by the incoordination and lain position what will last from half to one hour.

Cautions: Convulsions controlled by "Diazepam" may occur.

Doses: Intramuscular/Venous: 5 -1 5 mg/kg

Antagonists: There is none specific. 7. DRUGS COMBINATION

For the Cervidae we may use some combinations to make the immobilization more efficient, safe and less voluminous, raising the power of the isolated qualities of drugs.

7.1- "TILETAMINA" HYDROCHLORIDE + ZOLAZEPAN (Zoletil, Virbac)

Presentation: Lyophilized in vials with 5 ml diluent each, remaining the concentration of 50 mg/ml.

Prescriptions: Used for surgical anesthesia and immobilization purposes.

Effects: The "Tiletamina" provokes a dissociative anesthesia, while the "Zolazepam" is a tranquilizing, myorelaxing, anticonvulsive and anti-anxiety drug. It may be either used IM or IV, being the induction quicker if used IV (taking less than 30 seconds).

If necessary to keep the anesthetic plan for a longer period, half doses may be used, but they generally increase the time of return, because of the increase of the compound tranquilizing fraction. For this reason, some people use to supplement with "Ketamina". The time of return depends on the dose and is generally calm.

Cautions: Excessive salivation may be controlled by the "Atropina" Sulphate. A recent work reporting several deaths of tigers, within more than 20 hours after the immobilization, suggests caution when used in big felines.

Doses: For Mazama sp: 4-15 mg/kg IV. The effect time varies from 20 to 90 minutes. Subsequent IV doses may be necessary, using, however, half of the initial dose.

Antagonists: There is none specific.

7.2- "KETAMINA" + "XILAZINA" + "ATROPINA"

This combination has been efficiently and safely used for more than 30 years reaching good results. As all these drugs are hydrochlorides they may concentrate in sterilizers

- (see technique below), mixed and may be stored without any damage to the effect.

Doses: Intramuscular: Ketalar 5-8 mg/kg
Rompum 0. 5-1. 5 mg/kg
"Atropina" 0.005 mg/kg

Antagonist: Yohimbine Hydrochloride may be used to revert the "Xilazina", but do not affect the "Ketamina" that may continue working. For this reason, you will have to wait for 45 minutes for the "Ketamina" to metabolize before using the Yohimbine. 7.3 "KETAMINA" + "DETOMIDINA" + "ATROPINA"

Such a combination has been used in (Cervidae through darts or manual syringes with positive results.

Doses: Intramuscular: Ketalar 5-8 mg/kg
Domosedan 100 ug/kg
"Atropina" 0.05 mg/kg

Antagonists: The same procedures are applied to the processes described for the combination "Ketamina" + "Xilazina" + "Atropina".

8. ANTAGONISTS

8.1. YOHIMBINE HYDROCHLORIDE

Presentation: The drug is prepared and available in Brazil in manipulation drugstores. Thus, its presentation may vary being the vial of 2 ml with 3 mg/ml the most common one.

Pharmacological Action: It is a non-synthetic adrenergic alpha 2 blocker. The Yohimbine is responsible for exciting the Central Nervous System causing the increase of the blood pressure and of the cardiac beatings. It may be given intravenously or intra-muscularly. With an animal in a complete lateral position, after getting the intravenous injection one can observe an immediate increase of the respiratory frequency and deepness, a progressive consciousness observed by the ears shaking and twinkle of eyes followed by the front position and stagnation. This process may take from 30 seconds to some minutes. Moose seem to be the only are not satisfactorily reversed by the Yohimbine.

Doses: May vary from 0.125 mg/kg to 0.9 mg/kg. We normally use 0.3 to 0.5 mg/kg at average with positive results.

8.2- "FLUMAZENIL" (Lanexat, Roche)

Presentation: Vials of 3 ml each.

Pharmacological Action: The drug was synthesized in 1979 and produces a remarkable sedation reversion, apnea and muscular relaxation induced by benzodiazepines. The recommended dose is 0.6 to 3.0 mg/kg.

9. HOW TO CONCENTRATE DRUGS SOLUBLE IN WATER

To facilitate the injection of drugs through darts we may not use the drugs concentration through heat. It is just applied to drugs dissolved in water, as the Hydrochlorides. The method is very simple: a) Previously regulate the drying sterilizer for a constant temperature of 70 degrees.

b) Take the drug from vials with sterilized syringes and needles and put everything in a beaker or in any other clean and sterilized small wide mouth bottle.

c) Put the bottle in the sterilizer and constantly observe it. The drug water evaporation makes the remaining liquid more and more concentrated up to the desired point. It is convenient that the bottle or the beaker be marked with degrees for the operation follow-up. For example, 40 ml of "Ketalar" with 50 mg/ml after 12 hours in the sterilizer will show a volume of 10 ml with 200 mg/ml. The evaporation time may vary a lot because it depends on several factors.

Should the liquid be forgotten in the sterilizer, evaporating over the desired point, even becoming crystals or powder, only add distilled water q.s.p. to obtain the desired concentration with no power loss.

d) Then put the drug back in the vial. Label it again enhancing the contents and the concentration to avoid mistakes.

10. REMOTE SYSTEMS FOR INJECTING DRUGS

Much of the progress reached in the handling of wild animals is generally directly related to the development and improvement of the drug injection systems.

Although this system is not the most indicated one to capture a large number of animals, especially in the field, there are many situations in which they are highly useful and efficient. It has been mostly used in captivity where the animals need be more constantly anesthetized or treated by veterinarians, and wisely handling this equipment became a very important quality in order that the handling of wild animals in captivity be improved.

Thus, dealing with Cervidae, a species that uses to show runaway reactions and struggle against its being captured, the possibility of using the injection through darts represents a great advantage over the physical immobilization methods because it is quicker, more silent and offers lesser risks to the animal and team. There are many systems available in the market, whose majority is imported. Similar national systems use to be own manufactured or handmade and are not available unless in very special conditions or if ordered.

We are going to deal with just the most important systems of each kind we know better.

10.1 PALMER CAP-CHUR SYSTEM

The first projectile was developed in 1958 presenting the same features nowadays They are duraluminium darts with threaded ends where the needle and the tail are inserted, whose embolus pushes the drug after bursting a gunpowder capsule that explodes because of the impact. The needles are generally thick and may count on rings or barbs to penetrate the animal and ensure the drug total injection. After some time, except for barbed needles, the dart falls down to the ground thus being recovered for multiple uses.

Rifles and pistols using gunpowder capsules or compressed gas tubes account for triggering darts at a distance varying from 10 to 80 meters.

One of the main disadvantages is the so intensive strength the drug is injected that may cause injuries of tissues, such as necrosis.

Unfortunately, in Brazil the Companhia Brasileira de Cartuchos (CBC) is no longer producing a rifle that adapted itself to the Cap-Chur dart system, for this reason every equipment must be imported.

10.2 - BLOWPIPES

By using light plastic darts, the utilization of the old method used by South American Indians to capture animals, the blowpipe became possible. The blowpipe is a more attractive option than the metal darts, because it does not cause injuries to animals with small muscular mass, is silent and very efficient for small and medium ranges, being ideal for the captivity conditions. The small size of plastic darts is perfectly compatible with the use or the preparation of highly concentrated drugs.

At present, there are very accurate rifles, some of them with telescope sight that operate with compressed air and equipped with gages to control the shot impact.

Darts and needles are very simple, and may be easily manufactured at home with disposable syringes, making it very cheap. Darts are equipped with a chamber for the liquid and a chamber for the air under pressure, or butane gas. In disposable needles with their normal hole covered with glue, another lateral hole is made, a small silicon cylinder or even an electric wire shield closes the lateral hole that is pulled back when the dart reaches its target injecting the liquid with the embolus pushed by the compressed air.

Recommendations for the Brazilian Cervidae Handling and Immobilization

From a historical point of view, a great progress was attained as to the way wild animals,

mainly the Cervidae, may be captured and handled, and this fact must be considered worldwide for the maintenance of feasible populations either in captivity or in the natural habitat.

It is fundamental that this progress be made public and incorporated, with some adaptations, to the immobilization and handling techniques in effect in Brazil.

Except for one species, *Mazama gouazoubira*, every other species of Brazilian Cervidae may be deemed threatened with extinction, and such a fact enhances our responsibility for these populations.

So, by considering every method and system above, we may point out a series of recommendations for the successful handling of the Brazilian Cervidae.

* Capture of Cervidae in the natural habitat

Among the systems mentioned, the best ones are the waiting or goal nets, whose use was tested during the first phase of the marsh deer capture operations. However, during the second phase the system of nets triggered by guns enabled the capture in a shorter time, presenting lesser risks and smaller teams.

The system tested by Duarte seems to be very promising and showed to be very efficient for the Brocket Deer within the field concerned, that is, the flat and dry areas in Pantanal.

The social characteristics of the Brazilian Cervidae suggest that the stationary "bomas" or corral systems would not be applicable, or would present a very low efficiency rate.

* Handling of Cervidae in captivity

The majority of enclosures for Cervidae in Zoos are not yet constructed following the minimum safety and privacy requirements. It is essential that such criteria be always made public and remembered. The relevant legislation establishes some of the general characteristics, but many details must still be specified by technicians of each Zoo. The most important concept is the need of a PROPER PLACE FOR THE HANDLING OF ANIMALS, without which one will face many problems.

The Brazilian Zoo Society through its departments has always searched for informing and assisting the correct construction of enclosures for the Cervidae.

Handling protocols must be made public mentioning every handling and capture aspect.

In captivity Cervidae taming is a need as well as an advantage that apparently does not interfere very much with the reproduction aspects.

A tamed animal is less subject to stress and to its consequences.

* Animals kept in large fenced areas, known as semi-captivity or semi-freedom, show a series of handling difficulties. Taking into account the apparent reproduction success, its handling as a population, is many times impracticable because the animals become distrustful if constantly left without the human contact.

For these and other reasons large fenced areas shall frequently have animals attracted to and handled in smaller areas, so as to enable them to get used to them and better accept casual conditions of capture and transportation.

$ The capture time for any purpose is crucial for the (Cervidae. It involves several inappreciable factors if we take into consideration the premises, team, transportation and release of animals. Those are unique occasions that depend on the good sense and on a weighed evaluation of the situation and sometimes on quick decisions, that can produce good or bad results. Since emergency cases occur we should be prepared to face them.

So, capture and handling operations shall ALWAYS be carefully planned.

Once again, capture protocols shall be prepared and made public. Veterinarians, biologists and the entire team shall be trained in simulated and real situations to do their best. Such a training may be made with non-threatened with extinction (Cervidae as the Brocket Deer.

* In other countries, mechanical systems of capture have shown to be very efficient in hunting farms or safaris. The import or the development of national similar systems shall be encouraged to be used in similar conditions.

* Everyday new drugs are incorporated to the already abundant arsenal of chemical capture means. In this case, we recommend the development of tests using non-threatened with extinction animals as biological models, whose results may be extrapolated for those species in a crucial situation.

Preference should be given to drugs that better meet the pre-requirements of an ideal tranquilizer or immobilizer agent that can be easily acquired and present high solubility, reversibility, high safety margin, little interference in the physiological parameters and is applicable to several species.

However, we think that a chemical capture protocol that uses a drug or a drug combination with satisfactory results shall be only changed if it proves to be better than another one, otherwise enough experience and safety with any other drug will not be acquired.

Equipment and drugs for emergencies shall also be included in the capture protocol, and be periodically checked as to its validity and operation.

* The technicians' skill in handling different injection remote systems shall be constantly improved, from the syringe assembly to the aim, in movable and static targets.

As a training, we should make a chemical capture protocol in routine situations in which such protocol is not strictly necessary.

Every technician shall be personally in charge of cleaning and preparing his equipment besides making pressure tests of darts, because failing in the first attempt makes the second one much more complicated and stressing for the animal.

The quantity of material as well as the stock of anesthetic drugs shall foresee situations of repeated mistakes with the total loss of darts and drugs. As a precaution it is advisable to have at least three times the quantity foreseen for a procedure. Such a care is especially important for situations in field or far from the main premises.

* Final recommendations

We recommend that a series of Cervidae handling protocols, each one focusing one aspect, be prepared by a group of specialists and be widely divulged among the institutions that are responsible for this kind of fauna.

Additionally, training courses shall be given by entities that work in the area, for training the technical and operational teams.

Agreements and the creation of sister-entities shall be implemented for transferring materials and specific knowledge.

Constant updating of the number of animals kept in captivity as well as analyses of this data over the time will define problems and establish the priorities.

Influencia antrópica sobre uma população silvestre do Cervo-do-Pantanal *Blastocerus dichotomus* e perspectivas de manejo em reservas indígenas

Frans Leeuwenberg

Introdução

Poucas áreas silvestres de grande extensão permaneceram neste estado após o avanço agricola e a urbanização no centro-oeste brasileiro. Torna-se cada vez mais difícil, principalmente no centro e sul do país, encontrar áreas com superficie mínima necessária capazes de sustentar populações silvestres do cervo-do-Pantanal. Algumas das áreas naturais que ainda sustentam populações de cervo sofrem a caça de subsistência; mas nem sempre é conhecido se esta caça é ecologicamente sustentavel ou se pode vir a constituir uma nova ameaça para a preservação desta espécie.

O Centro de Pesquisa Indígena/CPI foi convidado pela comunidade Xavante da Reserva Pimentel Barbosa, estado de Mato Grosso, para realizar uma analise da caça de subsistência praticada pela comunidade. O objetivo básico da pesquisa é descobrir, pelo estudo da coleta das diversas espécies cinegéticas, se elas poderão ter suas populações recuperadas, entre elas o cervo-do- Pantanal.

É extremamente importante o conhecimento do impacto da caça praticada pelos índios sobre a população de cervos. No caso das reservas indígenas encontra-se fora de questão o simples ato de proibir a caça; isto porque a maioria dos indios dependem tradicionalmente do recurso fauna para sua alimentação. É necessário, ao invés, que se descubra até que ponto a exploração pode ser ecologicamente sustentável.

Torna-se ainda necessário o desenvolvimento de um trabalho onde se possa obter resultados confiáveis e indicativos da situação das populações de fauna sem no entanto se fazer uso de pesquisa predominantemente científica. O trabalho desenvolvido pelo CPI é em realidade uma tentativa de se descobrir métodos alternativos para se obter dados da situação atual. Mais importante ainda é a aplicação de métodos simplificados para que os índios possam facilmente levantar dados sobre a espécie e assimilar os índices sobre o manejo dentro do pensamento cultural Xavante.

Os proprios indios devem ser incentivados e, mais ainda, capacitados para detectar quedas nas populações da fauna de caça. Mas é importantíssimo levar em conta que a metodologia não pode modificar o espirito ou a cultura das caçadas.

Aproximadamente 90% dos 220.000 ha da reserva tem habitats adequados para o cervo, ou seja campo limpo, campo sujo, murundum de campo limpo e campo sujo, veredas, pequenos lagos com vegetação alta e média e brejos. O habitat predominante é o murundum.

Figura 1. Mapa do Brasil com localisação reserva Xavante

A reserva Xavante se encontra a leste da Serra do Roncador, no estado de Mato Grosso, ca. 350 km ao norte de Barra dos Garças. A área total da reserva é de 330.000 ha; por motivos internos às comunidades Xavantes, a parte mais ao sul da reserva não foi incorporada nas pesquisas.

Metodologia

Um questionário com nomenclatura da fauna em Xavante foi usado para registrar a coleta de caça em cada uma das caçadas, comunitárias ou individuais. Apenas o sexo dos animais foi distinguido.

Isto porque, logo no início, foi constatado que a anotação jovem e adulto não foi bem sucedida. Tais dados foram obtidos através da análise dos mandíbulas. Os questionáros foram preenchidos no máximo 1-2 dias após a caçada e fornecem todo o detalhamento da composição da cada caçada.

Cada sub-região de caça foi registrada com o nome Xavante para o local e posteriormente usado para mapeamento da área de caça. Foi utilisado um aparelho GPS para localisação das diversas sub-regiões com toponomia Xavante. Um mapa preliminar foi elaborado baseado em fotografias de satélite de 1990, escala 1:100.000.

A **coleta de caça** foi calculada por 1000 ha após uma estimativa da área de extensão de caça a cada ano e baseado no número absoluto da coleta de acordo com os questionários. A coleta de caça foi calculada sem extrapolação uma vez que a amostra foi de 100%.

O **sucesso por caçador - ou coleta por esforço** - foi calculado através do número de dias vezes caçadores, resultando em número por 1000-cacador-dias. O registro do tempo gasto para coleta de um animal não é realista, porque não é possivel acompanhar cada caçador. O caçador não vai ele próprio registrar, a cada hora, o tipo de atividade por ele executada; além disto, uma caçada não é direcionada para uma única espécie; e como distinguir o tempo gasto para um e para outro? Um registro não faz distinção entre o tempo gasto com deslocamento e o tempo gasto apenas para caçar um animal.

O **sucesso de caça** = a coleta de caça da espécie por unidade de esforço de caça por unidade de superfície caçada (e por unidade de tempo). O sucesso é a coleta/esforço/superficie/período. No presente estudo, o sucesso foi calculado na seguinte forma: coleta por 1000 cacador-dias por 1000 hectares por período comparavel.

Não foi possivel obter dados diretos sobre a **reprodução** anual, uma vez que a utilização dos animais é total. Os caçadores consomem as víceras logo após o abate dos animais, não tendo a paciência de coletar material pequeno e fino. Assim, foram coletadas as mandíbulas dos animais caçados para classificação etária dos indivíduos capturados.

Foi assumido que a troca de dentes se completa na idade de 18 meses. Não foi possivel fazer láminas dos dentes para colorização e distinção de linhas de cimentum; experiencias com Cervo-do-rabo-branco (White-tailed deer) na

Venezuela deram resultados negativos. Assim, as idades dos animais foram estimadas pela fase de erupção dos dentes e o nivel de gastura dos molares e premolares

Resultados/discussão

Nos anos 1991 (11 meses), 1992 (completo) e 1993 (10 meses) foram abatidos, respectivamente, 16, 21 e 34 indivíduos de cervo. A coleta por mês variou entre 0-14 indivíduos (média mensal = 2 indivíduos).

A partir de julho se iniciam as caçadas com fogo, principalmente nos campos e murundums e nas áreas úmidas, as quais permanecem secas por um curto periodo de tempo. Estes campos são os mais favoraveis para o cervo. Na época da seca o cervo ocupa um espaço importante na alimentação do povo Xavante.

O consumo do cervo tem sua importância alimentar entre maio e outubro. O principal período de caça do cervo se dá na época de seca, entre maio e setembro.
O principal motivo para a coleta dos dados foi observar se a caça do cervo-do-Pantanal é sustentavel. Para o cervo não existem cálculos sobre a produção e potencial de coleta por 100 ha. Talvéz com as informações do presente Workshop seja possível formar uma melhor ideia sobre tais aspectos de produção e potencial coleta.

Dados sobre reprodução e densidade não puderam ser levantados durante a pesquisa. No trabalho atualmente sendo desenvolvido com a comunidade Xavante são distinguidos 3 tipos de dados indicativos sobre a sustentabilidade da caça aqui especificados para o Cervo: o sucesso de caça, proporção dos sexos e faixa etária:

1. Mudanças no sucesso de caça.

A atual pesquisa demonstrou que a comparação da coleta por superfície ou o sucesso por esforço de caça não podem , isoladamente, constituir-se em indice indicativo de que a caça é sustentavel.

Tabela I.

A coleta por superficie depende da esforca e vice-versa. Por isto a comparação do dado solitário da coleta por 1000 caçador-dias ou da coleta por 1000 ha tem pouco significância.

A tendência da coleta por 1000 caçador-dias por exemplo é quase constante no período da pesquisa (tabela I). Também a coleta por 1000 ha aparentemente aumenta após uma queda em 1992. Mas o **sucesso de caça** está diminuindo com 25% no último ano.

Tabela II.

Acredito que o sucesso de caça, cuidadosamente definido, pode constituir-se em indice de sustentabilidade da caça. A definição do **sucesso de caca** = a coleta de caça de uma espécie determinada por unidade de esforço de caça por unidade de superfície caçada (e por unidade de tempo). A comparação de diversos anos pode ser um bom indicador da sustentabilidade da caça.

A área de caça mudou de região a cada ano. O sucesso de caça diminuiu 25% em 1993 em comparação com anos e locais anteriores. Isto quer dizer que o potencial de caça foi inferior na área de caça em 1993. Este menor sucesso de caça não foi **possivelmente** causado pela alta pressão de caça no passado, mas mais provavelmente pela menor capacidade dos habitats. É sabido que a qualidade dos habitats desta área é baixa para o cervo e provavelmente também sua capacidade de carga. Se **o sucesso de caça** na mesma área permanecesse o mesmo no ano seguinte, seria possível concluir que a caça provavelmente seja sustentável. Caso contrário, ou seja, se o sucesso de caça diminui, podemos concluir que a caça não é sustentavel.

MAPA da reserva Xavante

O sucesso de caça diminui se as populações diminuirem mais que a capacidade de recrutamento. Não é sabido como o sucesso de caça mudou em comparação com os 5-10 últimos anos. O ideal seria comparar o sucesso de caça para cada região onde ela ocorre.

2. Proporção dos sexos.

Um outro dado indicativo poderia ser a proporção dos sexos. Em áreas adequadas para cervídeos com uma baixa densidade óbvia, a proporção dos sexos pode chegar até 1 macho : 4 fêmeas. No momento em que a população alcança a capacidade de carga, a proporção será cerca de 1 : 1. Uma proporção de sexo a favor das fêmeas é uma indicação de alta mortalidade. A proporção de sexos encontrada na área Xavante para o cervo variou muito por região, ficando em 1:2,3 em 1991, 1:0,3 em 1992 e 1:2,0 em 1993 (macho:fêmea). Durante dois anos a proporção ficou a favor das fêmeas. Isto pode estar refletindo uma resposta da população `a a pressão de caça. Nas duas áreas Uiwede-hu -1991- e da Serra -1993 - houve uma pressão de caça de média a alta em anos anteriores. Mas também a proporção de jovens para adultos foi mais baixa nestas duas áreas, sendo 21 e 25%: Falta a saber qual produção realmente existiu nestas areas .

- Figura porcentagem jovem - adulto

A área do Corixão - 1992 - foi pouco caçada no passado. Consequentemente, a mortalidade pela caça foi sempre baixa. Possivelmente esta área apresente uma população mais estavel. Os habitats nesta região são mais adequados para o cervo. Mas temos que tomar cuidado com a interpretação por ser a amostra é muito baixa, principalmente para os anos 1991 (N=13) e 1992 (N=14).

É necessário saber qual a proporção de sexos em populações isentas de caça para que se possa intepretar as proporções de sexo encontradas nas populações que sofrem a caça. Espero nesta audiência poder obter informações também sobre esta questão.

3. Estrutura etária.

O retorno de mandíbulas apresentou uma variação entre 24-57% do total de cervos caçados. Do total de 16, 21 e 34 indivíduos, 89, 83 e 63% foram animais até 2 anos de idade. Isto sugere que a proporção de jovens até 2 anos foi relativamente alta. Por outro lado, deve-se tomar cuidado com a interpretação deste dado: Animais até 2 anos correm mais risco de serem caçados, principalmente aqueles entre 1-2 anos; estes foram recentemente abandonados pela fêmea sendo ainda inexperientes no conhecimento da área e nos riscos dos predadores como onça pintada, onça vermelha e os próprios cacadores Xavantes.

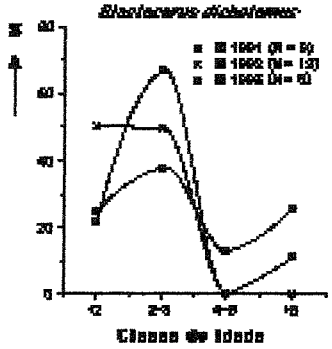


Figura 3. Classes de Idade dos individuos do cervo-do-Pantanal caçados em 1991, 1992 e 1993.

Nas populações onde a caça não é praticada, a mortalidade é baixa nos adultos e alta nos jovens e velhos. Nas populações que sofrem a caça, a principal mortalidade dos adultos é a caca. Em qualquer uma das duas situações, portanto - com ou sem caça - a mortalidade maior está entre os jovens.

A figura da estrutura de idade dos cervos caçados por ano proporciona um melhor detalhamento e demonstra que em 1991 e 1993 a maioria dos animais abatidos foram da classe de 2 anos de idade e não dos jovens. Isto significa que a pressão de caça se desviou para os animais subadultos. Apenas em 1992 a principal mortalidade ocorreu entre os jovens. Um aspecto preocupante é o fato de que, com excessão de 1993, pouquíssimos animais acima de 2 anos foram encontrados. Isto sugere a existência de um fluxo bastante limitado de animais sub-adultos para adultos.

Tabela III.

Conclusões

Alguns tipos de dados como **sucesso de caça**, **faixa etária** e **proporção de sexos** podem servir como indicadores sobre o nivel da população, mas precisam ser complementados com estimativas de densidade. Tais densidades devem ser tomadas em áreas com alta pressão de caça e áreas sem nenhuma pressão de caça, possibilitando melhor entendimento sobre o impacto da caça sobre a espécie.

O manejo e conservação do cervo em áreas indígenas exige acompanhamento. Mas num país com tantas reservas indígenas, tal acompanhamento torna-se inviável. Esta inviabilidade demanda uma procura de orientações simplificadas. Em cada área, deveriam ser gastos 3-5 anos para se obter suficientes dados e conhecimento cultural que possibilitassem cooperação da comunidade para realisação de um plano de manejo realmente efetivo.

O manejo da população de cervo - e outras espécies - dependerá do retorno ao sistema de caça rotativa. Somente assim as subpopulações podem se recuperar da pressão de caça, a qual será distribuida em diversos lugares ao invés de permanecer constante em um único local.

Nas Unidades de Conservação não há o problema de caça, mas outros fatores determinam o nivel da população, como caça ilegal, a presença de cachorros vadios, mortalidade devido ao tráfico em alguns locais como por exemplo no Taim, no Rio Grande do Sul, influencia de doenças transmitidas pelos animais domésticos etc. Existe ainda o crescente problema da degradação dos habitats pela **invasão de Gramíneas exóticas** como capim-gordura e capim *Brachiaria*. Os cervídeos não são beneficiados com tal invasão; ao contrário, a espécie sofre a perda de habitats adequados para sua sobrevivência.
Os cachorros vadios perturbam a população silvestre e causam a perda desnecessária de animais. A presença dos cachorros vadios faz com que os cervídeos mudem sua atividade e tenham, consequentemente, menos aproveitamento da tranquilidade e oferta alimentar dos habitats.

A preservação do cervo-do Pantanal não deve se dar apenas em unidades de conservação, mas também em áreas onde as populações humanas o utilizem como fonte de alimentação. Se as comunidades indígenas usam o cervo de maneira racional e sustentavel, eles também podem ser um dos melhores fiscalisadores para proteção da espécie contra a caça irracional e a degradação de seus habitats.

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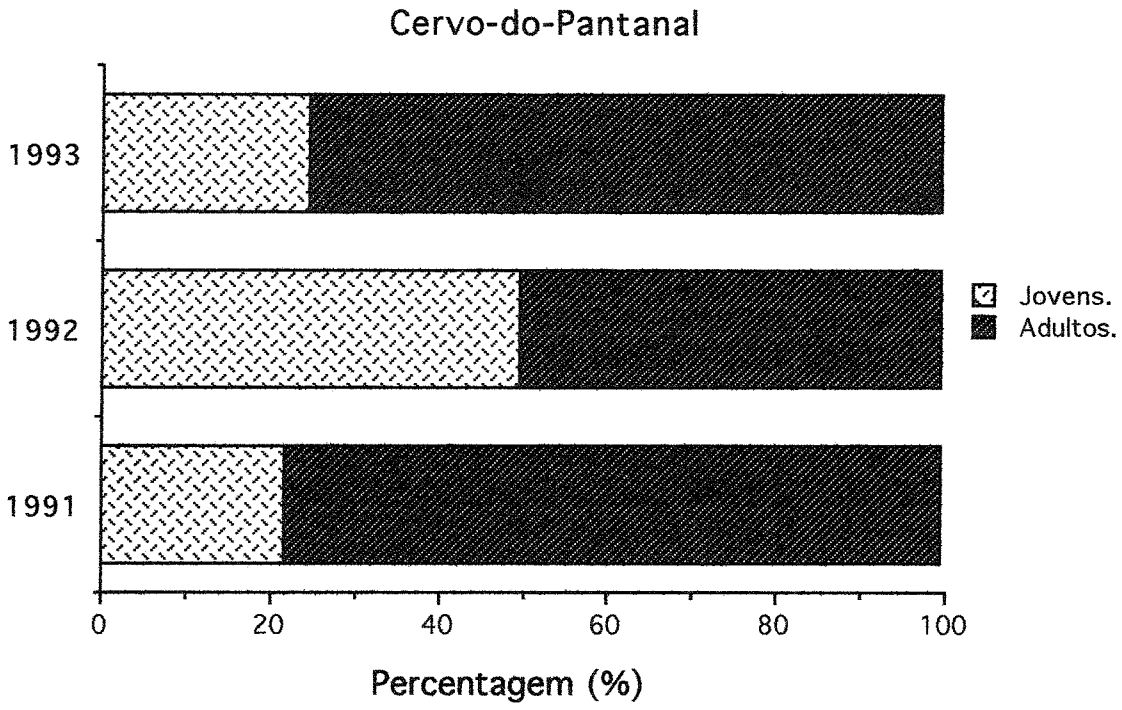

Cervo-do-Pantanal
1993
1992
1991
0
20
40
60
80
100
Percentagem (%)
Jovens.
Adultos.

Tabela I.

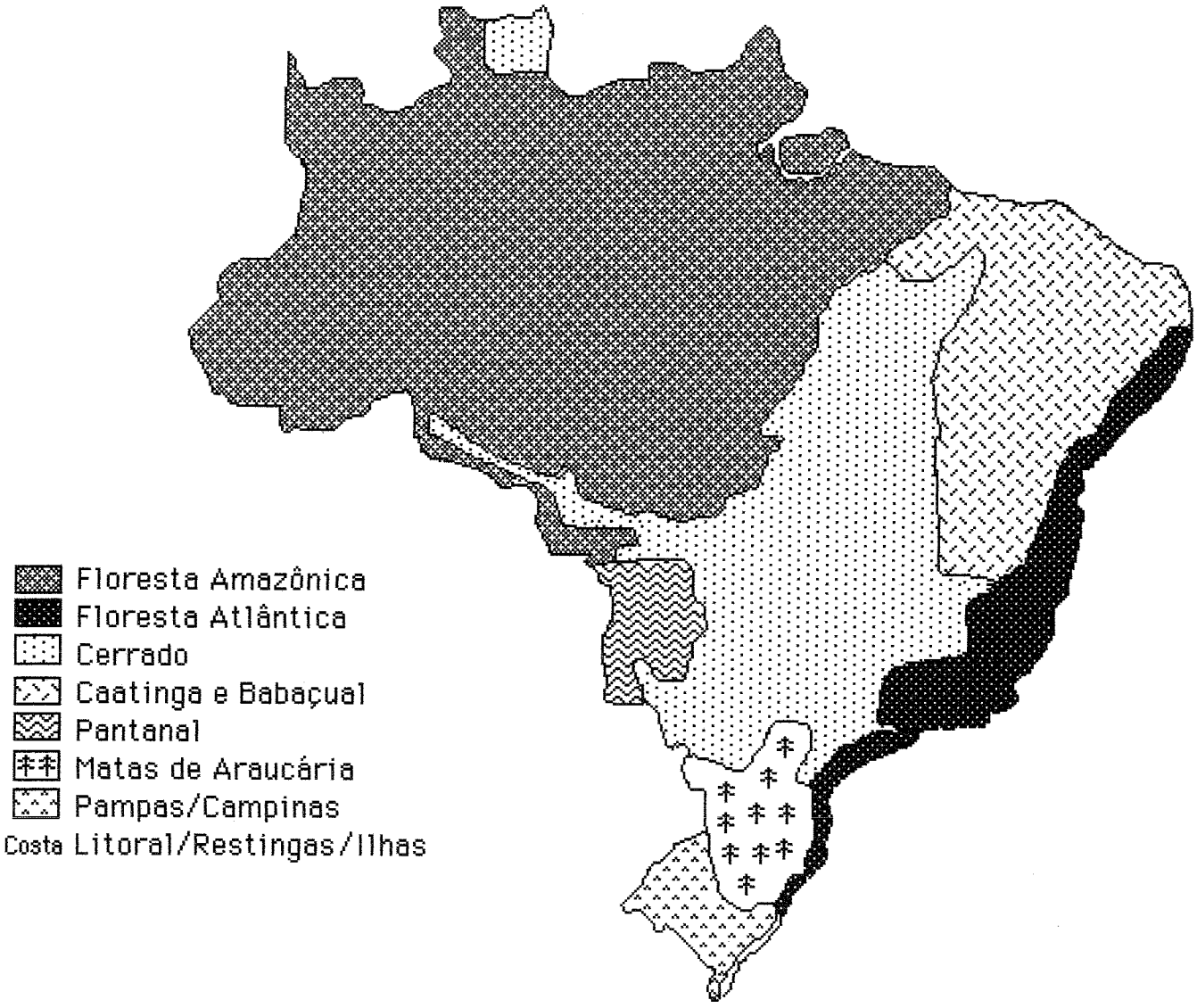
Ano	Coleta em 9 meses (fev.-otubro)	N caçador-dias	Superficie	**Sucesso** por 1000 caçador-dias por 1000 hectares
1991	14	1248	61.000	0,1839
1992	14	979	78.000	0,1833
1993	31	2330	97.000	0,1372

Tabela II.

	Coleta/1000 caçador dias ("kill-rate")			Coleta/1000ha habitat adequado		
	91	92	93	91	92	93
Cervo-do-Pantanal	11	14	14	0,23	0,18	0,32

Tabela III.

Qualidade da área	Intensidade de caça no passado	Porcentagem jovens	Sucesso de caça
1991 média Uiwede-hu	média-alta	22 %	0,1839
1992 altíssima Corixão	baixa	50 %	0,1837
1993 baixa depois a Serra	média-baixa	25 %	0,1372



Mapa mostrando as formações vegetais utilizadas na presente estratégia.

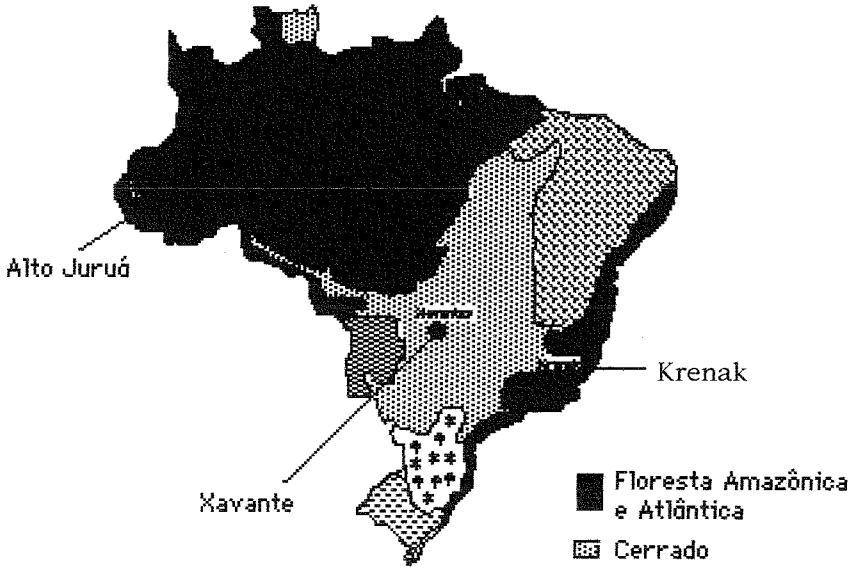
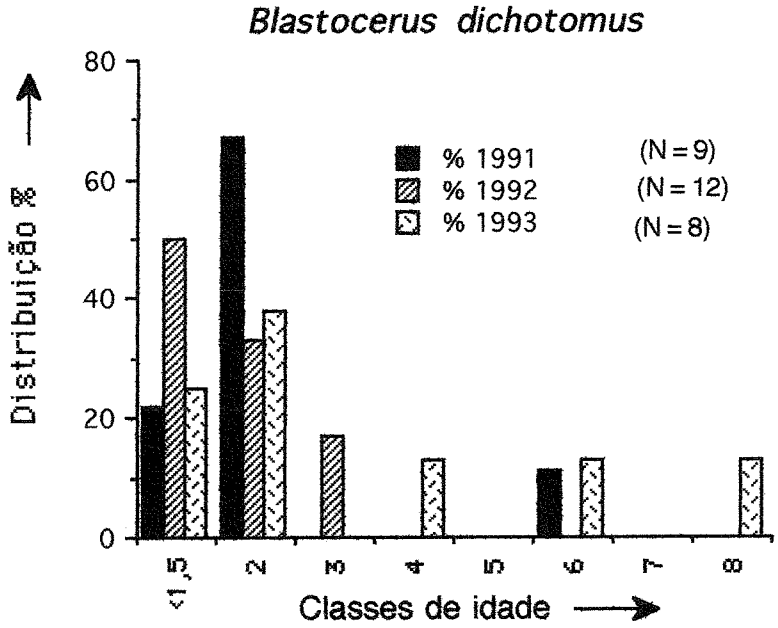


Figura 1. Localisação da área de pesquisa

Cervo-do-Pantanal (*Blastocerus dichotomus*)

Tabela II. Proporção de sexo no período de estudo

Cervo-do-Pantanal (*Blastocerus dichotomus*)	
1:2,3 (13)	1991
1:0,3 (14)	1992
1:2,0 (33)	1993



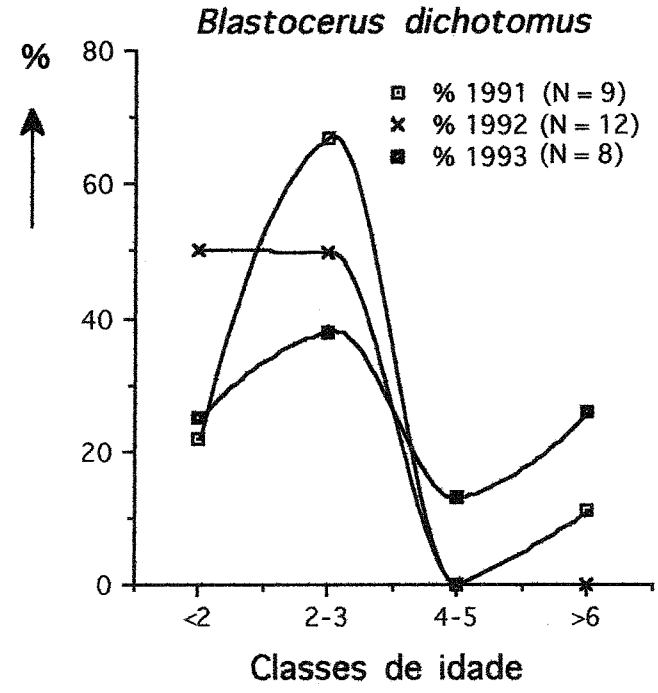


Figura 3[a] e 3[b] Index das classes de idade da coleta de caça do cervo-do-Pantanal