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Contents

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Endangered Species UPDATE
School of Natural Resources and Environment
The University of Michigan
440 Church Street
Ann Arbor, MI 48109-1041
(734) 763-3243; fax (734) 936-2195
E-mail: esupdate@umich.edu
http://www.umich.edu/~esupdate

Cover: Photo of giant anteater, adult and juvenile, courtesy of the Saint Louis Zoo. Photographer: Ray Meibaum.

Rethinking Regional Habitat Conservation Plan Monitoring Programs: An Innovative Approach in San Diego, California

Keith A. Greer[1, 2]
Melanie Johnson Rocks[3, 4]

[1]San Diego Association of Governments
401 B Street, Suite 800
San Diego, CA 92101
(619) 699-7390
(619) 699-1905 fax

[2]kgr@sandag.org

[3]City of San Diego
202 C Street MS 5a
San Diego, CA 92101
(619) 533-6300
(619) 236-6478 fax

[4]MSJohnson@sandiego.gov

Abstract
Habitat Conservation Plans (HCPs) have become a common, albeit still controversial, method for conserving endangered species at the regional level while balancing the social and economic needs of a region. Since 1982 when Congress first amended the Endangered Species Act to allow for HCPs, more than 400 HCPs have been implemented (USFWS 2005). Monitoring is a mandatory element of all HCPs (USFWS 1996) and is part of the implementation obligations. Without adequate and appropriate monitoring, the success of plans cannot be evaluated (Kareiva et al. 1999). This paper will focus on experiences in the review and revisions to the Multiple Species Conservation Program (MSCP) monitoring program. The MSCP, adopted in 1998, is a large and complex HCP covering portions 900 square miles (2330 km^2) of San Diego County, California (Ogden 1996). We suggest that this process can serve as a model for other HCPs in the initial development and periodic review of monitoring programs.

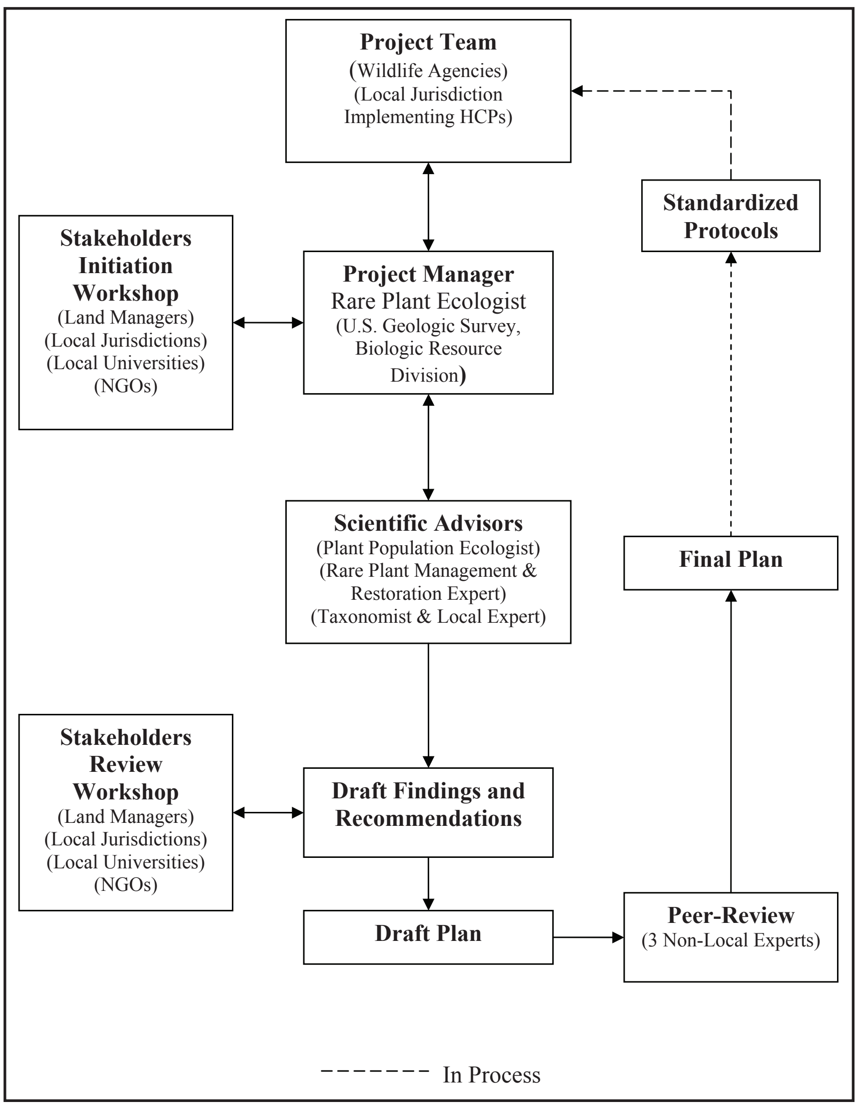
About the Authors
Keith Greer is a Regional Environmental Planner and Biologist for the San Diego Association of Governments. Formerly the Deputy Planning Director for the City of San Diego, he has been involved in environmental planning, biological management and monitoring in San Diego for the past 15 years. Keith holds a Bachelors of Science in Biology and a Masters in Geography, with a concentration in Natural Resources and Environmental Policy.

Melanie Johnson Rocks is a Biologist for the City of San Diego Planning Department's Multiple Species Conservation Program. She has worked in environmental planning and biological monitoring/management for seven years and holds a Master of Science degree in Environmental Science.

Background

The Multiple Species Conservation Program (MSCP) was developed in collaboration with the U.S. Fish and Wildlife Service, the California Department of Fish and Game, 11 local cities, and the County of San Diego. A multi-taxa monitoring plan was prepared for the 85 species and their habitats considered "covered" under the MSCP (Ogden 1996). The plan provided methods for "effectiveness monitoring," where the goal is to track the biological success of the Habitat Conservation Plan (HCP) in producing the desired results of species persistence and resilience (Kareiva et al. 1999). General groups of monitoring included (1) habitat monitoring (permanent and temporary loss, and change in the condition of vegetation), (2) wildlife corridor monitoring (movement of mega-fauna), (3) faunal species monitoring (avifauna and herpetofauna), and (4) endangered and rare plant monitoring. After several years of monitoring under the proposed plan, it was determined that a critical review of the monitoring plan was warranted due to methodology problems and questions about data reliability and analysis.Funded by the U.S. Fish and Wildlife Service and the California Department of Fish and Game, and administered by the City of San Diego, it was determined that rare plants would be the first component of the monitoring plan to be reviewed. The process of revision (Figure 1) to the rare plant program would serve as a pilot for revision of other components of the monitoring program. This allowed staff to compartmentalize the review and revisions, focus on a specific group of taxa or processes, engage specific technical experts, and match available resources (staff and funding) to the task at hand.

Figure 1. Conceptual model process for development and review of biological monitoring programs for regional Habitat Conservation Plans (HCPs).



Process

Early in the process, the lead agencies (U.S. Fish and Wildlife Service, California Department of Fish and Game, and the City and County of San Diego) decided that the plan needed a dedicated Project Manager supported by an independent scientific advisory committee. All members of this team would be experts in their field, but not previously involved in the development or implementation of the MSCP. This was done to attempt to remove any bias regarding the plan. Dr. Kathryn McEachern, a botanist from the U.S. Geological Service (USGS), Biological Resources Division, was asked to fill the role of Project Manager. The USGS has played a critical role in defining monitoring programs regionally (Atkinson et al. 2004).

One of the fundamental tenets of the MSCP was collaboration and stakeholder involvement. With this in mind, the lead agencies utilized the vast amount of regional institutional knowledge on rare plants through an open public workshop. This workshop, hosted by the City of San Diego, gave the public an opportunity to meet the Project Manager, as well as to provide input on the location and general condition of rare plants in the MSCP, provide their input on issues that they felt need to be addressed in the monitoring of these plants, and provide insight on the expertise needed for the scientific advisory committee (City of San Diego 2005).

Based on input from the public and the lead agencies, a scientific panel was established consisting of the Project Manager (expertise in restoration and rare plant monitoring), Mr. Rob Sutter, a plant population ecologist from the Nature Conservancy, Dr. Bruce Pavlik, a botanist with restoration and adaptive management experience from Mills College, California, and Dr. Jon Rebman, a taxonomist with local expertise of the natural history of the rare plants in the MSCP. The scientific panel established a series of week-long working sessions five months apart. During these weeks, staff from land management agencies, local biologists working on monitoring, and those involved with the development of the original monitoring plan were asked to explain their perspectives and issues in implementing the existing monitoring program. Time between these meetings was used to discuss (verbally or via email) the existing monitoring methodology, survey the current monitoring sites, analyze the existing data, and formulate new ideas.

This process culminated in a draft report, which was presented to the public during a second workshop where interested stakeholders were asked for feedback on the scientific group's findings. This interactive feedback from the stakeholders allowed for a meaningful dialog between the scientific advisors, the land managers, and the interested environmental non-government organizations. After the workshop, the revised draft report (McEachern et al. 2006) was sent to a select group of scientists for an independent peer review. Revisions to the final draft report from the peer review are being incorporated and will become the final monitoring plan (in press). Standardized monitoring protocols for the region will be established in the spring of 2007 based upon the final revised monitoring plan.

Results and Future Direction

The scientific advisors have recommended a move away from strict reliance upon quantitative status and trend monitoring of individual rare plants, and a movement to a semi-qualitative monitoring in the context of an adaptive management framework. This was a result of analyzing up to seven years worth of monitoring data that served to highlight the annual variability in the demographics of the monitored plant populations. As McEachern et al. (2006) state, "Year-to-year variations in precipitation and other environmental factors produce great variations in population responses. Such variation through time (stochasticity) requires large sample sizes and long assessment periods (per-

Figure 2. *Ambrosia pumila*

Figure 3. Dr. McEachern and Keith Greer plant monitoring.

haps decades) before trends emerge," (p. 19). Highly clumped populations and changes in environmental gradients also have led to difficulties in obtaining precise estimates of change. As the scientific advisors concluded, even if a positive or negative trend in population size could be statistically determined through increased sample size and changes in shape and size of sampling units, land managers and wildlife agency staff still would not know what is causing the increase or decrease in the population.

The movement to a semi-qualitative monitoring in an adaptive management framework would involve managing the threats to the rare plants populations (e.g., monitoring increase in undesignated trails), monitoring the rare plants in the context of their existing habitat (e.g., change in percent cover of invasive plants), and a move towards controlled experiments to learn what treatments and techniques increase species persistence, resilience, vigor, etc. A draft adaptive management conservation plan for one of the endangered plant species, *Ambrosia pumila*, is provided as an appendix in McEachern et al. (2006). This plan is serving as a pilot to establish an experimental approach towards the underlying drivers of the autecology of this species. Also recommended are both the standardized monitoring protocols and a regional database which are being prepared by the Project Team over the next year.

Conclusions

The proposed process was considered a successful approach in bringing together the scientific experts, wildlife agencies, local jurisdictions responsible for implementing the HCPs, and interested stakeholders. While this effort focused on revisions to the rare plants portion of the monitoring plan, an effort is underway to use the same process to review and revise the faunal monitoring and habitat condition components of the monitoring plan. While it is expected that the scientific experts and interested stakeholders may change, the process developed for the rare plant program is being used as the foundation for future collaborative revisions to the monitoring plan. We are encouraged that the process outlined in this paper can provide a fundamental structure for others engaged in the development or revisions of multi-taxa monitoring plans as required under HCPs. Further, the bulk of the scientific advisors' recommendations for the MSCP monitoring program are applicable to other monitoring efforts, and will likely be useful for others in creating HCP monitoring programs or in improving existing programs.

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Giant Anteater (*Myrmecophaga tridactyla*) Population Survey in Emas National Park, Brazil – A Proposed Monitoring Program

Guilherme H. B. de Miranda[1,5]
Walfrido M. Tomás[2,6]
Claudio B. Valladares-Pádua[3,7]
Flávio H. G. Rodrigues[4,8]

[1] Instituto Nacional de Criminalística/Departamento de Polícia Federal , SAIS Q. 7, Lote 23, Edíficio INC, Sala A121, Brasília, DF, Brazil - 70610-200

[2] Embrapa Pantanal

[3] Instituto de Pesquisas Ecológicas

[4] Departamento de Biologia Geral, Universidade Federal de Minas Gerais / Instituto Pró-Carnívoros

[5] guilherme.ghbm@dpf.gov.br

[6] tomasw@cpap.embrapa.br

[7] cpadua@ipe.org.br

[8] rodrigues@procarnivoros.org.br

Abstract

The population density of giant anteaters (*Myrmecophaga tridactyla)* at Emas National Park in central Brazil was estimated to determine the most suitable method to monitor this population. The data obtained is expected to underpin a more thorough evaluation of the population's recovery rate following a fire in 1994, and factors possibly affecting its numbers significantly. Population estimates were based on: 1) linear terrestrial transect surveys (distance method), which led to a density estimate of 0.396 ± 0.069 (se) individuals/km^2 for the park's flat area; 2) aerial surveys with double count correction, showing an estimated 0.209 ± 0.104 and 0.196 + 0.065 (se) individuals/km^2 for the Park's central and flat areas, respectively. A preliminary giant anteater population-monitoring proposal was outlined based on aerial count data. A power analysis indicated that, to achieve a > 90% probability of detecting a 5% annual population decline, a monitoring program would have to be established using five transects repeated five times a year for 18 years, four times a year for 17 years, or three times a year for 21 years. Terrestrial transect surveys seem more appropriate for more accurate estimates, although aerial surveys may be the best option in most cases.

About the Authors

Guilherme H. B. de Miranda is a Geologist and a Biologist, with a PhD in Ecology from the University of Brasília. He was chief of the Division of Management of Natural Resources of the Botanical Garden of Brasília, Zoology teacher in the Catholic University of Brasília, and Wildlife Researcher of Embrapa Pantanal. Currently, he is a Forensic Expert of the Department of Federal Police, acting in environmental issues.

Walfrido Moraes Tomás is a Veterinarian, M. S. in Wildlife Science at Oregon State University, and currently engaged in his PhD in Biodiversity Management at the University of Kent. He is a wildlife researcher of Embrapa Pantanal (Brazilian Agricultural Research Corporation).

Cláudio B. Valladares Pádua, PhD, is a Biologist and President of the University for Conservation and Sustainability. He is also co-founder of IPÊ - Institute for Ecological Research. He has edited two books and has more than 40 articles published in national and international journals.

Flávio H. G. Rodrigues, is a Biologist with a PhD in Ecology from the State University of Campinas, and teaches ecology at the Federal University of Minas Gerais. His main research interests are in ecology with a focus on the behavior and conservation of large and medium sized mammals, particularly carnivores and anteaters.

Introduction

The giant anteater (*Myrmecophaga tridactyla* L. 1758) is the largest extant representative of the order Xenarthra, with adults weighing 20 to 40 kg (Emmons 1990; Nowak 1999; Eisenberg and Redford 1999). Currently, large known populations of giant anteaters in Brazil are restricted to a few sites, e.g., Serra da Canastra National Park (SCNP) in Minas Gerais state (Shaw, Carter and Machado-Neto, 1985), Emas National Park (ENP) in Goiás state, and the Pantanal wetland areas (Medri and Mourão, 2005). This species is considered at risk for extinction (vulnerable) in Brazil (MMA 2003) by the Inernational Union for the Conservation of Nature and Natural Resources (IUCN), and is listed in CITES Appendix II (IUCN 2004).

Estimates of giant anteater population size or density are scarce, and available data precludes direct comparisons since they were obtained by different methods (Shaw et al. 1985, 1987; Coutinho et al. 1997). However, population surveys are the basis of population monitoring, which is essential for underpinning management strategies (Sutherland 2002a; Greenwood 2002). Mourão et al. (2000) suggested the use of standardized monitoring plans based on aerial surveys for some vertebrate species of the Pantanal region. Similarly, Tomás et al. (2001) emphasized the need for terrestrial surveys to monitor pampas deer populations in the same area. Information on monitoring methods for giant anteater populations is virtually nonexistent.

Habitat deterioration and reduction are the main causes for the decline in populations (Fonseca et al. 1999), although brush and forest fires may significantly impact this species (Silveira et al. 1999). In August 1994, 97% of ENP was destroyed by fire, including all of its grasslands. Silveira et al. (1999) estimated the death rate of large mammals, particularly giant anteaters, using the distance method and park roads as transects. This study reported a death toll of 332 giant anteaters resulting directly from this fire and a surviving population of around 100 individuals a few months after the fire. Because population estimates were unavailable prior to the fire, its impact could not be fully assessed. Morevoer, the lack of continuous post-fire monitoring precludes any precise recovery estimates for this population.

This study purported to estimate the population density of the giant anteater in Emas National Park and determine the best method to monitor the park's anteater population. The resulting data may provide important information to better evaluate this population's recovery rate following the 1994 fire and pinpoint possible factors that may affect its numbers in the future.

Methods

Study area

Emas National Park is a 1,319 km^2 protected area of cerrado (Brazilian savanna) in southwestern Goiás state, bordering the states of Mato Grosso and Mato Grosso do Sul, whose hydrographic basin comprises the Jacuba and Formoso rivers, which empty into the Paraná River basin. Although the park contains all types of cerrado physiognomies (IBDF/FBCN 1981), most of it is flat open grasslands, forming part of a plateau (approximately 1,000 km^2). The remaining areas are valleys with abundant woody vegetation, including gallery forests.

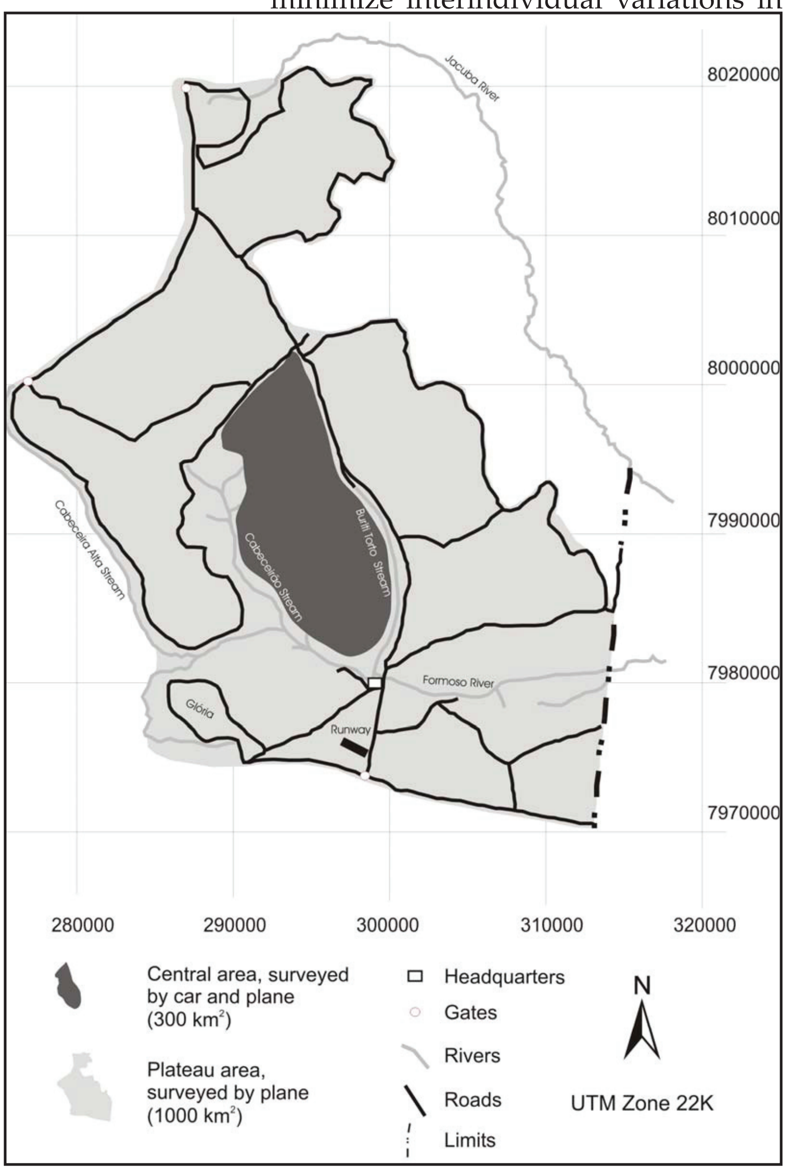
Population estimates

Population estimates were obtained by two different methods:

1) Terrestrial linear transects (distance sampling technique) – Using the distance sampling protocol (Buckland et al. 1993; Thomas et al. 2001), we surveyed a total of 111 transects of varying azimuths and extensions (0.3 to 30.0

km) from December 2000 to February 2002, totalizing 810 km in a 300 km^2 region limited by the Buriti Torto and Cabeceirão streams (Fig. 1). Transects were established using a 4x4 vehicle at constant speed (10 km/h), crossing open grassland areas or recently burned cerrado. The vehicle followed a linear track and was navigated with a GPS and a magnetic compass. Two observers sat on the roof of the vehicle (2.7 m vision height) searching for animals. In each sighting, the animal's perpendicular distance was measured by a pace count from the point where it was seen to the transect line. Only four field assistants participated in the 15-month survey to minimize interindividual variations in animal detection. Counts were avoided in the hottest hours of day from 11:00 to 15:00 h. The data were analyzed using the 4.0 Beta version of the Distance program (Thomas et al. 2001).

Figure 1. Location of main surveyed area in Emas National Park (total area of 1300 km^2.



2) Aerial count – Two aerial surveys were conducted to estimate the giant anteater population size. The first survey, on February 7 and 8, 2002, from 08:00 to 10:00 h, covered the park's entire plateau area (approximately 1000 km^2). A single-engine Cessna 152 overflew open areas in an east-west direction at 200 feet (61 meters) and an average speed of 200 km/h, covering 19 parallel transects. Each transect had a different length, totalizing 409 km traveled. Two observers sitting on the same side of the plane, observing the same 200 m strip at ground level, made independent counts. This area was delimited by marks on the plane's wing and was calibrated for each observer based on ground references. The sampling intensity of the aerial count corresponded to 8.2% of the surveyed area. We employed a double count method to correct for visibility errors and individual counts (Magnusson et al. 1978; Mourão et al. 2000). A correction factor was determined based on the inverse ratio of the number of sightings by the two observers divided by the total number of sightings by each observer.

On the second flight over the plateau on February 9, 2002, from 16:00 and 18:00 h, we sampled the park's central area corresponding to the 300 km^2 covered by the ground line transects, using the method previously described. We sampled eight 17.8 km-long east-west parallel transects totalizing 142.4 km and with a sampling intensity of 9.5%. These results were corrected by the correction factor estimated for each observer.

Monitoring plan

The aerial count data served as the basis for a preliminary monitoring plan for the giant anteater population of

ENP, based on the variation in relative abundance observed during the years when this species was monitored. We used the MONITOR program (Gibbs 1995) to run a power analysis (i.e., capability of detecting differences) on the aerial count data. The number of sightings expected in each transect, and its variance, are needed to run the analysis. Thus, among the 19 parallel transects previously sampled during the aerial counts of the entire ENP plateau, 13 were randomly selected and run twice more. For the simulations, we used the mean and standard deviation of sightings for each transect. However, we estimated these parameters for only six of the 13 re-sampled transects, since the remaining seven yielded no sightings. Simulations based on a one-tailed test provided an estimate of the amount of effort required to establish a >90% probability of detecting a 5% population decline and to avoid type II errors (i.e., deeming a population stable when it is actually declining). Thus, we varied: (1) the number of transects per year of monitoring; (2) the number of times that a sampling should be repeated each year; and (3) the number of monitoring years required to detect the pre-established decline.

Results

Terrestrial linear transect surveys
We obtained 65 valid sightings with a perpendicular distance of 0 to 400 m from the linear transect. The method that best adjusted the data was the half-normal model with a cosine correction. Surveys using terrestrial line transects yielded a density estimate of 0.40 + 0.07 (se) giant anteaters/km^2 (Table 1), with a variation coefficient of 17.33%. The 95% confidence interval was 0.28 – 0.56. The component percentage of variance of encounter rate was 67.8% and the detection probability was 32.2%. Since the park's valleys, which cover approximately 330 km^2, are inaccessible by vehicle, sampling via this method was impossible. However, assuming the same population density throughout the park, we estimated 530 ± 90 giant anteaters live in Emas National Park.

Surveys	Population Density (+ SE) (ind/km2)	Plateau Population (ind)	ENP Population (ind)
Terrestrial Line Transect - Central Area (this study)	0.40 + 0.07	400	530***
Aerial Strip Transect - Central Area (this study)	0.21 + 0.10	210	280***
Aerial Strip Transect - Plateau (this study)	0.20 + 0.07	200	260***
Terrestrial transects – August/September 94, after the 94 Fire - Silveira et al. (1999)	0.034	-	43
Terrestrial transects – December 94 to May 95, - Silveira et al. (1999)	0.085	-	109

*** Extrapolation for the entire National Park

Table 1. Population estimates of giant anteaters at Emas National Park.

Aerial surveys
For the aerial strip transect surveys using the double count technique, the correction factor was 1.49 for one of the observers and 2.00 for the other. The first observer sighted four individuals in the central area, yielding an estimate of 5.96 individuals in the 28.5 km^2 sampled and a density of 0.21 ± 0.10(se) individuals/km^2. Therefore, according to the Double Count Aerial method, we estimated that the plateau area contained 210 ± 100(se) giant anteaters. This figure was obtained by extrapolating the samplings made in the park's central area. Considering the valleys, the ENP as a whole contained 280 ± 140(sd) individuals.

On the entire plateau, we sighted 16 individuals in the 19 transects' 409 kilometers. This count was corrected by the appropriate factor (Fc = 2), yielding an estimate of 200 + 70(se) individuals in the plateau, or 260 + 90(se) individuals in the entire park, with a density of 0.20 ± 0.07(se) individuals/km^2, assuming the same density for the entire park.

Monitoring plan

A power analysis revealed that, in order to obtain a 95% probability of detecting a 5% annual population decline, a monitoring plan involving five transects repeated five times per year for 18 years would be required. Reducing the number of repetitions for the five transects to four per year would diminish the detection power to 91%, thus requiring a 17-year monitoring period. A reduction of the monitoring plan duration (number of years) diminish the detection power as well as a reduction of the plan annual effort (number of repetitions of counts per year), even with an increase of the duration of the plan. In addition, repeating the five transects three times per year would reduce the detection power to 92%, requiring 21 years of monitoring.

Discussion

Different methods to estimate population sizes can lead to very distinct values. These discrepancies should be carefully evaluated to avoid incorrect conclusions leading to inappropriate decisions about the population. In this study, the estimated population densities of the giant anteater at ENP varied according to the method, from 0.2 ± 0.07 (aerial strip transect) to 0.4 ± 0.07 (se) (terrestrial line transect) individuals/km^2.

Estimate errors from the aerial counts were greater than those of the terrestrial surveys, possibly due to the fewer sightings and the proportion of transects without sightings.

Aerial surveys yielded population estimates of 280 ± 140(se) and 260 ± 90(se) giant anteaters in the park's central and plateau areas, respectively, corresponding to nearly half the number detected by terrestrial transect surveys (i.e., 530 individuals). In fact, the aerial counts of the two areas of the park were lower than the lower population range limit estimated by the terrestrial survey method (around 440 individuals). The aerial samplings covered the plateau continuously, without habitat interference. The terrestrial transects, however, covered more open and/or newly burned areas, allowing us to use an off-road vehicle and achieve greater visibility. Therefore, extrapolating the counts from the open areas to the entire park may have resulted in an overestimated population size, despite the predominance of open savanna and flat terrain. The two estimates for the aerial surveys were very similar, indicating that the levels of the central area may be a reliable measure for other areas of the park.

Although the giant anteater population at ENP fulfills the requirements for conducting aerial surveys (e.g., it occurs in flat terrain, with sufficient visibility), as suggested by Caughley (1979), the results of the aerial count were disappointing. Jachmann (2002) stated that aerial count-based population estimates are considerably lower than terrestrial count-based ones. Underestimations may result from a probability of sighting bias; i.e., a significant decrease in the number of individuals at the aerial transects, which may be due to the lower probability of sighting isolated animals, small groups of animals or less conspicuous individuals. In addition, obstacles may hamper the observer's view, causing part of a population to remain undetected (visibility bias). The key factors influencing aerial visibility of large herbivores are their distribution, size, color, and reaction to the aircraft's movements. Individuals actively responding to an approaching plane are more likely to be detected than those that remain stationary. More specifically, giant anteaters lying at rest in high grassland vegetation and covered by their tails are virtually invisible from the air. Operational aspects such as altitude, speed, flight duration, width of the sampled area, and skill of the observer should also be considered (Jachmann 2002).

Some factors about the giant anteater should be taken into account: (1) This species is solitary by nature; (2) Its coloring and behavior are cryptic (despite its dark color, the giant anteater is not very conspicuous in the park's typical open grassland vegetation with numerous termite nests); (3) This species may not respond to a passing plane since it has limited vision and orients itself mainly by olfaction. Hence, the discrepancy between aerial and terrestrial counts may be ascribed to methodological limitations.

Although aerial surveys are more advisable for extensive flat natural areas (Mourão et al. 1994), this method of counting giant anteaters at ENP and other animals living in open habitats requires a more consistent assessment. In the case of giant anteaters, because their period of activity and frequency of use of open habitats varies according to the ambient temperature, correcting errors of visibility can be particularly complicated (Camilo-Alves 2003). Therefore, more flight hours and repetitions at different times and transects may be necessary, as well as observers better trained at identifying the target species from the air. Hence, the most accurate estimate of the giant anteater population size in ENP seems to be the one based on terrestrial surveys along linear transects.

The effort/time and operational costs for implementing off-road terrestrial linear transect surveys were very high. Eight one-week expeditions were required to obtain a suitable number of sightings (N > 60), using a 4 x 4 vehicle and a minimum three-member team. Furthermore, trees, bushes and other obstacles (burrows, holes, and termite nests) had to be avoided while still maintaining a linear path. The lengthy terrestrial counts, the team's physical exhaustion, the wear on the equipment and the environmental impact caused by a heavy vehicle (2000 kg) driving over pristine fields must also to be considered. Low-altitude flights obviously cause less impact, but their operational cost is higher (e.g., pilot fees, airplane rent, fuel). Nonetheless, terrestrial surveys also involve the high cost of offroad vehicles requiring frequent mechanical maintenance. Tomás et al. (2001) contested the use of vehicle-based surveys to count pampas deer in the Pantanal, mainly due to the biased layout of the roads in relation to the terrain and to the animals' natural tendency to keep away from roads to avoid encounters with vehicles. In our study, the vehicle crossed ENP fields linearly, avoiding roads to minimize the influence of these factors.

Sutherland (2002b) compared different counting methods for various orders of mammals, and recommended terrestrial linear transects (in strips or by distance) as the most commonly employed method for the order Xenarthra. However, mammal population surveys in Brazil are still rare and, for most species, they do not provide reliable estimates to underpin decision-making and conservation status evaluations of species and populations. In their studies at Serra da Canastra, Shaw and Carter (1980) and Shaw et al. (1985) initially estimated the giant anteater population density at 1-2 individuals/km^2, based on a time/area count method conducted in three sectors, and at 0.17-1.31 individuals/km^2 when employing terrestrial counts in quadrants adjacent to the park's roads. In a later study, Shaw, Machado-Neto and Carter (1987) found a minimum population density of 1.3 giant anteaters/km^2 in the same study area using the capture-recapture method.

These data corroborate Tomás et al.'s (2001) statements about the inadequate road-based population estimates obtained with pampas deer, which can also apply to giant anteater surveys. Nonetheless, the high giant anteater density rates in the Serra da Canastra National Park (SCNP), even if the methods are not directly comparable, may be due to an abundance of natural resources (e.g., termite and ant nests) and/or lack of predators or other negative factors (e.g., runovers, hunting). In fact, giant anteaters in ENP are preyed on by jaguars (*Panthera onca*), which are absent from the SCNP. In the Pantanal region, the only giant anteater population density data (d = 0.035 individuals/km^2) were those recorded by Coutinho et al. (1997) using aerial surveys of the entire area (approximately 140,000 km^2).

Population estimates and monitoring are essential for conservation purposes, providing a means of evaluating different impact factors, such as the 1994 fire in ENP that killed several giant anteaters (Silveira et al. 1999). Estimates of the minimum number of dead animals combined with those of the post-fire population size suggest the loss of approximately 2/3 of the local population (Silveira et al. 1999). If the present population of giant anteaters in ENP is considered fully recovered from the effects of the 1994 fire – i.e., equivalent to that prior to the fire – the results obtained during this study confirm Silveira et al.'s mortality estimate (1999). This fast population recovery probably resulted from a high migration rate, indicating the existence of numerous individuals living in the matrix that includes the park.

The monitoring plan to be adopted in ENP will probably be time- and resource-dependent. However, we strongly recommend it be implemented in the near future so that the tendencies of the giant anteater population in the park can be identified. Results from such a monitoring plan could be further improved, since only a few transects yielded results (i.e., 6 of the 13 randomly selected transects) and few repetitions were done (i.e., 3) due to the paucity of financial resources. For future surveys in ENP and other similar areas, terrestrial surveys using the Distance method may be suitable when accurate population estimates are required. However, aerial surveys offer a better cost/benefit ratio and are therefore the preferred method in most cases, mainly for fauna monitoring programs that do not require population density estimates, but instead are based on long-term variations of their abundance index.

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A Preliminary Checklist of Mammals and Plants: Conservation Status of Some Species in Salonga National Park

Bila-Isia Inogwabini

Wildlife Conservation Society
BP 15.872 Kin 1,
Kinshasa. Democratic Republic of Congo

binogwabini@wwfcarpo.org
or bi4@kent.ac.uk

Abstract

The Salonga National Park, the world's second largest tropical forest park and the largest in Africa (UNEP 20004; Gauthier-Hion et al. 1999; Kemf and Wilson 1997; Thompson-Handler et al. 1995), is located in the central basin of the Congo River and consists of two blocks: the northern and the southern sectors. Fifty-two mammal and 132 plant species were identified in the Salonga National Park between 1997 and 2005 in 11 different locations, and through different methods. Among mammals, eight primate species were confirmed. SNP is, however, among the least described protected areas in the Democratic Republic of Congo, despite its speculated high potential biodiversity. This lack of ground-truth knowledge on the SNP is attributable to the isolation and insecurity imposed by armed gangs (e.g. Krunkelsven et al. 2000), which precluded access to the park by the conservation and scientific communities. To craft a sound conservation plan for the SNP, as is the case for other protected areas, there is need for scientific information on SNPs biological diversity and distribution (Blake and Hedges 2004; Sutherland 2000, 1999 and 1996). This paper intends to provide an overall preliminary description of the major biodiversity components in the SNP with emphasis on the conservation status of indicator large mammals and plants across 11 sites of the SNP. Additionally, this paper will attempt to assess the extent of human activities in the SNP.

About the Author

Bila-Isia Inogwabini's previous work has included surveys of eastern lowland gorillas, chimpanzees, and elephants in eastern Democratic Republic of Congo, and bonobos in Salonga National Park. He recently served in the Regional Forest Program, Central Africa, with the Wildlife Conservation Society, where he has worked on the MIKE (Monitoring of Illegal Killing of Elephants) survey. Before joining the World Wide Fund for Nature/DRC Program, where he is currently the project manager for the CBFP-funded project in the Lac Tumba Landscape, he oversaw the Elephant Monitoring Program in the Odzala National Park in Congo-Brazzaville.

Introduction

The Salonga National Park (SNP; 36,000 km^2; Figure 1), the world's second largest tropical forest park and the largest in Africa (UNEP 20004; Gauthier-Hion et al. 1999; Kemf and Wilson 1997; Thompson-Handler et al. 1995), is located in the central basin of the Congo River and consists of two blocks: the northern and the southern sectors. Established in 1970, SNP became a World Heritage Site in 1980 (UNEP 2004; IUCN 1992) in order to protect rain forest habitat representative of the Congo Basin and its diverse wildlife. Yet, SNP is among the least described protected areas in the Democratic Republic of Congo despite its speculated high potential biodiversity, for example, list of potential resident mammals (Matuka 1975).

This lack of ground-truth knowledge on the SNP is attributable to the isolation and insecurity imposed by armed gangs (e.g. Krunkelsven et al. 2000), which have precluded access to the park by the conservation and scientific communities. The SNP remained largely ignored until the late 1990s; until then only a few studies (e.g. Gauthier-Hion et al. 1999; Alers et al. 1992; Evrard 1968; Meder et al. 1988) were conducted to assess the park's biodiversity potential. Recently, however, the situation has improved due to the confirmation of the presence of bonobo (e.g. Krunkelsven et al. 2000). Data is now becoming available (e.g. Inogwabini 2005; Blake and Hedges 2004; Eriksson et al. 2004; Van Krunkelsven et al. 2000; Van Krunkelsven and Draulans 2000), though geographical dimensions make attempts to gather the park-wide data difficult, rendering most available information essentially a localized picture. Simple information on readily identifiable and quantifiable large fauna and major vegetation is difficult to obtain; the sparse information that is available constantly changes from one location to another.

To craft a sound conservation plan for the SNP, as is the case for other protected areas, there is a need for scientific information on the park's biological diversity and distribution (Blake and Hedges 2004; Sutherland 2000, 1999 and 1996). This paper intends to provide an overall preliminary description of the major biodiversity components in the SNP, with emphasis on the conservation status of indicator large mammals and plants across 11 sites of the SNP. Additionally, this paper will attempt to assess the extent of human activities in the SNP.

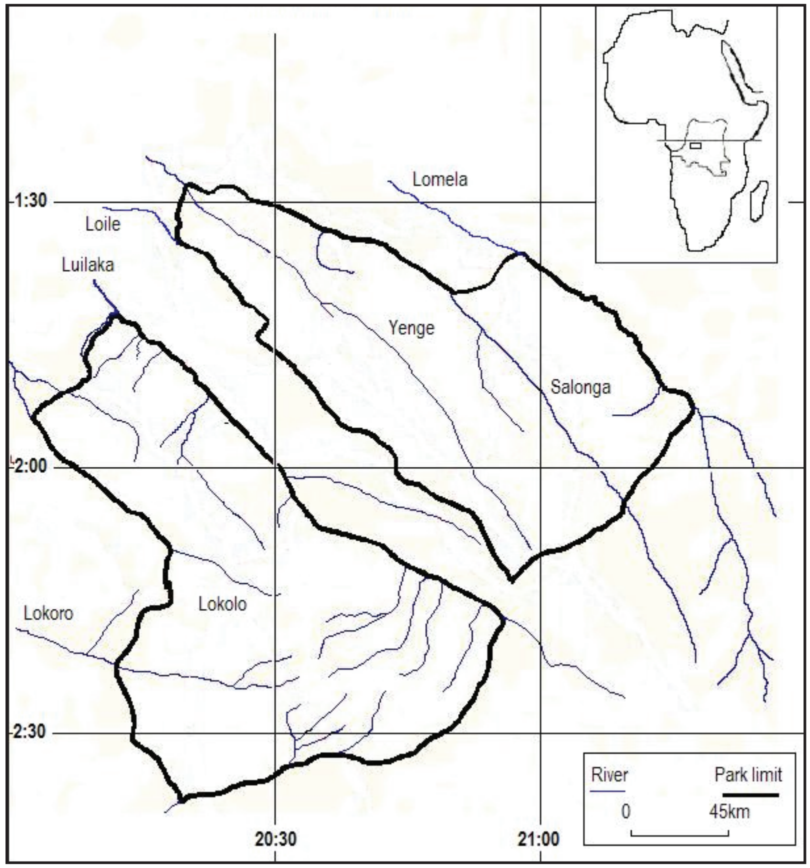

Figure 1. Salonga National Park.

Study sites

The SNP (36,000 km^2; Figure 1) is located between S1^o: 25′:00′′ S2^o: 45′:00′′ and E20^o: 20′:00′′ E21^o: 30′:00′′ (Inogwabini and Omari in press; Laporte 2000). The westernmost regions of the SNP are in the lowest platform of the Cuvette Centrale whose major characteristics are flat topography and low altitude (300m). The topography rises up eastward reaching approximately 700m (Gauthier-Hion et al. 1999; Matuka 1970; Evrard 1968), at which heights the terrain becomes a non-undulating plateau. The habitat is predominantly mixed mature lowland tropical forest (Gauthier-Hion et al. 1999; Kortlandt 1995; Evrard 1968), encompassing areas of seasonally flooded and permanently inundated zones characterized by open understory, composed of communities of *Guibortia, Raphia sese, Pandanus, Guibortia demeusi, Uapaca guineensis,* and *Uapaca heudelotii* (Inogwabini 2005; Gauthier-Hion et al. 1999; Evrard 1968). At long rainy seasons, 50% of the northern sector of the SNP is inundated (Gauthier-Hion et al. 1999). The terra firma forest of the SNP is characteristically mixed mature forest, wherein *Scorodophloeus zenkeri, Anonidium manii, Polyalthia suaveolens, Diospyros sp.*, etc. are the most common plant species. Patches of *Gilbertiodendron dewevrei* occur in the SNP although in less extensive unbroken areas (Kortlandt 1995; Evrard 1968). *Marantaceae* stands (e.g. *Haumania librechtsiana* and *Megaphrynium macrostachii*) are frequent in understories and, in some particular areas of the northern sector, constitute pure mono-dominant vegetation stands. Mean annual rainfalls oscillate between 2007 and 2106 mm (Gauthier-Hion et al. 1999; Griffiths 1972; Evrard 1968), with the mean annual temperature = 24.5°C (Inogwabini 2005; UNEP 2004; Griffiths 1972).

Methods

Data Collection

Large mammals were identified by direct sighting using Kingdon's 1997 guide for mammals. Unseen monkey species were identified by calls, using the audio CD-ROM of the Central African primate call repertoire recorded by Gauthier-Hion et al. (1999). The study also relied on indirect unquestionable evidences such as dung piles, pellet clusters, or fresh spurs (Parnell 2000). Data were collected either along line-transect methods (Buckland et al. 1993), reconnaissance routes, or opportunistically. Examples include the presence of species skins (e.g. F*elis serval, Civettictis civetta*, skins collected at Bofoku-mai, SNP-North), and dead specimens (e.g. S*mutsia tetradactyla* at Monkoto SNP-South).

Plant species were identified in situ by use of available botanic keys or books (e.g. Letouzey 1970; White and Abernethy 1997), or by collecting samples (leaves, flowers and/or fruits) of species that could not be identified in the field for further identification using the above keys and manuals. Local trackers were also used to identify plant species in the Lomongo, a local language, which were then converted into the scientific nomenclature using Hulstaert (1992) which incorporates three variants of Lomongo spoken in the region and uses museum collections to identify species (Inogwabini 2005). A final stage of the identification was a comparison between nomenclatures from Hulstaert (1992) and those of current botanical experts (e.g. White and Abernethy 1997; Letouzey 1970; Evrard 1968).

The following human signs were recorded to document the extent of human activities in the SNP: permanent campsites, recent machete cuts, snares, and open permanent human footpath.

Large Mammal Abundance Data Analysis

Dung piles, pellet clusters, sightings, and calls were used to estimate abundance indexes. Spurs (even the fresh ones) were not accounted for to avoid difficulties related to their conversion into abundance. Encounter rates (δ)(e.g. Blom et al. 2004; Inogwabini et al. 2000; Hart and Hall 1996) were calculated as total signs over total distance and are presented here as relative indexes of abundance. Encounter rates are the only appropriate method to provide estimates of relative abundance in this case because data were collected in different ways and therefore cannot be lumped to estimate densities. Furthermore, some species were recorded simply as present at the first sign and ignored. This was the case for species such as *Cricetomys gambianus, Anomalurus derbianus, Atherurus africanus* and *Dendrohyrax dorsalis*, which were either sighted or heard in several instances but were recorded only once. To provide an idea of the spatial distribution of human pressure on the park, human signs were summed and grouped by site and sector. There are four categories of conservation status: (1) Rare, (2) Common, (3) Abundant, (4) Very abundant. These were defined based on encounter rates as follows: (1) Rare: $1 < x < 10$ signs of the species over the total effort of 2000 km ($\delta = 0.005 - 0.05$ signs/km), (2) Common: $11 < x < 20$ signs ($\delta = 0.055 - 0.10$ signs/km), (3) Abundant: $21 < x < 30$ signs ($\delta = 0.105 - 0.15$ signs/km), (4) Very abundant: $x > 31$ signs ($\delta > 0.155$ signs/km).

Results

Large Mammal Diversity

Fifty-two species of mammals were identified in the SNP (Annex 1). These include, with the exception of the bonobos, herein treated separately, 8 species of diurnal primates: (1) black mangebey (*Lophocebus aterrimus*), (2) Angola pied colobus (*Colobus angolensis*), (3) blue monkey (*Cercopithecus ascanius*), (4) Allen's swamp monkey (*Allenopithecus nigroviridis*), (5) the Tshuapa red colobus (*Poliocolobus tholloni*), (6) Wolf's monkey (*Cercopithecus mona wolfi*), (7) De Brazza's monkey (*Cercopithecus neglectus*), (8) golden-bellied mangabey (*Cercocebus chrysogaster*). The bonobo (*Pan paniscus*), the only great ape occurring in this zone, was confirmed present in both sectors. Other mammals of conservation concern present in the SNP were: forest elephant (*Loxodonta africana cyclotis*), leopard (*Panthera pardus*), giant pangolin (*Smutsia gigantean*), African forest buffalo (*Syncerus caffer nanus*), bongo (*Tragelaphus euryceros*), sitatunga (*Tragelaphus spekei*), blue duiker (*Cephalophus monticola*), bay duiker (*Cephalophus dorsalis*), and water chevrotain (*Hyemoschus aquaticus*).

Plant Diversity

The study identified 132 plant species, with the *Caesalpinoideae* family totalling 11 species: (1) *Brachystegia laurentii,* (2) *Copaifera mildbraedii,* (3) *Cynometra sessiliflora,* (4) *Erythrophloeum suavolens,* (5) *Gilbertiodendron dewrei,* (6) *Guibortia demeusei,* (7) *Julbernalia sp.,* (8) *Macrolobium coeruleum,* (9) *Pachyelasme tessmannii,*(10) *Schotia bequaertii,* and (11) *Scorodophloeus zenkeri*. The second and third families with higher numbers of species were *Euphorbiaceae* and *Apocynaceae*, with 10 and 9 species respectively (Annex 2).

Large Mammals' Abundance Indexes and Human Signs

A total sampling effort of 200 km (transects and reconnaissance) was spent to record (excluding the bonobo and elephants that need a special type of analysis) 250 mammalian signs in both sectors. The total $\delta = 1.25$ mammalian signs/km. Three of the fourteen species, whose data permits to estimate relative

Table 1. Status of large mammals of Salonga National Park.

Species	Effort	# Signs	Rate	Status
Colobus angolensis	200	12	0.06	Common
Cercopithecus ascanius	200	16	0.08	Common
Lophocebus atterimus	200	28	0.14	Abundant
Piliocolobus tholloni	200	5	0.025	Rare
Potamocherus porcus	200	38	0.19	Very abundant
Cephalophus nigrifrons	200	21	0.105	Abundant
Cephalophus dorsalis	200	31	0.155	Very abundant
Cephalophus monticola	200	63	0.315	Very abundant
Cephalophus sylvicultor	200	5	0.025	Rare
Hyemoscus aquaticus	200	1	0.005	Rare
Tragelaphus spekei	200	12	0.06	Common
Tragelaphus euryceros	200	5	0.025	Rare
Smutsia gigantea	200	2	0.01	Rare
Panthera pardus	200	11	0.055	Common
Total		250	1.25	

Human sign/Sector	North	South	Total	Rate
Snares (metallic cables)	56	24	80	0.4
Active Human trails	25	8	33	0.165
Recent machete cuts	28	9	37	0.185
Permanent hunting camp	4	4	8	0.04
Total	113	45	158	0.79

Table 2. Human signs over a 200 km sampling effort.

abundances, are very abundant (Table 1): (1) *Cephalophus monticola* (0.315 signs/km), (2) *Potamocherus porcus* (0.19 signs/km), and (3) *Cephalophus dorsalis* (0.16 signs/km).

A total of 158 human signs were recorded over 200 km in both sectors of the SNP (Table 2). Of these, ~ 51% were metallic snares (δ = 0.4 snares/km). There were 33 active human trails, which were being used both for long distance traveling as well as hunting.

Discussion

Large Mammals

This study presents a ground-truth and up-dated evaluation of the biological diversity of large mammals and plant species in the SNP. Earlier published materials (e.g. UNEP 2004; Matuka 1970) speculated over the presence of species such as Okapi (*Okapia johnstoni*), savanna elephants (*Loxodonta africana africana*), dwarf elephant (*Loxodonta pumilio*), common chimpanzees (*Pan troglodytes*), and the Salongo monkey (*Cercopithecus dryas*). A continuous search over seven years in both sectors of the park had not confirmed the presence of these species, although the geographical extent of the SNP precludes all clear-cut conclusions. It is highly unlikely that chimpanzees, savanna elephants, and the okapi are present in the SNP. The Salongo monkey, considered to be endemic in the region, has not been recorded over 7 years of continuous field research in both sectors (Thompson personal communication; Inogwabini personal observation). Furthermore, local people do not recognize the species from a picture, which leads to the conclusion that the species may simply not exist in the SNP. The Salongo monkey is a rather enigmatic species for which field documentation is very slim. Apart from the specimen in the Museum, which helped identify the species, field effort has not discovered the species in areas previously described as its preferential habitat (J.A. Thompson personal comments). The golden-bellied mangabey (*Cercocebus chrysogaster*) is absent in the northern SNP and north of the southern sector, occurring only in regions south of the Lokolo River (Inogwabini and Thompson in preparation).

The black mangabey (*Lophocebus aterrimus*) was abundant while Angola pied colobus (*Colobus angolensis*) and red-tailed monkey (*Cercopithecus ascanius*) were common. The Tshuapa red colobus (*Piliocolobus tholloni*), an insufficiently known species (Kingdon 1997), was rare. This species has been observed in remote areas of the SNP river systems (Van Krunkelsven et al. 2000).

The SNP Mammal Diversity in a Regional Perspective

The total of 52 mammalian species equaled the large mammal diversity in the Mahale Mountain National Park (Tanzania), and is of the same magnitude as Mewru-Wantipa National Park (Zambia) and the Karuma and Kalinzu-Maramagambo forest (Uganda) of the Rift Albertine complex (Kityo et al.). With fifty-two mammalian species, however, the SNP comes under the Kahuzi-Biega National Park and the Itombwe Massif (DRC), Nyungwe National Park (Rwanda) (Kityo et al.; Omari et al. 1999). The SNP, however, has higher mammalian diversity than Gombe National Park (Tanzania), Bugoma, Kagombe and Kitechura forests of the Rift Albertine complex (Kitiyo et al). Particularly, with eight diurnal primate species, the SNP is comparable in Central Africa only to the Odzala National Park in Congo-Brazzaville (Bermejo 1999), which has the same high monkey diversity.

The high diversity of diurnal monkeys should not, nevertheless, overlook the fact that all species were in lower numbers as compared to Odzala, where equivalent species exhibited higher encounter rates. Nearly all primates of the SNP are legally either fully or partially protected (Kisoka 2000) but they remain hunted both for bushmeat trade and for subsistence. Particular attention needs to be paid to the case of the Tshuapa red colobus, an easy poaching target as the species moves in large groups. The species, lower encounter rates in areas adjacent to villages might indicate higher human pressure in areas surrounding villages.

Large Mammal Species Conservation Status

Three species were very abundant: (1) blue duikers (δ = 0.315 signs/km), (2) red river hogs (δ = 0.19 signs/km), and (3) bay duikers (δ = 0.155 signs/km). Black-fronted duikers were abundant (δ = 0.105 signs/km), as were leopards (δ = 0.55 signs/km), sitatungas (δ = 0.06 signs/km) were common but not widespread as previously inferred (Van Krunkelsven et al. 2000; Von Richter et al. 1990). Giant pangolins (δ = 0.01), bongos (δ = 0.025 signs/km), yellow-backed duikers (δ = 0.025 signs/km), water chevrotains (δ = 0.005 signs/km) and giant pangolins (δ = 0. 01 signs/km) were rare.

Von Richter et al. (1990) indicated that the conservation statuses of yellow-backed duikers and the bongos were satisfactory and that extensive swamp forest meant a widespread distribution of sitatungas all over the DRC. This study shows that bongos, yellow-backed duikers, and the water chevrotain were rare. Metallic snaring has been reported to deplete populations of large mammals across central Africa (Bowen-Jones and Pendry 1999). Higher metallic snaring rates (51% of human signs or δ = 0.4 snares/km), may have played a key role in reducing these species. Furthermore, bongo was described as a perfect target for commercial bushmeat, requiring substantial investment such as armed poaching because the species can provide higher returns of hunting costs (De Merode et al. 2000). With the rampant armed poaching in the SNP, the species may have served as a particular target. Bongos also were reduced in the northern Congo-Brazzaville by epizootics (Elkan personal communication), which might alternatively explain their decline. However, such a massive decimation by epidemic would hardly go unseen by the conservators of the SNP. Yellow-backed duikers, water chevrotains, and giant pangolins are culinary delicacies (Kingdon 1997; Lazarus 1994) that would also constitute special targets for subsistence. Traditional beliefs may have also played a role, particularly in the case of giant pangolins whose scales are used in traditional medicine (Lazarus 1994). In the region of the SNP, giant pangolins have a wide variety of traditional uses, including fetishes linked to power (Bom'oa Nkoso personal communication). A combination of such traditional demands and commercial bushmeat may have placed high tolls on these species, therefore reducing their numbers. With higher snaring rates, it appears at first, though rather puzzlingly, that blue duikers and red hogs are still in relatively great numbers, though they are targeted and vulnerable to cable snares. However, Kingdon (1997) suggested that blue duikers and red hogs have intrinsic growth rates that require less time to recover from perturbations, which may absorb the effects of hunting and stabilize their populations under dire exploitation conditions.

An overall caveat in comparing Von Richter et al. (1990) and current work is that Von Richter et al. (1990) based their evaluation on the availability of suitable habitats. Therefore, their results are not comparable to this study. However, habitat suitability can explain species abundance under ideal conditions (Sutherland 2000). It therefore remains apparent that high poaching levels (Kingdon 1997) played a determinant role in reducing large mammal populations.

The leopard (CITES Appendix I; Kingdon 1997) is a totem for tribes in the region of the SNP. Its skins, teeth and bones are used for different traditional authority ceremonies and are thought to embody the power. Traditional usages combined with the commerce of leopard skins fuels poaching of the species, though its ecology preserves the species in relatively sustainable numbers. In 2000, the ICCN staff confiscated leopard skin at Mondjoko from professional commercial traders particularly searching for leopard skins, a fact confirmed by Draulans and Krunkelsven (2002).

Overall, it is appalling that lack of information on species abundance and distribution has caused the fact that 65% of the mammals of the SNP are not rated at the IUCN red list (IUCN 2003). This means that almost all animals must start from the basic elements such as listing species and documenting their conservation status.

Plant diversity

The SNP Plant Diversity in a Regional Perspective

The total of 132 species reported in this study is lower than would reveal a detailed botanic study throughout the entire SNP. Preliminary reports from Lui-Kotal, at the southwestern edge, indicate high plant species diversity (Fruth et al. 2003). However, the plant diversity at Lui-Kotal is likely higher than average of the overall SNP because Lui-Kotal study site is at the forest-savannah ecotone. Ecotone systems are known to exhibit higher species (Richard 1966). Furthermore, the on-going study at Lui-Kotal incorporates tree climbers (Homann and Fruth 2003), which were not documented in this study.

The SNP Plant Diversity Conservation Status

Of the 132 tree species identified, eight are of high commercial value and posted to the international wood market websites (tt-Timber.com 2004; Chudnoff 1984): (1) *Entandrophragma angolense*, (2) *Entandrophragma cyclindricum*, (3) *Staudtia stipitata*, (4) *Chlorophora excelsa*, (5) *Pterocarpus casteelsii*, (6) *Erythrophloeum suavolens*, (7) *Piptadeniastrum africanum* and (8) *Celtis sp*. (Annex 2). Added to these species are also present in the SNP two species of the ebony (*Diospyros hoyleana* and *Diospyros sp*) (Annex 2). Four IUCN vulnerable plant species occur in the SNP (IUCN 2003): (1) *Garcinia kola*, (2) *Entandrophragma angolense*, (3) *Entandrophragma cyclindricum*, and (4) *Lovoa trichilioides*. These highly valued commercial species are illegally exploited by private operators in the southern sector, the bloc between Momboyo-Luilaka and the Lokolo. People come from distant towns such as Mbandaka and Kinshasa with outboards and forestry equipments to chop down trees. Tree logs are carried down, floated, and/or pushed by outboard motors and are traded to expatriates in the main towns. Illegal logging is not only detrimental to the protection of the SNP but also to the government as it deprives the state of taxes that are critical for the economy. Furthermore, and more importantly, for long term conservation, illegal logging operations have no management plan and lead to major habitat destructions. Illegal logging also encourages movements of people in and around the SNP, some large communities dwelling in the SNP even long periods after logging operations are over. Lawlessness has been a particular feature of the SNP since its creation (e.g. Inogwabini and Thompson in preparation; Van Krunkelsven et al. 2000). However, logging in the park is a new phenomenon, probably stirred up by the anarchy brought by the war

(Draulans and Krunkelsven 2002) and will increase levels of illegal hunting within the park.

Conclusion

The SNP still harbors numbers of species that presided over its creation. However, some species previously cited seem to be absent as they have yet to be confirmed by field observation. Some other species previously thought to occur in significant numbers were confirmed to be abundant but most of species are in strangely small numbers. This is because the SNP had hardly known any sort of law enforcement (Inogwabini et al. 2005; Blake and Hedges 2004). With a moderate human density of 0.4 people/km^2 (range: 0.1 --- 9 people/km^2; D'Huart 1998; INS 1984) around the SNP, hunting for subsistence would hardly reach current poaching levels. The depletion of wildlife species in the SNP is, hence, solely caused by illegal hunting (increased snaring rates and organized armed poaching), essentially to fuel market cities like Boende, Ingende, Mbandaka and Kinshasa. Poaching reached intolerable rates during the war (1998 – 2002), when massive numbers of troops amassed in Boende, Ingende and Mbandaka, which sensibly increased the demand in bushmeat to feed soldiers operating on different front lines. The situation remains very fragile; even with the peace agreement, fluxes of automatic weapons brought by the war are still circulating in the region of the SNP and will certainly place a high toll price on all species. Therefore, beautiful untouched forest stands of SNP should not mislead the conservation community; mammals residing therein are assaulted. Strong conservation measures are urgently needed to save what is can be saved.

Studies (e.g. Cowlishaw and Dunbar 2000; Colin et al. 1999; Oates 1986) suggested that primates are good biological indicators and tell about the ecological health of their habitats. Low abundances of several monkey species over large areas of the SNP, and particularly the very low abundance of the red colobus, may indicate disequilibrium in the SNP ecosystems and call for detailed research. This is but a preliminary step toward the understanding of the biodiversity of the SNP. More research is needed to fully document different segments of the biodiversity of the SNP, especially detailed ecological studies to unravel ecological parameters underlying current biodiversity patterns in the SNP.

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IUCN Key

EX	Extinct		NT	Near Threatened
EW	Extinct in the Wild		LC	Least Concern
CR	Critically Endangered		DD	Data Deficient
EN	Endangered		NE	Not Evaluated
VU	Vulnerable			

Annex 1. The preliminary checklist of common mammals of SNP

#	Scientific name	French name	English name	Local name	IUCN
1	*Allenopithecus nigroviridis*	Singe de marais	Allen's swamp monkey	Bongale (ekele, Bontoko)	RL/nt (1994)
2	*Anomalurus derbianus*	Ecureuil volant de Derby	Lord Derby's anomalure	Lokio	Not rated
3	*Aonyx congica congica*	Loutre du Congo	Swamp otter	Lioko (Lienge)	DD (1994)
4	*Atherurus africanus*	Porc-epic	Porcupine	Ikoo	Not rated
5	*Cephalophus callipygus*	Cephalophe de Peter	Peter's duiker	Bofala (Mbengele)	RL/nt (1994)
6	*Cephalophus dorsalis*	Cephalophe baie	Bay duiker	Bombende (Nkulufa)	RL/nt (1994)
7	*Cephalophus monticola*	Chephalophe bleue	Blue duiker	Mboloko	DD (1994)
8	*Cephalophus nigrifrons*	Cephalophe a front noir	Black-fronted duiker	Mpambi	LR/nt (1994)
9	*Cephalophus silvicultor*	Cephalophe a dos jaune	Yellow-backed duiker	Lisoko	RL/nt (1884)
10	*Cercocebus chrysogaster*	Singe a ventre dore	Golden-bellied mangabey	Linku	Not rated
11	*Cercopithecus ascanius*		Red-tailed monkey	Mbeka	Not rated
12	*Cercopithecus mona wolfi*	Mone de Meyer	Wolf's monkey	Nsoli	Not rated
13	*Cercopithecus neglectus*	Cercopitheque de Brazza	De Brazza's monkey	Mpunga	Not rated
14	*Civettictis civetta*	Civette d'Afrique		Liowoo	Not rated
15	*Claviglis lorraineus*			Inkesi	Not rated
16	*Colobus angolensis*	Colobe d'Angola	Angolan pied colobus	Libuka	Not rated
17	*Cricetomys gambianus*	Rat de Gambie	Giant pouched rat	Bontomba	Not rated
18	*Crocidura congobelgica*		White-toothed shrews	Bosutumpo	VU (1994)
19	*Crossarchus alexandri*	Mangue d'Alexandre		Likaala (enkanda)	Not rated
20	*Dendrohyrax dorsalis*	Daman d'arbre	Tree hyrax	Bombolo	Not rated
21	*Felis laurata*	Chat doré	Golden cat	Lowa	VU (1994)
22	*Felis serval*	Serval		Yolonkoi	Not rated
23	*Funischus anerythrus*	Finisciure a dos raye	Thomas's rope squirrel	Ekotshi	Not rated
24	*Galago phasma*			Lisile	Not rated
25	*Galagoides thomasi*	Galago de Thomas	Thomas's Galago	Engende	Not rated
26	*Genetta servalina*	Genette servaline	Servaline genet	Bonkono (Nsimba)	Not rated
27	*Genetta tigrina*	Genette tigrine	Blotched genet	Bomanga	Not rated
28	*Heliosciurus rufobrachium*	Heliosciure a pattes rouses	Red-legged sun squirrel		Not rated
29	*Herpestes icheneumon*	Manouste ichneumon	Egyptian mongoose	Bolia wa nkenge	Not rated
30	*Herpestes naso*	Mangouste a long museau	Long-snouted mongoose	Bolia	Not rated
31	*Hippopotamus amphibius*	Hippopotame	Hippopotamus	Ngubu	Not rated
32	*Hyemoschus aquaticus*	Chevrotain aquatique	Water chevrotain	Entambe	DD (1994)
33	*Hypsignathus monstrosus*	Sauve-souris	Hammer bat	Bokoma	Not rated
34	*Lemniscomys striatus*	Zebra mice		Inkengi	Not rated
35	*Lophocebus aterrimus*	Mangabey noir	Black mangabey	Ngila	LR/nt (1994)
36	*Loxodonta africana cyclotis*	Eléphant de forêt	Forest elephant	Ndjoku	EN
37	*Lutra maculicollis*	Loutre à cou tacheté	Spot-necked Otter	Botele (njondo)	VU (1994)
38	*Melivora capensis*	Ratel		Esisi	Not rated
39	*Pan paniscus*	Bonobo	Bonobo	Edja (bi)	EN
40	*Panthera pardus*	Panthère	Leopard	Nkoi	Not rated
41	*Perodictus potto faustus*	Potto de Bosman		Nkatu	Not rated
42	*Petrodromus tordayi*			Litoko	Not rated
43	*Poliocolobus tholloni*	Colobe bai de Thollon	Tshuapa red colobus	Djofe	Not rated
44	*Potamocherus porcus*	Potamochere	River red Hog	Nsombo	Not rated
45	*Potamogale velox*	Potamogale	Giant Otter Shrew	Yongo (Esofe)	EN
46	*Smitsia tetradactyla*	Pangolin a longue queue		Nkalamonyo	Not rated
47	*Smutsia gigantea*	Pangolin géant	Giant pangolin	Nkanga	Not rated
48	*Smutsia triscuspis*	Pangolin commun		Nkalamonyo	Not rated
49	*Syncerus caffer nanus*	Buffle de foret	African forest buffalo	Ngombo	RL/cd (1994)
50	*Tragelaphus euryceros*	Bongo	Bongo	Mpanga	RL/nt (1994)
51	*Tragelaphus spekei*	Sitatunga	Sitatunga	Mbuli	RL/nt (1994)
52		Rainette		Litaka	Not rated

Annex 2. The preliminary checklist of common plants of SNP.

	Family	Local name	Scientific name	IUCN
1	***Acanthaceae***	Bolefapo	*Thomandersia laurifolia*	Not rated
2	***Agavaceae***	Boleme	*Dracaena sp.*	Not rated
3	***Ancthaceae***	Impete	*Pseuderanthemum ludovicianum*	Not rated
4	***Annonaceae***	Belinda	*Polyalthia suavolens*	Not rated
5	***Annonaceae***	Bendenge	*Annonidium mannii*	Not rated
6	***Annonaceae***	Bensange	*Xylopia aethiopica*	Not rated
7	***Annonaceae***	Bontole	*Cleistopholis glauca*	Not rated
8	***Annonaceae***	Nsangalongo	*Xylopia chrysophylla*	Not rated
9	***Apocynaceae***	Bokuka	*Alstonia bonei*	Not rated
10	***Apocynaceae***	Bondongo	*Clitandra cymulosa*	Not rated
11	***Apocynaceae***	Likete	*Rauvolfia mannii*	Not rated
12	***Apocynaceae***	Bongonge	*Ancylobotrys pyriformis*	Not rated
13	***Apocynaceae***	Bosomba	*Holarrhena floribunda*	Not rated
14	***Apocynaceae***	Bokokota	*Hunteria congolana*	Not rated
15	***Apocynaceae***	Ngende	*Landolphia mannii*	Not rated
16	***Apocynaceae***	Iyongo	*Landolphia violacea*	Not rated
17	***Apocynaceae***	Botofe	*Saba florida*	Not rated
18	***Apocynaceae***	Lokolola	*Strophantus sarmentosus*	Not rated
19	***Araceae***	Elembe	*Culcacia sp.*	Not rated
20	***Araceae***	Nkoto	*Caladium sp.*	Not rated
21	***Begoniaceae***	Ekomela	*Begonia sp*	Not rated
22	***Begoniaceae***	Bekai ya toto	*Begonia eminii*	Not rated
23	***Bombacaceae***	Isongu	*Ceiba pentandra*	Not rated
24	***Burseraceae***	Besau	*Dacryodes edulis*	Not rated
25	***Burseraceae***	Bobee	*Canarium schweinfurthi*	Not rated
26	***Burseraceae***	Bofelenga	*Dacryodes yangambiensis*	Not rated
27	***Caesalpinioideae***	Beemba (Belafa)	*Gilbertiodendron dewrei*	Not rated
28	***Caesalpinioideae***	Befili	*Scorodophloeus zenkeri*	Not rated
29	***Caesalpinioideae***	Bekumbo	*Schotia bequaertii*	Not rated
30	***Caesalpinioideae***	Beleko	*Pachyelasme tessmannii*	Not rated
31	***Caesalpinioideae***	Bembanga (Bomanga)	*Brachystegia laurentii*	Not rated
32	***Caesalpinioideae***	Betuna	*Cynometra sessiliflora*	Not rated
33	***Caesalpinioideae***	Bokongo (waka)	*Guibortia demeusei*	Not rated
34	***Caesalpinioideae***	Efomi (Ngbanda)	*Erythrophloeum suavolens*	Not rated
35	***Caesalpinioideae***	Loanga	*Macrolobium coeruleum*	Not rated
36	***Caesalpinioideae***	Wamba	*Copaifera mildbraedii*	Not rated
37	***Caesalpinioideae***	Wango	*Julbernalia*	Not rated
38	***Combretaceae***	Besoi	*Combretum sp.*	Not rated
39	***Commelinaceae***	Batetele (liteletele)	*Palissota barteri*	Not rated
40	***Compositae***	Bekolongo	*Emilia sp.*	Not rated
41	***Connaraceae***	Bokoto (Ikakai, Mpoa)	*Connarus griffonianus*	Not rated
42	***Dioscoreaceae***	Lomama	*Dioscora preussi*	Not rated
43	***Dioscoreaceae***	Boololi	*Dioscorea semperflorens*	Not rated
44	***Dioscoreaceae***	Lilungu	*Discorea sp.*	Not rated
45	***Ebenaceae***	Mbanja	*Diospyros sp.*	Not rated
46	***Ebenaceae***	Iyombo	*Diospyros hoyleana*	Not rated
47	***Euphorbiaceae***	Besenge	*Uapaca guineensis*	Not rated
48	***Euphorbiaceae***	Boketa	*Erythrococca sp.*	Not rated
49	***Euphorbiaceae***	Bolando-lando	*Alchornea floribunda*	Not rated

Annex 2. Continued.

	Family	Local name	Scientific name	IUCN
50	***Euphorbiaceae***	Boondje	*Alchornea cordifolia*	Not rated
51	***Euphorbiaceae***	Befeko	*Ricinodendron sp.*	Not rated
52	***Euphorbiaceae***	Meenge	*Macaranga sp.*	Not rated
53	***Euphorbiaceae***	Ifumbwa	*Alchornea hirtella*	Not rated
54	***Euphorbiaceae***	Bolanga	*Bridelia bridelifolia*	Not rated
55	***Euphorbiaceae***	Bonyanga	*Croton haumanianus*	Not rated
56	***Euphorbiaceae***	Bomenga	*Phyllanthus discoideus*	Not rated
57	***Flacourtiaceae***	Isake	*Caloncoba welwetschii*	Not rated
58	***Guttiferae***	Bakoli (Bosefe)	*Mammea africana*	Not rated
59	***Guttiferae***	Balongo	*Symphonia globufera*	Not rated
60	***Guttiferae***	Besefe	*Garcinia punctata*	Not rated
61	***Guttiferae***	Bompoma	*Garcinia kola*	VU
62	***Guttiferae***	Boolongo	*Garcinia ovalifolia*	Not rated
63	***Huaceae***	Boyenge	*Afrostyrax kamerunensis*	Not rated
64	***Irvingiaceae***	Boseki	*Klainedoxa gabonensis oblongifolia*	Not rated
65	***Irvingiaceae***	Boyombo	*Irvingia sp.*	Not rated
66	***Irvingiaceae***	Bopalanga	*Klainedoxa gabonensis*	Not rated
67	***Lauraceae***	Bongolu	*Belschmiedia corbisieri*	Not rated
68	***Lecythidaceae***	Bondjolo	*Combretodendron macrocarpum*	Not rated
69	***Leguminosae***	Besulu (Besiyo)	*Pterocarpus casteelsii*	Not rated
70	***Loganiaceae***	Nsamba	*Strychnos sp.*	Not rated
71	***Marantaceae***	Bekombe	*Haumania liebrechtsiana*	Not rated
72	***Marantaceae***	Lokongo	*Sarcophrynium sp.*	Not rated
73	***Marantaceae***	Nkongo	*Megaphrynium macrostachii*	Not rated
74	***Melastomaceae***	Ikasakenge	*Dissotis decumbens*	Not rated
75	***Meliaceae***	Lifake (ba)	*Entandrophragma angolense*	VU
76	***Meliaceae***	Bekalaka (Bokolo)	*Carapa procera*	Not rated
77	***Meliaceae***	Bosasa	*Entandrophragma cylindricum*	VU
78	***Meliaceae***	Bolondo	*Trichilia gilgiana*	Not rated
79	***Meliaceae***	Ilondole	*Lovoa trichilioides*	VU
80	***Menispermaceae***	Lofete (Lokumbo)	*Penianthus longifolius*	Not rated
81	***Menispermaceae***	Bokaso	*Kolobopetalum chevalieri*	Not rated
82	***Mimosoideae***	Beala	*Pentaclethra macrophylla*	Not rated
83	***Mimosoideae***	Bekungu	*Piptadeniastrum africanum*	Not rated
84	***Mimosoideae***	Boamba	*Albizia adianthifolia*	Not rated
85	***Moraceae***	Balondo	*Chlorophora excelsa*	Not rated
86	***Moraceae***	Bekombo (Betumbe)	*Musanga cercopoides*	Not rated
87	***Moraceae***	Bekomu	*Myrianthus arboreum*	Not rated
88	***Moraceae***	Bobimbo (Boimbo)	*Treculia africana*	Not rated
89	***Moraceae***	Bofonge	*Bosqueia congolensis*	Not rated
90	**Moraceae**	*Bonkaa*	*Ficus capensis*	Not rated
91	**Moraceae**	*Limonge*	*Ficus sp*	Not rated
92	**Moraceae**	*Lokumo*	*Ficus sp*	Not rated
93	**Myristicaceae**	*Bontole (bosenga, Bosongu)*	*Pycnanthus angolensis*	Not rated
94	**Myristicaceae**	*Ikolombe*	*Staudtia stipitata*	Not rated
95	**Octoknemaceae**	*Ebenge*	*Octoknema borealis*	Not rated
96	**Olacaceae**	*Betaka*	*Strombosia grandiflora*	Not rated

Annex 2. Continued.

	Family	Local name	Scientific name	IUCN
97	**Olacaceae**	*Boleko*	*Ongokea gore*	Not rated
98	**Palmae**	*Lifeke (ba)*	*Raphia sese*	Not rated
99	**Palmae**	*Bakau (-)*	*Ancystrophyllum secundiflorum*	Not rated
100	**Palmae**	*Ikali*	*Raphia laurenti*	Not rated
101	**Palmae**	*Ilebo (Ilewo, Ileo)*	*Borassus*	Not rated
102	**Palmae**	*Mpetempete*	*Sclerosperma mannii*	Not rated
103	**Pandanaceae**	*Lileke*	*Pandanus candelabrum*	Not rated
104	**Papilionoidaea**	*Lilangi*	*Millettia psilopelata*	Not rated
105	**Piperaceae**	*Balombo*	*Piper umbellatum*	Not rated
106	**Piperaceae**	*Beleko*	*Piper cubeba*	Not rated
107	**Rosaceae**	*Befale (Bokanja)*	*Parinari glabra*	Not rated
108	**Rubieceae**	*Bokendu*	*Aidia micrantha*	Not rated
109	**Rubieceae**	*Bonsole*	*Psychotria sp.*	Not rated
110	**Rubieceae**	*Indole*	*Amaralia sherbourniae*	Not rated
111	**Rubieceae**	*Lioko*	*Virectaria major*	Not rated
112	**Rubieceae**	*Bokakate*	*Morinda lucida*	Not rated
113	**Rutaceae**	*Engondo*	*Fagara lemairei*	Not rated
114	**Sapindaceae**	*Bonsemi*	*Chytranthus carneus*	Not rated
115	**Sapindaceae**	*Botende (be)*	*Pancovia harmsiana*	Not rated
116	**Sapotaceae**	*Bepambu (Bofambu)*	*Chrysophyllum lacourtianum*	Not rated
117	**Sapotaceae**	*Bofunga*	*Chrysophyllum perpulchrum*	Not rated
118	**Sapotaceae**	*Bolonge*	*Chrysophyllum africanum*	Not rated
119	**Sapotaceae**	*Ilonge*	*Chrysophyllum laurentii*	Not rated
120	**Sapotaceae**	*Wanga (Lito ya nsombo)*	*Tridesmostemon claessensi*	Not rated
121	**Sterculiaceae**	*Boluku*	*Sterculia tracantha*	Not rated
122	**Tiliaceae**	*Bolembo (Lilemanjoku)*	*Desplatsia dewevrei*	Not rated
123	**Ulmaceae**	*Bongonda*	*Celtis sp*	Not rated
124	**Zingiberaceae**	*Besombo*	*Aframomum sp*	Not rated
125		*Befumbo*	*Microcos*	Not rated
126		*Bolukutu*	*Gabunia*	Not rated
127		*Bomposo*	*Chomelia*	Not rated
128		*Bonkole*	*Banksia*	Not rated
129		*Bosendja (be)*	*Landolphia jumellei*	Not rated
130		*Bonsefo*	*Tetrorchidium*	Not rated
131		*Lokokoloko*	*Phrynium confertum*	Not rated
132		*Lokosa*	*Mannyphytum africanum*	Not rated

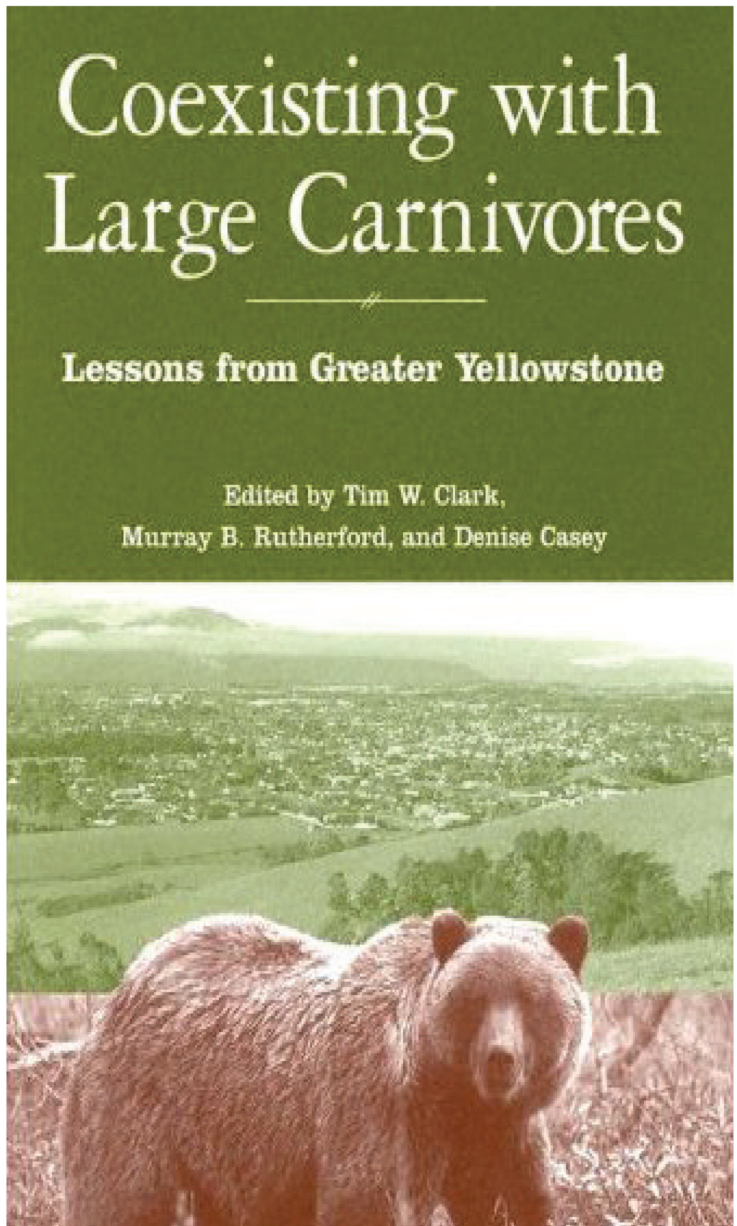
Book Review:
Coexisting with Large Carnivores: Lessons from Greater Yellowstone

Edited by Tim W. Clark, Murray B. Rutherford & Denise Casey
Island Press, Washington, DC 2005

Joel T. Heinen

Professor and Chair
Department of Environmental Studies
Florida International University
Miami, Florida

heinenj@fiu.edu



Large mammalian predators form a basis for much conservation research for several reasons. As a group, they are: land dependent, and thus more extinction-prone than most other organisms; can frequently serve as both flagship and umbrella species; and, they are scary. The last has inspired mythologies from cultures worldwide and continues to do so in places where these species still occur. For any conservation issue and for any species of concern, it is well accepted that science alone, while essential, will not solve the core of the problem. The crux of decline and endangerment lies in species' interactions with humans and thus solutions will necessarily involve input from the social and policy sciences.

Tim Clark has built his professional career on the last point, and it is an important one. Yellowstone National Park itself is a symbol, as are the three large predators that inhabit its vastness: grizzlies (*Ursus arctos*), wolves (*Canis lupus)* and cougars (*Felis concolor*). For some, these species are symbols of a healthy wilderness and an irreplaceable natural heritage. For others, they are symbols of horror and death. For many Americans, they may be symbols of both. To an unfortunately large degree, previous federal eradication policies were so successful that the first two species are federally listed in all areas except Alaska, and the third (cougars) is listed in Florida–the only eastern state with a remnant wild population. Predators color our fears and inspire our hearts. They also present unique and fascinating issues for conservationists and conservation research.

This is the backdrop of the present volume. In total there are 10 authors, but Clark authored or co-authored six of the eight chapters, as well as the Appendix. The authors have done a masterful job of highlighting the biological, social, and economic controversy surrounding the conservation of large predators in American's first national park and in the wider region in which these species are making a comeback, where conflicts with humans exist. Part One, with two chapters, sets the context, which includes Clark's research framework on problem orientation (Chapter 1) and the management context under which action happens (Chapter 2). There is not much new here for readers who have been oriented toward this framework (i.e. many of Clark's previous volumes use it), or for those who are conversant on modern issues in natural resources management in the sparsely populated regions of the west. The authors emphasize the contrast between 'old west' and 'new west' mentalities, as the human populations themselves are greatly changing in small towns near Yellowstone. Nonetheless, the chapters are essential to set the stage for what follows. They are also brief, informative and well written.

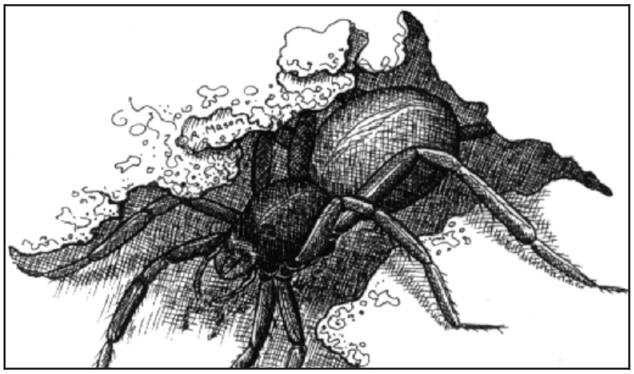
The new meat of this volume begins with Part Two (case studies). Chapters 4, 5, and 6 take up the particular issues surrounding cougars, grizzlies and wolves, respectively. While there are some similarities among these species in terms of public perception, there are also many differences and conservation issues surrounding each, warranting separate chapters. Cougars can be hunted legally, are rarely seen by humans, and ranchers in the region express less concerns about them than grizzlies and wolves. Outfitters, whose clientele include big game hunters, have very negative views about cougars. Like all large predators, public perception of risk is much greater than any real threat and, unlike the situation elsewhere (e.g. California), there have been no human deaths attributable to cougars in Wyoming. When a female denned near Jackson, WY for a 42-day period to rear her cubs in 1999, over 15,000 people came to see her. Most were not disappointed, and this rare opportunity increased awareness and improved perceptions. Given that cougars are not federally listed in the west, they are little studied in most places. Identifying the values that people hold, what they feel is at stake with each predator, and clarifying goals of management form the crux of these chapters. Better biological research is needed in the case of cougars, as the management agency (the State in this case) has largely operated blindly on legal hunting and the issue has become politicized.

Given that the federal government is fully involved in managing grizzlies and wolves in Wyoming, and given the historical enmity between state versus federal control in the 'old west', the next two chapters are destined to be more heated. Grizzlies (Chapter 4) kill both livestock and people on rare occasions, and wolves (Chapter 5), which have never been proven to kill people in North America (there is a possible recent case in Canada), can and do affect livestock operations greatly. The wolves of Yellowstone are an experimental population introduced from Canadian stock, and their numbers have increased greatly in the past ten years. Much more is known about the status of both of these populations (compared to cougars) as a result of federal listing, and both are increasing. The ecological effects of wolves, in particular, are under close study. Since reintroduction of wolves to Yellowstone National Park, elk are less abundant and more wary, and willow and aspen stands are improving, meaning better habitat for songbirds and beaver. They have directly killed fewer livestock than was anticipated, but there is evidence that their forays can wreak havoc on herds due to panic. Thus, wolves may cause more mortality indirectly than is appreciated.

Part Three is devoted to exploring alternatives. Agriculture now forms only a small portion of the economy of western Wyoming, yet agricultural interests have dominated predator management. The authors make a plea for restoring civil society to reduce the tendency for predators to be scapegoats for more pressing societal concerns and allow more voices to be heard. The role of political appointments is also considered, as are the issues of power and control, which influence the actions and perceptions of state agencies. Chapter 8 discusses predator management as a clash of cultural problems. Of course, context matters in all cases, but there is an engaging section about applying lessons learned in Yellowstone to other settings. Are we to have a constant paramilitary presence to assure the conservation of predators, and/or are we to engage the public and all vested stakeholders to arrive at more civil solutions? This question keeps a great many professionals and researchers throughout the world busy. Although the contexts are different for tigers in Nepal or jaguars in Belize, for example, many issues are shared. The volume thus finishes with an applied guide for decision makers that is generalizable anywhere large mammalian predators still roam, and the book can be easily recommended to a number of audiences. It is aimed at professional wildlife managers, but is also of interest to a wider audience of professionals, future professionals (students) and academics in natural resources and other areas of public policy due to its breadth of coverage and focus on solutions, and to the consistent use of a standard research and problem solving framework.

FOCUS ON NATURE ®

Insight into the lives of animals



There's no reason to have eyes when you live in total darkness. Instead, air movement from prey is felt by the sensitive hairs on your eight legs. Hidden deep within the moist darkness a **KAUA'I CAVE WOLF SPIDER**, or Pe'e pe'e maka 'ole, (*Adelocosa anops*) waits for her next meal. Along meanders another native cave species, the Kaua'i Cave amphipod. The chase is on and the long legs of the spider help win the race and the meal. The female senses a male wolf spider trying to seduce her. Once mated, she'll spin and carry an egg sac containing 15-30 mini versions of herself. The newborn hatchlings ride atop her back for several days while gaining independence. Survival is difficult here in the lava caves of southeastern Kaua'i as development continues above as does the seepage of toxins and pesticides. *Artwork and text by Rochelle Mason © 2002-2006 www.Rmasonfinearts.com (808) 985-7311*

News From Zoos

Giant Anteater Born at Santa Barbara Zoo

In keeping with the theme of this Endangered Species UPDATE, we are delighted to report that the Association of Zoos and Aquariums (AZA) accredited Santa Barbara Zoo (www.sbzoo.org) celebrated the birth of a female giant anteater (*Myrmecophaga tridactyla)* on July 8, 2006. This marks the 25th birth for the zoo since it began breeding giant anteaters in 1975, and the second for the breeding pair. Due to Santa Barbara Zoo's thirty-year track record of successful giant anteater births, the institution has become a leader in nationwide giant anteater studies. The zoo's production of the first giant anteater husbandry reference manual will promote captive breeding of this species at other AZA-accredited institutions, 36 of which currently house giant anteaters. This reference will also be shared with zoological professionals working in giant anteater range countries.

Listed as Vulnerable by IUCN, giant anteaters are threatened by habitat destruction and hunting, with an estimated population reduction of 20% in the next 10 years. Native to Central and South America, the giant anteater uses its 18-24 inch long tongue to eat termites, ants, and grubs. This solitary animal plays a critical role in its ecosystem due to its tremendous impact on local insect communities.

Trumpeter Swan Pair Bred by Lincoln Park Zoo First to Nest in Illinois Since 1847

Two trumpeter swans (*Cygnus buccinator*) bred and released into the wild by the AZA-accredited Lincoln Park Zoo in Chicago (www.lpzoo.com) have made history by hatching two healthy chicks. This is the first known wild trumpeter swan nesting in the state of Illinois since 1847.

Since 1991, Lincoln Park Zoo has been hatching trumpeter swan chicks and sending them to Iowa, where the Iowa Department of Natural Resources has released more than 700 cygnets into the wild since 1995. This is part of a collaborative breeding and release effort involving 17 zoos and 50 private individuals, along with a 20-year wetlands restoration program conducted by the governments of surrounding states.

The trumpeter swan is the largest waterfowl species in North America. Once common in the Midwest, over hunting caused these majestic birds to disappear almost entirely by the 1890s. Hitting a population low of 35 birds in 1954, the species has since rebounded thanks to the efforts of conservation organizations, local governments, and zoos like Lincoln Park. There are now over 5,000 wild trumpeter swans in the Midwest region.

Other AZA institutions involved in trumpeter swan recovery include Bramble Park Zoo, Brookfield Zoo, Buttonwood Park Zoo, Detroit Zoo, Jackson Zoo, Kansas City Zoo, Louisville Zoo, Memphis Zoo, Milwaukee County Zoo, Minnesota Zoo, Oglebay's Good Zoo, Sedgwick County Zoo, the Wilds, and Toronto Zoo.

Aquarium of the Pacific Helps Establish Sustainable Seafood Forum

The AZA-accredited Aquarium of the Pacific in Long Beach, CA (www.aquariumofpacific.org) is partnering with Kings Seafood Company and Santa Monica Seafood to create a Sustainable Seafood Forum. Why would an aquarium want to promote the consumption of ocean animals? The answer lies in preserving the oceans' resources for future generations. Without sustainable fishing practices in place, many ocean animal populations will decline, causing trouble for seafood markets.

The forum is an innovative way to ensure that companies and individuals who buy and sell seafood are doing so in a sustainable manner. For instance, restaurants that participate in the forum guarantee their customers that all seafood served is sustainable. According to the forum's standards, sustainable seafood must "(1) come from sustainable wild stocks or environmentally friendly aquaculture farms, (2) be healthful, and (3) have no major negative impacts on the local community and even contribute when possible." While the Kings chain aims to have all menu items come from sustainable sources by 2009, Santa Monica Seafood is focusing on ensuring that each of their suppliers implements sustainable harvesting methods.

Threatened Silverspot Butterflies Released

Oregon Zoo (www.oregonzoo.org), an AZA-accredited institution, released 22 pupae and 18 larvae of the threatened Oregon silverspot butterfly (*Speyeria zerene hippolyta*) at The Nature Conservancy (TNC)'s 280-acre Cascade Head Preserve this season. This is the eighth year that the zoo has released butterflies reared in its conservation lab, and the first year that student interns from local high schools have helped staff to rear the butterflies. With the start of this intern program, Oregon Zoo is leading the way for community involvement in the protection of this threatened species.

The recovery program began in 1998 when the Oregon silverspot population numbered only 57 individuals, having averaged over 1,000 individuals prior to 1992. Partnering with AZA-accredited Woodland Park Zoo (www.zoo.org), TNC, the U.S. Fish and Wildlife Service, and the Washington Department of Fish and Wildlife, Oregon Zoo began collecting female butterflies near the end of their life cycle and inducing them to lay eggs at their butterfly breeding facility. They then released adult larvae in the wild.

Oregon silverspot butterflies are listed as threatened under the U.S. Endangered Species Act, now remaining in only a few sites due to habitat loss and the loss of the butterfly's host plant, the western blue violet. Oregon silverspots are medium-sized butterflies that inhabit grassland areas. Their original range spanned northern California and southern Washington, but is now limited to a handful of sites in Oregon state.

Seven Black-Footed Ferrets To Be Reintroduced

Of the 24 endangered black-footed ferret (*Mustela nigripes*) kits born at AZA-accredited Cheyenne Mountain Zoo (www.cmzoo.org) this year, seven have been sent to the U.S. Fish and Wildlife Service (USFWS) National Black-Footed Ferret Conservation Center in Fort Collins, CO in preparation for their release into the wild at four different sites. Cheyenne Mountain Zoo, located in Colorado Springs, was one of the first institutions to join the USFWS-led black-footed ferret breeding and recovery efforts, which began in 1990. Three years earlier, the last remaining wild ferrets had been placed in captivity to prevent the species' extinction. Working alongside other AZA institutions involved in the AZA Black-Footed Ferret Species Survival Plan, Cheyenne Mountain Zoo has contributed almost 70 individuals to the release programs to date.

The global population now numbers approximately 1,000 individuals, of which over half are captive-reared individuals that have been reintroduced to the wild. Unfortunately, the ferrets have not fared well at some release sites, especially those where prairie dogs, the ferrets' main prey, have been stricken by sylvatic plague. However, recent news of wild-born kits in Colorado suggests that there is hope for this population even in areas that have been hit by disease.

The only ferret native to North America, black-footed ferrets range from 15 to 22 inches in length and have historically inhabited prairie dog towns throughout the Great Plains. A ten thousand acre prairie dog town is required to sustain a viable black-footed ferret population. Extermination of prairie dogs by farmers and ranchers has led to the dramatic decline in black-footed ferrets, which were thought to be extinct until a population was discovered in Wyoming in 1981. Black-footed ferrets have been listed as endangered by USFWS since 1967.

Oregon Zoo Leads Pygmy Rabbit Breeding Efforts

The Washington pygmy rabbit is geographically separated from populations of other pygmy rabbits and critically endangered in Washington State. Only 40 individuals of this subspecies existed in the wild a few years ago, and that number has since declined. In an attempt to save the dwindling population from extinction, the AZA-accredited Oregon Zoo (www.oregonzoo.org) began a breeding program for the Washington pygmy rabbit, following the success of its Idaho pygmy rabbit breeding efforts in 2000. The Oregon Zoo in Portland and Washington State University in Pullman, most recently joined by AZA-accredited Northwest Trek Wildlife Park in Eatonville, WA (www.nwtrek.org), have formed a recovery alliance and continue to maintain successful breeding programs for this critically endangered species.

The pygmy rabbit is the smallest rabbit in North America, measuring 9.2-11.6 inches in length and weighing approximately one pound when full grown. The rabbits dig their own burrows into loose dirt and depend on sagebrush for food. Their numbers continue to diminish mainly because of habitat loss from agricultural land use and wildfires.

News From Zoos

In a disheartening turn of events, the last male purebred pygmy rabbit died in June of 2006 leaving just two purebred females to pass on the genes of this distinct population. The two breeding facilities will continue to integrate genes from the purebred rabbits with those from the closely related Idaho pygmy rabbit through a crossbreeding program. They hope to maintain a bloodline of 75 percent Washington pygmy rabbit and 25 percent Idaho pygmy rabbit. So far this approach has proven successful, with 17 new rabbits born at the Oregon Zoo between January and June of 2006. A release of rabbits back into the wild is planned for this fall and will mark another first for the program.

AZA Zoos Aid in Mexican Gray Wolf Recovery

Following the near extinction of the United States population of gray wolves in the early 1900s due to increased human settlement, five wolves were found alive in Mexico between 1977 and 1980. This species was listed as federally endangered in 1976, prompting the creation of a recovery team and associated breeding program. Since 1994, 24 AZA institutions have participated in a bi-national breeding program run by the U.S. Fish and Wildlife Service to breed and return wolves to the wild. Ninety Mexican gray wolves have been released to the wild since 1998 thanks to the breeding program, although only about 35 are confirmed living.

In 1998 the first reintroduction of Mexican gray wolves took place at the Blue Range Wolf Recovery Area, which stretches from east-central Arizona to west-central New Mexico, in hopes that they will eventually expand to their native habitats; portions of Arizona, New Mexico, Texas, and Mexico. Reintroductions are often controversial among local landowners, and predation on domestic cattle continues to be a troublesome issue, raising concerns among stakeholders that will have to be addressed. However, the captive population is now at over 300 animals and gives hope to the possibility of a sustainable wild population in the near future.

Threatened Snowy Plover Chicks Raised and Released by Oregon Coast Aquarium

Two abandoned snowy plover eggs were brought to the AZA-accredited Oregon Coast Aquarium (www.aquarium.org) earlier this year and hatched at the aquarium's new Western Snowy Plover Exhibit. This fall the chicks, which had reached adulthood, were released near the site of the original nests. Two more rescued chicks will be released later this fall. The aquarium's new exhibit was created in partnership with the U.S. Fish and Wildlife Service and aims to educate the public about threats facing these rare birds. Aquarium curators have expressed hope that this exhibit and the rehabilitation and release programs conducted by aquarium staff will spur the public to act to restore Western snowy plover populations.

The Western snowy plover is a small shorebird native to Oregon that lives and nests on beaches, between dunes and high tide lines. Due to an influx of invasive European beach grass, the plover's habitat is now confined to several small areas at river mouths. In addition, human activities and increased predation by other birds over the past few decades have reduced the population to fewer than 100 individuals. Oregon Coast Aquarium and its partners' efforts toward rescue and rehabilitation are essential for the continued survival of this species.

ASSOCIATION OF ZOOS & AQUARIUMS

Zoos and aquariums accredited by AZA have demonstrated that they are dedicated to providing excellent care for animals, a great experience for visitors and a better future for all living things. AZA collaborates to improve the future for wildlife by coordinating the wildlife conservation initiatives of AZA accredited institutions, and by building relationships with other conservation partners. Learn more by visiting www.aza.org !

Call for Submissions

Our Mission Statement

With increased pressures on our world's plant and animal life, the success of endangered species recovery programs is more important than ever. The major downfalls faced by professionals involved in these programs, however, are based in miscommunication—scientists do not talk to policy makers and policy makers do not consult scientists. The Endangered Species UPDATE, an independently funded quarterly journal published by the University of Michigan's School of Natural Resources and Environment, recognizes the paralyzing power of poor communication. Now entering its 23rd year, the UPDATE's primary goal is to bridge the chasm between policy and science.

Call for Articles

The UPDATE is seeking articles ranging from feature articles to opinion articles to reports from the field regarding endangered species recovery and policy issues. We are currently accepting submissions for our October–December 2006 and January-March 2007 issues.

Interested authors may e-mail esupdate@umich.edu. Please see the instructions to authors or visit our website at www.umich.edu/~esupdate for more information.

Instructions to Authors

The Endangered Species UPDATE is committed to advancing science, policy, and interdisciplinary issues related to species conservation, with an emphasis on rare and declining species. The UPDATE is a forum for information exchange on species conservation, and includes a reprint of the U.S. Fish and Wildlife Service's Endangered Species Technical Bulletin, along with complementary articles relaying conservation efforts from outside the federal program.

The UPDATE welcomes articles related to species protection in a wide range of areas including, but not limited to:

-Research and management of rare and declining species;

-Theoretical approaches;

-Strategies for habitat protection and reserve design;

-Policy analyses and approaches to species conservation;

-Interdisciplinary issues;

-Emerging issues (e.g., wildlife disease ecology).

In addition, book reviews, editorial comments, and announcements of current events and publications are welcome.

Subscribers to the UPDATE span a wide range of professionals in both scientific and policy fields including corporations, zoos, and botanical gardens, university and private researchers. Articles should be written in a style that is readily understood but geared to a knowledgeable audience.

Acceptable Manuscripts

The Endangered Species UPDATE accepts several kinds of manuscripts:

1. Feature Article — on research, management activities and policy analyses for endangered species, theoretical approaches to species conservation, habitat protection, and interdisciplinary and emerging issues. Manuscripts should be approximately 3000 words (8 to 10 double spaced typed pages).

2. Opinion Article — concise and focused argument on a specific conservation issue; may be more speculative and less documented than a feature article. These are approximately 450-500 words (About 2 double spaced typed pages).

3. Technical Notes/Reports from the Field — ongoing research, application of conservation biology techniques, species conservation projects, etc., at the local, state, or national level. These are approximately 750 words (3 double spaced typed pages).

4. Species at Risk — profiles of rare and declining species, including the following information: taxonomy, distribution, physical characteristics, natural/life history, conservation status, and economic importance. These profiles are approximately 750-1500 words (3 to 6 double spaced typed pages).

5. Book Reviews — reviews should include such information as relevant context and audience, and analysis of content. Reviews are approximately 750-1250 words (3 to 5 double spaced typed pages). Please contact the editor before writing a book review.

6. Bulletin Board — submissions of news items that can be placed on the back page. These items can include meeting notices, book announcements, or legislative news, for example.

Instructions to Authors

Manuscript Submissions and Specifications

Submit the manuscript to:
Editor, Endangered Species UPDATE
School of Natural Resources and Environment
University of Michigan
440 Church Street
Ann Arbor, MI 48109-1041

To submit your manuscript electronically, e-mail the manuscript as a Word file or rich text format (.rtf) attachment to esupdate@umich.edu.

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Initial acceptance of a proposal or manuscript does not guarantee publication. After initial acceptance, authors and editors work closely on all revisions before a final proof is agreed upon.

Citations, Tables, Illustrations, and Photographs

Literature citations in the text should be as follows: (Buckley and Buckley 1980b; Pacey 1983). For abbreviations and details consult the Editor and recent issues of the Endangered Species UPDATE.

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Author credit instructions for each author of the article should accompany the manuscript.

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Authors are asked to do the final copy editing of their articles. It is in the authors' power to save themselves and the journal the embarrassment of having to explain mistakes that could have been avoided.

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In its 23 years of publication, the Endangered Species UPDATE, published by the School of Natural Resources and Environment at the University of Michigan, has established itself as the primary forum for government agencies, conservation organizations, private consulting and law firms, zoos, museums, educational institutions, and others to exchange ideas and information on species conservation issues.

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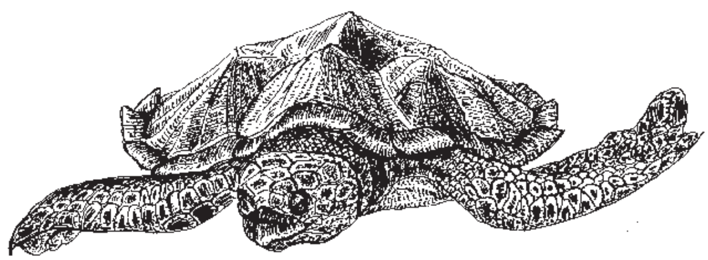

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