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Factors Affecting Population Size in Texas' Golden-cheeked Warbler

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Abstract

Populations of Golden-cheeked Warblers (*Dendroica chrysoparia*) are small, apparently declining, and limited to breeding in oak-juniper in central Texas, a habitat threatened by urbanization and clearing for cattle pastures. In addition, Texas studies indicate that oak-juniper patches less than 50 ha in size have few breeding birds. Theoretical work predicts that members of migratory species should be absent from seemingly suitable breeding habitat if their populations are held below breeding habitat carrying capacity by winter habitat availability. A recent study using satellite imagery to calculate total amounts of breeding and wintering habitat, along with field studies assessing potential and actual warbler densities during the breeding and wintering phases of the life cycle, suggest that diminishing winter pine-oak habitat in the highlands of southern Mexico and Central America could limit warbler populations and cause breeding habitat to appear underused. Conservation efforts should take into account the possibility of winter population control for this species.

Resumen

Las poblaciones de chipe (reinita, Dendroica chrysoparia) son pequeñas, están en aparente disminución, y limitadas a reproducción en el hábitat de encino-junípero (roble-enebro) del centro de Texas, un hábitat amenazado por la urbanización y pastoreo de ganado. Además, estudios de Texas indican que los fragmentos de encino-junípero (roble-enebro) de un tamaño menor de 50 ha. tienen pocos pares reproductivos. El trabajo teórico predice que los miembros de especies migratorias estarían ausentes de su hábitat de reproducción aparentemente ideal, si sus poblaciones se mantienen por debajo de la capacidad de carga por la disponibilidad del hábitat invernal. Usando imágenes de satélite para calcular la cantidad de hábitat reproductivo e invernal, un estudio reciente, junto con estudios para determinar las densidades posibles y actuales de chipe (reinita) durante las etapas de reproducción e invierno de su ciclo de vida, sugiere que el hábitat invernal de pino-encino (pino-roble) en disminución de las montañas del sur de México y Centro América podrían limitar las poblaciones de chipe (reinita) y causar que el hábitat reproductivo parezca subutilizado. Los esfuerzos de conservación deberían tomar en consideración la posibilidad de control de población invernal para estas especies.

Introduction

The Golden-cheeked Warbler (*Dendroica chrysoparia*) breeds in mature oak-juniper habitat in the hill country of central Texas and winters over 1,200 km to the south in highland pine-oak from southern Mexico to Honduras (Figure 1). Concern regarding declines in this species began over a century ago, as biologists noted the rate of conversion of their woodland breeding habitat to pasture for cattle. These concerns have only increased over time as the species' numbers have dwindled. The bird was formally placed on the U.S. Endangered Species List in 1990 (USFWS 1990).

Until recently, almost all attention by conservationists had been focused on the preservation of breeding ground habitat because that appeared to be the factor limiting Golden-cheeked Warbler populations (Beardmore et al. 1996). However, there was very little information on the nonbreeding portion of the life cycle, with fewer than 50 winter records (sight or specimen) published when we began our investigations (Rappole et al. 2000). In a project funded by the U.S. Fish and Wildlife Service, we spent three seasons (December through February) investigating the occurrence, density, and ecology for Golden-cheeked Warblers on their wintering grounds in Chiapas, Mexico, Guatemala, and Honduras from 1995 to 1998. Sherry Thorn, Wylie Barrow, Peter Leimgruber, and several others provided assistance with the work. We collected detailed information on habitat and elevation at all sites where the bird was found and used these data along with satellite imagery to map and quantify the amount of Golden-cheeked Warbler winter habitat. The U.S. Fish and Wildlife Service had sponsored a similar mapping exercise in the 1990s covering the Texas breeding ground, providing us with the unique opportunity for comparing breeding versus winter habitat carrying capacity to determine which portion of the life cycle might serve as the bottleneck for the Golden-cheeked Warbler. Using both our data and those collected by D. Diamond and C. True, we estimated carrying capacity for known breeding habitat in Texas and wintering habitat within the range of the bird in the highland tropics. Our analyses indicate that winter habitat availability could limit Golden-cheeked Warbler populations (Rappole et al. 2003). In this paper, we review reported threats to Golden-cheeked Warbler populations, interpret them relative to new information on population densities and breeding and wintering habitat extent, and consider the possible theoretical implications concerning the point in the annual cycle where Golden-cheeked Warbler population limitation might occur.

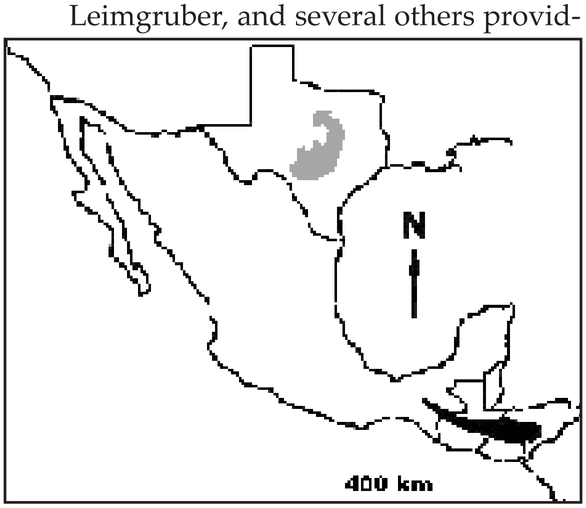

Figure 2. Map of Golden-cheeked Warbler breeding and wintering distribution

Factors Thought Responsible for Golden-cheeked Warbler Population Decline

The following is an exhaustive review of factors that have been suggested in the literature as potentially limiting Golden-cheeked Warbler populations. These can be divided into two general categories: habitat extent and habitat quality.

1. Habitat Extent—For a migratory species like the Golden-cheeked Warbler, habitat extent can be divided into at least two parts depending on time of the year, namely breeding and wintering. Wahl et al. (1990) estimate loss

of 35% of oak-juniper habitat suitable for breeding Golden-cheeked Warblers since 1962, with a trend toward increasing rates of loss, particularly to urbanization along the Austin-San Antonio corridor. In addition to apparent declines in amounts of breeding habitat, Rappole et al. (1999, 2000) found that significant declines had occurred in Central American highland pine-oak as well, the preferred wintering habitat for Golden-cheeked Warblers.

2. Habitat Quality—Various factors have been suggested as affecting habitat "quality," i.e., the ability of a warbler pair to produce offspring in a particular piece of habitat. One such factor is the size of remaining breeding habitat blocks. Significant amounts of the Golden-cheeked Warbler breeding habitat that remains is in fragments less than 50 ha in size, which are more or less isolated. Wahl et al. (1990) found few or no birds breeding on visits to some patches less than 50 ha in size despite the fact that these sites appeared to be otherwise suitable for the species. Cowbird nest parasitism has also been cited as affecting habitat quality. Pulich (1976) reported cowbird parasitism in 19 of 33 (58%) Golden-cheeked Warbler nests found. The actual effect of social parasitism on breeding populations is unknown, but assumed to be important (Keddy-Hector 1992). In addition to these factors, the Golden-cheeked Warbler Recovery Plan (Keddy-Hector 1992) listed various forms of human disturbance (e.g., traffic noise, trails, roads, fences, and rights-of-way) as potentially damaging to warbler breeding populations through their effects on habitat quality. Benson (1990) reported an apparent negative effect of urbanization on warbler breeding densities. Nest predation is another factor potentially affecting warbler numbers; Engels and Sexton (1994) found a negative correlation between an important nest predator in urban environments, the Blue Jay (*Cyanocitta cristata*), and Golden-cheeked Warbler breeding density. Finally, habitat deterioration caused by oak wilt (*Ceratocystis fagacearum*), overbrowsing by white-tailed deer (*Odocoileus virginianus*) and exotic ungulates, or various human range treatments affect oak-juniper habitat in central Texas with possible negative consequences for Golden-cheeked Warblers (Wahl et al. 1990, Keddy-Hector 1992).

Figure 2. Golden-cheeked Warbler oak-juniper breeding habitat.

Each of these factors may have the potential to affect local numbers of Golden-cheeked Warblers. However, the association between the disappearance of the species from a particular site and range-wide population change is not clear. In order to determine which factor is most likely to limit the total population of Golden-cheeked Warblers, all of the potential limiting factors need to be considered together. This effort requires estimates of warbler numbers and breeding and winter habitat availability, as well as consideration of the potential effects of different forms of habitat change on warbler populations.

Golden-cheeked Warbler Habitat Availability and Population Size

There have been several attempts to estimate the total extent of breeding habitat for Golden-cheeked Warblers. Pulich (1976) estimated 3,003,933 acres (1,215,675 ha) for the total amount of the warbler's "virgin cedar brake" breeding habitat in 1974 using Soil Conservation Service (SCS) data. Based on subsequent discussions with SCS personnel and his own experience with the bird, he reduced the estimate of warbler habitat to 739,645 acres (299,330 ha) of "virgin Ashe juniper." In contrast, Wahl et al. (1990) used satellite imagery, corrected based on random visits to sites identified in the initial LANDSAT image analysis as Golden-cheeked Warbler habitat (ground-truthing) to obtain a supervised habitat classification, which subsequent ground-truthing demonstrated to be 91% accurate. The figure for total amount of suitable warbler habitat (237,163 ha) was then reduced using the following habitat patch size considerations. First, the investigators assumed that patches less than 50 ha in size would not support warbler breeding populations, based on surveys in several patches of that size or smaller where they found few or no birds. Then they calculated the percent of habitat in blocks less than 50 ha in size for two urban counties and two rural counties and used the range of percentages obtained to calculate "best" and "worst" case percentages of habitat in patches less than 50 ha for the remaining counties in the assessment based on whether they were rural or urban. These procedures reduce the estimated total amount of suitable Golden-cheeked Warbler breeding habitat to either 106,776 ha ("best") or 32,149 ha ("worst").

D. Diamond and C. True, in a study conducted for the U. S. Fish and Wildlife Service, also used data gathered by LANDSAT thematic mapper satellite imagery to obtain estimates of total breeding habitat for Golden-cheeked Warblers, although they did not use buffering criteria as restrictive as those used by Wahl et al. (1990) (i.e., eliminating habitat fragments < 50 ha in size). They prepared an estimate of oak-juniper in blocks greater than 5 ha in size for 29 of the 31 Texas counties in which the warbler is known to breed, an amount equaling 643,454 ha.

We estimated the extent of winter habitat for Golden-cheeked Warblers, also using LANDSAT thematic mapper satellite imagery. We prepared an "unsupervised" classification (i.e., a habitat classification not corrected by random site visits) of pine-oak habitat greater than 1,219 m in elevation (96.8% of all winter records are from elevations greater than 1,219 m) throughout the known winter range of the species in southern Mexico, Guatemala, and Honduras. We then conducted random site visits at localities in all three countries, collecting vegetation information to correct the satellite habitat assessment, and running transects to estimate Golden-cheeked Warbler density in appropriate habitat. With these data, along with additional satellite information from the USGS EROS Data Center, we calculated the total amount of pine-oak habitat greater than 1,219 m in elevation for the bird's winter range, an amount equal to 675,005 ha.

These estimates of habitat extent were combined with known warbler densities to derive population estimates (Table 1). Pulich (1976) used his habitat estimate in combination with an estimated average density of one pair/50 acres (one adult bird/10.1 ha) to calculate a potential population size of 29,500 birds. He then modified this estimate by further re-classifying the "virgin Ashe juniper" habitat into "excellent" (one pair/8.0 ha), "average" (one pair/20.2 ha), and "marginal" (one pair/ 34.2 ha). This classification was based on visits to all of the 31 counties known to harbor warbler breeding populations. The total number of birds in each of these habitat classes was calculated and summed to provide an estimate of the total breed-

Table 1. Estimates of population size for the Golden-cheeked Warbler.

Data Source	Method	Density (Birds/ha)	Total Breeding Habitat (ha)	Total Winter Habitat (ha)	Population Size
Pulich 1976:11	Total SCS "cedar brake" habitat estimate and average pair density based on three intensive survey sites.	1/10.1	1,215,675	------------	120,363
Pulich 1976:11	Total SCS "virgin Ashe juniper" habitat estimate and average pair density based on three intensive surveys.	1/10.1	299,330	------------	29,636
Pulich 1976:163	Variable bird density estimates based on divisions of virgin Ashe juniper habitat estimate into three "quality" ratings.	1/4.0 1/10.1 1/17.2	30,352 ("Excellent") 41,279 ("Average") 60,299 ("Marginal")	------------ ------------ ------------ TOTAL	7,588 4,087 3,505 15,180[1]
Wahl et al. 1990:55	Extrapolation from 1974-1981 LANDSAT habitat estimates and bird densities based on transects at 11 sites.	1/3.3	237,163	------------	71,867
Wahl et al. 1990:55	Extrapolation from 1974-1981 LANDSAT habitat estimates, with patches <50 ha in size omitted, and bird densities based on transects at 11 sites.	1/3.3	32,149 to 106,776[2]	------------	9,742–32,356
Keddy-Hector 1992	Re-calculation of data in Wahl et al. based on refinement of "patch-size" assumptions (34% occupancy in patches < 50 ha).				27,600
Rappole et al. 2003	Extrapolation from Diamond & True satellite estimate of oak-juniper breeding habitat and Fort Hood bird density estimate.	1/2.8	643,454	------------	228,426
Rappole et al. 2003	Extrapolation from estimates of highland pine-oak winter habitat and transect calcuations of bird winter density in appropriate habitat.	1/18.9	------------	675,005	35,714

[1] This number differs from Pulich's (1976) total of 14,950 due to rounding and conversion from acres to ha.

[2] A range of habitat available for warbler use based on "best" and "worst" habitat patch size distribution. See text for explanation.

ing population.

Similarly, Wahl et al. (1990) conducted censuses for Golden-cheeked Warblers at 11 sites located in nine counties to obtain breeding density estimates in appropriate habitat. They then combined this estimate with their habitat assessment to obtain an estimate for total breeding population size (Table 1). Keddy-Hector (1992) used the data from Wahl et al., in combination with recent findings documenting warbler use of 34% of sites < 50 ha in size (Benson 1990), to recalculate the population size data, which yielded a similar estimate (Table 1).

Rappole et al. (2003) calculated a potential population based solely on satellite estimation of total oak-juniper breeding habitat and an established breeding density using the analyses of Diamond and True. Making no assumptions concerning variations in the suitability of this habitat, we calculated the potential breeding population size for the species by dividing total habitat by the average pair density of 1 pair/5.6 ha (one adult bird/2.8 ha) found in the largest and best-studied breeding population (Fort Hood, Jettj et al. 1998). This is an intermediate estimate that we consider to be representative of range-wide densities based on recent extensive reports in the literature (Ladd and Gass 1998).

Finally, we used our wintering habitat estimate with our density data derived from winter transects (1 bird/18.9 ha) to obtain an estimated population size of 35,527 birds, with a 95% confidence interval of - 14,467 to 83,317 birds (Rappole et al. 2003). Note that the low density estimates derived from our transect counts occur because Golden-cheeked Warblers appear to be obligate mixed-species flock participants during the winter period, normally with a single member of this species in 87% of flocks containing Golden-cheeked Warblers. Only three of 157 birds observed were found outside flocks.

Figure 3. Golden-cheeked Warbler highland pine-oak winter habitat in Guatemala.

The variation among estimates for breeding populations of Golden-cheeked Warblers reflect differences among studies in the technology available to assess habitat extent, and also the assumptions used to classify habitat as suitable. We are confident that, of these estimates, that of Rappole et al. (2003) is the most reasonable, for the following reasons. Pulich (1976) used the best data available to him; however, he did not have access to sophisticated remote sensing technology. Wahl et al. (1990) used remote sensing although they used what turned out to be an unreasonable assumption, i.e., that warblers would not use fragments < 50 ha, when in fact published information indicates that they will use fragments < 1 ha in size (Benson 1990).

The results of these attempts to estimate the Golden-cheeked Warbler population size, as summarized in Table 1, demonstrate the extraordinary difficulty of obtaining reliable numbers for a migratory bird population spread thinly across hundreds of thousands of hectares, much of which is inaccessible. Slight variations in assumptions or procedures can produce large variation in findings. Nevertheless, a critically important conclusion can be drawn from these estimates: either the Golden-cheeked Warbler population size is far larger than has been assumed, or vast areas of apparently suitable breeding habitat are underoccupied or unoccupied (Wahl et al. 1990, Beardmore et al. 1996).

Carrying Capacity and Population Control in Migratory Species

Reduction of breeding ground carrying capacity, whether from actual habitat loss or some form of degradation, has been cited or implied as the underlying reason for Golden-cheeked Warbler declines by most investigators (Pulich 1976, Wahl et al. 1990, Keddy-Hector 1992, Beardmore et al. 1996, Ladd and Gass 1999). Clearly habitat loss has the potential to reduce population size. However, available evidence indicates that, despite the fact that breeding habitat is declining, large amounts remain, apparently sufficient to support a population several times the estimated size of the population (Table 1).

Negative effects of habitat degradation on populations are much more difficult to substantiate than changes in habitat extent. In most cases, the documentation presented to prove effects of various forms of degradation, from patch size to human disturbance, is scarcity or absence of birds (Pulich 1976, Keddy-Hector 1992). But lack of birds from breeding habitat is not evidence of a breeding population that has reached carrying capacity. In fact, an opposite effect would be expected. Theoretically, all suitable breeding habitat should be filled for a population in which breeding habitat is limiting, in marginal as well as excellent habitats (Fretwell 1972, Rappole and McDonald 1994, 1998).

The implication concerning degraded habitats contained in the carrying capacity argument is that they are unusable; i.e., that birds using them would be unable to raise offspring. Therefore, they do not use the degraded sites and thus habitat degradation is equivalent to habitat destruction. The investigations by Wahl et al. (1990) document the absence of birds from some patches < 50 ha, but do not document absence of suitability, i.e., whether or not birds could successfully raise offspring if they were to use a patch < 50 ha in size. Investigation of this question by other researchers has documented that Golden-cheeked Warblers can and do occupy smaller patches. For instance, Benson (1990) examined impact of patch size, per se, on warbler breeding density, and found no statistical difference in occupancy rate on his study sites between large and small patches, with some pairs occupying patches as small as 0.6 ha. Benson's patch size study did, however, show lower densities of birds in highly urbanized settings, regardless of patch size. Nevertheless, though numbers were lower in urban areas, there were still pairs using them, indicating that urban patches were not "unusable," and hence not evidence of limitation from a carrying capacity perspective. Kroll (1980) found that breeding pairs did not avoid sites bordering roads, trails, or clearings and, in fact, were as successful or more so in raising offspring than birds on sites less subject to human disturbance. Ladd (1985) reported similar results, although the findings of both studies have been challenged by Keddy-Hector (2000).

Sherry and Holmes (1995), among many others, have argued that multiple factors control population size in migratory birds so that summer, winter, and migration mortality factors all contribute toward the determination of total numbers. This argument is correct only under the special circumstance in which the population never reaches carrying capacity during any portion of the annual cycle. However, if carrying capacity is reached during one portion of the year, then mortality factors occurring at other times become essentially irrelevant in terms of limiting the population.

Rappole and McDonald (1994, 1998) predicted that populations of migratory birds in which breeding habitat carrying capacity was limiting would show breeding habitats filled to capacity, regardless of quality. However, if wintering ground carrying capacity was less than breeding ground carrying capacity, the species would show lower than expected densities in breeding habitat. They based these predictions on the logic of Fretwell (1972), and further predicted that species limited by winter habitat availability would likely show an "area effect" during the breeding period, in which breeding pairs would be rare or absent from small or otherwise marginal habitat because the competition for excellent habitat had been reduced or eliminated. This pattern was documented 30 years ago in the Golden-cheeked Warbler by Pulich (1976), and it is our contention that much of the data on breeding populations gathered since, showing low occupancy rates or absence of birds from suitable habitat (e.g., Wahl et al. 1990), implies possible wintering ground population limitation for this species.

Our recent study of winter social organization and total amounts of remaining habitat for breeding and wintering birds provides further indication that these birds could be threatened by winter habitat loss (Rappole et al. 2003). As mentioned above, we found Golden-cheeked Warblers restricted to association with mixed-species flocks in highland pine-oak habitats, with one individual per flock. Though we have few observations from the fall arrival period, we have seen that, initially, several Golden-cheeked Warblers will settle in a flock. However, competition, including chases and vocalizations, appears to be intense, and within a matter of a few days, only one Golden-cheeked Warbler remains as a flock member; the others, presumably, have moved on to locate a flock of their own.

Measures Required to Avoid Extinction in the Golden-cheeked Warbler

Based on our wintering ground studies of the species (Rappole et al. 1999, 2000, 2003, King and Rappole 2000), along with results of breeding ground studies documenting scarcity of birds in seemingly appropriate habitat, we conclude that the destruction of winter habitat is a possible cause of Golden-cheeked Warbler decline. Naturally, we agree with the many excellent conservation biologists working hard in Texas to preserve the species (e.g., Keddy-Hector 2000) that destruction or degradation of breeding habitat will affect presence or absence of local populations, and, of course, if allowed to continue, could surpass winter habitat as the factor controlling warbler population size. At present, however, it appears that the loss of highland pine-oak habitats in southern Mexico, Guatemala, and Honduras is the probable reason for Golden-cheeked Warbler disappearance. If we want Golden-cheeked Warblers to continue to be part of the Texas avifauna, something will have to be done to preserve their threatened highland pine-oak wintering habitat in Central America, as well as their Texas cedar brakes breeding habitat.

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Opinion
Big-Leaf Mahogany Challenges CITES

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Abstract

High demand for big-leaf mahogany creates pressure for unsustainable extraction. While mahogany logging provides foreign exchange for developing economies, inadequate regulations and resource conflicts exacerbate social injustice and ecological degradation. Additional measures are necessary to help member parties uphold their CITES commitments and improve broader political, economic, and environmental policies. Institutional and financial support to mahogany source countries can help increase participation in natural resource governance and shift incentive structures to encourage long term forest management. International buyers and consumers can also purchase more selectively, including products from independently certified sustainable sources and lesser-known tree species, to allow for mahogany regeneration.

Resumen

La alta demanda por la caoba de hoja ancha aumenta la presión para extracción no sustentable. Mientras la tala de caoba provee intercambio de divisas para las economías en desarrollo, regulación inadecuada y conflictos de recursos aumentan la injusticia social y la degradación ecológica. Se necesitan medidas adicionales para ayudar a todas las partes a mantener sus compromisos con CITES y mejorar su política general de pólizas económicas y ambientales. Apoyo institucional y financiero a los países de donde viene la caoba pueden ayudar a aumentar la participación en el gobierno de recursos naturales y cambiar las estructuras de incentivos para promover el manejo forestal a largo plazo. Compradores internacionales y consumidores también pueden comprar con mas discreción, incluyendo productos de fuentes independientemente certificadas y de especies de árboles menos conocidas, para permitir que la caoba se regenere.

Big-leaf mahogany (*Swietenia macrophylla*) is one of the Convention on International Trade in Endangered Species of Wild Fauna and Flora's (CITES) greatest challenges to date. Pressures to extract and trade are intense because mahogany is the most precious tree in many Latin American countries. Between 1995 and 2002, under a CITES Appendix III listing, illegally obtained big-leaf mahogany frequently entered international markets. *S. macrophylla* was transferred to Appendix II in 2002, where it joined two other mahogany species.

The Appendix II listing may have several important results. Most importantly, a yearly quota must be set by each exporting country to assure that sustainable levels are not surpassed, thus requiring states to complete forest inventories and determine regeneration patterns. However, these activities are time consuming and expensive: many countries are uncertain how to proceed. CITES depends on each member party to uphold its commitments, since oversight procedures have little regulatory "bite."

While providing an essential framework to monitor trade, CITES policies neither target the root causes of overextraction nor address issues of social justice surrounding mahogany harvesting and sales. CITES' mandate will be weakened if current efforts are unsuccessful in protecting this threatened species, but the convention requires additional support to institute sustainable management. The following activities, which target reform within and beyond the CITES framework, should be prioritized.

Decentralization and Improved Participation: CITES offices in mahogany-supplying countries are overly centralized and non-state partnerships often remain poorly developed, with a few high-profile exceptions. Decentralized state institutions usually do not influence the formulation of mahogany management legislation even though they are expected to implement it. Local officials are less likely to invest scarce resources to uphold mandates that they consider misguided or ineffective. Wider participation from impacted populations and civic or nongovernmental organizations is also necessary to make policy more sensitive to local conditions and improve voluntary compliance.

Economic Incentives and Alternatives: First, there are insufficient economic incentives to regulate harvest in export countries. Buyers and consumers generally do not prioritize mahogany originating from sources deemed sustainable. Blundell and Gullison (2003) note that buyers in U.S. markets, where 60% of mahogany exports end up, not only accept illegally harvested mahogany but also help finance foreign logging operations in order to secure supply (Blundell and Gullison 2003). Due to indifference about the sustainability of sources, most mahogany purchased in international markets does not originate from concessions independently certified as sustainable. Rather than financing long-term operations, mahogany hunters search for new areas with existing stands. As sources become depleted, extractors shift to other locations. Liquidation logging provides more immedi-

Mahogany timber is trucked from the Miskitu indigenous village of Alamikangban in eastern Nicaragua.

These mahogany trunks measure around ten inches, or less than half the legal minimum for harvest. Mahogany can still be found in eastern Nicaragua, but larger trees are rapidly disappearing. Illegal mahogany trafficking rivals cocaine trafficking along this remote coast.

ate and higher financial returns when compared to sustainable forestry. Second, while extraction creates important rural income, some populations sell mahogany trunks or timber for as little as US $25 per cubic meter, even though a cubic meter of mahogany lumber on the international market is routinely sold for over US$1,000. In addition to fairer prices, source areas need economic alternatives, such as markets for lesser known timber species or non-timber forest products.

Land Tenure Resolution: Much mahogany is harvested from indigenous territories lacking formal land titles. There is increasing violence stemming from resource conflict as mahogany scouts target remote areas looking for remaining stands. Participatory land demarcation is necessary to resolve access and tenure conflicts and to create a foundation for community based forest management.

Domestic Controls: Internal trade does not fall under CITES' responsibilities, but only a portion of tropical roundwood enters international markets. Mahogany is also popular in Latin American domestic markets. Although the asking price is considerably lower, mahogany generally remains the most valuable species circulated internally. When export controls tighten so that mahogany can only cross borders or ship from ports when accompanied with CITES permits, undocumented wood may be dumped domestically. The availability of inexpensive mahogany in national markets reinforces internal demand and local preference for mahogany.

Poor domestic controls and the increase in international mahogany trade monitoring coincide to encourage extraction and illegality. First, loggers remain confident that they will find a national buyer even if they do not access more profitable export markets. Second, ineffective national regulations create new opportunities for profit from illegal harvest and trade. For example, while some countries have improved domestic controls through the use of transportation checkpoints, this has sometimes contributed to the concentration of logging profits within elite groups that either have the political connections to avoid punitive measures or the financial ability to pay bribes or fines.

Although limited by insufficient funding, CITES is expected to fulfill a difficult and overly broad mandate. With the potential for profit from illegal mahogany and a labyrinth of domestic and international transit routes, harvest and trade documents are often unreliable or falsified. While it is essential for convention party members to improve the implementation of trade policies, CITES cannot be expected to resolve all mahogany management constraints. Additional actions beyond the authority and focus of CITES are necessary to lower extraction to sustainable levels while protecting local livelihoods and rights.

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Encounter Frequency with the Urbanized San Joaquin Kit Fox Correlates with Public Beliefs and Attitudes Toward the Species

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Abstract
A systematic public survey can prove vital to resource managers as a means of quantifying willingness to protect endangered species, helping to focus education, and evaluating the factors that influence public beliefs and attitudes. During the fall of 2003, we conducted a postal survey of 879 randomly selected citizens of Bakersfield, California to assess the factors related to beliefs and attitudes regarding a robust population of endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) living within city limits. Of 248 respondents, 89% indicated familiarity with the kit fox. Of these self-identified knowledgeable respondents, 86% had seen an urbanized fox at least once. Those who reported the most encounters, however, were more likely to incorrectly perceive kit foxes as common or abundant rangewide, suggesting a failure or absence of education regarding species status and obstacles to recovery. Despite this misconception, many respondents appreciated (40%) or were neutral (45%) toward urbanized foxes and supported their protection (49%). Furthermore, respondent exposure to and appreciation of foxes were directly related, suggesting that this urbanized population may act as an ambassador for the species. As natural and low-density human landscapes are converted to urban and suburban uses, wildlife-human encounters will continue to increase. This study identifies some of the ways these encounters may influence public opinion.

Resumen
Una encuesta de opinión publica puede ser vital para los que manejan recursos como una manera de cuantificar la disposición de proteger especies amenazadas, ayudar a enfocar en la educación, y evaluar los factores que influyen las creencias y actitudes del público. Durante el otoño de 2003, hicimos una encuesta por correo de 879 ciudadanos de Bakersfield, California escogidos al azar para determinar los factores relacionados a las creencias y actitudes con relación a la robusta población dentro de los limites de la ciudad de la amenazada zorra desértica de San Joaquín (Vulpes macrotis mutic). De los 248 que respondieron a la encuesta, 89% indicaron estar familiarizados con la zorra desértica. De los que respondieron que se auto-identificaron como conocedores, 86% había visto una zorra urbanizada al menos una vez. Sin embargo, los que reportaron la mayor cantidad de encuentros eran los más propensos a incorrectamente identificar la zorra desértica como abundante en todo su territorio, lo que sugiere un fracaso o una falta de educación con respecto al status de la especie y sus obstáculos para la recuperación. A pesar de esta mala interpretación, muchos de los que contestaron la encuesta apreciaban (40%) o estaban neutrales (45%) hacia la zorra urbanizada y apoyaban su protección (49%). Aun mas, la exposición de los que contestaron la encuesta, y su apreciación por la zorra estaban directamente relacionadas, sugiriendo que esta población urbanizada puede actuar como embajador para la especie. Mientras los paisajes naturales y de poca densidad humana se convierten a usos urbanos o suburbanos, los encuentros de vida silvestre y seres humanos continuaran aumentando. Este estudio identifica algunas de las maneras en que estos encuentros pueden influencias la opinión pública.

Conservation efforts are more often successful when social and political factors are evaluated prior to implementation (Kellert 1985, Reading and Kellert 1993, Riley and Decker 2000, Rodriguez et al. 2003). This is perhaps most true in human-dominated landscapes, such as urban areas, where human interests are prioritized above those of wildlife, and where economic (e.g., property values) and social (e.g., property rights) considerations can inhibit conservation. Yet, as urban areas continue to grow, natural resource managers are frequently asked to mediate between the needs of people and urbanized wildlife (e.g., Kellert 1995). Solutions range from habitat mitigation to lethal control or translocation of nuisance animals. In the rare instances that conservation programs affect private lands or otherwise reduce availability of land for human uses, polarized citizen conflict often results (e.g., Peterson et al. 2002, 2004). It is in this environment that wildlife managers must carefully balance conservation priorities against the social implications of meeting these goals. Therefore, an accurate assessment of the factors that influence public opinion regarding rare species in urban environments is vital.

Red wolf (*Canis rufus;* e.g., Moore and Smith 1991), gray wolf (*Canis lupus*, e.g., Bath and Buchanan 1989), Key deer (*Odocoileus virginianus clavium*, e.g., Peterson et al. 2002, 2004), and numerous other endangered species recovery efforts have benefited from evaluating citizen beliefs, attitudes, and behaviors. One factor that routinely goes unstudied, however, is the impact that interaction with a species has in forming public opinion. Human-wildlife interaction, especially where large mammals are involved, also can increase indirect exposure to the species (e.g., media coverage or word of mouth) as people relate their experiences. When endangered wildlife coexists with humans in urban environments, the chances of interaction and potential consequences for conservation (both positive and negative) can be expected to increase.

The San Joaquin kit fox (*Vulpes macrotis mutica*) is an ideal model species for investigating the relationships between human-wildlife interaction and public opinion in an urban environment. A 2 to 3 kg canid that is adapted to arid lands, the kit fox was listed as endangered federally in 1967 and threatened in California in 1973 (U. S. Fish and Wildlife Service 1998). Approximately 95% of the shrub and grassland communities historically occupied by kit foxes have been converted to human uses, profoundly reducing recovery potential, bringing remaining populations into close contact with humans, and increasing likelihood of encounters. In fact, robust fox populations occur on highly altered private land in some urban centers of the southern San Joaquin Valley (Cypher et al. 2003). Because the extent of urban fox populations has only recently been appreciated by regulatory agencies, they are currently not identified as critical to the recovery of the species (U. S. Fish and Wildlife Service 1998). The largest of these populations, in the city of Bakersfield, is likely to become a future conservation priority. It occupies an important location for maintaining connectivity among natural lands and has been identified as a potential source population for reintroduction. Bakersfield, however, is rapidly developing. Meaningful protection of its foxes will certainly result in economic, social, and political consequences.

Clearly, an informed and sympathetic public will be necessary to successfully implement changes to urban land development that benefit the kit fox. Our informal interactions with Bakersfield residents over the past seven years indicated that positive sentiment and support for expanded protection existed for urban foxes. Citizens frequently reported encountering foxes within city limits and expressed appreciation and concern for their welfare. Furthermore, it appeared that people with the greatest frequency of interaction with the species were most concerned about its protection. Among this group were citizens who had a recurrent pastime of kit fox observation and feeding and who expressed knowledge and affinity for individual animals (Figure 1). Misconceptions regarding the species also were prevalent. Most importantly, citizens frequently were unaware or doubted that the species was endangered.

Our interactions with Bakersfield citizens, while useful in framing the issues regarding human-fox interactions in urban environments, were anecdotal and may have been misleading if applied directly to conservation and education programs. Therefore we conducted a systematic mail survey to evaluate relationships among public demographics, exposure to, knowledge of, and attitudes toward the kit fox. Our goals were three-fold: (1) assess public support for urban fox conservation; (2) identify beliefs and misconceptions to be addressed with targeted education; and (3) test the hypotheses that exposure to urbanized kit foxes positively relates to citizen knowledge of fox biology, appreciation of the species, and support for protection. While the results of this study are directly pertinent to kit fox conservation, they also yield information on relationships between human interaction with urban wildlife and public opinion that will prove useful to rare species conservation efforts in other urbanizing environments.

Study area

Bakersfield is located at the southern end of the San Joaquin Valley in central California. As of January 2003, the metropolitan area was approximately 580 km^2 (224 mi^2) with 394,234 residents (Greater Bakersfield Chamber of Commerce 2004). The urbanized area of Bakersfield grew by 23.6% from 1990-2000 (U.S. Census Bureau 2000) and future expansion is expected. San Joaquin kit foxes occupy golf courses, commercial and industrial developments, schools, parks, canals, drainage basins, undeveloped lots, and construction sites throughout the city (Cypher et al. 2003). During opportunistic trapping in the southwest sector of Bakersfield from 1997 to present, we captured 365 individuals a total of 812 times (Cypher unpublished data). Urban foxes consume a mixed diet of natural and anthropogenic foods, including rodents, birds, insects, refuse, pet food, and handouts from residents. Preliminary results indicate that reproduction and survival of the Bakersfield fox population is similar to that reported for natural habitat. A number of factors negatively affect urbanized kit foxes, including land conversion to higher density development and increasing traffic volume – both currently prevalent within Bakersfield.

Figure 1. San Joaquin kit fox eating a handout at a golf course community in Bakersfield, CA (Photo C. Van Horn Job).

Methods

To obtain information on citizen interaction with and perception of urban foxes, we designed a mail-back survey consisting of 15 questions. In 2003, this survey was delivered using the United States Postal Service to 879 Bakersfield residents. Recipients were randomly selected from telephone directories and screened for single-family and apartment dwellings using zoning maps in a geographical information system. To increase response rate we avoided technical jargon, and enclosed a self-addressed stamped envelope, a free pass to a local zoo, and a statement of purpose on California State University letterhead.

We began by asking whether the respondent knew what a kit fox was and prompted those responding negatively to forgo the remaining questions and return the survey. Two questions then gauged respondent exposure to kit foxes, 3 assessed respondent knowledge of kit fox biology, and 5 evaluated attitudes regarding foxes and their conservation. These questions employed multiple-choice responses with ordinal scaling where appropriate. An opened-ended question prompted respondents to express their concerns about kit foxes in the urban environment. We ended the survey with questions pertaining to respondent gender, age, and length of residency. The questionnaire was reviewed by 6 natural resource professionals and pre-tested on 24 randomly selected Bakersfield citizens. Questions were modified based on the responses of these test groups. To evaluate potential bias on the part of nonrespondents, we conducted a telephone survey of 160 households that had not replied to the postal survey. We successfully administered the survey to 27 of these residents.

We used contingency table analysis to test for relationships between citizen demographics, exposure to kit foxes, knowledge of fox biology, attitudes about foxes and their conservation. We recoded perceived abundance of kit foxes in the San Joaquin Valley by combining those who answered "almost none" and "few" into the category "rare" and those answering "common" or "abundant" into "common." Similarly, we recoded attitudes toward kit foxes by expanding the categories "like" and "dislike" to include both those with strong and mild feelings. Finally, respondents who reported encountering kit foxes weekly or monthly were recoded as having "frequent" exposure. We used chi-square tests for homogeneity to examine potential nonresponse bias by comparing answers to each question between the postal and telephone surveys. *P*-values ≤ 0.05 were considered statistically significant.

Results

We received 248 completed questionnaires for a response rate of 28%. Respondents varied in age (23% within 20 to 39 year age bracket, 41% within 40 to 59 age bracket, and 35% were 60 or over), typically had greater than five years of local residence (90%), and lacked gender bias ($\chi^2_1 = 0.42$, $P = 0.52$). Most individuals (89.1%) reported previous knowledge of kit foxes. The survey population and associated statistics are hereafter limited to self-identified knowledgeable respondents.

Eighty-six percent of those familiar with the San Joaquin kit fox reported seeing foxes within city limits, and 74.4% reported multiple encounters. Most respondents (81.7%) correctly identified night as the period of peak fox activity. Beliefs regarding overall abundance of kit foxes in the San Joaquin Valley were mixed, with many answering that kit foxes are abundant (7.8%), common (35.6%), few (30.1%), or of unknown numbers (26.0%). In general, respondents expressed positive (40.3%) or neutral (45.2%) attitudes toward urban kit foxes, felt that foxes caused no harm to people (48.9%, versus 28.8% who thought that foxes caused harm), and believed that people harmed foxes

(76.1%). A near majority of respondents supported protection of kit foxes within city limits (Yes = 48.6%, No = 17.9%, Neutral = 24.3%, Don't Know = 9.2%).

Our hypothesis that frequency of interaction with foxes would relate to citizen knowledge was upheld, but the relationship was not simple. With greater exposure to urban foxes, respondents were more likely than expected to correctly answer that the species is nocturnal ($\chi^2_6 = 34.36$, $P < 0.01$; Figure 2*a*), but also more often had the misconception that kit foxes are common rangewide ($\chi^2_6 = 33.76$, $P < 0.01$; Figure 2*b*). Respondents having only a single encounter with urban kit foxes were most likely to consider them rare throughout the San Joaquin Valley; those with no exposure were more frequently unsure of both activity and abundance.

There also was evidence supporting our hypothesis that citizen attitudes and frequency of encounter with kit foxes are correlated. Respondents who reported frequent encounters more often expressed appreciation of urban foxes, while those who had no interaction with the species generally were neutral ($\chi^2_6 = 14.00$, $P = 0.03$; Figure 3*a*). Likewise, there was a significant relationship between exposure and beliefs regarding whether kit foxes harm people ($\chi^2_6 = 14.25$, $P = 0.03$), with perception of threat appearing to decrease as interaction with urban foxes increased. Exposure was not related to beliefs regarding whether people harm foxes ($\chi^2_6 = 8.98$, $P = 0.18$) or support for urban fox protection ($\chi^2_6 = 10.36$, $P < 0.11$). Nevertheless, there appeared to be a general trend wherein those with greater exposure were more supportive of protection (Figure 3*b*).

To test whether knowledge related to attitudes, we compiled respondent answers to fox activity schedule and abundance into a composite knowledge index (CKI). The index consisted of 3 groups, those answering correctly to both questions (code = 2), those with 1 correct answer (code = 1), and those with no correct answers (code = 0). There was a significant relationship between CKI and attitude toward urban foxes ($\chi^2_4 = 15.01$, $P < 0.01$), and it appeared that more knowledgeable respondents held more favorable opinions (Figure 3*c*). Likewise, CKI and willingness to protect were related ($\chi^2_4 = 11.35$, $P = 0.02$). Approximately 50% of respondents who correctly answered one or more knowledge questions were in favor of protection (Figure 3*d*). In contrast, a majority (53%) of those who responded incorrectly to both questions were neutral toward protection.

Of the demographic variables we examined, only gender was related to beliefs and attitudes. There was support that men had more encounters with urban foxes ($\chi^2_3 = 7.60$, $P = 0.06$). Furthermore, men were more likely to view foxes as common or abundant (χ^2_2

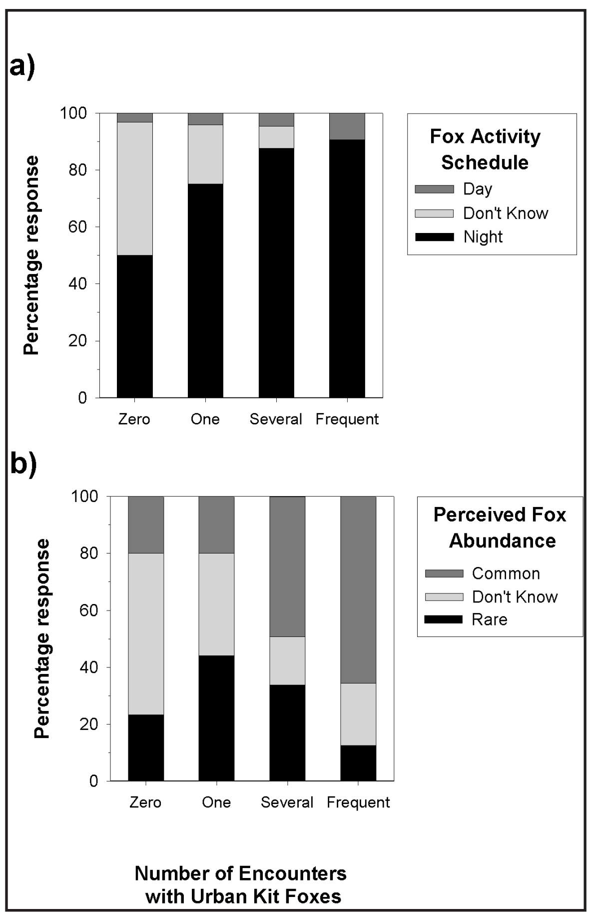

Figure 2. Respondent perception of fox activity schedule (a) and rangewide abundance (b) of the San Joaquin kit fox as a function of encounter frequency with urban kit foxes in Bakersfield, CA. Kit foxes are primarily nocturnal and have been Federally protected as endangered since 1967.

= 8.74, $P = 0.01$), while women appeared more likely to be unsure of fox population status. While there was no relationship between gender and attitude toward foxes ($\chi^2_2 = 1.58$, $P = 0.45$; Figure 3*e*), men appeared more likely than expected to oppose protection ($\chi^2_2 = 8.55$, $P = 0.01$; Figure 3*f*). Length of residency and age were unrelated to beliefs and attitudes.

There were relationships between all attitudinal questions, indicating consistency of response. Respondents who liked kit foxes in Bakersfield were more likely to support protection ($\chi^2_6 = 50.60$, $P < 0.01$) and feel that people harmed foxes ($\chi^2_4 = 18.28$, $P < 0.01$), but were less likely than expected to feel that foxes harmed people ($\chi^2_4 = 45.13$, $P < 0.01$). Likewise, those in favor of protection were less likely to feel that foxes harmed people ($\chi^2_6 = 24.69$, $P < 0.01$), and more likely to feel that people harmed foxes ($\chi^2_6 = 31.65$, $P < 0.01$).

In general, those who had previously stated appreciation for urban foxes used our open-ended inquiry ("What is your greatest concern about foxes living in Bakersfield?") to express concerns for fox welfare, while those who held a negative attitude toward urban foxes expressed concerns for human welfare. Primary concerns for fox welfare included harm by people or domestic animals, road kill, urban sprawl, loss of habitat, and insufficient protection (listed in decreasing order of response). Others were apprehensive that foxes would halt development, spread disease, attack humans or domestic animals, and that protection would infringe upon citizen rights, or that "environmentalists" would cause harm on behalf of kit foxes.

There were no significant differences between answers provided by respondents and the nonrespondents contacted by telephone. Nevertheless, nonrespondents encountered kit foxes less frequently (70% versus 86% for

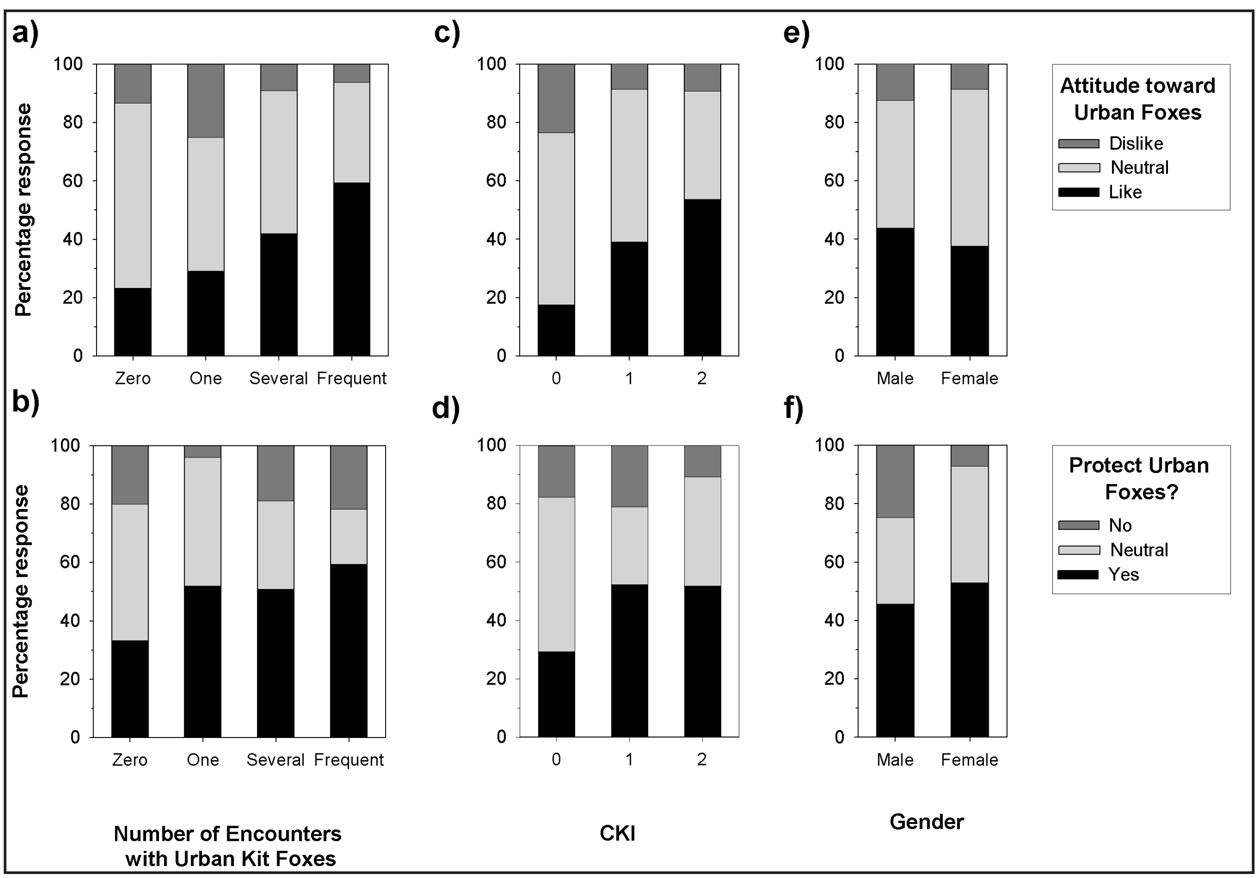

Figure 3. Interaction between respondent attitude and (a) frequency of encounter with urban San Joaquin kit foxes, (c) composite knowledge index (CKI), and (e) gender. Also, interaction between willingness to protect urban kit foxes and (b) encounter frequency, (d) CKI, and (f) gender. CKI coded as 3 categories: repondents answering correctly that kit foxes are most active at night and rare throughout their range (code = 2), respondents with one correct answer (code = 1), and respondents with no correct answers (code = 0).

respondents), less often correctly answered that foxes are nocturnal (74% versus 82%), and were more often neutral toward urban foxes (57% versus 45%). Therefore, the respondent pool may have had greater knowledge of, appreciation for, and frequency of encounter with urban foxes than the general populace. There is no reason to suspect, however, that there was a non-response bias to the significant relationships among demographics, exposure, beliefs, and attitudes.

Discussion

There appears to be widespread interaction between citizens of Bakersfield and urbanized kit foxes. Furthermore, we found strong support for our hypotheses that interaction with urbanized foxes correlates to public beliefs and attitudes. In particular, the observed relationship between exposure and beliefs may have important implications for the recovery of the species. While the knowledge that kit foxes are nocturnal increased among respondents who had greater encounter frequency, we also found a relationship between encounter rate and the misconception that the endangered kit fox is common rangewide. These results suggest that citizen perception of the species was based on direct experience (the greater the encounters, the greater the perceived abundance) rather than formal education. Given that the kit fox has been listed as endangered for nearly forty years, there would appear to have been ample time to educate the citizenry regarding its conservation status. Either the relationship between encounter frequency and perception of abundance is strong and persistent, or communicating information to the public has not been a conservation priority. In support of the latter, current access by Bakersfield citizens to information regarding the kit fox is limited to a local zoological park display and periodic news stories, which often result from human-fox conflict. Management agencies (federal and state) and conservation organizations do not have local or regional education programs for this species. We suggest that targeted information on kit fox legal status, justification for protection, and threats to recovery may be an important part of future initiatives. While access to factual information has been shown to influence public behavioral beliefs (e.g., Luaber and Knuth 2004), information appears to affect people in different ways. Therefore, a means of selecting the type of information for dispersal and testing the effectiveness of the education program is warranted.

Despite the misconception of kit fox abundance, citizens generally reported positive feelings toward foxes and, more often than not, were in favor of protective measures for the urban population. The kit fox was only infrequently viewed as a direct source of harm, unlike public perception of many larger carnivores that are implicated in human or livestock depredation (Clark et al. 1996, Kellert et al. 1996). Some authors suggest that increased knowledge of wildlife is simply used to support a pre-existing perspective (Reading and Kellert 1993, Kellert et al. 1996). When respondent knowledge of kit foxes was examined as an index (CKI), however, there was a relationship to both attitude and willingness to protect. Most notably, those who answered both knowledge questions incorrectly rarely (17.6%) expressed appreciation of urbanized animals, but a majority (53.7%) of the most knowledgeable respondents mildly or strongly liked fox presence in Bakersfield. It remains unclear whether knowledge was a correlate to some other variable that affected attitudes, or in fact contributed to the formation of attitudes toward the urbanized fox population.

Respondents with greater encounter frequency may consider the species common, which in turn may decrease the perceived need for fox protection.

For example, men appeared to have more frequent encounters, more often thought of foxes as common, and were less supportive of protection. Perhaps gender affects the way an individual uses information to make decisions about wildlife issues, as some authors suggest (e.g., Lauber et al. 2001, Dougherty et al. 2003). Teal and Loomis (2000), however, did not find differences between the sexes in willingness to pay for environmental programs for wildlife in the San Joaquin Valley. An alternative hypothesis is that gender-specific behaviors affected exposure to foxes (e.g., men may have worked or engaged in leisure activities more often outside or at night), and the level of exposure (not gender) influenced beliefs and attitudes toward the species.

Specific concerns expressed by residents provided further evidence of misinformation. Although citizens who worried about fox welfare identified sources of mortality with remarkable accuracy (e.g., vehicle strike, predation by domestic animals, urban development and associated habitat loss), some anxieties over urban foxes (inhibited urban development, disease transmission, attacks on people or domestic animals) were factually unsupported. A habitat conservation plan for Bakersfield was implemented in 1994 to minimize the impact of endangered species rulings on urban development (Metropolitan Bakersfield Habitat Conservation Plan 1994). Under the terms of this plan, the core conservation strategy for kit foxes entails acquisition of natural habitat outside of Bakersfield. Required mitigation for urbanized kit foxes is limited to pre-construction surveys where dens are known to occur (strongly biased toward areas of past research) and excavation of occupied dens prior to land conversion. Therefore, only in rare cases (e.g., presence of natal dens) do resident foxes impact development, and these impacts are in the form of delays as opposed to project preclusion. The San Joaquin kit fox has never been implicated in the transmission of infectious diseases (e.g., canine parvovirus, canine distemper virus) to domestic animals or zoonotic diseases (e.g., rabies) to humans. Thus, although they can never be discounted as a vector of disease, this risk appears to be minimal. Finally, there are no reports of kit fox attacks on humans or domestic animals, although domestic dogs may be a source of mortality for urbanized foxes (Cypher unpublished data).

The results of this survey in conjunction with our informal discussions with residents of Bakersfield suggest three important conclusions. First, citizens appear to favorably regard the urban fox population. Many express enjoyment at observing foxes and some feed the animals that frequent their homes or businesses. Second, residents are misinformed about kit foxes in the urban environment and in general. The public largely does not comprehend the threat of extinction this species faces. Third, beliefs and attitudes appear to be based at least in part on personal experiences, including frequency of exposure to urbanized foxes, which of course varies widely among people. Encounters between wildlife and humans are likely to increase as natural habitats come into closer and more fragmented contact with human landscapes. How citizens interpret the resulting encounters with wildlife may strongly influence attitudes towards conservation. In this case, the positive relationship between citizen exposure to and appreciation of foxes indicates that the urbanized kit foxes of Bakersfield may act as an ambassador population for the species. A targeted education program, however, is needed to promote an accurate and unbiased perception of kit fox abundance and conservation status.

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A Landscape-Wide Distribution of *Pan-paniscus* in the Salonga National Park, Democratic Republic of Congo

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Abstract

A total of 15 discrete communities of bonobos (*Pan paniscus)* in the Salonga National Park (SNP) are reported: nine in the northern sector and six in the southern sector. These communities occupy about 1120km^2, representing only 3% of the total area of SNP. Average community niche width was estimated to be ≈80 km. Mean distances between communities were 57 km (SD ± 32) and 89 km (SD ± 70) in the northern and southern sectors respectively; thus, inter-community interactions may not occur. Adjusting densities published by Sabater-Pi and Vea (1990), Uehara (1988), (Van Krunkelsven *et al*. (2000, 2000a), and Kano (1992) to account for patchiness and patch width, the population of Salonga totals 1,440 bonobos at minimum: 864 and 576 bonobos in the north and south sectors respectively. The estimate of 1,440 bonobos in the SNP compels a complete rereading of both methods used to estimate bonobo populations in the wild and a re-setting of conservation action priorities. These results provide insights for a new species-targeted approach for bonobo conservation in the SNP to be effective.

Resumen

Hay un total de 12 comunidades discretas de bonobos (Pan paniscus) en el Parque Nacional de Salonga (SNP, por sus siglas en ingles) fueron reportadas: 8 del sector del norte, y cuatro del sector del sur. Estas comunidades ocupan aproximadamente 1120km2, que representan solamente el 3% del área total del SNP. El estimado del tamaño del nicho promedio de la comunidad fue de ≈80km. Las distancias promedio eran de 57km (SD+ 32) y 89km (SD + 70) en los sectores del norte y el sur respectivamente, por ende puede que no ocurran interacciones inter-comunitarias. Ajustando las densidades publicadas por Sabater-Pi y Vea (1990), Uehara (1988), (Van Krunkelsven et al. (2000, 2000a), y Kano (1992) para tomar en consideración la fragmentación y tamaño del fragmento, la población total de Salonga es de 1344 bonobos como mínimo: 864 y 480 bonobos en los sectores norte y sur respectivamente. El estimado de 1344 bonobos en el SNP hace un llamado a la reevaluación tanto de los métodos utilizados para estimar la población silvestre de bonobos como una reestructuración de acciones prioritarias de conservación. Estos resultados nos proveen un mayor entendimiento para un nuevo enfoque al identificar especies, para que la conservación del bonobo en el SNP sea efectiva.

Introduction

A fundamental aspect of conservation biology is describing the distribution of plants and animals (Sutherland 1999, 2000). Species distributions are often associated with availability of food (Coe 1984) or predation (Cowlishaw and Dunbar 2000), particularly for primates, and can capture the natural history of a given species (Darwin 1860). For conservation purposes, knowledge of the distributions of the species of interest is key to the allocation of conservation effort over time and space and is, together with species abundance, a determinant of effective and sound conservation strategy.

Bonobos *(Pan paniscus*) occur only in the Central Basin of the Congo River. It was the last species of great ape to be described, receiving full species status in 1933 (Reinartz and Inogwabini 2000; Kempf and Wilson 1997; Kingdon 1997; Kano 1992; Coolidge 1933). The distribution of the species was not described accurately until early 1980s when Kano (1979) undertook a survey in the region to document bonobo occurrence and threats to its conservation. Kano (1982, 1984) used both short field trips and interviews to assess their distribution. Salonga National Park (SNP) which encompasses *about* 36,000 km^2, was created in 1970 to protect the then supposed significant populations of bonobos and a great variety of other wildlife and the lowland tropical rain forest (IUCN 1992, Matuka 1975). However, previous range-wide surveys mistakenly reported that bonobos were absent from this massive wilderness (Kano 1979; Badrian and Badrian 1977). Meder *et al*. (1988) and D'Huart (1988) confirmed the presence of the species in the southern sector. It was only in the late 1980s that bonobos were reported in the northern sector near Watshi-Nkengo (D'Huart 1988) and confirmed by an independent scientific inquiry (Van Krunkelsven *et al*. 2000).

Since the confirmation of bonobo populations in both sectors of the park, several site-specific studies have been launched to study species abundance and distribution (e.g. Zoological Society of Milwaukee, Max Plank Institute, Lukuru Wildlife Research Project, Wildlife Conservation Society) and several others are being planned in the short and mid-term. Thus far, however, no single study has provided distribution of bonobos for the entire SNP, information that would guide conservation action and the implementation of new research programs. Bonobos occupy a maximum territory of 135,000 km^2 (Kortlandt 1995, Kano 1984) confined by two large river systems: the Congo-Lualaba and the Kasaï-Sankuru (Kortlandt 1995). SNP sits at the heart of this range and represents approximately 27% of the total historical distribution of bonobos. Thus, providing ecological knowledge within the SNP is of paramount importance for conservation strategies for the species.

This paper presents the first data on the distribution of bonobos SNP gathered over the last eight years. This study provides geographical data on zones where bonobos proved to be present by field teams either by nests or by direct observation. We also discuss different patterns of bonobo distribution in the SNP in light of human pressures, food availability, physical lay of the land, and indications of recent and ancient forest history.

Study site

SNP (figure 1) is located in the central basin of the Congo River, in the Democratic Republic of Congo (DRC), and stretches over four provinces (Equateur, Bandundu, and the two Kasais), and is divided into two sectors, respectively called SNP North and SNP South. The habitat is predominantly mixed mature lowland tropical forest (Gautier-Hion *et al*. 1999; Evrard 1968) with large expanses of seasonally flooded and inundated zones. Characteristics of inundated zones are open understorey, with important tree communities composed of *Uapaca heudelotii, Uapaca guineensis* and *Guibortia demeusi, Raffia sese,* and *Pandanus candelabrium* (Inogwabini 2005; Gautier-Hion *et al*. 1999; Evrard 1968). *Terra firma* mixed mature forest includes indicative species such as *Scorodophloeus zenkeri*, *Anonidium manii*, *Polyalthia suaveolens*, *Diospyros sp.*, etc. Patches of mono-dominant *Gilbertiodendron dewevrei* occur in small but unbroken stretches (Kortlandt 1995; Evrard 1968). *Marantaceae* stands (i.e. *Haumania librechtsiana* and *Megaphrynium macrostachii*) occur frequently in the understorey and sometimes constitute pure monospecific vegetation cover strata.

Forest altitudes vary between 300 and 700 m (Evrard 1968) and SNP is criss-crossed by a dense network of small rivers that feed the main systems of the Momboyo-Luilaka, the Salonga-Yenge and Lomela-Tshuapa (Inogwabini 2005) which all flow to the main Congo River. Mean annual rainfall oscillates between 2007 and 2106 mm (Griffiths 1972, Evrard 1968). The mean annual temperature is 24.5°C. Two dry seasons (long: July-September; short: January-February) and two rainy seasons (long: March-June; short: October-December) are characteristic of the region.

Materials and methods

Data presented in this study were collected using two different conventional methods: strict line transects and reconnaissance walk surveys. To document bonobo presence, evident bonobo signs such as nest sites, dung, food remains, knuckleprints and direct sightings were recorded. Nest sites were georeferenced with hand-held Garmin GPS units. The geographic coordinates of individual nest sites were plotted on a map using ArcView computer map package (Waters and Shockley 2000). Because previous studies indicated that a social unit of bonobos is a geographically stable community that ranges over 22 km^2 (Badrian and Badrian 1984), nest sites whose spatial distributions were clumped together within the range of ≈5 km straight-line were considered to be part of the same community. This range conforms to the study at Etate by the first author between 2000 and 2002, which indicated a radius of ≈5 km for group range (unpublished data). To provide the spatial extent of geographical range of each community, geographic centers of nest site locations were plotted and then buffered by circles of 3 km radius, ∂, the home range size provided by Badrian and Badrian (1984). A further buffer of 2 km was added to capture any need by bonobos to use the fringes of their habitats. Thus a radius to 5 km was used in the formula $A = \pi\partial^2$, to obtain the total range width, assuming that the latter was circular. Community size estimates were obtained through multiplying range width by known densities. No densities were calculated in this study since sample sizes were often too small where conventional line-transects were used. We calculated mean distances between community ranges per sector by simply summing straight distances (obtained with ArcView distance tool) between centers of individual ranges divided by number of communities.

Results

A total of 15 discrete communities were found in SNP (Figure 1). There are nine communities in the northern sector: (1) Bolafa-Yongo, (2) Etate, (3) Ikolo, (4) Isanga-Imoto (5) Kinki-grotte, (6) Lokata, (7) Luputa, (8) Ngomba and (9) Yafala (figure 1). The six communities of the south are: (1) Boangola, (2) Beminyo, (3) Ila-Ediki, (4) Lokofa, (5), and (6) Luikotale (figure 1). The northern communities occupied a total area of ≈ 640 km^2 in discrete ranges of maximum width ≈ 80 km^2. The four southern communities occupied a total area of ≈ 320 km^2. This makes a total area of ≈ 960 km^2 of bonobo occupancy, merely ≈ 3% of SNP. The mean distances between ranges were 57 km (SD ± 32) and 89 km (SD ± 70) in the northern and southern sectors respectively.

Estimates of bonobo density vary between ≈ 0.4 individuals/km^2 (Sabater-Pi and Vea 1990; Uehara 1988) and ≈ 3 individuals/km^2 (Van Krunkelsven *et al*. 2000a; Kano 1992) with a mean estimate of 1.2 for Salonga (Van Krunkelsven *et al*. 2000). Both the minimum and maximum densities were used to calculate population size. The use of 1.2 bonobos/km^2 is justifiable because this is the most recent, if not the only, estimate for the SNP. With that density estimate, the nine communities of the northern sector number a maximum of 864 bonobos while those of the southern sector 576 bonobos. This makes a total of 1,440 bonobos in the entire SNP. The minimum population size would be 346 and 230 individuals for the northern and southern sectors respectively.

Group sizes also vary across the bonobo's range, from 4 (Thompson 1997) to 15 individuals/group (Badrian and Badrian 1977). Using the upper limit, each community identified has between ≈2 and ≈6 groups within the 80km^2.

Discussion

We estimate that the 15 communities identified number only about 1,440 bonobos for the entire SNP. This is a striking result and compels a complete rereading of both methods used to estimate bonobo populations in the wild and a redrafting of conservation action priorities. On the methods front, the common practice has been to multiply density estimates by total area to obtain population estimates. Extrapolation using this conventional method would obtain a minimum of 14,400 (density estimate ≈ 0.4) and a maximum of 43,200 bonobos (density estimate ≈ 1.2) in SNP alone. Numbers obtained through the use of known communities and range size account for only 9% of the minimum or 3% of the maximum population estimated by flat-map calculations. Some authors (e.g. Van Krunkelsven *et al*. 2000) have cautioned against crude density estimates obtained in this way, as these estimates do not take into account ranging ecology and may inadvertently affect conservation effort by obscuring the reality on the ground. This paper shows that extrapolation of bonobo densities over large flat-area maps is inaccurate and should be viewed with caution. The study suggests that because bonobos have patchy distributions; the best estimators for their populations are nested estimators that take into account discrete communities discontinuously spread over the space. The only way to achieve this throughout the entire range is first to get accurate patch distribution maps, and get to census patch by patch, which is a laborious, time and money consuming process, and can come only from long-term field surveys. However, it remains the most sensible approach if we require precise population estimates.

Bonobos are known to occur in patches (Kortlandt 1995; Alers *et al*. 1992; Kano 1984) however reasons for this distribution feature are not yet clearly elucidated. Kortlandt (1995) argued that such a distribution resulted from major flooding zones within the core range, a sleeping sickness epidemic between 1895-1900, high hunting pressure, and forest exploitation. The bonobo populations described here have not been observed ranging in wet areas, although footprints were observed at the fringes of *terra firma* muddy soil both at Etate and Bolafa-Yongo. The fact that ≈ 50% of the northern sector of SNP is inundated during the heavy rainy seasons (Gautier-Hion *et al*. 1999; Evrard 1968) may help explain the paucity in bonobos in this sector. A reduced population in the southern sector, where the rainy season affects little of the *terra firma* forest strata, does however compel other explanations. The conservation community thought that the remoteness of this region would have had deterred heavy human incursion into SNP. In reality, the region has been exposed to massive human movements through a well-established trail system for many years (see Figure 1). During colonial times, trails such as Amateka–Bonima were used to extract copal and wild rubber from the forest and carry them to ports where they were loaded onto steamboats for exportation (Bom'oa Nkoso, *personal communication*). The trail network connects the deep forest of the Equateur Province to the mineral rich provinces of Kasai, and may have served as a commercial route for forest products for decades. Although no particular patterns of bonobo distribution in relation to these trails seem to emerge (see Figure 1) it is logical to infer that the actual distribution of bonobos in both sectors is indeed a result of human history in the region and that the trail network may have played a significant role in shaping it.

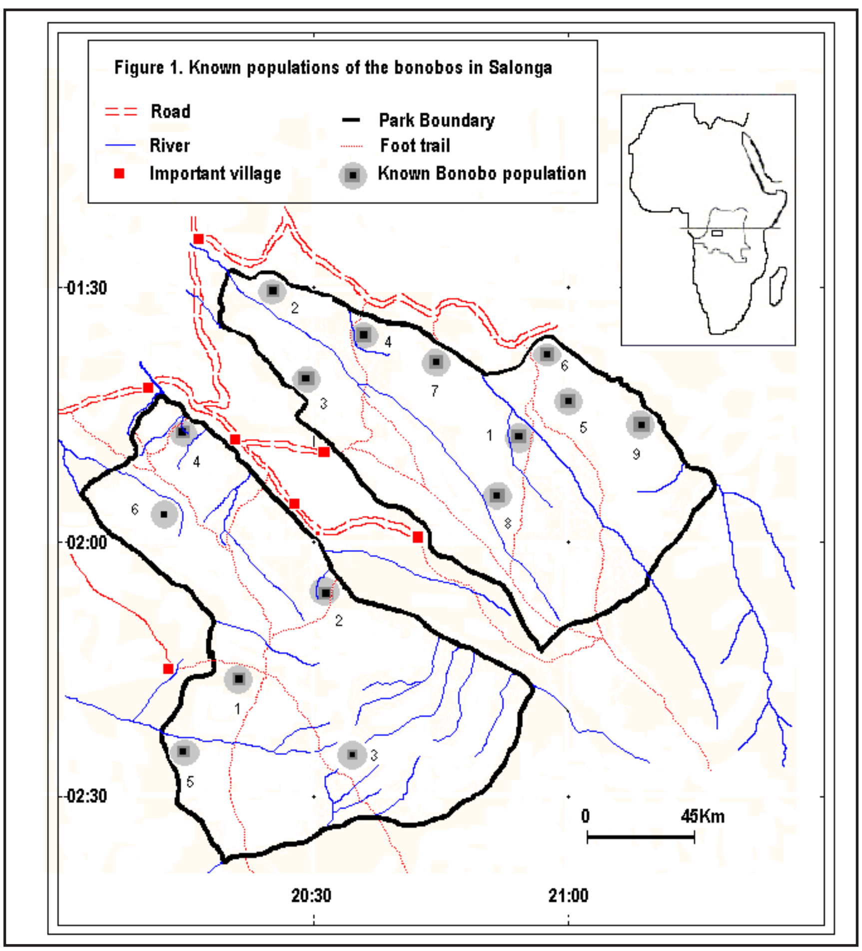

Figure 1. Known populations of the bonobos in Salonga

The conclusion that human history in the region may have played a role in shaping actual bonobo distribution remains valid even if one considers food availability as a determinant distribution factor. The bonobo food matrix comprises significant quantities of *Haumania liebrechtsiana* (Sommer *et al*. 2004; Malenky and Wrangham 1994; Idani *et al*. 1994; White 1992; Wrangham 1986; Badrian and Malenky 1984; Kano and Malavwa 1984, Kano 1983, Badrian *et al*. 1982; Horn 1980; Susman 1979) which is available year-round even during periods of fruit shortage which might otherwise limit group size and distribution. *Haumania liebrechtsiana* is found throughout both sectors of the SNP (Inogwabini *et al.* 2000) hence food availability would not explain a reduction in bonobo numbers.

Different communities of the bonobos in the SNP are under different human pressure levels. The community impacted most heavily is that of Ikolo (3 northern sector, Figure 1). In 2000, Ikolo was the most heavily poached region of the SNP, where 56 cable snares were removed for a sampling effort of 9km of straight line transects. Armed people were also reported to be active in this zone, apparently supplied with ammunition and automatic weapons by different fighting factions to provision troops on the front lines with bushmeat. Other bonobo communities exposed to high levels of poaching are those of Lokata and the Kinki-Grotte region, since the Institut Congolais pour la Conservation de la Nature (ICCN) has had only limited authority to enforce the law since the park's creation in 1970 (IUCN 1992). The *Kitawalists*, a neo-Africanist animist group, invested the zone to take refuge in the late 1960s after being defeated by the Congolese national army (IUCN 1992; D'Huart 1988). A further threat to bonobos residing in this region was the outbreak of the 1998 war as different troops alternatively occupied the strategic station of Lokalo, less than 30km from Kinki. Troops at Lokalo obtained food from the Kinki region of the park (Mulomba *personal communication*). In 2000, an infant bonobo captured from the zone of Lokalo was seized in the town of Boende (Inogwabini *et al*. 2000). The communities of Ngomba and Beminyo are also exposed to high hunting pressure, particularly with cable snares and arms. In 1997, Van Krunkelsven et al. (2000) came across a gang of poachers near the region of Ngomba; a single poacher had more than 300 bullets for automatic AKA machine guns. In 2001, the Zoological Society of Milwaukee (ZSM) research team discovered great numbers of snares and other evidence of poaching, such as elephant bones, hunting camps, and shot-gun cartridges, in the Beminyo region. The Conservator confirmed that patrols rarely reach this area far from headquarters, and it has been under siege by armed poachers (Bofenda, *personal communication*). Other communities are in better shape only because of their proximity to SNP's headquarters or patrol posts (e.g. Lokofa (4) in the southern sector, Figure 1) or, to more recently established scientific research bases (e.g. ZSM at Etate (2) in the northern sector, Max Planck Institute at Luikotale (5) in the southern sector, figure 1).

The mean distances between known communities are large. Using blood samples from captive bonobos, Reinartz (1997) and Reinartz *et al*. (2000) found that their geographical origins could be differentiated genetically. Long distances between communities may explain genetic differentiation, as discrete populations may not have interacted with their neighbors for long spans of time. Furthermore, the SNP river network separates the park into five broad blocks: (1) Lomela-Salonga, (2) Salonga-Yenge, (3) Yenge-Loile, (4) Luilaka-Lokolo, and (5) Lokolo-Lokoro (see Figure 1). These major rivers serve as natural barriers to bonobo interactions, implying that each sub-population in a river-limited block is a distinct conservation unit that may exhibit a specific ecological or genetic character (e.g. Eriksson *et al*. 2004). An illustration of this is that bonobos at Etate build ≈ 11% of their night nests on the ground, a habit that has not been documented in any other bonobo communities in the SNP.

The small size of the total population of bonobos in SNP, long distances between subpopulations and potential ecological and genetic impacts warrant a reshuffled species-targeted conservation strategy. Current conservation activities in the SNP operate from the park's six headquarters and advanced patrol posts located outside the park. Guards on patrol follow different itineraries based on river and trail systems with no precise objectives. This has to change if the protection of bonobos is the prime conservation objective in SNP as pledged in most official documents. Concretely, the strategy should focus on redeploying guard patrol posts and patrol itineraries to target locations with *known* bonobo populations. This means that 12 patrol posts have to be relocated nearer to known communities (figure 1). Guards posted here should be better trained to track animals in the forest and to document some important population parameters such as group size and numbers of offspring. As a consequence of this species-targeted strategy, the guard force's performance should be judged on precise indicators of their impact on the bonobo population to each post. By placing patrol post near bonobo communities, conservation aims are much more likely to be achieved. The ZSM has been testing this approach for the last five years in the Etate Region. Although the long-term benefits of this approach are not yet fully understood, the experience in Etate shows that bonobos have come closer to the trail network and can regularly be observed even though there is no habituation program. The backdrop of this strategy lies, however, in the sustainability of funding to support guards. Inogwabini *et al*. (2005) documented low numbers of guards, low salaries, relatively unqualified and ageing personnel for the entire protected area system in the DRC, a situation which is worse in SNP where geography constrains sound and sustained conservation efforts. Qualified personnel with material support is key to this species-targeted conservation approach, implying that sufficient resources need to be raised to train qualified guards and to sustain their action in the future. This is highly difficult in a country where insecurity waves are quasi-permanent but the future of small isolated bonobo populations depends on how well we succeed in securing resources to protect them physically. What is at stake is critically important, and we need to act.

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Report from the Field
U.S. Gutting Protections from Destructive Gillnet and Longline Fishing

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While international efforts are underway to explore high seas marine protected areas for the purpose of protecting highly migratory species, the U.S. government is increasingly gutting model marine closures that are protecting such species as the critically endangered leatherback and loggerhead sea turtles.

For example, since early 2004, National Oceanic and Atmospheric Administration (NOAA) Fisheries has been advocating the use of "circle hooks" (which are claimed to reduce the number of sea turtles that are hooked internally) as a technological fix so that they can reopen areas once closed to longlining. This type of fishing threatens populations of leatherback and loggerhead sea turtles, as well as albatross, sharks, billfish, and marine mammals. According to data obtained from NOAA Fisheries, as many as 4.4 million sea turtles, seabirds, sharks, billfish, and marine mammals are injured or killed by longlines each year in the Pacific.

The problem with the change to the reliance on circle hooks as the means to protect these species is that there are numerous scientific flaws in the research methodology and findings of the original industry-sponsored circle hook study. Despite these numerous scientific flaws, NOAA Fisheries used the results from the study to rush into place the new regulation requiring the use of circle hooks. This was done without the data having been checked internally for mistakes or flaws, independently peer reviewed, or published. The new regulation is itself loosely applied and entirely exempts tuna longlining.

What has been overlooked is that replacing fishery closures with the circle hook does not address the issue of high levels of bycatch of other species, nor does it reduce fishing effort like the closures did.

In Hawai'i and the Atlantic, longline fishing for swordfish and tuna is once again being allowed in areas where dangerously high bycatch levels had previously led to closures.

Additionally, this past September, the Pacific Fishery Management Council passed a measure that would allow exemptions to time and area closures for gillnet fishing intended to protect these species along the California coast. Until NOAA Fisheries reviews and signs off on this, the council plans to put into place interim exemptions that could go into effect as early as April 2006. The council is also expected to attempt to overturn a ban on longlining on the Pacific Coast that went into effect in 2004.

In short, established and proven conservation measures to protect highly migratory marine species are being gutted and overturned at the request of industry and fisheries councils that are dominated by industry and plagued by conflicts of interest.

To date, 1,007 scientists from 97 nations, 231 nongovernmental organizations from 62 nations, and thousands of other citizens from many countries have called on the United Nations urging it to implement a moratorium on high seas pelagic longlining and gillnet fishing in the Pacific. Eminent scientists including biologist Dr. E. O. Wilson, Dr. Jane Goodall, DBE, and Dr. Sylvia Earle have signed this letter to the United Nations.

Rather than reverse a decade of model conservation measures, the United States needs to heed their advice and protect all U.S. waters from these destructive fishing practices.

For an analysis of the circle hook rule and science download the report at:

http://www.seaturtles.org/press_release2.cfm?pressID=222

To sign on to the letter to the United Nations please visit:

http://www.seaturtles.org/actionalertdetails.cfm?actionAlertID=43

Opinion

Silk Purse or Sow's Ear? The Pombo Bill and the Endangered Species Act

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After more than thirteen years of gridlock, a bill to reauthorize the Endangered Species Act (ESA) finally passed the U.S. House of Representatives on September 29, 2005. The bill, H.R. 3824, titled the Threatened and Endangered Species Recovery Act of 2005, was sponsored by one of the ESA's most vociferous critics, Representative Richard Pombo (R-CA), chairman of the House Resources Committee. Pombo rammed his bill through the House with the speed of a Vegas wedding: introducing it, holding a hearing on it, marking it up in committee, and taking it to the House floor in less than two weeks.

While the House adopted Pombo's bill by a vote of 229-193, the bill was nearly derailed by a bipartisan substitute sponsored by Representatives George Miller (D-CA) and Sherwood Boehlert (R-NY). The substitute was narrowly defeated by a vote of 216-206. A shift of a mere six votes on the substitute would have derailed Pombo's bill.

Given the speed with which Pombo moved his bill through the House, its full impact on the ESA is only now becoming clear. A review of the bill reveals that it would undermine the fundamental protections of the ESA in several ways:

- Circumvents section 7 consultation. The Pombo bill circumvents the requirement in section 7 of the ESA that federal agencies consult with the U.S. Fish and Wildlife Service or the National Marine Fisheries Service to insure that their actions do not jeopardize the continued existence of listed species. The Pombo bill authorizes the creation of unspecified "alternative procedures" to consultation, potentially allowing agencies to bypass consultation altogether. In addition, the Pombo bill exempts habitat conservation plans and associated incidental take permits from section 7 consultation.
- Exempts pesticide use and regulation. The Pombo bill exempts all use and regulation of pesticides from ESA requirements for at least five years, no matter how severe the impact on endangered species. Under the Pombo bill, compliance with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act is deemed sufficient to comply with the ESA.
- Eliminates habitat protection. The Pombo bill eliminates requirements for the designation and protection of critical habitat. While the Miller-Boehlert substitute also would have eliminated critical habitat, it replaced it with a requirement that habitat necessary for species recovery be identified in a recovery plan, it adopted a strong statutory definition making clear that any action that impairs the recovery of a species jeopardizes its continued existence, and it mandated that federal agencies consider the impact of their actions on such habitat during section 7 consultation. Those provisions, particularly the strong jeopardy definition, would have made recovery the central focus of the law, strengthening its effectiveness. The Pombo bill contains none of these safeguards, making the recovery of endangered species far less likely and the extinction of species far more likely.
- Undermines section 9 take prohibition and section 10 incidental take permit requirements. The Pombo bill simultaneously undermines two of the most important provisions of the ESA: the section 9 prohibition against take of endangered species and the section 10 requirements for incidental take permits. Under the Pombo bill, a developer can demand that the U.S. Fish and Wildlife Service determine, within 180 days, whether a proposed

development will result in take of a listed species. If, for any reason whatsoever, the Fish and Wildlife Service fails to make that determination within the allotted time, the developer is free to go forward with the development regardless of how much take of listed species will occur. Moreover, even if the Fish and Wildlife Service meets the deadline and determines that the proposed development will result in take of listed species, the developer can then demand full compensation from taxpayers for the fair market value of the proposed development in exchange for not going forward with it. The Pombo bill contains no restrictions on how many times a developer can obtain compensation for different proposed developments on the same location. Thus, a developer could propose to open a casino in the midst of endangered species habitat, demand and receive millions of dollars in compensation from taxpayers for not killing endangered species, then propose a shopping mall on the same location and receive millions more in compensation for that proposal. Consequently, the Pombo bill removes any incentive for landowners to apply for incidental take permits and to develop habitat conservation plans under section 10.

- Politicizes the use of science. The Pombo bill politicizes the use of science in endangered species management by directing the Secretary of the Interior to promulgate regulations detailing what constitutes best available science and by imposing new bureaucratic requirements restricting the types of scientific information that can be used in endangered species conservation decisions. For example, by requiring that data be empirical, the bill limits the use of important tools, such as population models and projections.
- Eliminates the National Oceanic and Atmospheric Administration from marine species conservation. The Pombo bill strips responsibility for management of endangered marine species from the Secretary of Commerce, acting through the National Oceanic and Atmospheric Administration, and places that responsibility with the Secretary of the Interior, acting through the U.S. Fish and Wildlife Service. However, the Pombo bill fails to provide additional resources for the Fish and Wildlife Service to carry out these added responsibilities and it fails to ensure that more than 30 years of National Oceanic and Atmospheric Administration expertise in marine species conservation will be transferred as well.

Although Representative Pombo has been relentlessly critical of the ESA for, in his view, failing to recover species, the changes his bill will make to the ESA make species recovery even less likely. Eliminating protection for critical habitat, undermining the prohibition against take, circumventing federal agency obligations to consult on agency actions that may harm endangered species, and removing any reason to develop mitigation for harmful activities all add up to a wholesale retreat from the ESA's goal of saving endangered species and the habitats upon which they depend.

The outlook in the Senate for the Pombo bill and, ultimately, the ESA is uncertain. Senator James Inhofe (R-OK), chairman of the Senate Environment and Public Works Committee has expressed support for the Pombo bill. On the other hand, Senator Lincoln Chafee (R-RI), the chairman of the Fisheries, Wildlife, and Water Subcommittee, as well as Senator Hillary Clinton (D-NY), the Subcommittee's ranking member, have indicated that they plan to take a more deliberative approach to ESA reauthorization.

While ESA reauthorization is long overdue, the Senate should resist the urge to rush to judgment. Responsible reauthorization of the ESA should include incentives for conservation by private landowners, a strong and meaningful focus on species recovery, enhanced conservation and management of endangered species habitat, and greater participation by the states in endangered species management. While Representative Pombo claims that his bill addresses these issues, in fact it will eviscerate the ESA. Consequently, the Senate should start from scratch rather than taking up the Pombo bill. As the old saying goes, you can't make a silk purse out of a sow's ear.

FOCUS ON NATURE ™ *by Rochelle Mason*

Insight into the lives of animals

Diving into the cool, clear waters the robin-sized **MARBLED MURRELET** (*Brachyramphus marmoratus marmoratus*) swims adeptly using her strong wings like fins. She swims faster than the shiny, small fish she now catches in her sharp beak. Crustaceans are also plucked from the underwater landscape. She spent the past 8 months out at sea but now, in late spring breeding season, flies inland using well-camouflaging plumage of marbled gray and brown. Old-growth coniferous forests from here in central California all the way up to Alaska provide nesting habitat for the murrelet. Having fed all day a few miles offshore, she returns at dusk to the soft, moss-lined nest high in the branches of a quiet redwood. She and her mate will spend the night sharing parental responsibilities for a solitary egg before feeding begins again at dawn. *Artwork and text by Rochelle Mason © 1999-2003 www.rmasonfinearts.com (808) 985-7311*

News from Zoos

Panda Babies in AZA Zoos

Two same-species births don't typically make national headlines, but for the giant panda, 2005 was certainly an eventful year. The first birth occurred at Washington DC's National Zoo and brought recognition to the nation's capitol for the first panda birth in the zoo's history. The second birth occurred at the San Diego Zoo, which also saw panda births in 1999 and 2003.

There are only 10 adult and 2 baby giant pandas in four AZA-accredited zoos, all of which are on loan from China. While many people think that holding pandas increases an institution's revenue, it actually causes a financial loss after the initial spike in public curiosity. China requires that institutions holding pandas pay at least US $1 million per year for adults, which are on lease for various lengths of time. In addition, institutions must pay around $500,000 per cub with the understanding that the youngsters will be returned to China at age two or three. All money provided in these loan agreements goes toward panda conservation efforts in the wild.

Pandas are difficult to breed due to their reproductive cycles. Female pandas only come into heat for one short period each year. Following this brief opportunity, they often show false signs of pregnancy. If and when a baby is born, it's the size of a stick of butter and very vulnerable. Breeding at AZA-accredited zoos aims to enhance the survival of wild populations through research, including studies on nutrition, reproduction, and bamboo. A four-year long research study recently estimated that about 1,600 wild pandas currently live in China.

A Benchmark in Cloning at Audubon Nature Institute

The AZA accredited Audubon Nature Institute in New Orleans was home to a notable scientific first in July 2005. Two cloned African wildcat females each bred with the resident cloned wildcat male, Ditteaux, to produce two separate litters of kittens. This is the first time in history that healthy babies have been born to two unrelated clones of a wild species. Not only is this concept intriguing, but the potential to utilize cloning amongst near-extinct populations of wild animals to enhance limited gene pools is one step closer to becoming a reality.

This research also has immense implications when coupled with cryopreservation techniques. If a genetically valuable animal's cells are preserved in a frozen zoo, those genes can eventually be cloned and then reintroduced back into the population. These successes offer hope to the growing number of critically endangered species for which cloning might become a viable last resort.

Bermuda's Waters: A Green Turtle Haven

Last summer, a joint effort between the Caribbean Conservation Corporation and the AZA-accredited Bermuda Aquarium, Museum and Zoo allowed a select group of University students from all over the world to participate in the identification and tagging of green turtles. Green turtles are endangered, but are also the most common type of turtle in many local waters in Bermuda. It's here that this two-week event took place, immersing students in a conservation effort where the goal was to tag as many turtles as possible. Students donned snorkel gear and spent the days disentangling turtles from the capture nets surrounding their boat. Turtles were then tagged and weighed, and blood samples were taken. This type of information helps researchers judge the presence of the green turtles in the area, information that is important to the conservation of this species.

Bermuda has protected the sea turtles in their waters for some time, and consequently the area has become a haven for the creatures. Young turtles often arrive when they're about five years old and stay until they are ready to reproduce, which is between the ages of 30 and 50. One notable quality of the waters off Bermuda is that the sea turtles inhabiting the area are typically free of disease, a problem that is often prevalent in other areas. This research is a key element in promoting a healthy environment for the endangered green turtles.

Southern California's Amphibian Revival

The mountain yellow-legged frog is one of the most endangered creatures in southern California. An estimated 100 frogs are thought to be the only surviving members of this species, found in a few streams of the San Bernardino, San Gabriel and San

Jacinto mountains. A large group of the frogs used to inhabit the Los Angeles area, until the fire of 2003 decimated the area of City Creek. Survivors were taken in at the AZA-accredited Los Angeles Zoo where they were kept safe; all their wild counterparts were assumed to be extinct. However, a recent USGS survey found 11 wild survivors in the area, a surprising feat considering that a post-fire flood destroyed any habitat remaining after the fire. The presence of wild frogs shows the potential for self-renewal of the local ecosystem and a comeback of this endangered amphibian, while the frogs at the Los Angeles Zoo retain the potential for a breeding program that could supplement local populations.

Submitted by Amanda Strandquist
American Zoo and Aquarium Association,
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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 22nd 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 January–March and April–June 2006 issues.

Interested authors may e-mail esupdate@umich.edu. Please see the instructions to authors on pages 134–135 or visit our website at www.umich.edu/~esupdate for more information.

Notes

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 are very knowledgeable about endangered species issues. The readership includes a broad 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.

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 formatted text (.rft) attachment to: esupdate@umich.edu.

Manuscripts should be typed, double-spaced, with ragged right margins to reduce the number of end of line hyphens. Print must be in upper- and lower-case letters and of typewriter quality. Metric measurements must be given unless English measurements are more appropriate, in which case metric equivalents must be given in parentheses. Statistical terms and other measures should conform to the Council of Biology Editors Style Manual. All pages should be numbered. Manuscripts must be in English.

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.

Illustrations and photographs may be submitted as electronic documents or as hard copies. If hard copies are submitted, the author's name and the figure number should be penciled on the back of every figure. Lettering should be uniform among figures. All illustrations and photos should be clear enough to be reduced 50 percent. Please note that the minimum acceptable resolution for all digital images is 300dpi.

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

Policy on Reviewing Proofs

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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