



Intraguild Competition as a Potential Factor Affecting the Conservation of Two Endangered Cats in Argentina

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Abstract

Although the kodkod, *Oncifelis guigna*, and Andean Mountain cat, *Oreailurus jacobita*, are the two cats in most immediate danger of extinction in Latin America, information on these felids is very scarce. As part of our effort to understand their current distribution, we collected data on the carnivore guild composition of these two small felids from 1998 to 2002. Sign search, in combination to genetic analysis of scat samples, enabled us to record the presence of the Andean Mountain cat, the similar-sized Pampas cat, *Oncifelis colocolo*, and the Culpeo fox, *Pseudalopex culpaeus*, at a site located at the high-altitude Argentina Andes. At this site, the abundance of *O. colocolo* and *P. culpaeus* appears greater than that of *O. jacobita*. At another site located at the Patagonia Mountain forest in Argentina, the kodkod, the slightly larger Geoffroy's cat, *Oncifelis geoffroyi*, and the Culpeo fox were live trapped. The population abundance of the kodkod in the more competitive guild of Argentina seems lower than what has been previously reported for the species in Chile. We suggest that intraguild competition may be an important factor affecting the present conservation status of the Andean Mountain cat and kodkod, and stress the need of a guild approach to the conservation of these endangered small carnivores.

Competencia Intragrupal Como un Factor Potencial en la Conservación de Dos Felinos en Peligro de Extinción en Argentina

Resumen

Aunque el kodkod, *Oncifelis guigna*, y el gato montés andino, *Oreailurus jacobita*, son los dos felinos en mayor riesgo de extinción en América Latina, la información referente a estas dos especies es muy escasa. Como parte de nuestros esfuerzos por entender su distribución actual, de 1998 al 2002 colectamos datos sobre la composición del grupo taxonómico de carnívoros al que estos dos pequeños felinos pertenecen. La búsqueda de signos, en combinación con análisis genético de muestras fecales, nos permitió registrar la presencia del gato montés andino, del gato de las pampas, *Oncifelis colocolo*, y del zorro andino, *Pseudalopex culpaeus*, en un sitio a gran altitud localizado en los Andes argentinos. En este sitio, la abundancia de *O. colocolo* y *P. culpaeus* parece ser mayor que la de *O. jacobita*. En otro sitio localizado en el bosque de montaña de la Patagonia en Argentina, el kodkod, el gato montés (de un tamaño un poco mayor al del kodkod), *Oncifelis geoffroyi*, y el zorro andino fueron trampeados. La abundancia poblacional del kodkod en el grupo taxonómico más competitivo en Argentina parece ser menor de lo que había sido previamente reportado para esta especie en Chile. Sugerimos que la competencia intrataxonómica puede afectar en forma importante el estatus del gato montés andino y el kodkod, y que existe la necesidad de una nueva propuesta para la conservación de estos dos pequeños carnívoros en peligro de extinción que tome en consideración la competencia intragrupal.

La Concurrence Intraguilde Comme Facteur Potentiel Affectant la Conservation de Deux Chats en Péril en Argentine

Résumé

Bien que le kodkod, *Oncifelis guigna*, et le chat de montagne andin, *Oreailurus jacobita*, soient les deux chats le plus en danger immédiat de disparition en Amérique latine, l'information disponible sur ces felids est très rare. En tant qu'élément de notre effort de comprendre leur distribution courante, nous avons rassemblé des données sur la composition de guildes carnivores de deux petits felids de 1998 à 2002. Recherche des Signes, en combinaison avec l'analyse génétique des échantillons de matières fécales, nous avons permis d'enregistrer la présence du chat de montagne andin, du chat Pampas d'une taille semblable, *Oncifelis colocolo*, et du renard Culpeo, *Pseudalopex culpaeus*, dans un site dans l'haute-altitude des Andes argentines. Dans cet site, l'abondance *O. colocolo* et de *P. culpaeus* semble plus grande que celle de *O. jacobita*. Dans un autre site dans la forêt des montagnes patagones de l'Argentine, le kodkod, le chat Geoffroy *Oncifelis geoffroyi* (légèrement plus grand que le kodkod), et le renard Culpeo étaient capturés vivants. L'abondance de la population kodkod dans la guildes plus concurrentielle de l'Argentine semble plus basse que ce qui a été précédemment rapporté pour les espèces en Chili. Nous proposons que la concurrence entre-guildes puisse être un facteur important affectant le statut actuel de conservation du chat de montagne andin et du kodkod, et soulignons le besoin d'une approche de guildes à la conservation de ces petites carnivores en péril.

Introduction

Argentina hosts all ten species of Neotropical felids, almost 28% of all the species in the world (Nowell and Jackson 1996). This impressive diversity of cats results in extensive range overlaps, which, in some regions, may involve up to eight species (Soler and Lucherini in press). The preservation of this felid diversity requires detailed knowledge about the true extent of sympatry and implies answering theoretical questions about niche overlap and segregation (Johnson et al. 1996).

The kodkod, *Oncifelis guigna*, and the Andean Mountain cat, *Oreailurus jacobita*, are the two cats that are in most immediate danger of extinction in Latin America and have been listed among the highest conservation priorities by the IUCN Cat Specialist Group (Nowell and Jackson 1996; Nowell 2002a) and as vulnerable in the Argentine Red List of mammals (Diaz and Ojeda 2000). Andean Mountain cats only inhabit the Puna, a high-altitude desert area of the Andes of Peru, Bolivia, Chile and Argentina (Oliveira 1994; Yensen and Seymour 2000). Although its natural history is still very poorly known, fragmentation, low local densities and decreasing prey populations are thought to be the causes of the endangered status of *O. jacobita* (Nowell and Jackson 1996). The main reasons for *O. guigna*'s status are its extremely limited distribution and strong association to the Andean Patagonia forest of Southern Chile and Argentina, which is under strong human pressure (Nowell and Jackson 1996). Two recent studies have reported the first data on the natural history of two kodkod populations in Chile (Dunstone et al. 2002; Sanderson et al. 2002), while almost no information is available on the Argentine side of the Andes (Lucherini et al. 2000).

The population density of many carnivores has been found to be strongly correlated to prey biomass (Fuller and Sievert 2001; Carbone and Gittleman 2002). However, some of the variation in carnivore population density that is not explained by prey biomass may be due to the unique features

of each population (Carbone and Gittleman 2002). Intraguild competition has been shown to be a widespread cause of mortality in carnivores (Palomares and Caro 1999), and one of the factors determining their abundance (Linnell and Strand 2000).

In this study, we report new data on the sympatry of *O. jacobita* and *O. guigna* with other carnivores in Argentina, and analyze the possible effects of intraguild competition on the conservation of these felids.

Study Sites

Data were collected from seven expeditions we conducted from 1998 to 2002 in the Andean Puna and Andean Patagonia forest. Four of these expeditions were carried out in the Puna, an arid, high-altitude (usually above 3500-4000 m a.s.l.) section of the Andes that extends 12,457,000 ha (Bertonatti and Corcuera 2000). This ecoregion is ranked regionally within the highest conservation priorities because of its outstanding biological value and vulnerable conservation status (Biodiversity Support Program 1995). We conducted three expeditions in the Patagonia Mountain forest in Argentina, a 6,604,000 ha southern temperate forest that has been ranked as Endangered and as a High Regional Priority (Biodiversity Support Program 1995; Bertonatti and Corcuera 2000). In the southern Argentine province of Chubut inside the Patagonia Mountain forest, the 263,000-hectare Los Alerces National Park (ANP) represents one of the largest protected areas in the southern temperate forest.

Data Collection

Because of the long-term nature of these projects and particularly, the great differences in the habitats where these cats live, we used an array of study techniques. The Puna survey areas were selected on the basis of previous reports and interviews with local cattle breeders regarding the presence of Andean Mountain cats. Cat presence was assessed by sign search. In the survey areas, we intensively searched rocky

areas, since, in this region, small cat scats are mainly found in shelters among rocks and boulders (Lucherini et al. 1999). All cat evidences were geopositioned with a Geographic Position System Device (GPS). Cat scats were identified on the basis of their shape, texture, size, and, particularly, smell (Lucherini et al. 1999). Although none of these features alone is sufficient, their simultaneous use permits the correct identification of a sample (Lucherini et al. 1999). Fecal samples were collected in the Anconquija mountain range and Tucumán province in 1999, southwest of Jujuy province in 2001, and western Salta province in 2002. Each area was surveyed for 15 to 25 days. Collection methods are described in detail in Lucherini et al. (1999). For genetic analyses, all fresh feces were stored in paper bags and dried with silica-gel. The DNA of a sub-sample of each one of these scats was later extracted and amplified by polymerase chain reaction. The species were identified using a sequence-based analysis of the 16S rRNA mitochondrial gene (e.g. Johnson and O'Brien 1997).

Since 1998, the presence/absence of the kodkod has been studied in the Andean Patagonia forest, the only ecoregion of occurrence of the kodkod. Since 2000, presence/absence of small cats has been studied through live-trapping in ANP, which is the easternmost part of the kodkod distribution (trapping procedures have been described in detail in Luengos Vidal et al. in press). Baited traps were set along trails crossing different habitats and checked three times a day. The total trapping effort was 1051 trap days. Cats were captured in box-traps and immobilized by intramuscular injection with tiletamine-zolazepam (Zoletil®) at a dosage suggested by Kreeger (1997). The combination of these two drugs has been widely recommended and its safety has been documented for a number of carnivores (Travaini and Delibes 1994; Larivière and Messier 1996). All individuals were released at the capture site after their complete recovery. Trapping pro-

cedures have been described in detail in Luengos Vidal et al. (in press).

Results

Puna Carnivores

Twenty-five small cat fecal samples from the Puna were genetically analyzed, 14 of which were successfully identified. One of the five fecal samples collected in 1999 from the Tucumán province, and eight of the eleven scats from Salta province were identified as belonging to Pampas cats. Four of the nine scats collected in May 2001 in the vicinity of the village of Coranzuli, Jujuy province, matched *O. colocolo*, while a scat found on a very steep rocky cliff at 3940 m a.s.l (about 23°04'30"S 66°16'W) matched *O. jacobita*. One of the Pampas cat's feces was collected close (2,000 m) to this *O. jacobita* scat. We also collected a cat skull at less than 2,900 m from the Andean Mountain cat scat that we later identified as a Pampas cat's skull, on the basis of Garcia Perea's (1994) craniometric review. Genetic analyses also confirmed the presence of the Culpeo fox (*Pseudalopex culpaeus*) in this area.

Patagonia Carnivores

Ten carnivores (two Patagonia skunks, *Conepatus humboldtii*, four Culpeo foxes and four small cats) were trapped in ANP. In October 2000, a kodkod cat was observed and photographed by a tourist about 500 m from Villa Futalaufquen, the main village of ANP. Based on this sighting we carried out carnivore live-trapping in the surroundings of Villa Futalaufquen from November 2001 to March 2002, and from September to December 2002. On December 18, 2001 at Puerto Limonao, 4,000 m from Villa Futalaufquen, a 2.7-kg, adult female cat was trapped (see Lucherini et al. 2002, for a photograph of this specimen). Its morphological characteristics (dark brown, heavily spotted coat; long and dense fur, thick tail with many black rings; comparatively large paws) mainly resembled those of a kodkod, but its size, larger than those previously reported (Sunquist and Sanderson 1998;

Dunstone et al. 2002), and relatively long ears, resembled those of a Geoffroy's cat (*Oncifelis geoffroyi*). On March 6, 2002, another adult female cat was restrained in close proximity of Villa Futalaufquen (see Lucherini et al. 2002, for a photograph of this individual). The characteristics of this 3.2-kg cat were typical of the southern form of *O. geoffroyi* (Lucherini et al. 2001). On October 6, a 1.3-kg *O. guigna* (an adult female) was captured in the same area (42°53'S - 71°37'30"W). Kodkod trapping efficiency (computed as the number of kodkods captured/100 trap days) was 0.19 in Los Alerces, while trapping efficiency of all wild cats was 0.39. The DNA isolated from a sample of four cat scats (out of six collected in 2001 and 2002 in the proximity of Villa Futalaufquen) matched that of *O. geoffroyi*. Pumas (*Puma concolor*) were present but rare, while the likely occurrence of the lesser grison (*Galictis cuja*) has not been confirmed yet (Chehebar 2002).

Discussion

Puna Carnivores

Although the presence of skins of both the Andean Mountain cat and Pampas cat in the homes of villagers of the Andean Puna had been previously reported (García Perea 2002, Walker and Novaro 2003), this is the first empirical evidence that these two cats can live sympatrically and at the same site.

Despite the scarcity of resources, the carnivore guild of the Puna comprises at least seven species. The body sizes of four of them (*P. concolor*, *O. colocolo*, *P. culpaeus*, and the South American gray fox, *P. griseus*) make them potential competitors of the Andean cat, while less niche overlap may be expected with the lesser grison, *Galictis cuja*, and the hog-nosed skunk, *Conepatus* spp. The information we gathered suggests that *P. griseus* uses more open and dry areas than the other carnivores, and a certain degree of spatial and habitat separation also occurs between cats, Culpeo foxes and pumas (Lucherini et al. 1999; Lucherini unpubl. report). It also suggests that, at present,

both the Culpeo fox and the Pampas cat are much more common than *O. jacobita*. Because of the new evidence that the Pampas cat may use the same areas as *O. jacobita*, we suspect that interspecific competition may affect the current status of the Andean Mountain cat.

The population density has been found to be strongly correlated to prey biomass in many carnivores (Fuller and Sievert 2001). One of the implications of intraguild competition is that human-caused changes to the main prey of one carnivore species are likely to have effects through the entire carnivore community. This may be the case with the Andean Mountain cat. *O. jacobita* is considered to be a conservation priority largely because it is thought to be dependent upon chinchillas (*Chinchilla brevicaudata*) and their less-valued relatives, the Mountain viscachas (*Lagidium viscacia*) (Nowell and Jackson 1996). Chinchillas have almost been exterminated in the wild because of their prized fur and are now listed as critically endangered both nationally (Diaz and Ojeda 2000) and internationally (IUCN 1976), while Mountain vizcachas colonies appear to be distributed very irregularly, separated by large unpopulated areas (Lucherini et al. unpubl. data). It is logical to expect that a decrease in the availability of *O. jacobita* main prey would cause a direct reduction in the numbers of the Andean Mountain cats. The indirect consequences of this alteration in prey populations are more difficult to predict. In the co-occurrence of two similar-sized, evolutionary-related, carnivores, we might expect that when a resource becomes limiting, intraguild competition increases strongly. The Pampas cat, because of its wide geographical and ecological distribution, is considered to be a more adaptable small felid (Oliveira 1994), and may be able to switch to alternative preys and would be competitively favoured with respect to the more specialized *O. jacobita*.

Patagonia Carnivores

Until now, the kodkod was thought not

to occur in sympatry with the Geoffroy's cat in the Andean Patagonia forest (Nowell and Jackson 1996). Interspecific competition can take two forms: exploitation and interference. In many cases, in presence of larger species, small carnivores are affected by both types of competition and their density can be strongly reduced when compared to what might be expected on the sole basis of prey abundance (Linnell and Strand 2000). We suggest that this may be the case with the kodkod in Argentina. In the Chile Island of Chiloé, the largest carnivore coexisting with *O. guigna* is the small (three kg of body mass) Darwin fox, *Pseudalopex fulvipes* (Jiménez and McMahon in press). In the Laguna San Rafael area (Southern Chile), no other carnivore is present (Dunstone et al. 2002). Our results suggests that the kodkod lives in a larger and more competitive carnivore guild in Argentina, which can only be compared to that of the Chilean Queulat National Park (QNP). Dunstone et al. (2002) reported the occurrence of *Puma concolor*, *Pseudalopex culpaeus*, *Mustela vison* and *Lyncodon patagonicus* in QNP. Thus, the main difference between QNP and ANP, which are located at similar latitudes, is the presence of *O. geoffroyi* in the latter. If the co-occurrence of related carnivores results in competition as well as habitat and spatial segregation (as it has been shown in the case of *P. culpaeus* and *P. griseus*, Johnson and Franklin 1994), we would expect a lower kodkod population density at ANP than at QNP. Consistent with this prediction, the trapping efficiency in Queulat was 2.04 (Dunstone et al. 2002), more than 10 times that recorded in Los Alerces. Although other factors such as prey abundance (Carbone and Gittleman 2002) may affect carnivore population size, and taking into account that trapping efficiency is a very crude estimate of population abundance, this comparison suggests that the kodkod abundance is remarkably lower in our study site than in Chile. Furthermore, scat frequency seems to indicate that the Geoffroy's cat is more abundant than

O. guigna at Los Alerces. Thus, as in the case of the Andean Mountain cat, our results support the hypothesis that intraguild competition may be an important factor affecting the conservation status of the kodkod.



Kodkod cat (*Oncifelis guigna*). Photograph by Mauro Lucherini.

Although they are generally accepted as two different species (Wozencraft 1993; O'Brien 1996), it has also been suggested that the kodkod might be a subspecies of the Geoffroy's cat (Nowell and Jackson 1996). The only available molecular genetic studies, based on an extremely small sample size, put these two cats in the same phylogenetic subgroup (Johnson and O'Brien 1997; Johnson et al. 1998). Since character displacement would be expected between similar species in the zone of sympatry (Dayan and Simberloff 1996), the capture of an individual with a mixture of traits of the

two species stresses the need of data that will enable researchers to clarify the phylogenetic relatedness of *O. guigna* and *O. geoffroyi*.

General Conservation Implications

While the presence of other carnivores in the areas of occurrence of the Andean Mountain cat and the kodkod was previously known, our findings show that both of them live in close sympatry with related carnivores of similar size. Since the potential for competition between two species tends to increase with their relatedness and morphological similarity (Odum 1966), our results suggest that intraguild competition may be affecting the present status of *O. jacobita* and *O. guigna*.

The effective conservation of a species requires detailed knowledge of its present distribution, population status, ecological requirements, and genetic identity (Wilson 2000). Despite the increased attention they received in the last few years, *O. jacobita* and *O. guigna* are still among the species with a low research effort in comparison to their precarious conservation status (Nowell 2002b). Our results contribute to the reduction in this gap, which is especially wide in Argentina (Soler et al. in press).

The conservation of carnivores has traditionally been a species-by-species effort. However, it has been recently suggested that all carnivores are influenced to some degree by intraguild competition (Palomares and Caro 1999; Linnell and Strand 2000). In particular, intraguild competition can negatively affect the conservation status of extinction-prone carnivore populations (Creel et al. 2001). Consequently, a guild-based approach is more appropriate for conserving endangered carnivores when potential for competition is likely to exist. Our results emphasize the urgent need of this more complete approach to the conservation biology of endangered small carnivores, which combines the collection of autoecological data, and the simultaneous study of the interactions between guild members.

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News from Zoos

Oregon Zoo and Woodland Park Zoo Give Endangered Turtles a Head Start

The Oregon Zoo and Woodland Park Zoo recently released 35 endangered western pond turtles—a species on the verge of extinction in Washington a decade ago—in the Columbia River Gorge near Vancouver, Washington.

Working collaboratively with the Washington Department of Fish and Wildlife (WDFW) and the U.S. Fish and Wildlife Service (USFWS), the zoos "head-start" newly hatched turtles gathered from wild sites. The turtles are nurtured at both zoos for about 10 months until they grow large enough to avoid being eaten by non-native bullfrogs and large mouth bass.

"Giving young turtles a head-start during the first months of their lives, gives them a real edge," explains Dr. David Shepherdson, Oregon Zoo conservation program scientist. "Woodland Park Zoo and Washington Department of Fish and Wildlife have been working to save Washington's western pond turtles for 13 years. We are glad that we could provide additional assistance in helping save these highly endangered turtles."

The turtles are in trouble due to habitat degradation and disease. The biggest threat, however, is bullfrogs. Found east of the Rockies, this non-indigenous frog has thrived throughout the west, driving pond turtles and a host of other small, vulnerable aquatic species to the brink of extinction.

In the past few years, the cooperative efforts have brought the pond turtles' numbers in Washington up from a low of 150 in 1990 to nearly 800 today. Now listed as an endangered species in Washington State and a sensitive species in Oregon, the western pond turtle was once common from Baja, California to Puget Sound.

Baltimore Zoo Teams Up to Help Butterflies

The Baltimore Zoo, along with a coalition of environmental groups and butterfly enthusiasts, has recently begun work to revive populations of the Baltimore checkerspot butterfly, Maryland's official state insect.

The zoo has joined forces with Environmental Defense (ED), a Washington, D.C. based non-profit dedicated to finding solutions to complicated environmental problems. Having recently joined the Butterfly Conservation Initiative (BFCI), a coalition of organizations committed to butterfly recovery, the zoo had been looking for ways to participate in community conservation efforts. Environmental Defense, also a partner in the BFCI, saw the Baltimore checkerspot as an excellent opportunity to encourage local participation by working on a declining, but not yet federally endangered species. Their hope is to provide a model for local partnerships designed to keep butterflies and other species off the endangered species list through targeted conservation action.

As with many other imperiled species, suburban development has been a cause of the checkerspot's population decline. In addition, the checkerspot's host plant is also in trouble in the wild. Deer eat the tips of the turtlehead plant and either kill the larvae or knock them from their leaves. The Baltimore Zoo provides an ideal habitat for the butterfly because its Turtle Bog area supports an abundance of turtlehead plants and is protected from deer.

The zoo's butterfly project has two objectives. The first is to start a Baltimore checkerspot captive breeding program at the zoo that will eventually provide stock to take back out to wild colonies. The other is to educate Marylanders about the checkerspot and its plight. As Steve Sarro, the Baltimore Zoo's Curator of Birds explains, "It is easy for the zoo to say we are going to help save tigers and elephants, but here is something local that people can actually relate to."

San Diego Zoo Helps Establish National Park in Cameroon

Field researchers from San Diego Zoo's Center for Reproduction of Endangered Species (CRES) have played a key role in the establishment of a new national park and several integral ecological reserves in Bakossiland, Cameroon. According to CRES Director Alan Dixson, PhD, Bakossiland lies within what scientists regard as the top one to two percent of the Earth's most biologically diverse regions. The new protected area within western Africa will cover approximately 580 square miles of montane forest that is home to hundreds of threatened species including birds, amphibians, antelope, and endangered primates including red colobus, guenon, chimpanzees, and drills.

While tracking through dense Ebo forest also in Cameroon, Bethan Morgan, PhD, and other CRES researchers recently discovered evidence of gorillas in a region where gorillas had never been seen before. Nest sites, dung and a gorilla skull were located before researchers discovered a silverback, a few females, and some young. Two subspecies of Western lowland gorillas are native to Cameroon, but neither is known in this particular region. Due to CRES' significant discovery of the gorilla population, the Cameroonian government has recommended that their Ebo forest habitat be protected as a faunal sanctuary.

Calgary Zoo Releases Marmots Into the Wild

Vancouver Island marmots born in captivity and raised at the Calgary Zoo were successfully released into the wild recently, providing hope that the highly endangered mammals will make a dramatic comeback from near extinction. The zoo released four animals, two wild and two born in captivity, and paired the wild animals with the captive-born marmots in hopes of giving any new pups a chance of inheriting natural instincts.

The Vancouver Island marmot is one of the world's rarest mammals and the most endangered animal in North America, numbering less than 30 in the wild and 81 in captivity. The decline in their numbers has been attributed to clearcut logging of high elevation forests. It is hoped that the population can increase to between 400 and 600 individuals within the next 10 to 15 years (Adapted from an article in the Calgary Herald by Jessica Foster).

New York Aquarium Receives Teen Docent Grant

HSBC in the Community (USA) Inc., the foundation established by HSBC Bank USA, has given a grant of \$10,000 in support of the New York Aquarium's *Sea Teen* programs which comprise the *Earth, Sea, Sky* docent program with area junior high and high schools. *Sea Teen* participants serve as docents and/or attend sequential, interactive programs at the Aquarium. Students might wade into the ocean to sample the plankton, collaborate with peers to learn about marine invertebrates, or help visitors understand the animals they are watching. Participants are supervised and guided by staff members of the Aquarium Education Department, which has a 30-year history of teaching and inspiring people of all ages. Working with *Sea Teens* fulfills an important part of that mission. The fund from HSBC will be used toward ongoing operation cost to sustain these valuable education programs.

Information for News and Zoos is provided by the American Zoo and Aquarium Association



Vegetation Biomass Data in the Amazon: How Good is Historical Data for Remote Sensing Ground Truth?

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Abstract

One of the most important remaining forests in the world is in the Amazon region. A great part of the world's carbon is stored in the Amazon's vegetation biomass, but its exact amount, and the assessment of the region as either a sink or a source of carbon is still open to scientific discussion. The first step in understanding biomass behavior is its accurate measurement. In this paper, I analyze how biomass field measurements are made and possible problems with the data. I discuss its suitability as remote sensing ground truth and make the case for remote sensing as a tool to scale punctual and/or site-specific data.

Datos de Biomasa Vegetativa en el Amazonas: ¿Qué tan Correctos Son los Datos Históricos para la Verificación en el Terreno de Información Obtenida con Sensores Remotos?

Resumen

La región amazónica es uno de los remanentes boscosos más importantes en el mundo. Una gran parte del carbón mundial se encuentra almacenada en la biomasa vegetal del Amazonas, pero las cantidades exactas de carbón y la evaluación de la región como una zona de absorción o producción de carbón es un asunto aún sin resolver. El primer paso en el entendimiento del comportamiento de la biomasa es lograr una medición exacta de la misma. En este artículo analizo la forma en que la obtención en campo de datos de carbón es llevada a cabo, así como los posibles problemas con este tipo de datos. Además, discuto la posibilidad de usar información obtenida con sensores remotos como una herramienta de evaluación de biomasa.

Biomasse de Végétation Dans l'Amazonie: Sont les Données Historiques Pour la Vérification Sur le Terrain de Télédétection Bonnes?

Résumé

La région de l'Amazonie a un des forêts restantes les plus importantes dans le monde. Il a une grande partie du carbone du monde stocké dans la biomasse de végétation, mais les quantités exactes de carbone et l'évaluation de la région comme puits ou source de carbone est raison pour une discussion scientifique. La première étape dans la compréhension du comportement de biomasse est d'avoir une mesure précise de la biomasse. Dans cet article, j'analyse comment les relevés de biomasse sur le terrain sont faites et discute des problèmes possibles avec ce genre de données. Je discute aussi sa convenance en tant que vérification sur le terrain de télédétection et fais le point de droit pour la télédétection comme outil pour l'élargissement des données opportunes et/ou spécifiques aux emplacements.

Introduction

With the rise in the atmosphere's carbon dioxide and the resulting climate change, there has been an increase in the number of studies that attempt to measure forest biomass. The objective of these studies is to determine if forests are sinks or sources of carbon and their subsequent role in the global climate. An often complicated process, forest biomass must be measured at different time intervals to determine if carbon is increasing or decreasing. Although a series of studies have been conducted in the Amazon in the last decade, the biomass numbers are very different, even when performed in the same region.

In this paper, I review a limited number of studies on the different methods and inferences used to assess vegetation biomass (quantification and partitioning). I also calculate means and coefficients of variation for the results presented. I discuss how to measure vegetation biomass in one moment of a time series and I comment on the methods and uncertainty of the sources. Certain authors have recently questioned methods of acquiring vegetation biomass values (e.g. Clark et al. 2001; Clark 2002; Keller et al. 2001), thus I discuss the importance of those alleged problems when using this data as remote sensing ground truth. Finally, I make the case for remote sensing as a tool to scale punctual and/or site-specific data.

Measuring Biomass

Different approaches can be used to assess vegetation biomass. The simplest method that is less prone to errors is to remove all vegetation biomass in a certain area and then to dry and weigh it. This method, called the destructive method, is usually used when measuring small areas only since all the vegetation is destroyed.

The most common approach when measuring forest biomass is to use the destructive method for a small area, and, based on the results, to devise allometric equations. These equations can measure the vegetation biomass of

larger areas indirectly by using non-destructive measurements such as diameter at breast height (DBH) or basal area as inputs. Trees above a certain DBH are measured and their species are identified, an important detail that determines the appropriate allometric equation. Depending on the tree species, the density will have a different weight in the equation or may not be included (e.g. allometric equations for hollow species such as *Cecropia* spp, do not include density).

Partitioning

Aboveground live biomass (AGLB) is the most common vegetation biomass measurement. Because this method was developed by the timber industry concerned primarily with economically valuable wood in natural or agricultural plots, belowground live biomass (BGLB) is not considered. However, AGLB does take into account leaves and tree branches, as well as smaller plants.

A more representative quantity in carbon budget studies is total biomass (TB) which is the sum of total aboveground biomass (TAGB) plus standing and fallen dead material and BGLB. Belowground biomass can be measured directly, but it is more commonly inferred from AGLB using root/shoot ratios obtained from the literature (Houghton et al. 2001) since it is difficult to destructively measure big tree roots.

Allometric Equations

Honzak et al. (1996) provide a good example of how allometric regression equations can be used. They tested the TAGB calculation using different allometric equations in an area north of Manaus, Brazil that contains trees smaller than 35 cm in diameter. The inputs were DBH (D, cm), tree height (H, m), and for some of the equations, wood density (S, Mg m⁻³).

The equations are:

TAGB = exp (-2.327 + 0.937 ln(D²HS)),

with wood density or:

TAGB = exp (-3.068 + 0.957 ln(D²H)),

without wood density.

Belowground biomass was assumed to be 19% of the TAGB based on studies conducted in the Amazon forests. In these studies, the reported BGLB values for tropical forest range from eight percent to 25%.

Although height can be measured directly with an inclinometer using trigonometry formulas, sometimes the top of trees cannot be viewed in a dense tropical forest. In these situations, height estimation equations correlating height to diameter are used. Since each species has a characteristic structure, the equations can be species specific. In more uniform forests, the same equation may be used. In their study, Honzak et al. (1996) used the following equation:

$$H = \exp(1.387 + 0.539 \ln D)$$

The series of biomass studies done in the Amazon forest demonstrates that species composition greatly influences the amount of biomass calculated using different allometric equations. Nelson et al.'s (1999) study on allometric regressions for improved estimate of secondary forest biomass in the central Amazon illustrates how to adapt original equations to different species compositions. The authors developed species-specific and mixed-species regressions for estimating AGLB using eight abundant forest tree species in central Amazon secondary forests. Nelson et al. (1999) obtained better results when factoring in wood density in the mixed-species equations than in the species-specific equations. They also showed a slight reduction in error when they used tree height. In addition, Nelson et al. tested other equations developed for "primary" forests. Their tests showed that biomass was overestimated by as much as 60%. This overestimation was even bigger when *Cecropia* DBH was included in the calculations.

Sampling method is another important component in measuring biomass. Using simulation, Keller et al. (2001) tested four different equations and sources of sampling error. Based on their results, a sample of 21 randomly selected 0.25-ha plots in a 392-

ha patch of moist tropical forest will produce 20% sampling error with a 95% confidence.

Uncertainty Sources

Hollow Trees, Wood Density, Species Composition

Fearnside (1992) outlines uncertainty sources when measuring biomass in his rebuttal to Brown and Lugo's (1992) study of AGLB estimates for tropical moist forests in the Brazilian Amazon. Hollow trees are one source of uncertainty. Besides the always structurally hollow *Cecropia*, other hardwoods acquire this characteristic with maturity. Fearnside (1992) cites studies that found that nearly 27% of trees with DBH greater than 40 cm in Manaus are hollow. This means that 30% of the tree stem volume is either air or light material such as debris from termites. Another important factor in calculating biomass is wood density, but the values for wood density are unavailable for most of the Amazonian species. As mentioned above, figures are available only for trees with commercial value (trees with low density) resulting in an artificially low average density. Another problem with determining density is that bark is measured with DBH although it is less dense than wood, and the relation between bark and wood changes as trees grow.

Recently, more fine-tuned allometric equations have been proposed. Nelson et al. (1999) proposed methods to improve forest biomass estimation. By applying species-specific and mixed-species allometric equations that use DBH and specific density of the wood as inputs, the authors reduced error from 10-60% overestimation to 10-15%.

Randomness of Plot Selection

Another important source of bias when measuring biomass is plot selection. In many cases, accessibility, transportation and other logistic issues prevent forest survey plots from being selected at random. In their discussion of sampling and allometric uncertainties, Keller et al. (2001) highlight that most

of the forest biomass estimates in the Amazon depend mainly on a limited database of forest plots sampled over three decades. The location of these plots was not randomly selected or distributed over any spatial or vegetation classification scheme, making the assessment of possible bias in site selection difficult to determine. In her analysis of long-term plot data, Clark (2002) also comments on site selection subjectivity and experiment unreproducibility. To alleviate this problem, remote sensing can be used to extrapolate results from a specific area to a whole region. Data collected by remote sensing can be applied only if the sampling plots exact position is available and plot size and sensor resolution are equivalent.

Methodological Artifacts

Clark (2002) also expressed concern about methodological artifacts in allometric equation inputs such as the use of diameter measurements at breast height (~1.4 m). Most tropical trees have buttresses and other protuberances on their stem. These irregularities have a disproportional rapid radial increase. Thus, Clark proposed that measurements should be made above the buttresses. Phillips et al. (2002) examined this suggestion by evaluating potential biases related to changes in growth of tropical forests. They concluded that even if the errors identified by Clark occur, they are on the order of 10 percent for basal area, which will not impede the use of most tropical-forest plot data.

Large Scale Biomass Figures

The numbers proposed for the Amazon forest biomass fluctuate greatly due both to the natural variability in a forest over such a large region and to the different methodological approaches in the quantification. Tables 1, 2, 3, and 4 illustrate the discrepancy of some Amazon forest biomass figures.

Table 1 displays the values for total biomass for the whole Brazilian Amazon as found in Fearnside (1992) and Brown and Lugo (1992). Brown

and Lugo's data (1992) is separated into four categories: a) studies conducted during the 1950's; b) small sampling areas; c) RADAMBRASIL study plots;

	TB (Mg ha ⁻¹)
Fearnside (1992)	272
Brown and Lugo (1992) 1950's	227
Brown and Lugo (1992) Small Samples	414
Brown and Lugo (1992) RADAMBRASIL	227
Brown and Lugo (1992) corrected	300
Mean	288
Standard deviation	69

and d) results corrected by the authors. The average value was 288 Mg ha⁻¹, with a standard deviation of 69 Mg ha⁻¹ and a coefficient of variation (standard deviation as a percent of the mean) of 24%.

Total biomass values for selected areas are shown in Table 2 for the Tapajos area (Keller et al. 2001) and areas north of Manaus (Fearnside 1992; Lucas et al. 1996). The mean was 323 Mg ha⁻¹, with a standard deviation of 62 Mg ha⁻¹ and a coefficient of varia-

	TB (Mg ha ⁻¹)
Keller et al. (2001) Tapajos	372
Fearnside (1992) Manaus	235
Lucas et al. (1996) Manaus	362
Mean	323
Standard deviation	62

tion of 19%.

Table 3 shows the values for the AGLB for selected areas in Tapajos (Keller et al. 2001; Luckman et al. 1997) and in areas north of Manaus (Laurance et al. 1999; Carvalho et al. 1995). The mean was 330 Mg ha⁻¹, with a standard deviation of 50 Mg ha⁻¹ and a coefficient of variation of 15%.

Houghton et al. (2001) grouped 34 sites in the Amazon, including areas outside Brazil, according to three different plot sizes (Table 4) and calculated

Table 1. Total biomass for the Brazilian Amazon

Table 2. Total biomass for selected areas in Tapajos and Manaus

their mean AGLB. The mean of these three classifications was 290 Mg ha⁻¹, with a standard deviation of 40 Mg ha⁻¹

	AGLB (Mg ha ⁻¹)
Keller et al. (2001) Tapajos	282
Luckman et al. (1997) Tapajos	284
Laurance et al. (1999) Manaus	356
Carvalho et al. (1995) Manaus	399.3
Mean	330
Standard deviation	50

Table 3. Above ground live biomass for selected areas

1 and a coefficient of variation of 14%.

Discussion

In this article, I reviewed a limited but representative sample of studies that quantify Amazon forest biomass, a necessary calculation in determining the role of the Amazon forest in the global carbon budget. Assessing whether the forest is capturing carbon dioxide, releasing carbon in the atmosphere, or having no net primary productivity is vital for global climate change research.

	AGLB (Mg ha ⁻¹)
Houghton et al. (2001) plots > 5 ha	241
Houghton et al. (2001) 0.5 < plots < 5 ha	290
Houghton et al. (2001) plots < 0.5 ha	339
Mean	290
Standard deviation	40

Table 4. Mean AGLB for 34 sites in Amazonia grouped according to plot size

Forest biomass is also crucial in determining the amount of carbon released by the anthropogenic action of deforestation and conversion of forest to agriculture or pasture. In addition, biomass measurements make it possible to determine if changes in forest growth are a result of an increase in the atmospheric carbon dioxide.

Biomass estimates are geographically and temporally variable. However, a comparison of the values from Fearnside (1992) and Brown and Lugo's (1992) corrected value in Table 1, show that they are very close, and the values for Manaus and Tapajos in Table 3 are

almost the same.

Biomass values vary only slightly when calculated for large regions using data collected from many sites. This is evident in Table 4, which shows a coefficient of variation of 14% when analyzing plots of different sizes. The mean AGLB computed using Houghton et al.'s (2001) results is very close to the values calculated by Fearnside (1992) and the corrected values calculated by Brown and Lugo (1992) (Table 1). In contrast, the values for total biomass given by Fearnside (1992) and Lucas et al. (1996) in Table 2 differ greatly. This difference is expected considering Fearnside's (1992) value is an average for all the area north of Manaus, while Lucas et al.'s (1996) is an average of only two plots in the area.

Honzak et al. (1996) recommended using data collected from remote sensing to estimate biomass. They emphasized the importance of basing predictive relationships on accurate ground data. These data can be obtained from historical plots or from traditional field campaigns. Errors from historical plots may be smaller since measurements are taken in the same site over time, which allow the use of area specific allometric equations.

Radar remote sensing data offers one of the best approaches to extrapolating biomass to large areas (Luckman et al. 1997). The radar saturates its signal only in very high biomass areas, contrary to optical vegetation indexes. Using precise biomass measurements to calibrate the backscatter models makes it possible to estimate the biomass across large regions, distinguishing among areas with varied biomass density.

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FOCUS ON NATURE™ by Rochelle Mason
Insight into the lives of animals



Walking along the muddy bank in search of a meal, an Iriomote mountain cat (*Mayailurus iriomotensis*) spots movement up ahead. He slinks forward eyeing a mudskipper on a mangrove root. As he pounces the fish drops into the shallow water. Undaunted, he follows the wiggling body and is rewarded for his small effort. The size of a housecat, this crepuscular feline has short legs and a short, bushy tail and is an excellent swimmer and tree-climber. Most of the prey species (mammals, birds, reptiles and fish) here on Iriomotejima (Japanese island off Taiwan) cannot escape the stealth and agility of this cunning carnivore. Following another urge, he howls for a female in estrus. She must be somewhere within his territory that ranges from the beach into the subtropical forest and farmland. A soft reply is heard.

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Book Review

The Whaling Season: An Inside Account of the Struggle to Stop Commercial Whaling

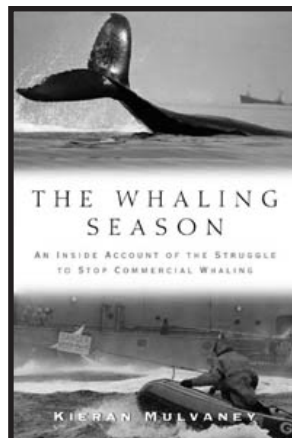
Kieran Mulvaney
Island Press 2003

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Abstract

It is hard to believe there is still a call for books like Kieran Mulvaney's *The Whaling Season: An Inside Account of the Struggle to Stop Commercial Whaling*. With the populations of many whale species still in danger of total collapse due to numerous environmental pressures, the resumption of legal commercial whaling seems unthinkable. Yet, as Mulvaney points out in his book, there has been a strong effort in recent years on the part of whaling nations like Japan, Norway and Iceland to resume the hunting of minke, sei and other whales. Thus, books such as Mulvaney's are still necessary to bring the issue of whaling to the public's attention. The balance of *The Whaling Season*, unfortunately, is a hit-or-miss affair. The historical sections provide a solid overview of their subjects and add heft to a book that might otherwise be lacking in that regard. By contrast, the International Whaling Commission chapters too often become a dry recitation of dates and vote tallies. The advantage of a book like *The Whaling Season* is that there is room enough for both the short and long views, and from both perspectives, Mulvaney succeeds in making his case to the general reader. If in fact, as Mulvaney speculates, "we are witnessing ... the last defiant death throes" of an "unmourned and unloved" industry, we have Greenpeace and Mulvaney in part to thank for it. If, instead, we are on the brink of a revival of commercial whaling in our time, a book like *The Whaling Season* could become an important document in future efforts to bring this ugly chapter in the planet's history to a conclusive end.



Crítica de Libros

La Temporada de la Caza de la Ballena: Un Recuento Interior de la Lucha para Frenar la Caza Comercial de la Ballena

Kieran Mulvaney
Island Press 2003

Resumen

Es difícil de creer que aún exista la necesidad de libros como *La temporada de la caza de la ballena: Un recuento interior de la lucha para frenar la caza comercial de la ballena*, escrito por Keran Mulvaney. Con las poblaciones de muchas especies de ballenas aún en peligro de un colapso total debido a diversas presiones ambientales, el reinicio de la caza comercial de ballenas parecería impensable. Sin embargo, como Mulvaney establece en su libro, ha habido un esfuerzo importante en años recientes de parte de naciones balleneras como Japón, Noruega e Islandia para restablecer la caza de minke, sei y otros tipos de ballenas. Por lo tanto, libros como el escrito por Mulvaney son aún necesarios para atraer la atención del público sobre este tema. El balance de *La temporada de la caza de la ballena* es uno de aciertos y desaciertos. Las secciones históricas proveen de un resumen sólido del tema y le da importancia a un libro que de otra manera carecería de una perspectiva histórica. Por el contrario, los capítulos acerca de la Comisión Ballenera Internacional (International Whaling Commission, IWC) son frecuentemente una recitación simple de fechas y apuntes. La ventaja de un libro como *La temporada de la caza de la ballena* es que en él existe espacio suficiente para perspectivas cortas o largas, y en ambos casos, Mulvaney triunfa en presentar su caso al lector no especializado. Si es cierto, como Mulvaney especula, que "estamos presenciando...la angustiosa muerte" de una industria odiada y a la que nadie extrañaría, tenemos que agradecer en parte a Greenpeace y Mulvaney. Si por el contrario, estamos al borde de la reaparición de la caza comercial de ballenas, este libro pudiera ser un documento importante en los futuros esfuerzos de poner un punto final a este horrendo capítulo en la historia del planeta.

Revue de livre

La Saison de la Chasse à la Baleine: Un Reportage Interne de la Lutte Contre la Chasse à la Baleine Commerciale

Kieran Mulvaney
Island Press 2003

Résumé

Il est difficile de croire qu'il y a toujours un appel pour des livres comme celui de Kieran Mulvaney appelé *La saison de la chasse à la baleine: Un reportage interne de la lutte contre la chasse à la baleine commerciale*. Avec les populations de beaucoup espèces de baleines toujours en danger d'effondrer totalement dû à de nombreuses pressions environnementales, la reprise de la chasse à la baleine commerciale légale semble impensable. Cependant, comme Mulvaney précise dans son livre, il y a eu un effort fort ces dernières années de la part des nations qui font la chasse à la baleine comme le Japon, la Norvège et l'Islande de reprendre la chasse des baleines minke et sei, parmi les autres. Ainsi, les livres tels que celui de Mulvaney sont encore nécessaires pour améliorer la connaissance du public à la chasse à la baleine. Le reste de *La saison de la chasse à la baleine* est malheureusement désordonné. Les sections historiques fournissent une vue d'ensemble pleine de leurs sujets et ajoutent masse à un livre qui pourrait autrement manquer à cet égard. En revanche, les chapitres sur la Commission internationale de la chasse à la baleine (IWC) deviennent trop souvent un raconte sec des dates et des taux de votes. L'avantage d'un livre comme *La saison de la chasse à la baleine* est qu'il y'a assez espace pour les perspectives étroites et larges, et des deux perspectives, Mulvaney réussit à gagner sa cause au lecteur général. Si nous témoignons effectivement les dernières affres d'une industrie ni aimé ni pleuré, comme raisonne Mulvaney, c'est dû à Greenpeace et à Mulvaney en partie. Si, par contre nous sommes sur le point d'une renaissance de la chasse à la baleine commerciale dans notre temps, un livre comme *La saison de la chasse à la baleine* peut devenir un document important dans de futurs efforts d'apporter ce chapitre terrible dans l'histoire de la planète à une fin concluante.

In some ways it is hard to believe there is still a call for books like Kieran Mulvaney's *The Whaling Season*. Nearly thirty years after Greenpeace gained worldwide prestige as the scrappiest of environmental activist organizations through its media-savvy "Save the Whales" campaign, and more than twenty years after the International Whaling Commission (IWC) imposed an indefinite moratorium on all commercial whaling, with the populations of many whale species still in danger of total collapse due to numerous environmental pressures, the resumption of legal commercial whaling seems unthinkable.

Yet, as Mulvaney points out, there has been a strong effort in recent years on the part of whaling nations like Japan, Norway and Iceland to resume the hunting of minke, sei and other whales. They have found allies within the mainstream media such as New York Times columnist Nicholas D. Kristof, who in September 2003 wrote that "there are hundreds of thousands of minke whales, perhaps as many as a million, and they don't seem to be in any jeopardy." Kristof's statistic of a million minke whales is dubious at best—in 2001, the IWC Scientific Committee, in Mulvaney's words, "announced that extrapolation from more recent data produced a figure ... perhaps as low as 300,000, and that minke whale numbers in the Antarctic might actually be falling." More importantly, Kristof ignores the historical circumstances that led to the imposition of the moratorium in the first place; never has the whaling industry demonstrated an ability to keep its catches within sustainable limits.

The fact is that even now, within the framework of the moratorium and in the heart of an international whale sanctuary, the whaling industry continues to "stubbornly persist" in hunting whales, in part thanks to a provision in the International Convention for the Regulation of Whaling (Article VIII) that allows the killing of whales for scientific purposes. Every summer since 1987, a Japanese whaling fleet has taken

advantage of this loophole to kill hundreds of minke whales in the Southern Ocean below the Antarctic Circle under the guise of performing scientific research; the meat is then sold as a specialty item in the Japanese marketplace. During several of these whaling seasons, Greenpeace sent a ship of its own to track down the Japanese fleet, interfere with its operations, and call attention to the fact that whales continue to be pursued as a commodity despite the international ban. Mulvaney, now the editor of *Ocean Update* and a freelance journalist, led four of those risky, often frustrating expeditions, and in this brisk, entertaining book, written for a general audience, he offers a first-hand account of the campaigners' and crew's battles with weather, technology, inexperience, personal demons, poor decisions and the whimsy of fortune in their increasingly desperate efforts to save whales on the open seas.

Given *The Whaling Season's* highly emotional subject matter and the author's activist background, the reader might be forgiven for expecting a book fraught with the sentimentality and breast-beating that marks so much popular environmentalist literature. Perhaps the sea air had a curing effect on Mulvaney's prose, because he wisely keeps the rhetoric to a minimum and never demonizes his adversaries, trusting that the facts will speak for themselves and win the reader's sympathy. He does have a penchant for cliché ("It felt as if we were the first people ever to be here, to discover this enchanted place") and at one point even admits to "cursing my inadequacies as a writer" when faced with the alien beauty of the Southern Ocean. But even as he describes a whale being killed before his eyes, Mulvaney never stoops to mawkishness: "Finally, on the seventh attempt, the harpoon found its mark. The sea was still, the ship came to a halt, and the catcher's crew pulled the stricken whale to the bow. It had died instantly, and a bright crimson cloud colored the water as its body was hauled to the surface and tied alongside the catcher."

Mulvaney is at his best when describing the thrill of the chase or (more often) the agony of wandering day upon day through the hunting grounds with no sign of the whaling fleet. During their second expedition, the activists fail to find any of the whaling ships until the final week of their search, after having been buffeted by 100-knot winds, suffered major damage to their helicopter, and had an unpleasant run-in with tourists on McMurdo Sound. "We shouldn't even be down here," Mulvaney says to his cohorts as a storm rages outside. "Humans don't belong here." Yet such is the bipolar nature of their undertaking that within minutes of spying one of the whalers, the entire crew is plunged headlong into the manic work of stopping the harpoons. In these chapters, the book takes on the quality of a Jon Krakauer adventure story and makes for gripping reading.

The balance of the book, unfortunately, is a hit-or-miss affair. A few chapters are given over to history—of Greenpeace, the whaling industry and the exploration of Antarctica—while others describe the efforts within the IWC to come to some resolution regarding a permanent ban on commercial whaling. The historical sections provide a solid overview of their subjects and add heft to a book that might otherwise be lacking in that regard. By contrast, the IWC chapters too often become a dry recitation of dates and vote tallies. This fact is doubly unfortunate because Mulvaney himself attended the IWC meetings as both an observer and a participant from the late 1980's onward and was privy to the behind-the-scenes machinations of the pro- and anti-whaling contingents, not to mention the conflicts within the anti-whaling camp itself. Only rarely does Mulvaney inject the IWC meetings with anything like the drama he puts into his narration of the expeditions. It is as if he, or his editor, did not believe readers would have much use for the wheeling and dealing that goes into the formation of policy. True, there is something viscerally thrilling about the im-

age of a few brave souls in an inflatable raft staring down the sharp end of a harpoon gun; but given the strong views (and no doubt strong personalities) on all sides, not to mention the stakes involved, the IWC conferences must have had plenty of drama in their own right. The story that ties all the pieces together, showing how Greenpeace-style activism directly affects (or does not affect) the decisions of the policy makers, remains largely untold.

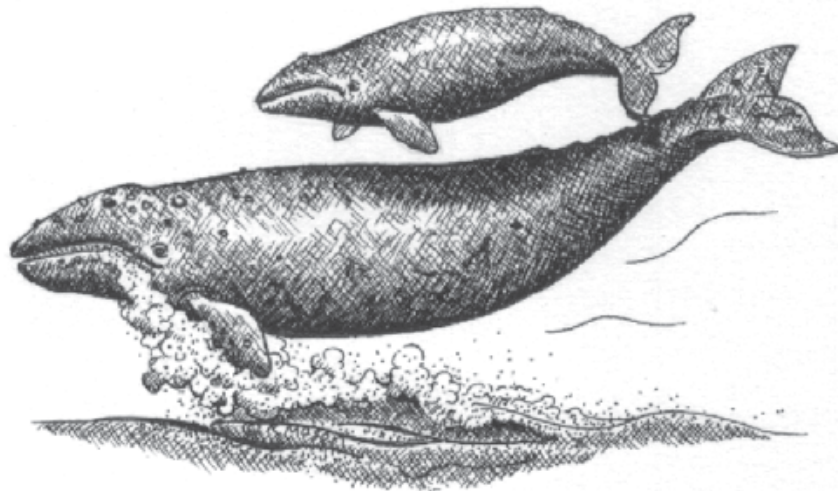
Readers with some background in the sciences may be irked or amused by the story of the third expedition, in 1994-95, which included a team of scientists conducting surveys of humpback whales, collecting phytoplankton samples to assess the effects of the hole in the ozone layer on the Southern Ocean's food chain, and other research. Mulvaney provides a textbook example of why scientists and activists, even when closely aligned, often find themselves working at cross purposes, because their main objectives are so completely different. The scientists are there to collect data on the whale's total environment, and to understand how an array of human actions are exerting pressure on whale populations; the activists are there to save individual whales and garner media attention on the immediate issue of Japanese whaling. The danger of the activists' approach is that the general population hears terms like "moratorium" or "sanctuary" and assumes the survival of whales has been secured; yet without the activists' work, there may be no public awareness whatsoever of the whales' plight.

The advantage of a book like *The Whaling Season* is there is room enough for both the short and long views, and from both perspectives Mulvaney succeeds in making his case to the general reader. If in fact, as Mulvaney speculates, "we are witnessing ... the last defiant death throes" of an "unmourned and unloved" industry, we have Greenpeace and Mulvaney in part to thank for it. If, instead, we are on the brink of a revival of commercial whal-

ing in our time, a book like *The Whaling Season* could become an important document in future efforts to bring this ugly chapter in the planet's history to a conclusive end.



FOCUS ON NATURE™ by Rochelle Mason
Insight into the lives of animals



Relaxing in the warm, blue waters with her 15-foot, newborn calf, a gray whale (*Eschrichtius robustus*) keeps a watchful eye. During February and March these shallow waters in the lagoons off Baja, California, Mexico provide a safe nursery for her and the other cows who have travelled 5,000 miles to give birth. After mating, usually every two or three years, the pod begins its long journey back north. Migrating along the continental shelf in the coastal waters of western North America allows for good people-viewing. Building a large appetite over the past several months, the 41-foot cow is anxious to begin feeding in the rich, polar waters of the Bering, Chukchi and Beaufort Seas. Scraping her rostrum, or snout, along the sea bottom, she raises clouds of silt, mud and delicious shrimp-like amphipods. Large mouthfuls of the murky water are taken into her expanding mouth and filtered back out through the rows of baleen, or comb-like teeth. The crustaceans left behind are then swallowed. With plentiful food, her calf no longer needs to nurse and begins feeding on its own after eight months. Fattened up, the female notices the days are getting shorter, food is becoming scarce, and the water feels cold. She knows the time has come for her and the rest of the pod to begin their long winter journey, once again, to the warm blue waters down south.

A success story for the Endangered Species Act of 1973, the gray whale has made such a remarkable comeback from near extinction caused by over-hunting that it was removed from the federal list of endangered species in 1994. This and other marine inhabitants greatly appreciate beach clean-up days, usually held on Earth Day each year.

Artwork and text by Rochelle Mason © 2003 (808) 985-7311



Book Review

Making Sense of Intractable Environmental Conflicts: Concepts and Cases

Roy J. Lewicki, Barbara Gray, and Michael Elliott, eds.
Island Press 2002

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Abstract

A prime characteristic of many environmental disputes is their intractability. *Making Sense of Intractable Environmental Conflicts* provides several case studies of intractable environmental conflicts in the United States. The authors use the technique of framing analysis as a tool to explore how and why certain conflicts elude resolution, while in other cases the disputants are able to find common ground. The result is a comprehensive text on conflict resolution that could become an important learning tool for scientists, environmental activists, government agency officials, and other parties to local, national and global environmental conflicts.



Crítica de libros

Entendiendo Conflictos Ambientales Inmanejables: Conceptos y Casos

Roy J. Lewicki, Barbara Gray, and Michael Elliott, eds.
Island Press 2002

Resumen

Una característica principal de muchas disputas ambientales es su intratabilidad. *Entendiendo Conflictos Ambientales Inmanejables: Conceptos y Casos*, expone conflictos ambientales modelo en los Estados Unidos. Los autores usan la técnica de análisis de marco ("framing analysis") como una herramienta para explorar cómo y por qué ciertos conflictos eluden resolución, mientras en otros casos las partes en conflicto logran llegar a un común acuerdo. El resultado es un texto extenso que podría llegar a ser una importante herramienta de aprendizaje para investigadores, activistas, oficiales de agencias gubernamentales y otras partes involucradas en conflictos ambientales a nivel local, nacional y global.

Revue de livre

Se Comprendre des Conflits Environnementaux Itraitables: Des Concepts et Des Cas

Roy J. Lewicki, Barbara Gray, and Michael Elliott, eds.
Island Press 2002

Résumé

Une caractéristique principale de beaucoup de conflits environnementaux est leur intraitabilité. Ce livre fournit plusieurs études de cas des conflits environnementaux insurmontables aux Etats-Unis. Les auteurs emploient la technique d'encadrement analytique comme outil pour explorer comment et pourquoi certains conflits éludent leur résolution, tandis que dans d'autres cas les opposants peuvent trouver un terrain d'entente commun. Le résultat est un texte complet sur la résolution des conflits qui pourrait devenir un outil d'étude important pour les scientifiques, les activistes environnementaux, les fonctionnaires des organisations gouvernementales, et d'autres parties aux conflits environnementaux locaux, nationaux et globaux.

A prime characteristic of many environmental disputes is their intractability. Whether the issue at hand is the preservation of habitat and protection of ecosystems, the sustainable use of resources, the regulation and cleanup of toxic materials, the reduction of greenhouse gas emissions, or almost any other matter where ecological imperatives come into conflict with human perceptions, desires, traditions and innate behavior, one does not have to look far to find "conflicts that are long-standing and elude resolution." Where the protection of endangered species is concerned, intractable conflicts may sometimes seem like more the norm than the exception, with potentially grave consequences; every year where protections are delayed, challenged or undermined is another year closer to extinction for the species in question. Finding a way to bring these disputes to some positive final conclusion is thus a matter of increasing urgency. In *Making Sense of Intractable Environmental Conflicts*, the editors bring together timely case studies of several intractable environmental conflicts in the United States, on subjects ranging from natural resource management and water quality to the cleanup of toxic waste sites and efforts to limit urban sprawl. Each study explores how and why a particular conflict became intractable, and how, in a few cases, the disputants were finally able to achieve constructive resolutions.

Throughout the book, the authors employ the common psychological and sociological methodology of framing analysis. A "frame," in this context, is an individual's way of understanding, shaping and focusing some aspect of a situation. When disputants frame a conflict's origin and salient issues differently, when they frame the dispute in hostile terms (as a "war" or "us against them"), when they frame the dispute in personal terms, or when they frame the motives and character of other disputants in negative or distorted terms, the potential increases for the conflict to become intractable. Framing analysis provides the authors

with a common vocabulary and structure, and helps the reader to gain a deeper understanding of the nature of intractable conflicts from one study to the next. The result is a comprehensive text on conflict resolution that could become an important learning tool for scientists, environmental activists, government agency officials, business leaders, farmers and interested citizens as they attempt to find a way forward in future local, national and global environmental conflicts.

A straightforward example of how negative framing can lead to intractability appears in a case study concerning the contentious meetings of a water regulation advisory group in Ohio during the late 1990s. The group, which was charged by the state Environmental Protection Agency (EPA) to find strike a compromise between environmental and business interests with regard to antidegradation policy, was explicitly divided into two distinct factions, the Environmental Caucus and the Regulated Caucus. The caucuses quickly conformed to the strong identities imparted on them by their names, and discussions between the caucuses were marked with negative characterizations on both sides—the Environmental Caucus often referred to the Regulated Caucus as "polluters," while the Regulated Caucus regularly cast aspersions on the Environmental Caucus's understanding of technical and legal matters. These frames, among others, prevented the two sides from finding any common ground on several contentious issues, with the result that the advisory group was unable to meet its responsibilities.

The power of framing analysis becomes further evident in more complex cases, where the issues are more subtle and several parties may be involved over a period of many years. The Quincy Library Group case provides an example of a conflict where the disputants were able to "reframe" the issue in terms that all (or most) parties could rally around. In this case, local environmentalists and loggers, after years of pitched legal battles over the

amount of timber that could be removed annually from Plumas and Lassen National Forests in Northern California, were able to find common ground in the notion of sustainable logging when it became clear that standard logging practices would swiftly leave the loggers out of work. The two sides were able to come together for the sake of their local economy and shared love of the forest, and drafted a plan that would promote selective cutting. However, when the plan came into the hands of the Forest Service, national environmental groups came out strongly against it, framing the locals as dupes of the big lumber companies and prompting a new round of political and legal wrangling that pitted environmentalists against one another. Eventually, after a matter of some years, the plan was signed into law by President Clinton and implemented by the Forest Service. The authors' analysis shows a clear shift in the language and attitudes of all the local parties as an agreement became a possibility, and effectively contrasts the local negotiations with the national brouhaha that followed, showing how a conflict may move along a spectrum from intractable to tractable and back again as the issues are reframed both by the course of events and by the hard work of the disputants themselves.

Perhaps the most valuable aspect of the book is that it forces all parties to take a good long look at themselves in

the mirror. In every case included in the book, all the disputants at one time or another contribute to the intractability of the conflict, sometimes even when they believe they are acting to compromise and bring about resolution. Happily, the authors see cause for optimism, as most of the studies demonstrate that "reframing" is almost always a possibility, even in the most toxic and longest standing conflicts. In the book's study of the decades-old Voyageurs National Park controversy, the authors note that common ground exists between the disputants in the form of a shared love of the land, if only they could set aside their personal animosity long enough to recognize it. In another study, concerning toxic pollution in Chattanooga, Tennessee, the citizens are able to rise above the viscerally divisive forces of economic inequity, racial tension and geographic separation in order to address a problem common to them all. If, under such circumstances, a place like Chattanooga can successfully make itself from the "worst polluted city" in the United States into a model of a green community without driving out the industrial base that keeps the city economically vibrant, certainly there is cause for hope in intractable environmental disputes throughout the United States and the world. A book such as this one brings us one step closer to making that hope a reality.



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