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Contributors

Katharine L. Adams holds a Master's degree in Biology and a Master's degree in Education from the University of Michigan. She has done studies on the evolution of coral snake mimics as a defense mechanism against bird predation. She is currently collaborating with the Biokids interdisciplinary research group at the University of Michigan, developing curriculum to teach biodiversity to children in public schools. Research interests include primate behavior, the effect of landscape patterns on medium-sized carnivore social structure, and how communication hinders or facilitates learning in humans and other organisms.

Holly Freifeld received her Ph.D. from the University of Oregon in 1998. Her dissertation research explored spatial and temporal variation in forest birds in American Samoa. She is now a biologist with the U.S. Fish and Wildlife Service in Honolulu, where her work focuses on endangered vertebrate species in Hawaii and U.S. Pacific territories.

Eric Gilman has a M.S. in Marine Resources Management (Oregon State University 1993). He is the Pacific Representative for the National Audubon Society's Oceans Department and Chair of the Society of Wetland Scientists' International Chapter. Current programs include research on seabird deterrent methods in Hawaii and Argentine longline fisheries, community-based mangrove management in American Samoa, and recovery of seabird populations of the Main Hawaiian Islands.

Gloria E. Helfand received her Ph.D. in Agricultural and Resource Economics from the University of California at Berkeley (1988). She served on the faculty of the University of California at Davis before coming to the University of Michigan in 1996. She conducts research on regulatory approaches to pollution control and a variety of issues in environmental policy.

John Vandermeer holds a Ph.D from the University of Michigan, where he has been faculty since 1971. His research interests include nonlinear dynamics, especially as applied to population models; dynamics of rain forest succession following catastrophic damage; ecology of multidimensional agroecological systems; and dynamics of rain forest destruction and conservation — socioeconomic and political analysis of neotropical conversion. He has done extensive fieldwork in Costa Rica, Nicaragua and Mexico.

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School of Natural Resources and Environment
The University of Michigan
430 E. University
Ann Arbor, MI 48109-1115
(734) 763-3243; fax (734) 936-2195
E-mail: esupdate@umich.edu
http://www.umich.edu/~esupdate

Cover: Laysan (*Phoebastria immutabilis*) (left, laying down), Black-footed (*P. nigripes*) (center, facing camera), and Short-tailed (*P. albatrus*) (right, standing) Albatrosses.
Photo by Eric Gilman.

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Marine Matters
Seabird Mortality in North Pacific Longline Fisheries

Eric Gilman [1]
Holly Freifeld[2]

[1]National Audubon Society
2718 Napua'a Place
Honolulu, HI 96822
EricGilman@earthlink.net

[2]U.S. Fish and Wildlife Service Pacific Islands Office Box 50088
Honolulu, HI 96850
Holly_Freifeld@fws.gov

Abstract
One of the most globally critical threats to seabirds is mortality in longline fisheries. Available estimates for total albatross mortality in North Pacific pelagic longline fisheries, along with population modeling experiments on the Black-footed Albatross, highlight the concern that mortality in longline fisheries threatens the existence of Black-footed Albatrosses and may pose a significant threat to the other North Pacific albatross species. The potential exists to minimize seabird mortality in longline fisheries to insignificant levels, given the degree of international attention, the existence of legally binding accords, the availability of cost-effective seabird deterrent methods, and the usefulness of economic incentive instruments. To realize this potential, however, will require widespread implementation of relevant multilateral accords and initiatives, provision of strong economic incentives for vessels to voluntarily use effective seabird deterrents, and implementation of effective formal constraints that provide strong economic disincentives for noncompliance with seabird conservation measures. Adoption of an international performance standard for hook sink rate with concomitant standardization of gear line weighting by gear manufacturers is offered as a specific next step to help abate this problem.

Mortalidad de Aves Marinas en las Líneas Extensivas de Pesca en el Pacífico Norte

Resumen

Una de las más graves amenazas a nivel global para algunas especies de aves marinas es la mortalidad en líneas extensivas de pesca. Las estimaciones disponibles de la mortalidad total de albatroses en las líneas extensivas de pesca de la zona pelágica del Pacífico Norte, así como también los experimentos sobre modelos poblacionales del albatros de patas negras, enfatizan el temor de que la mortalidad en pesca de línea extensiva amenaza la existencia del albatros de patas negras y pudiera ser una amenaza significativa para otras especies de albatroses del Pacífico Norte. Dado el grado de atención internacional, la existencia de acuerdos legales restrictivos, la disponibilidad de métodos efectivos de prevención de captura de aves que además reducen costos, y la utilidad de incentivos económicos, existe el potencial para minimizar la mortalidad de aves marinas en pesca de línea extensiva a niveles insignificantes. Sin embargo, para poder lograr este potencial, se requiere una implementación amplia de acuerdos e iniciativas multilaterales relevantes, la provisión de fuertes incentivos económicos a embarcaciones para el uso voluntario de métodos efectivos de prevención de captura de aves marinas, y la implementación de restricciones formales efectivas que impongan fuertes sanciones económicas para aquellos que no cumplan con las medidas de protección de aves marinas. La adopción de un estándar internacional de efectividad del grado de hundimiento de anzuelos en combinación con la estandarización del pesaje del equipo de línea hecha por los fabricantes, se ofrece como un siguiente paso específico para abatir este problema.

Mortalité des Oiseaux Marins dans la Pêche Palangrière du Pacifique du Nord

Résumé

Une des menaces la plus sérieuse globalement pour les oiseaux marins est leur mortalité dans la pêche palangrière. Les estimations disponibles sur la mortalité totale des albatros dans la pêche palangrière du Pacifique du Nord, avec des expériences modelant la population de l'albatros à pieds noirs, accentuent le souci que la mortalité dans la pêche palangrière menace l'existence des albatros à pieds noirs et peut constituer une menace importante aux autres espèces d'albatros du région. Le potentiel existe pour réduire la mortalité des oiseaux marins dans la pêche palangrière à un niveau insignifiant, donné la priorité de la communauté internationale, l'existence des accords obligatoires, la disponibilité des mesures préventives des oiseaux marins efficace et économique, et l'utilité des instruments économiques. La réalisation de ce potentiel, cependant, exige une exécution répandue des accords et initiatives multilatéraux pertinents, une fourniture forte d'incitations économiques pour que les navires emploient volontairement des mesures préventives des oiseaux marins, et mettent en oeuvre des contraintes formelles qui produisent de fortes préventifs économiques contre non-conformité aux mesures de conservation des oiseaux marins. L'acceptation d'une norme de rendement internationale pour le taux descensionnelle de crochet, associé avec un étalonnage du taux pesant par des fabricants d'attirails de pêche est offerte comme une prochaine étape spécifique pour assister à diminuer ce problème.

Introduction to Seabird Mortality in Longline Fisheries

Of all the threats to seabirds, one of the most globally critical is mortality in longline fisheries (Brothers et al. 1999; Gilman 2001a). Birds are hooked or entangled primarily while fishing gear is being set and are dragged underwater and drown as the gear sinks. Hundreds of thousands of seabirds, including tens of thousands of albatrosses, are caught annually in longline fisheries worldwide (Brothers 1991; Gilman 2001a and b; CCAMLR 2002). During the 1980's the Japanese pelagic longline tuna fleet south of 30 degrees South latitude alone was estimated to take 44,000 albatrosses per year (Brothers 1991). Pirate fishing (illegal, unregulated and unreported) for Patagonian Toothfish (*Dissostichus eleginoides*) in the Southern Ocean, conducted primarily by vessels who choose a "flag of convenience" from a state which neglects to ensure that vessels flying its flag comply with fisheries management measures, kill approximately 145,000 seabirds per year (CCAMLR 2002).

The species of seabirds most frequently caught by longliners are albatrosses and petrels in the Southern Ocean; Arctic fulmar (*Fulmarus glacialus*) in North Atlantic fisheries; and albatrosses, gulls, and fulmars in North Pacific fisheries (Brothers et al. 1999). The health of populations of albatrosses and large petrels are most at risk from this threat.

According to IUCN (The World Conservation Union), of the 61 species of seabirds affected by longline fisheries, 25 are threatened with extinction, including 17 species of albatrosses, and there is compelling evidence that longline mortality is a significant component in the declines of many of these species (Gales 1998; Brothers et al. 1999). An estimated 10% of the world's population of Wandering Albatrosses (*Diomedia albatrus*) is killed on longline hooks each year (Brothers 1995). The Spectacled Petrel (*Procellaria conspicillata*), a single-island endemic with a small population, is taken in fisheries off the Atlantic coast of South America (Brothers et al. 1999). The remaining albatrosses of the family Diomedeidae, the Southern Giant Petrel (*Macronectes giganteus*), Northern Giant Petrel (*M. halli*), White-chinned Petrel (*Procellaria aequinoctialis*), and Grey Petrel (*P. cinerea*) of the Southern Ocean are other seabird species at risk of extinction that are taken in large numbers by the large pelagic longline fisheries targeting Southern Bluefin Tuna (*Thunnus maccoyii*) and the pirate fisheries for Patagonian Toothfish (Brothers et al. 1999).

The increase in anthropogenic-induced mortality above natural levels is especially significant in seabirds. Seabirds populations are particularly sensitive to increases in adult mortality rates because of their life history traits. Seabirds live relatively long lives (e.g., albatrosses live into their 60s), have delayed maturity (e.g., albatrosses do not begin breeding until they are between 5 and 12 years old), and have relatively low reproductive rates (seabirds can raise only one chick every one or two years) (Hamer et al. 2002). Both parents take part in incubation and chick rearing in most albatross species, so if one parent is killed on a longline hook, the chick likely will die of starvation. Also, albatrosses typically stay with the same partner for life, so if one partner is killed, it may take several years for the remaining bird to find a new mate. One-third of all albatross populations comprise fewer than 100 breeding pairs, making them extremely sensitive to acute increases in mortality rates (Gales 1998). All of these characteristics mean that seabird populations may be severely stressed by the continual loss of a large number of individuals.

North Pacific Albatrosses

North Pacific albatrosses include the Short-tailed (*Phoebastria albatrus*), Black-footed (*P. nigripes*) and Laysan (*P. immutabilis*) (Figure 1). A fourth member of this genus, the Waved Albatross (*P. irrorata*) is largely confined to the Galapagos Islands and surrounding waters. Although the Waved Albatross

does range north of the equator, it does not forage as widely as the other three species (Anderson et al. 1998). The Waved Albatrosses' foraging distribution overlaps with the fishing grounds of the Peruvian artisanal pelagic longline fleet and Japanese eastern Pacific pelagic longline fleet off northern Peru, indicating that interactions with longline vessels in the Southern Hemisphere is a potential threat to this species. However, there is no direct information on whether Waved Albatrosses are captured in these longline fisheries (Anderson et al. 1998; Jahncke et al. 2001).

The total population of the Short-tailed Albatross is approximately 1,400 birds. The majority of breeding pairs nest in a single colony on the slopes of an active volcano in Japan. Historically, millions of Short-tailed Albatrosses roamed the Pacific. In the late 1800s and early 1900s, this species was brought to near extinction by the feather trade and volcanic activity. Slowly recovering, the species has experienced an average population increase of over 7% annually. This increase partly reflects efforts to improve nesting habitat. The Short-tailed Albatross is classified as Vulnerable in the 2002 IUCN Red List of Threatened Species (BirdLife International 2000; IUCN 2002).

The Black-footed Albatross, with a population of approximately 300,000, is also included on the 2002 IUCN Red List of Threatened Species as a Vulnerable species (BirdLife International 2000; IUCN 2002). There has been a 9.6% decline in Black-footed Albatross breeding pairs from 1992 to 2001, a 1.1% annual decline, based on monitoring data from three colonies in Hawaii where over 75% of the world population nests (U.S. Fish and Wildlife Service 2001).

The Laysan Albatross, the most abundant of North Pacific albatrosses, has a population of approximately 2.4 million birds, with an IUCN status of Lower Risk, Least Concern (BirdLife International 2000; IUCN 2002). There has been a 30% decline in Laysan albatross breeding pairs from 1992 to 2001, a 3.3% annual decline, at three monitored nesting colonies where 90% of the world's population nest. The number of Laysan breeding pairs increased 2% from 1992 to 1997, but decreased more than 31% between 1997 and 2001 (U.S. Fish and Wildlife Service 2001). Scientists are reviewing the IUCN status of this species (Nel and Croxall 2003).

Figure 1. Laysan (left, laying down), Black-footed (center, facing camera), and Short-tailed (right, standing) Albatrosses on Midway Atoll.
Photograph by E. Gilman.

These recent declines in breeding pairs of Laysan and Black-footed Albatrosses may result from numerous causes. For example, albatrosses may increasingly skip breeding years due to depleted food resources caused by El Niño and general warming of the oceans. This scenario would result in only a temporary decline in breeding pairs and no population declines. But declines may be real and may be influenced by various sources of actual mortality. One of the most significant sources of this mortality likely is from interactions with longline vessels.

Available estimates for total albatross mortality in North Pacific pelagic longline fisheries, along with population modeling experiments on the Black-footed Albatross, highlight the concern that mortality in longline fisheries may threaten the existence of Black-footed Albatrosses and poses a significant threat to Laysan and Short-tailed Albatrosses (Cousins and Coo-

per 2000; Gilman 2001b). Population modeling experiments indicate that the world Black-footed Albatross population can withstand a loss of no more than 10,000 birds per year from all mortality sources and remain stable (Cousins and Cooper 2000). Mortality in pelagic longline fisheries alone may exceed this threshold (Cousins et al. 2001; Crowder and Myers 2001; Gilman 2001b). Based on their lowest mortality estimates of 1.9% of the Black-footed population killed per year in pelagic longline fisheries, Crowder and Myers (2001) project that the Black-footed Albatross population likely will continue to decline over the next 20 years. Similar modeling experiments have yet to be conducted for the Laysan and Short-tailed Albatrosses.

Multilateral Initiatives and National Regulations

Several multilateral efforts directly address seabird mortality in longline fisheries in the North Pacific Ocean. The legally binding United Nations *Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks* contains several articles with measures to conserve associated or dependent non-target species, including seabirds (Haward et al. 1995). The Implementing Agreement became effective in December 2001. Contracting parties are obligated to implement the accord's provisions by adopting or amending national enabling legislation.

The *Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Central and Western Pacific Region* establishes a regional mechanism for the conservation and management of highly migratory fish stocks in the central and western Pacific Ocean (Gilman 2001a). Adopted in 2000, the Convention has yet to come into force. The Convention requires contracting parties to adopt measures to minimize catch of non-target species, including seabirds.

The United Nations Food and Agriculture Organization (FAO) produced an *International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries* (FAO 1999). The plan is voluntary and not legally binding. The plan calls on all states to implement the plan, starting with an assessment of longline fisheries to determine if a seabird bycatch problem exists. If a problem exists, states are then encouraged to develop a National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries. At the FAO Committee on Fisheries session held in February 2001, eleven countries and one regional economic integration body (Australia, Brazil, Canada, China, the European Community, Japan, New Zealand, Norway, Philippines, South Africa, USA, and Vietnam) reported that they have made, or are in the process of making, a decision to produce a seabird national plan (Cooper 2001).

IUCN Resolution 1.15, adopted in 1996, entitled *Incidental Mortality of Seabirds in Longline Fisheries*, calls upon states to adopt the goal of reducing seabird bycatch within longline fisheries to insignificant levels, and immediately implement seabird bycatch reduction measures by longline fisheries (IUCN 1996). IUCN Resolution 2.66, *Pirate Fishing and Seabird Mortality from Longlining in the Southern Ocean and Adjacent Waters*, adopted in 2000, calls upon states and regional fishery bodies to combat pirate fishing for Patagonian Toothfish; to reduce the mortality of seabirds in longline fisheries in the Southern Ocean; to comply with the FAO International Plan of Action on seabird bycatch; and to support development of an Agreement for Southern Hemisphere Albatrosses and Petrels (IUCN 2000). Resolution 1.16, *Fisheries By-catch*, and Recommendation 19.61, *By-catch of Non-target Species*, also call on states and fishery bodies to address the problem of seabird bycatch in longline fisheries (Gilman 2001a). These IUCN resolutions and recommendation are advisory and not legally binding.

Pelagic longlining, where gear is suspended from line drifting at the sea-surface, mainly targets large tunas for

sashimi markets, swordfish, and billfishes. Japan, China, Republic of Korea, and Taiwan constitute the main high seas pelagic longline nations with fleets operating in the North Pacific (Brothers et al. 1999). The U.S. and Mexico have smaller pelagic longline fleets operating in the North Pacific. There are over 3,000 pelagic longline vessels operating in the North Pacific. U.S. pelagic longline fisheries constitute less than 5% of this total. The U.S., Canada, Japan, and Russia have demersal longline fisheries in the North Pacific, where gear is set at the seabed to target species such as halibut, cod, and sablefish (Brothers et al. 1999). There are approximately 17,000 demersal longline vessels operating in the North Pacific. U.S. demersal longline fisheries constitute about 15% of this total.

Some national governments have adopted regulations to manage seabird mortality in their North Pacific longline fisheries. The following countries have promulgated regulations requiring employment of specified seabird deterrent methods and other measures: Japan (for both demersal and pelagic longline fleets); the U.S. (for Alaska demersal and Hawaii pelagic longline fisheries); and Canada (for British Columbia demersal longline fisheries) (U.S. National Marine Fisheries Service 1997, 1998 and 2002; Government of Japan 2001; Canada Department of Fisheries and Oceans 2002). The U.S. also has plans to adopt regulations to manage seabird mortality in pelagic longline vessels based out of the West Coast (U.S. Pacific Fishery Management Council 2001). China, Korea, Mexico, Russia, and Taiwan do not have seabird regulations (Brothers et al. 1999; Huang and Day 2000).

Mitigation Research

Over the past 15 years, national governments, regional organizations, and longline industries have developed and tested seabird deterrent methods. These methods include changes in fishing gear (e.g., adding weights to the line and using a line-setting machine), fishing practices (e.g., thawing bait, night setting, deploying bird-scaring tori lines, and establishing area and seasonal closures), and vessel layout (e.g., altering the location where offal and spent bait are discarded, and altering deck lighting) (Brothers 1995; FAO 1999; Brothers et al. 1999).

Figure 2. Performance assessment of an underwater setting chute was conducted in 2002 in the Hawaii pelagic longline tuna fishery. The chute eliminated seabird capture during this short-term trial. Expressed as contacts per 1000 hooks per albatross, the chute was 95% effective at reducing albatross contacts with fishing gear compared to a control. Based on an assessment of bait retention and hook setting interval when using the chute versus conventional practices, vessels would experience a gain in efficiency of between 14.7% and 29.6% when albatrosses are present (Gilman et al. 2002b). Photograph by Nigel Brothers.

Several experiments on seabird deterrents have been conducted in North Pacific longline fisheries. In 1998, the U.S. Western Pacific Fishery Management Council sponsored research on the effectiveness of selected seabird deterrent measures in the Hawaii longline swordfish fishery (McNamara et al. 1999). The U.S. National Marine Fisheries Service conducted separate research to test the effectiveness of deterrent measures (Boggs 2001) and also conducted a statistical analysis of observer data collected in Hawaii longline fisheries to infer the effects of night setting and area closures on seabird interactions (U.S. National Marine Fisheries Service 2000). In 2001, the U.S. Washington Sea Grant Program completed a two-year study on vessels in the Alaska halibut and sablefish fishery and in the Pacific cod fishery to test selected seabird deterrent measures (Melvin et al. 2001). In 2002, the National Audubon Society, U.S. National Marine Fisheries Service, and Hawaii Longline Association collaborated to conduct performance assessment of an

underwater setting chute in the Hawaii pelagic longline tuna fishery (Figure 2) (Gilman et al. 2002b). In 2000 Japan's Fisheries Research Agency conducted research on the effectiveness of blue-dyed bait to deter seabird interactions in the Japanese pelagic longline tuna fishery (Minami and Kiyota 2002). Results from these studies in the North Pacific indicate that several mitigation measures reduce seabird interaction rates in these fisheries by more than 90%.

Unfortunately, no single seabird deterrent measure can be expected to effectively and practicably reduce seabird mortality in all longline fisheries (Brothers et al. 1999). For instance, while an underwater setting chute has been shown to be very effective at avoiding seabird interactions in the Hawaii pelagic longline tuna fleet (Gilman et al. 2002b), trials of the chute in the Australian pelagic longline fishery have not been as promising, likely due to the seabird species complex found in Australian waters, the weighting design of Australian fishing gear, and the use of live bait (Brothers 2003). The underwater setting chute and other seabird deterrents are the subjects of ongoing research.

The Way Forward

The incidental mortality of seabirds in longline fisheries, one of several major threats to North Pacific albatrosses, can be feasibly addressed. The source and extent of longline mortality can be determined, management authorities already exist, there are internationally accepted principles regarding seabird mortality in both legal and pirate longline fisheries, and economically practical solutions are available. This warrants guarded optimism. Similar mechanisms may not be available to address other significant threats to seabirds, such as contaminants, plastic ingestion, and global climate change.

Implementation of incentive instruments can help minimize seabird mortality in longline fisheries (Gilman et al. 2002a). Incentive methods, inducements for stakeholders to avoid and minimize the mortality of seabirds, include eco-labeling, developing and raising industry awareness of effective seabird deterrent methods that increase fishing efficiency, distributing mitigation devices for free, implementing a fee and exemption structure, and applying formal constraints (Gilman et al. 2002a). Instituting incentive instruments is especially important in fisheries where resources and political will for effective management and enforcement are scarce. In fisheries where formal constraints and enforcement are ineffective, alternative incentive instruments are needed to induce industry to voluntarily minimize incidental seabird capture. Incentive instruments can motivate longline fishers and industry to minimize seabird mortality by tapping their desire to continue their way of life; maximizing profit; being perceived by the public as good players; and fulfilling their conservation ethic. The longline industry likely responds most strongly to economic incentives and disincentives. Seabird mitigation methods that can be demonstrated to significantly increase fishing efficiency have the highest chance of being accepted by industry. Conversely, if regulations requiring fisheries to minimize seabird mortality are consistently enforced and carry significant economic consequences for non-compliance, this will likely result in broad industry compliance.

Most countries with longline fleets have a low degree of political will to address the problem of incidental seabird mortality, and have scarce resources for enforcement of seabird conservation measures. Few national fishery management authorities have frameworks to manage interactions between seabirds and longline vessels and do not require employment of effective seabird deterrents (Brothers et al. 1999; BirdLife International 2003; FAO 2003). A bottom-up approach that fosters a sense of industry ownership for effective seabird mitigation methods, and concomitant voluntary compliance with legally-required use of seabird deterrent methods, is needed

in these countries. Longline fishers are among the most qualified people to innovate seabird mitigation methods, and should be encouraged to develop and test seabird deterrents. In this way, industry develops a sense of ownership for these tools and supports their required use.

Most longline vessels probably do not employ effective seabird deterrents despite the availability of effective seabird deterrents that also increase fishing efficiency. Reasons for this may be low industry awareness of the availability, effectiveness, and practicability of these seabird deterrent methods, or lack of a strong economic incentive to change long-standing fishing practices. Establishing an international performance standard for longline hook sink rate, and prescribing gear weighting designs that meet this standard that are achievable by all longline fisheries, will contribute to resolving this problem of low vessel use of seabird deterrents. Line weighting is one effective seabird deterrent method that facilitates high compliance because gear manufacturers would build the gear according to the international convention, and crew would use gear as provided by gear suppliers. While standardized line weighting and hook sink rate alone would not adequately minimize seabird interactions in all fisheries, an international standard would be an important step forward, especially for fleets that currently do not employ any seabird deterrent methods, including pirate fisheries.

Adequate onboard observer coverage throughout the region would allow fishery management authorities to determine if regulatory requirements and performance standards are being met, estimate the level of seabird mortality from this data source, and estimate trends in seabird mortality in longline fisheries. The protocol to estimate seabird capture should be standardized so that observers estimate seabird capture during the set and not the haul, and normalize capture rates for bird abundance (Gilman et al. 2002b). Seabird catch rates recorded on fishing vessels from observations of dead birds hauled aboard are conservative underestimates because not all seabirds that are caught are hauled aboard, as there is unobserved discarding of incidentally caught seabirds by crew, and seabirds can fall from the hooks before hauling (Brothers 1991; Gales et al. 1998; Gilman et al. 2002b). Normalizing seabird bycatch rates for seabird abundance allows for more meaningful comparisons between seabird interaction rates, allowing for an accurate evaluation of a vessel's and fisheries' efforts to minimize seabird interactions (Gilman et al. 2002b).

Given the degree of international attention, the existence of relevant legally binding accords, the availability of both effective and cost-saving seabird deterrent methods, and the usefulness of incentive instruments, the potential exists to minimize seabird mortality in longline fisheries to insignificant levels. To realize this potential, however, will require widespread implementation of relevant multilateral accords and initiatives, implementation of effective formal constraints that provide strong economic disincentives for noncompliance with seabird conservation measures, provision of strong economic incentives for vessels to voluntarily use effective seabird deterrents, and standardization of gear line weighting to meet an international performance standard for hook sink rate.

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Book Review

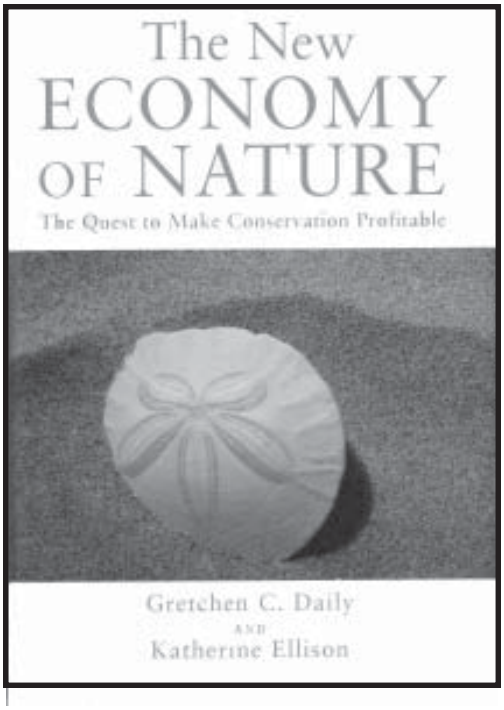
The New Economy of Nature: The Quest to Make Conservation Profitable

by Gretchen C. Daily and Katherine Ellison. 2002.
Island Press, Washington, DC. 260pp.
Hardcover ISBN: 1-55963-945-8.

Gloria E. Helfand
Associate Professor of Environmental Economics
University of Michigan
430 E. University
Ann Arbor, MI 48109
(734) 763-3243
ghelfand@umich.edu

Abstract

The New Economy of Nature: The Quest to Make Conservation Profitable, by Gretchen C. Daily and Katherine Ellison, describes the possibility of using private markets to protect the environment. Because people care about environmental goods and services (products), they are often willing to pay to protect them. If those willing "buyers" can be brought together with those who can provide ecosystem products, then everyone wins, including the environment. This book tells ten stories of possible for-profit opportunities for environmental protection. As enthusiastic as the authors are for this new paradigm for ecosystem products, reasons exist that markets for these products have often not worked. The authors use economic theory to argue that private markets are not likely to provide adequate levels of public (environmental) goods and services because each person will hope that someone else will provide them. Market-based successes for providing environmental products deserve to be celebrated, but not as an alternative to the role of the public sector.



La Nueva Economía de la Naturaleza: La Búsqueda por Hacer la Conservación Económicamente Remunerable

Resumen

"*The New Economy of Nature: The Quest to Make Conservation Profitable*" (La Nueva Economía de la Naturaleza: La Búsqueda por Hacer la Conservación Económicamente Remunerable), escrito por Gretchen C. Daily y Katherine Ellison, describe la posibilidad de usar los mercados privados para proteger el medio ambiente. Ya que las personas se preocupan por los bienes ambientales, ellas están frecuentemente dispuestas a pagar por proteger esos bienes. Si estos "compradores" dispuestos pueden ser agrupados con aquellos que pueden proveer los servicios de ecosistemas, entonces todos ganan, incluyendo el medio ambiente. Este libro relata diez historias de posibles oportunidades de remuneración económica por brindar protección ambiental. A pesar del entusiasmo de los autores por este nuevo paradigma de servicios de ecosistemas, existen razones para que los mercado de estos bienes frecuentemente no funcionen. La teoría económica argumenta que los mercados privados generalmente no proveen los niveles adecuados de bienes públicos (ambientales) porque cada persona espera que alguien mas provea estos bienes. Las historias exitosas de provisionamiento de bienes ambientales basadas en el mercado merecen ser celebradas, pero no como alternativas al rol del gobierno para proveer servicios de ecosistemas.

La Nouvelle Economie de la Nature: la Recherche pour Rendre la Conservation Profitable

Résumé

"*The New Economy of Nature: The Quest to Make Conservation Profitable*" (La Nouvelle Economie de la Nature: la Recherche pour Rendre la Conservation Profitable), par Gretchen C. Daily et Katherine Ellison, décrit la possibilité d'employer les marchés privés pour protéger l'environnement. Puisque les gens se préoccupent des biens et services environnementaux, ils sont souvent disposés à payer pour les protéger. Si ces "acheteurs" disposés peuvent être rassemblés avec ceux qui peuvent fournir des produits d'écosystème, alors chacun gagne, y compris l'environnement. Ce livre ébauche dix possibilités de gain pour la protection de l'environnement. Aussi enthousiaste que les auteurs sont pour ce nouveau paradigme pour des produits d'écosystème, des raisons existent pourquoi les marchés pour ces produits n'ont pas souvent fonctionné. Les auteurs utilisent la théorie économique pour expliquer que les marchés privés ne sont pas susceptibles de fournir à des niveaux proportionnés des biens et services (environnementales) publiques parce que chaque personne espérera que quelqu'un d'autre les fournira. Le succès du marché pour fournir des produits environnementaux méritent d'être célébré, mais pas comme alternative au rôle du secteur public.

Can the power of private markets be harnessed to protect the environment? Economic theory suggests not. Under this theory, people pollute because polluting is cheaper than being environmentally friendly; if it were profitable to be green, we would not have environmental problems. Since there clearly are environmental problems, there must be advantages from creating them. In recent years, though, both private- and public-sector enterprises have experimented with markets to see if environmental protection really has to be at the expense of other goods. "Green" goods — those produced in more earth-friendly ways — and purchases of development rights on lands to protect their ecosystem services are just two examples of using the power of economic forces to improve the planet.

The New Economy of Nature: The Quest to Make Conservation Profitable, by Gretchen C. Daily and Katherine Ellison, explores the possibilities of creating markets to protect the environment. After a prologue arguing that self-interest can and should be harnessed to provide ecosystem services, it provides a number of tales of entrepreneurs, activists, researchers, and government officials trying to determine whether working with nature might provide two types of greenery. The continuing theme is that, if protecting the environment can pay for itself, then environmental quality need not rely on government intervention; the power of the private marketplace will provide the benefits.

Daily and Ellison eagerly encourage the idea that protecting the environment can be profitable. As any introductory economics course will teach, a good, including the environment, becomes more valuable if it becomes scarcer and demand for it increases. This work argues that markets can bring together those with increasing demand for protecting the environment and those with the means to provide that protection. Daily and Ellison want people everywhere to explore the potential of these markets.

Economists have long argued that markets can be used to reduce the costs of environmental protection. If willing buyers and willing sellers can make a deal, then all parties are better off, or they would not have made the deal. *The New Economy of Nature* shows some exciting examples of people trying to apply the principle that markets can provide win-win solutions to novel situations. For instance, if Defenders of Wildlife benefits from reintroducing wolves to Yellowstone National Park, but neighboring ranchers face the cost of the wolves reducing their sheep or cattle herds, then a win-win solution can be created if Defenders is willing to compensate the ranchers for killed livestock. The ranchers earn their income, and the wolves can stay in Yellowstone.

The stories in this book tell of dealmakers who seek to turn ecosystem services into profit opportunities. New York City, for instance, found that buying development rights to protect its watershed was less expensive than building a filtration plant; in addition, limiting development protected habitat and open space, which provided additional benefits. In Costa Rica, an orange juice producer sought an environmentally friendly way to dispose of huge quantities of waste pulp; biologist Daniel Janzen suggested that it be used as fertilizer to restore a biodiversity reserve from a cattle pasture to its original status as a dry deciduous forest. The result was less expensive disposal and a renewed ecosystem. Globally, those who emit carbon dioxide, which contributes to climate change as it builds up in the atmosphere, might be induced to pay landowners to grow forests, which can act as carbon sinks and offset the effects of those emissions. Another idea includes a Conservation Exchange, in which people interested in protecting the environment would buy shares in providing ecosystem services.

The stories in this book are both inspirational and cautionary. In fact, while the tone of the book is highly enthusiastic about possible win-win situ-

ations, most of the examples either have not yet happened or have faced significant obstacles. Watershed protection in New York ran into opposition from communities that resented limits on their growth opportunities. The orange pulp disposal deal in Costa Rica was blocked by the government, perhaps over concerns over disease spread, or perhaps due to opposition from competitors in orange juice production. The Conservation Exchange never got off the ground. Can these markets ultimately succeed in protecting our planet? While the authors appear very optimistic, they admit the difficulties inherent in this approach.

Economists argue that environmental problems arise from market failure – from the inability of markets to address environmental goods adequately. Ecosystem services are "public goods" – goods whose use by one person does not affect their use by another. Public goods are typically under-provided compared to what is socially desirable, due to free riding on other people's efforts. In many of the stories here, there are some private benefits associated with the public goods, and the hope is that the private benefits are enough to pay for the private costs, with the public good as a bonus. The public benefits are nevertheless likely to get the short shrift. For instance, everyone on the planet benefits if biodiversity is protected, regardless of how much an individual contributes to the benefits by, for instance, buying shares in the Conservation Exchange. If everyone receive the same benefits regardless of who buys shares, then I may not buy any; I will hope that somebody else buys shares instead. If many people feel the same way ,then it would be remarkable that any biodiversity gets protected.

The traditional economic remedy for provision of public goods has been government supply. Revenues from taxing the public can be used to provide these goods, and the enforceability of government taxation means that nobody can free-ride. While Daily and Ellison seem to hope that markets for ecosystem services might lead to less need for government, a careful look at their case studies shows that many could not happen without it. Development rights in the Hudson River watershed were purchased by the City of New York; the possibility of substantial carbon dioxide markets relies on passage by national governments of an international treaty that would limit greenhouse gas production; an innovative plan to protect the city of Napa, California, from flooding by protecting the ecosystem services of the floodplain required the agreement and involvement of federal, state, and local agencies. Although governments do not always act in the public interest in the way that economists expect of them, private markets are likely to suffer from market failures that lead to environmental problems in the first place without government regulation

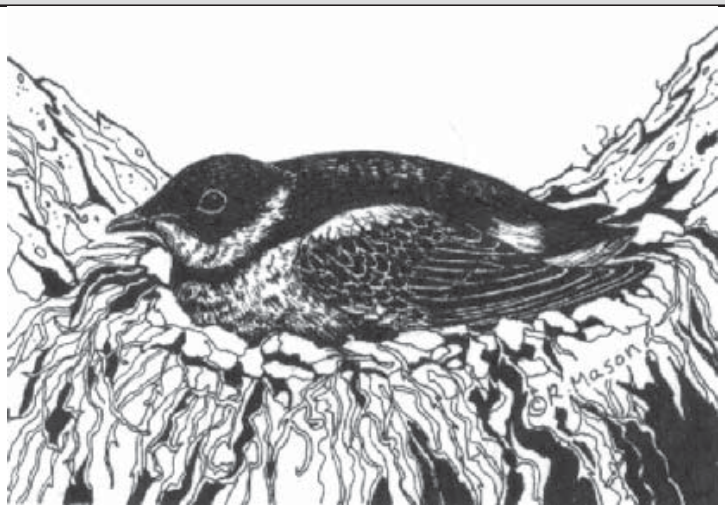
The prime audience for *The New Economy of Nature* is likely to be those who care about environmental issues and seek innovative solutions to them. For this audience, the book is both a wonderful call to arms and a potentially serious danger. The authors' excitement over the possibility of non-governmental, no-cost, market-based solutions to environmental problems will rally its readers to pursue these approaches, and every innovative win-win solution to an environmental problem deserves to be celebrated and repeated. At the same time, it implies that these approaches might suffice to protect our planet. The insight from economic theory — that markets cannot adequately address the "public goods" aspects of environmental problems — has not gone away in the new economy, as the case studies in this book in fact demonstrate. The authors do not ignore these difficulties, but they seem to want to believe that in private-markets, everyone-gains solutions are just around the corner, if the entrepreneurs find the right formula. Their theme, closely related to free market environmentalism, implicitly emphasizes the limitations of government action over the benefits government can provide.

While there is no question that government activity has sometimes caused environmental problems (e.g., the traditional engineering solutions to flooding in the Napa Valley, provided by the U.S. Army Corps of Engineers, may have contributed problems as much as they solved them), any number of environmental laws shows the ability of government to act in a positive fashion. The Nature Conservancy's private efforts to protect ecosystems, as truly laudable as they are, pale in comparison to the ecosystem services of federal and state parks and forests.

Markets are very powerful, and markets for environmental goods deserve greater development. There can be win-win solutions out there. At the same time, neither market failures nor their consequences should be ignored or considered out of date. Solving environmental problems will typically involve real tradeoffs, with real winners and losers. Readers of *The New Economy of Nature* will be inspired to the power of markets, but the book would benefit from ensuring better that those readers understand the problems and limitations of markets as well.

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*

Opinion

Agricultural Scientists are Wrong about Agriculture and Conservation Scientists are Wrong about Conservation

As delivered to the Ecological Society of America symposium on agroecology

John Vandermeer

Department of Ecology and Evolutionary Biology

Center for the Study of Complex Systems

Michigan Center for Theoretical Physics

University of Michigan
2081 Natural Science Building
Ann Arbor, MI 48109
(734) 764-1446
jvander@umich.edu

Abstract

Effective conservation has to start with a change in mentality of agriculturalists and conservationists. The "productionist" mentality of agriculturalists in a system where over-production is one of the main problems has to be changed with a goal of sustainability as a priority. Also, a philosophical change should take place to substitute the sick farm philosophy (i.e. viewing insects as pests) with one that considers the ecological integrity of agroecosystems (i.e. insects as a legitimate component of farms). The ideal primeval forest that many conservationists envision has to be changed with an understanding of agroecosystems as repositories of biodiversity and the technological transformations of these agroecosystems as the major threat to biodiversity. Viewing agroecosystems as both harbors of and matrices for the biodiversity should be the new focus. The new research agenda should include agricultural scientists whose focus is on preserving the biodiversity in agroecosystems and conservation ecologists whose focus is on preserving the agroecosystems so as to conserve biodiversity.

Los Agrónomos Están Equivocados Acerca de la Agricultura y los Conservacionistas Están Equivocados Sobre la Conservación

Como fue presentado en el simposium sobre agroecología de la Sociedad Ecológica de Norteamérica

Resumen

Una conservación efectiva tiene que empezar con un cambio en la mentalidad de agrónomos y conservacionistas. La mentalidad "productivista" de agrónomos en un sistema donde la sobreproducción es uno de los principales problemas, tiene que cambiar con la meta de sustentabilidad como prioridad. Además, debe llevarse a cabo un cambio de mentalidad para substituir la filosofía de un campo de cultivo enfermo (esto es, ver a los insectos como plagas) por una filosofía que considere la integridad ecológica de los agroecosistemas (esto es, ver a los insectos como un componente legítimo de un campo de cultivo). La idea de un bosque primitivo con el que muchos conservacionistas sueñan tiene que cambiarse por un entendimiento de los agroecosistemas como "contenedores" de biodiversidad y de las transformaciones tecnológicas de estos agroecosistemas como la mayor amenaza para la biodiversidad. El nuevo enfoque debe ver a los agroecosistemas como reservas y matrices para la biodiversidad. La nueva agenda de investigación debe incluir científicos agrícolas cuyo enfoque es preservar la biodiversidad de agroecosistemas y ecológos de la conservación cuyo enfoque sea preservar los agroecosistemas para conservar la biodiversidad.

Les Scientifiques Agricoles Ont Tort au Sujet de l'Agriculture et les Scientifiques de Conservation Ont Tort au Sujet de la Conservation

Comme livrés au colloque de la Société Ecologique de l'Amérique sur l'Agroécologie.

Résumé

Une conservation efficace devrait commencer par un changement de la mentalité des agriculteurs et des conservateurs. La mentalité productrice des agriculteurs dans un système où la surproduction est l'un des problèmes principaux devrait être changé avec le but de durabilité comme priorité. En outre, un changement philosophique devrait substituer la philosophie de ferme malade (c.a.d. les insectes comme pestes) avec celle qui considère l'intégrité écologique des agroécosystèmes (c.a.d. les insectes comme partie légitime des fermes). La forêt primitive idéale qu'envisagent la plupart des conservateurs devrait être changée avec une compréhension des agroécosystèmes comme dépôts de la biodiversité et que les transformations technologiques de ces agroécosystèmes constituent une menace principale á la biodiversité. Le nouveau point focal est de considérer les agroécosystèmes en tant qu'hébergement et matrice pour la biodiversité. Le nouveau programme de recherche devrait inclure les scientifiques agricoles dont leur but est la préservation de la biodiversité dans les agroécosystèmes et les conservateurs écologistes qui focalisent sur la préservation des agroécosystèmes afin de conserver la biodiversité.

Presenting a complex argument frequently takes some time and no less some creative and heuristic argumentation of both proofs and refutations. Indeed, some of the greatest science writers are not famous because of their choice of material, but rather because of their abilities to make the complex seem simple — Carl Sagan, Richard Feynman, Steven Jay Gould. Others are quite famous for the reverse, making simple ideas seem complex, examples of which are probably already abundant in everyone's mind.

While presenting a complex idea clearly and simply is certainly challenging, there is an even more difficult type of problem for those seeking to enlighten some corner of the world. This is the problem of presenting a politically unpopular idea. Probably the most famous case is that of Galileo. The schoolchild version is that Galileo was a brilliant scientist, whose invention of the telescope enabled him to see the truth in the Copernican system, which put him in conflict with the politically powerful, who persecuted him. His unwillingness to swerve from what he knew to be the truth landed him in jail. That story is not true. In fact Galileo was an extremely influential scientist, probably the most famous scholar south of the Alps and he was keen on maintaining his status and influence. The Copernican system was accepted throughout the rest of Europe and it was only the typically myopic Vatican that refused to endorse what everyone knew to be the truth. Galileo sought to convince the Vatican, through careful argument, that it should change its opinion and join the rest of Europe, if for no other reason to appear less ridiculous than it did at the time. He presented his argument as a dialog between a supporter of the Copernican system and a supporter of the Vatican. Apparently his defense of the Vatican in the dialogues was not convincing enough, and he was judged to be in violation of Vatican orders. But so fearful was he of banishment and loss of his position that he made Herculean efforts to mollify the Vatican, including an explicit rejection of the Copernican system. For example, he wrote,

"The falsity of the Copernican system must not an any account be doubted especialy by us Catholics, who have the irrefutable authority of Holy Scripture interpreted by the greatest masters in theology, whose agreement renders us certain of the stability of the Earth and the mobility of the Sun around it. The conjectures of Copernicus and his followers offered to the contrary are all removed by that most sound argument, taken from the omnipotence of God."

Galileo was clearly a victim of that basic problem of trying to present a position that was politically unpopular in a palatable way, but during times when the point he was making was apparently so challenging to those who held political power that no amount of palatability would have helped. Indeed, even an explicit rejection of his own position was not sufficient, and banished he was, although he never really spent any time in jail.

Today we live in a sociopolitical environment in which the words of academics are thought to be far less influenced by political forces. But this is more appearance than fact. Our basic ideology stems from the European Enlightenment and we pride ourselves on the fact that no matter how unpopular our views are, no one is going to persecute us politically — Voltaire lives! How nice it would be if that were true. Rather, we are similar to most other populations in history, in that we are unable to see clearly the way in which political power is manifest. And that is the strength of political power as a general phenomenon. One's political power over someone else is measured by how that someone else is willing to censor his or her own position without having to be told to do so.

In all aspects of life we are judged, and those judgements create the social and political context in which we must operate in the future. Judged today as having a lunatic idea creates a context for tomorrow's judges. We

must fear, especially in the academic realm, being judged as having a lunatic idea. No Vatican will banish us from our university, but the contemporary equivalent of the Vatican of Galileo's times is contained within the Academy, and our ideas are easily banished from serious consideration from the current judges whether an argument is lunatic or prescient.

In the case at hand, my judges are agricultural scientists and conservation scientists. It is my contention that agricultural scientists are generally wrong about agriculture and conservation scientists are generally wrong about conservation, a position that is not likely to be supported, at least initially, by anyone at all. Yet I shall not kowtow to power and, risking banishment, I shall tell what I think is the truth about both agriculture and conservation.

The Problem with Agricultural Science

Two years ago I was invited to give a plenary talk at the International Crop Sciences meetings in Hamburg, Germany. Having made my position on agriculture known in various writings, I assumed that I was being invited to give some sort of alternative point of view. I was also asked to contribute a written version of my talk as the plenary presentations were to be collected in a published volume. My talk was obviously not well-received by the organizers of the event, which is what I expected. But, surprisingly, the audience resonated strongly with my presentation. Indeed the first commentary from the floor was "hallelujah brother," and other commentaries left little doubt that the generally younger generation of crop scientists in attendance were not sold on the fundamental underlying paradigm of the older established agricultural scientists. My presentation clearly resonated with probably a majority of the younger scientists present, but alas, the Vatican was not pleased.

My talked contained various commentaries on the current state of agricultural research and my vision of where it should go. For example, I said,

"Agroecosystems should be designed to benefit human beings rather than as support structures for some temporary human construction, be it the nineteenth century dreams of Napoleon to dominate Europe or the twentieth century dreams of the international banking industry to dominate the world. Agroecosystems emerged from the need to provide food and fiber to the human population, not to create political power for an elite."

Apparently some people found such statements offensive, and my presentation was the only one of the plenary talks that did not make it into the published volume. But we cannot be taken seriously if we charge censorship. It was simply peer review!

The centerpiece of my talk was a criticism of the general philosophy of the vast majority of agricultural research agricultural research. Consider, for example, the coffee agroecosystem. During my past ten field seasons I have spent considerable time talking with small and large producers, workers, ex producers, agricultural economists and the like. In short, I have been speaking with a broad range of people involved with coffee production, from regional planning to picking the berries. "What is the principle problem with the coffee industry these days?," I have asked. The response has been invariably that the basic problem is overproduction and that low prices are its consequence. In contrast, when I have spoken with coffee research workers, and I have asked what is the main purpose of their research, the answer has been also consistent – to increase production. It takes a very creative mind to be able to ignore the contradiction between what the research workers are doing and what is the universally acknowledged problem with coffee outside the agricultural research sphere. And despite some important movement towards the idea of sustainability, this "productionist" mentality is still fixed in the minds of the vast majority of agricultural research workers.

Clearly a move towards re-

placing the productionist mentality with the goal of sustainability is a priority and well-worth all the efforts that have already been spent by many progressive agroecosystem ecologists. But there is another, perhaps more philosophical, criticism I have of the conventional productionist paradigm. Here I always cite the marvelous work of Helda Morales in Guatemala. Dr. Morales is currently professor of agroecology at the Colegio de la Frontera Sur in Chiapas, Mexico. In her work with traditional methods of pest management among the highland Maya of Guatemala, her plan was to conduct a series of interviews about pest problems and traditional solutions and then experimentally verify whether or not the traditional solutions were truly efficacious in the sense of western science. However, she ran into trouble immediately. To the question "what kind of pests do you have?" the answer was uniformly "we have no pests." This was immensely disappointing to a researcher whose goal was to study pests. But then Morales had an insight. She changed the question from "what kind of pests do you have?" to "what kind of insects do you have?" Here she got all sorts of answers. And interestingly, among the insects that small Mayan peasants said were commonly observed in their traditional maize fields were many that were commonly known to be pests elsewhere. So the question immediately arose, "why are these insects not considered pests?" to which a variety of answers emerged. Some answers had to do with traditional planting schedules, some with maneuring regimes, some with cultivation procedures. In short, these Mayan farmers knew what they were doing, and they knew that their management procedures were maintaining potential pests below threshold levels.

In short, Morales began asking the question "what are your problems?" and wound up asking the question "how come you have no problems?" And her research focus similarly changed from "how do farmers solve problems?" to "how do farmers manage the ecology of their farms such that problems do not emerge?" Using a medical metaphor, she went from trying to cure the disease to trying to understand what kept the disease at bay in the first place.

Here we see a characterization of what might be called the two cultures of agricultural science, that of the agronomist (and other classical agricultural disciplines such as horticulture and entomology), and that of the ecologist (or agroecologist). The agronomist asks, "what are the problems the farmer faces and how can I help solve them." The agroecologist asks "why are things that could be problems not." This is not a subtle difference in perspective but rather a fundamental difference in philosophy. The admirable goal of helping farmers out of their problems certainly cannot be faulted on either philosophical or practical grounds. Yet by focusing on solving problems, agronomists only see the sick farm, the farm with problems, and never fully appreciate the farm running well, in "balance" with the various ecological factors and forces that inevitably are operative.

With this focus we are immediately drawn into the issue of conservation. When conservationists talk of conserving biodiversity they frequently do so in a philosophical vacuum, as I will argue below. When agroecologists talk of preserving biodiversity, there is a justifiably normative talk with a solid philosophical backbone. I now turn to conservation of biodiversity, and a critique of conventional thought.

The Problem with Conservation Science

"The natural world in crisis" is a generic title for those of us who write articles and books concerned with the mass extinction on the horizon. In each of those books there is a preface, and in many cases the preface has a personal story of a young man or woman facing the semi-religious beauty of the natural world. My own story, told in a prose as romantic as I was able to muster in my book "Reconstructing Biology," is of a kid raised in an urban environment

with an attachment to grasshoppers in empty city lots and garter snakes in the wilderness of Suburban Chicago. As with many working class children of urban America, I was treated to a week of summer vacation in the "wilderness." My family traveled to the wilds of northern Wisconsin once a year, and I recall the thrill I felt when we entered the zone of paper birches. The beautiful white bark of the birch trees in the morning sun filled me with an inexplicable joy. There was something of adventure, something of unadulterated beauty, something that I could only experience in a nature that was defined to be outside of the grimy neighborhood of Chicago where I was forced to spend most of my time. I will never forget those forests dominated by those beautiful birch trees.

But I think differently now that I have had many years to contemplate those early feelings. Paper birch is a secondary species that occupies areas that have been deforested by fires, storms or loggers. Those beautiful forests dominated by paper birch are in fact testament to the avaricious logging that devastated not only all of northern Wisconsin, but also of most of my current home state of Michigan. Native stately pines were replaced by the fast growing weeds known as paper birch. The native pines formed trunks so reminiscent of the pillars of European churches that the forests were frequently dubbed "cathedral-like," a not so subtle reminder of the religious nature of much nature loving. So, the forests that were the Eden of my naive childhood are now the remnants of hell of my informed adulthood. But the forests are still there. The forests have not changed, but the person has. Trying to come to grips with the meaning of the environment, it is important to acknowledge the experience of the viewer. Just as the birch forests were different for the child and adult, so is a particular environment different for different people, for different groups of people. One person's Eden is another's Hell, and there are no absolutes about how any piece of nature is, or should be, organized.

In my professional work I encounter many brands of nature lovers — bird watchers, butterfly collectors, backpackers, and the like. Indeed, I am one of them. But there is an underlying philosophy that operates almost as if it were a membership card in a secret society. Nature, real nature, is unadulterated by *Homo sapiens*. I shall always remember the comment by a colleague in a small rain forest preserve in Costa Rica. He said, as we walked near the back of the property, "the trouble with this place is that you can hear the trucks on the highway even here in the back of the property." I nodded in agreement. But then I began to reflect on the comment. The forest is the forest, isn't it? The trees, the insects, the birds, even the soil and the litter that covers it, are all the elements of what is normally called a forest. What in the world does the sound of a truck have to do with it? And, of course, the real answer is that my colleague (like me) does not really love "the forest" but rather the idea of the forest — and not just the idea of the forest, but the *ideal* of the "forest primeval." I find it difficult to conclude anything else than we are back to envisioning Eden.

Too often as we analyze environmental issues we tend to venerate an ideal, rather than material reality. Our species has a long history of such thought. In the specific case of the conservation movement there are clear tendencies in that direction, with so many environmentalists having their own personal Edens. Indeed it is always surprising to me when exploring belief systems with environmentalists the wide range of Edens deeply felt. In many ways this romantic idealism is a stumbling block both to understanding the world and striving to improve it.

This sort of romanticism is sometimes bolstered by a seemingly scientific approach which leads to basically the same conclusion. I was recently assailed by a conservation biologist for ignoring the "highly coevolved and fragile construction of natural (sic) eco-

systems." Viewing such a statement through an honest scientific lens, what evidence does exists that the tropical rainforest is a coevolved system? What is the evidence that the biodiversity of a coral reef makes it fragile, or stable, or anything else? And what is a "natural" ecosystem in the first place, the savannahs that probably existed where dry forests now are being reconstructed in Costa Rica? Or the Oak Hickory woodlots in eastern North America that are the result of Native American burning prior to European invasion? Should we introduce elephants to Mexico to reconstruct the mix of organisms that lived there before *Homo sapiens* arrived? A serious scientific look at statements such as "a highly coevolved and fragile construction of natural ecosystems" reveals that this romanticized natural ecosystems are similar to those Edens that Eve screwed up with that damn apple and restoration ecology begins to look more like religious resurrection than science.

If we are to make a science of conservation, we really need to rid ourselves of such romanticism. I insist that my love of reptiles is legitimate. But I would never claim that that romantic love is a rationale for a course of action that the world should take. If I wish to enlist the creative energies of other people I should be required to construct a rational argument that compels that enlistment.

Conservation and Agriculture — A Program

Developing a clear argument for conservation is not as easy a task as most conservation scientists seem to assume. The prevailing paradigm is that conservation is right and our job is to figure out how to convince the rest of the world of that. Nowhere is this idea more evident than in the specific issue of conservation of biodiversity.

One position taken by very many conservationists is that the world is divided into conserved and non-conserved. We have certain areas that are either metaphorically or physically fenced off and other areas that are of no concern. The latter are largely the areas devoted to agriculture and other activities that are necessary for human survival. The extreme form of this position is essentially determinist. The human animal breeds whenever it can and thus increases its population at an exponential rate. All those people need food. Land must be devoted to providing food for them, which is land that cannot be devoted to the preservation of species. Increasing agricultural efficiency and spreading condoms around the world thus should be the two main goals for preserving biodiversity. If we can stop the growth of the human population with condoms and produce much more food on the land we are already using for agriculture, and even reduce the amount of land needed, even more land can be devoted to biodiversity preservation. This rationale explains why many in the biodiversity conservation biz advocate such technological fixes as genetically modified crops, and massive spraying of pesticides. This position is taken by many of the most respected conservationists, although they are numerically a minority.

A second position is that of the function of biodiversity. Here there is great debate, which I do not have time to go into. Suffice it to say that there is great confusion at both philosophical and empirical level. Most studies that claim to show a "function" of biodiversity are at least questionable and much further research is needed. My personal prejudice is that biodiversity has important, even critical, functional significance, but that thus far ecologists have been unable to convincingly demonstrate that fact. The function of biodiversity is probably true in most cases, but we still need to face up to the challenge.

A third position emphasizes the fact that a vast majority of the world's terrestrial surface is currently in a managed state, and almost all the rest is in some sort of recuperating state. Almost all attempts to find "pristine" ecosystems eventually discover some footprint of *Homo sapiens.* For all practical purposes we should simply acknowl-

edge that the world is composed of managed ecosystems and a program that seeks to be limited to those incredibly small corners of the world that may not have been influenced by humans, is doomed to that famous ashbin of history. When the history of how we saved the world's biodiversity is written, probably very little will be written about biological preserves. Almost all the story will be about how we got our act together to readjust our managed ecosystems in light of the need to preserve biodiversity.

Perhaps the most important, although not the only, example of how this will happen is in the area of pesticide applications. While the biodiversity conservation elite continue pushing lions and tigers and quetzales on the general public, if we ask where in the world is the biggest threat to biodiversity, it is my personal judgement that it lies in the continual massive spread of biocides in the world. Certainly it is true that we will not conserve our two species of elephants unless we have large elephant-friendly areas. But it is also true that the extinction of the world's small things should cause us as much, if not more, concern than the extinction of charismatic megafauna. Insects, mites, nematodes, microbes, and representatives from at least 30 different kingdoms of organisms abound in the soils, leaf litter and other niches in every environment in the world. A grape orchard in California's central valley contains zero ant species, as far as my personal faunal surveys could determine, as does an old cotton field in Nicaragua. These environments used to contain many ant species. How many were endemic and no longer exist we have no idea. Most were never catalogued by science. And what killed them? Not the lack of a biological preserve on a local mountainside, which is the only place the politically powerful class in Nicaragua was willing to allow us in the first place, but the massive spraying of pesticides in a failed 30 year experiment that not only failed to bring riches to the Nicaraguan people, but managed to screw up the land for many years after cotton was abandoned.

The fact is that agroecosystems can be rich depositories of biodiversity, and it is the technological transformations of agroecosystems themselves that are the biggest threat to biodiversity. The extreme conservationist position, as I outlined it above, tacitly assumes that when the original habitat (whatever that is) is converted to a managed system, like an agroecosystem, the biodiversity is simply lost. The literature now abounds with falsifications of that point of view. Agroecosystems can be rich depositories of biodiversity, depending on how they are organized. A typical grape orchard in the Central Valley of California is reminiscent of the opening lines of Silent Spring, but a traditional coffee farm in the mountains of Chiapas, Mexico contains as many ground foraging ant species as an adjacent forest. If you convert that traditional system to a pesticide-drenched grape orchard, I predict you will see the same dramatic decline in biodiversity we have seen in all other such agricultural transformations.

Not only are some agroecosystems rich depositories (perhaps the main depositories if we consider little organisms) of biodiversity, but they also function in a more subtle fashion in the modern world. Almost the entire terrestrial surface of the globe is a mosaic of different kinds of habitats. The state of Michigan as well as Nicaragua, when viewed from above, looks like islands of farm fields, abandoned fields, woodlots, stream courses and, cities. Some of those habitats harbor great biodiversity, others less so. But those habitats that harbor less biodiversity may be extremely important for those that harbor more. Now that we understand something of the dynamics of populations in spatially heterogeneous environments, it is sheer folly and demonstrative of a profound misunderstanding of elementary ecological principles to maintain that the world is divided into real habitats and agriculture, preserves and other. Indeed, in the fragmented landscape that characterizes

almost all the world's terrestrial surface, those habitats that are biodiversity poor, may indeed be extremely important as passageways for the habitats that are biodiversity rich. The so-called matrix within which the "good" habitats are located may be of various qualities in terms of its ability to support necessary services for those "good" habitats. In short, a collection of small biological reserves in a sea of pesticide-drenched biological deserts is probably far worse for the overall biodiversity preservation than a smaller collection of biological reserves in a sea of traditional agroecosystems managed organically. The matrix matters!

Conclusion

As I promised, I have argued that most agricultural scientists are wrong and most conservation ecologists are also wrong. What, then, would be right in my view? It is really quite simple. First, the productionist mentality of still a majority of agricultural scientists must be changed. Sustainability and other goals need to be recognized as far more important than production, and research programs aimed at understanding how real farms function, especially when they are functioning well, should be a major priority. Part of those other goals and part of a new research priority set will invariably involve some component of biodiversity. Second, the pristine wilderness mentality of still a majority of conservation ecologists must be changed. There are probably very few truly pristine wildernesses in the world, and they are not necessarily where most of the world's biodiversity is actually housed anyway. Viewing agroecosystems as both harbors of and matrices for the biodiversity should be the new focus. Consequently, the new research agenda should include agricultural scientists whose focus is on preserving the biodiversity in agroecosystems and conservation ecologists whose focus is on preserving the agroecosystems so as to conserve biodiversity. The effects could be very rewarding.

Species at Risk
The Cozumel Island Coati *(Nasua nelsoni)*

Katharine L. Adams

University of Michigan
9401 Stinchfield Woods Road
Pinckney, MI 48169
(734) 426-4742
kladams@umich.edu

Abstract

Nasua nelsoni is a diurnal mammal that lives only on Mexico's Cozumel Island in the Caribbean Sea. The Cozumel island coati is a species considered very similar to the white-nosed coati (*N. narica*), which has an extensive range but does not reach Cozumel Island. There have been no studies on the natural history of *N. nelsoni* but its social structure and habitat requirements are thought to be similar to the white-nosed coati. The IUCN Red List of Threatened Species reports *N. nelsoni* as an endangered species. Although the white-nosed coati is able to live in populated areas and is considered common over most of their range, there are no known studies on the interaction between human and coati populations. In order to make informed decisions about conservation, identifying those unique qualities and conditions of the island coati that distinguish it from the white-nosed coati may be particularly valuable.

El Coatí de la Isla de Cozumel

Resumen

Nasua nelsoni es un mamífero diurno que vive sólamente en la isla de Cozumel en México, localizada en el mar Caribe. El coatí de la isla de Cozumel es considerado co-específico del coatí de nariz blanca (*N. narica*), el cual tiene un rango de dispersión muy extenso, pero que no llega a la isla de Cozumel. No ha habido estudios sobre la historia natural de *N. nelsoni* pero se piensa que su estructura social y requerimientos de habitat son similares al coatí de nariz blanca. La lista roja de especies amenazadas de la ICUN (International Union for the Conservation of Nature, Unión Internacional para la Conservación de la Naturaleza) reporta a *N. nelsoni* como una especie en peligro de extinción. Aunque la especie co-específica, el coatí de nariz blanca, es considerado común en la mayor parte de su rango geográfico, no existen estudios sobre la interacción entre las poblaciones humanas y de coatís. Para poder tomar decisiones sobre conservación sustentadas en información confiable, sería particularmente valioso identificar las cualidades y condiciones únicas del coatí de la isla que lo distinguen del coatí de nariz blanca.

Le Coati d'île de Cozumel

Résumé

Nasua nelsoni est un mammifère journalier qui vit seulement sur l'île de Cozumel au Mexique dans les Caraïbes. Le coati d'île de Cozumel est considéré comme une espèce très similaire du coati à museau blanc (*N. narica*) qui a une vaste répartition mais ne se trouve pas sur l'île de Cozumel. Il n'y existe aucune étude sur l'histoire naturelle du *Nasua nelsoni* mais sa structure sociale et besoins écosystèmes sont sensés d'être semblables au coati à museau blanc. La liste rouge d'UICN des espèces menacées indique le *Nasua nelsoni* comme espèce en voie de disparition. Bien que le coati à museau blanc puisse vivre dans des lieus peuplés et soit considéré répandu dans leur répartition, il n'y a aucune étude connue sur l'interaction entre les humaines et les populations de coati. Afin de prendre des décisions au sujet de leur conservation, il est peut être particulièrement utile d'identifier les qualités et caractéristiques uniques du coati d'île de Cozumel pour le distinguer du coati à museau blanc.

Cozumel Island Coati
Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Carnivora
Family: Procyndae
Genus: Nasua
Species: *Nasua nelsoni*

Geographic Range

Nasua nelsoni lives only on Mexico's Cozumel Island in the Caribbean Sea (IUCN 2002). Off the east coast of the Yucatan Peninsula, Cozumel Island is located 17.7 km out separated from the mainland by a 914-meter deep channel (National Geographic 2002; Travelnotes 2003) (Figure 1). This island endemic is considered a conspecific of *Nasua narica*, the white-nosed coati. The range of the white-nosed coati is extensive, but does not reach Cozumel Island. The white-nosed coati can be found on the North, Central, and South American continents (Deker 1991; SILO 2003). Present from the south of Arizona and New Mexico down through Mexico and Central America into western Ecuador and Colombia, the white-nosed coati is a common species throughout its range (Poglayen-Neuwall 1990).

Physical Characteristics

Coatis are medium-sized mammals with a rather stocky build, rounded ears, and narrow face (Gittleman 1989). The body averages 38 cm in length and the tail extends another 20-24 cm (Postanowicz 2003). The ringed tail and flexible snout are both long and mobile. The tail is used for balance when climbing and held aloft while walking, and the snout is used to forage in the soil and undergrowth. The Cozumel Island coati appears very similar to the white-nosed coati with slightly softer and shorter, gray to brown colored fur (Postanowicz 2003). It also has the same light muzzle, throat, and underbelly that distinguish *N. narica* from other coati species. All four feet have sharp claws and lack fur on their soles. Male coatis are larger than females.

Natural History

The behavior and lifestyle of the Cozumel Island coati have not been closely studied. However, their social structure and habitat requirements are thought to be similar to their conspecific, the white-nosed coati (Postanowicz 2003). Most research on the white-nosed coati has been done in tropical forests, and several seminal works have focused on populations resident to Barro Colorado Island in Panama. On Cozumel, the island species primarily inhabits forested areas. Cozumel Island is largely undeveloped and covered with dense jungle and scrub. The island is 53 km long and 15 km wide, and much of the land and surrounding waters are protected as National parks (Noble et al. 2003).

Among *N. narica*, females and young of both sexes live in bands while adult males are solitary, except for a brief period of about two weeks when one male will join a band and mate with several females (Gompper 1994). In tropical forests of Central America band size often ranges from 4-12 individuals, whereas in the desert scrub of northern Mexico bands numbering over thirty individuals have been reported. Adult female band members are often related, but may include non-relatives, and larger bands are more likely to include non-relatives than smaller bands. Members in a band do not display strong dominance hierarchies, however during individual conflicts, coalitions form in support of individual band members (Russell 1983; Gompper 1994).

Although conflicts within bands do occur, white-nosed coati spend most of their time foraging, resting, or grooming one another (Gompper 1994). So-

cial interactions involve reciprocal grooming, vocal communication, and shared protection of the young, but once an individual finds a food source, she is unlikely to share (Gompper 1994; Compton et al. 2003). Coati are diurnal and sleep in trees at night (Valenzuela and Ceballos 2000). They are not highly territorial, but they do maintain home ranges that may overlap with others (Valenzuela and Ceballos 2000; Hass 2002). They use their powerful claws and strong, flexible snout to root for invertebrates or small vertebrates on the ground. They prefer to eat the fruit of trees when it is available and will become more territorial, preventing other coati bands from having any access to the fruiting tree. Such trees are usually wider spaced and temporary food sources in tropical forests. When confronted by a larger band, smaller bands and solitary males renounce their claim to a fruiting tree.

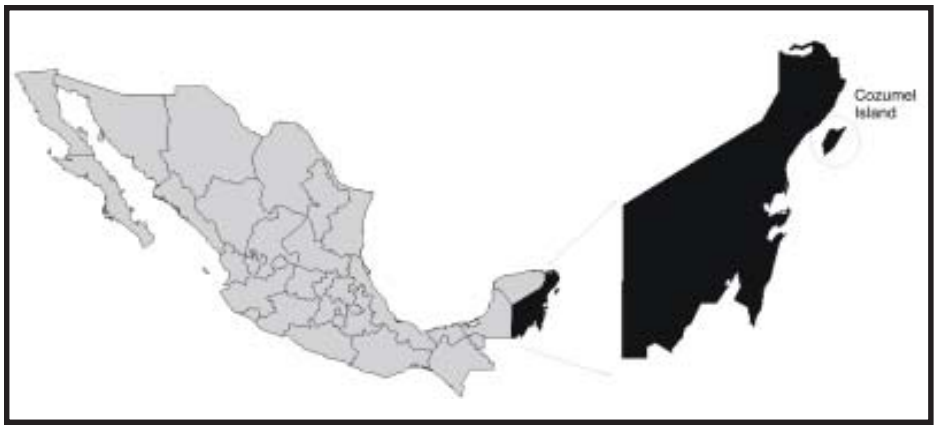


Figure 1. Cozumel Island, East of the State of Quintana Roo, Mexico

Female white-nosed coati disperse and live solitarily when giving birth and during the first few weeks of growth. Gestation lasts approximately 77 days and young are weaned at about 4 months of age (Walker's Mammals of the World 2003). Shortly after weaning, bands of females and juveniles reform. Gompper (1996) noted that when foraging mature females in the group tend to form a loose oval with all the young contained in the center. He and others have hypothesized that this may be effective protection from predation for the young coati (Hass and Valenzuela 2002). Males do not help raise young and are actively driven away from bands except during the brief mating period.

Conservation Status

IUCN Red List of Treatened Species (2002) reports *N. nelsoni* as an endangered species. The island population was last assessed in 1996 and little work has been done to monitor the species' status. White-nosed coatis are able to live in human populated areas and are considered common over most of their range. However, there have been no studies on the combination of ongoing habitat loss due to human development and hunting that do take a toll on *N. nelsoni*, especially when the population size is inherently limited by the restricted range of the island. There are no known studies on the interaction between human and coati populations.

Conservation Action

There is a dire need for further research to assess both the status and risks to this endangered species. Although Cozumel is home to the impressive Chankanaab Lagoon National Park, no known conservation efforts are targeted specifically to monitor or protect *N. nelsoni*. The cosmetic and taxonomic similarity between *N. nelsoni* and *N. narica* coupled with a dearth of research on the island coati, have led to many assumptions regarding the population's condition and needs. Those assumptions may inhibit efforts to conserve the island's species. The white-nosed coati is considered common throughout its range, while the island species is endangered. In order to make informed decisions about conservation, identifying those unique qualities and conditions of the island coati that distinguish it from the white-nosed coati may be specially valuable.

Economic Importance

Tourism is the primary economic enterprise of Cozumel Island. Wildlife, including the coati, are important tourist attractions for the island. In addition, coati are hunted for their fur and meat.

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Coatí de la isla de Cozumel
Reino: Animalia
Filum: Chordata
Clase: Mammalia
Orden: Carnivora
Familia: Procynidae
Género: Nasua
Especie: *Nasua nelsoni*

Rango Geográfico

Nasua nelsoni vive sólamente en la isla de Cozumel en México, en el Mar Caribe (IUCN 2002). En la costa este de la Península de Yucatán, la isla de Cozumel está localizada a 17.7 km del continente separada por un canal de 914 m de profundidad (National Geographic 2002; Travelnotes 2003) (Figura 1). Esta especie endémica de la isla es considerada co-específica del coatí de nariz blanca, *Nasua narica*. El rango de distribución geográfica del coatí de nariz blanca es extenso, pero no abarca la isla de Cozumel. *N. narica* se encuentra en Norte, Centro y Sudamérica (Deker 1991; SILO 2001). Se presenta desde el sur de Arizona y Nuevo México, por todo México y Centroamérica hasta la parte oeste de Ecuador y Colombia, siendo común a través de todo este rango geográfico (Poglayen-Neuwall 1990).

Características Físicas

Los Coatís son mamíferos de tamaño mediano con un cuerpo robusto, nariz achatada, orejas redondeadas y una cara angosta (Gittleman 1989). El promedio de longitud del cuerpo es de 38 cm y la cola se extiende otros 20-24 cm (Postanowicz 2003). Tanto la cola anillada como la trompa flexible son largas y móviles. La cola es usada para balance al escalar y es mantenida levantada al caminar, mientras que la trompa es usada para buscar alimento en el suelo y subsuelo. El coatí de la isla de Cozumel tiene una apariencia muy similar al coatí de la nariz blanca con un pelaje de gris a café, ligeramente más suave y corto (Postanowicz 2003). También tiene el mismo hocico, garganta y vientre bajo de color claros que distinguen a *N. narica* de otras especies de coatís. Las cuatros patas tienen garras filosas y las plantas de las patas carecen de pelaje. Los machos son más grandes que las hembras.

Historia Natural

El comportamiento y estilo de vida del coatí de la isla de Cozumel no han sido estudiados muy de cerca. Sin embargo, se piensa que su estructura social y requirimientos de hábitat son similares a su co-específico, el coatí de nariz blanca (Postanowicz 2003). La mayor parte de la investigación sobre el coatí de nariz blanca se ha hecho en los trópicos, y varios trabajos fundamentales se han enfocado en poblaciones residentes de la isla de Barro Colorado en Panamá. En Cozumel, la especie de la isla habita principalmente areas boscosas. La isla de Cozumel no se encuentra desarrollada y en su mayoría está cubiertad densamente de vegetación tropical y arbustiva. La isla tiene 53 km de largo por 15 km de ancho y gran parte de la isla y las aguas que la rodean están protegidas en forma de parques nacionales (Noble et al. 2003).

Las hembras e individuos jóvenes de ambos sexos de *N. narica* females viven en bandas mientras que los machos adultos son solitarios, excepto por un breve periodo de cerca de dos semanas en el que un macho se une a una banda y copula con varias hembras (Gompper 1994). En regiones tropicales de Centroamérica el tamaño de los grupos frecuentemente varía de 4-12 individuos, mientras que en el desierto del norte de México las bandas de más de treinta individuos han sido reportadas. Las hembras adultas dentro de las bandas están frecuentemente genéticamente

relacionadas entre sí, aunque estos grupos pueden incluir miembros sin ningún parentesco, lo que tiende a occurrir con mayor frecuencia en bandas de mayor tamaño que en bandas pequeñas. Los miembros de una banda no presentan un arreglo jerárquico, sin embargo, coaliciones que apoyan a diferentes miembros de la banda se forman durante conflictos entre individuos (Russell 1983; Gompper 1994).

Aunque conflictos dentro de las bandas llegan a presentarse, el coatí de nariz blanca pasa la mayor parte del tiempo buscando comida, descansando, o aseándose entre sí (Gompper 1994). Las interacciones sociales involucran aseo recíproco, comunicación vocal y protección compartida de individuos jóvenes, pero es muy raro que un individuo comparta comida, una vez que una fuente de alimento es localizada (Gompper 1994; Compton et al. 2003). Los coatís son animales diurnos y duermen en árboles durante la noche (Valenzuela y Ceballos 2000). No son altamente territoriales, pero mantienen un rango territorial que puede ser compartido en algunas partes con otros grupos (Valenzuela y Ceballos 2000; Hass 2002). Los coatís usan sus poderosas garras y sus flexibles trompas para buscar invertebrados o vertebrados pequeños en el suelo. Prefieren comer la fruta de árboles cuando está disponible y llegan a ser más territoriales, evitando que miembros de otras bandas tengan acceso al árbol con frutos. Arboles con disponibilidad de frutos se encuentran bastante separados entre si y son una fuente temporal de comida en bosques tropicales. Cuando una banda chica es atacada por una banda de mayor tamaño, la banda pequeña y machos solitarios renuncian al árbol con frutos en disputa.

Al dar a luz las hembras del coatí de nariz blanca se dispersan y viven solitarias durante las primeras semanas de crecimiento. El periodo de gestación dura aproximadamente 77 días y empiezan a consumir otros alimentos además de la leche materna cerca de los cuatro meses de edad (Walker's Mammals of the World 2003). Un poco después de este cambio de alimentación, las bandas de hembras e individuos jóvenes vuelven a formarse. Gompper (1996) notó que hembras maduras tienden a formar un oválo no muy cerrado que contiene a los individuos jóvenes en el centro. Este y otros investigadores han hipotetizado que este comportamiento podría ser una medida efectiva de protección de coatís jóvenes contra depredadores (Hass y Valenzuela 2002). Los machos no ayudan con la crianza de los individuos jóvenes y son activamente rechazados por las bandas a excepción del corto periodo de cópula.

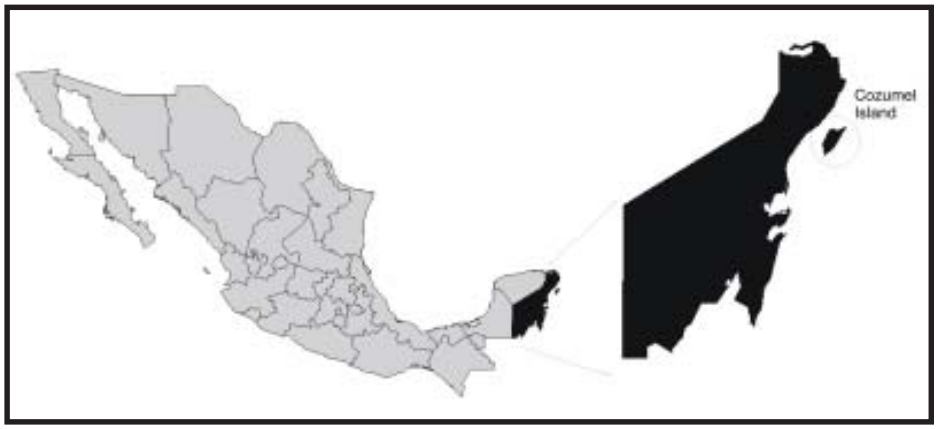

Figura 1. Isla de Cozumel, al este del estado de Quintana Roo, Mexico

Estatus de la Conservación

"IUCN Red List of Treatened Species" (Lista Roja de las Especies Amenazadas de la International Union for the Conservation of Nature, Unión Internacional para la Conservación de la Naturaleza) (2002) reporta a *N. nelsoni* como una especie en peligro de extinción. La última vez que la población de la isla fue determinada fue en 1996 y desde entonces se ha hecho poco trabajo para "monitorear" el estatus de la especie. Los coatís de nariz blanca pueden vivir en lugares poblados por seres humanos y se consideran comunes a través de la mayor parte de su rango geográfico. Sin embargo, no ha habido estudios sobre el efecto de la combinación de pérdida de hábitat debido al desarrollo humano y la caza de *N. nelsoni*, que afecta fuertemente a la especie, especialmente

cuando el tamaño de la población está limitado en forma natural debido al rango restringido de la isla. No se conoce ningún estudio sobre la interacción de humanos y las poblaciones de coatís.

Acción para la Conservación
Existe una necesidad urgente para una mayor investigación para establecer el estatus y los riesgos que afectan a esta especie en peligro de extinción. Aunque la isla de Cozumel alberga el impresionante parque nacional de la laguna Chankanaab, no existen esfuerzos de conservación cuyo objetivo específico sea "monitorear" o proteger a *N. nelsoni*. La similitud taxonómica y cosmética entre *N. nelsoni* y *N. narica* junto con la carencia de investigación de la especie insular, han llevado a asumir muchas de las condiciones y necesidades poblacionales de esta especie. Estas asunciones pudieran inhibir los esfuerzos por conservar la especie isleña. El coatí de nariz blanca es considerado común a través de su rango geográfico, mientras que *N. nelsoni* está en peligro de extinción. Para poder tomar decisiones de conservación basadas en información confiable, la identificación de las cualidades y condiciones únicas que distinguen al coatí de la isla de Cozumel del coatí de nariz blanca pudiera ser especialmente valiosa.

Importancia Económica
El turismo es la principal industria de la isla. La vida silvestre, que incluye al coatí, son importantes atractivos de la isla. Además, el coatí es cazado por su pelaje y carne.

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News from Zoos

North Carolina Zoo and Zoo Society Launch "Field Trip Earth" Website

The North Carolina Zoo and the North Carolina Zoological Society recently unveiled *Field Trip Earth*. This online learning project, located at *www.fieldtripearth.org*, is the result of more than a year of work by a team of zoo researchers and several conservation organizations. Financial support came from the Zoo Society and a $258,000 grant from the Institute of Museum and Library Services (IMLS).

Field Trip Earth helps teachers and students in K through 12 classrooms around the world with the integration of fundamental conservation issues into their learning of more traditional subjects such as languages, mathematics, fine arts, natural and social sciences and technology. In addition to communicating information about key issues such as species endangerment, habitat protection and captive management, the website encourages students to better understand how their daily decisions affect the world around them. An extensive library of background readings about various wildlife conservation projects, species and regions is available from the site. Students have the possibility to communicate directly with field scientists, as well as with other classrooms using the site, forming a community of learners around the project. Other highlights of the program include a study of black bear (*Ursus americanus*) population dynamics in the Great Smokey Mountains National Park and a multi-faceted look at Atlantic sea turtle (*Chelonia mydas*) conservation efforts. A number of other field conservation programs focusing on species ranging from white-winged wood ducks (*Cairina scutulata*) to Mexican wolves (*Canis lupus baileyi*) and Przewalski's horse (*Equus przewalski*), taking place around the world, are under development and will be added to the site in the coming months.

Zoo Atlanta Updates Virtual Gorillas

Cybernet Systems Corporation recently announced the completed upgrade of Zoo Atlanta's Virtual Gorilla computerized educational tool. Partly funded by a National Science Foundation project led by Dr. Kenneth Hay at the University of Georgia, the Virtual Gorilla program is used to help students become familiar with the scientific method and form a better understanding of gorillas (*Gorilla gorilla*) using a virtual environment and virtual gorillas. Cybernet Systems improved the program's realism by giving the virtual gorillas newly enhanced physical features and motion detection capabilities, and by placing them in a more realistic habitat. Users now can become a virtual gorilla and actually experience the species' social structure through interaction while other students view the exchange on a screen.

Before entering the exhibit in the Zoo's Conservation Action Resource Center, students learn about the social structure of the gorilla and develop a hypothesis on how different gorillas will react to certain behavior. Upon entering the virtual environment as a gorilla, students then test their hypotheses by interacting with a silverback male and two adult female gorillas. Through different vocalizations and gestures that gorillas use to communicate, including screams, grunts and chest beatings, students can gauge the gorillas' reaction and change their own behavior accordingly.

The project is currently a part of Dr. Hay's Gorilla Modeling Project, which combines the use of a virtual environment, a set of modeling tools and video-streaming experiences with on-site observations. Students use gorilla observations to develop virtual reality biomechanical models of gorilla movement, and then produce an interactive model using a rule-building system. The inquiry-based approach fosters understanding of animal behavior that includes biomechanics and individual gorilla interactions.

Further information about the Virtual Gorilla exhibit is available at www.openskies.net/gorilla.

Zoo Cats Help Wild Cousins

By introducing the public to animals the average person might never see, wildlife institutions perform an important educational service. Over 70 million people visit zoos each year in the United States where they learn about the plights of endangered species such as pandas, rhinos, and snow leopards through signage, lectures, and guided tours. But zoos do more than provide a glimpse of exotic animals. Zoos are in an excellent position to help in the fight to save endangered species. Over two hundred zoos in North America are accredited by the American Zoo and Aquarium Association (AZA), a non-profit organization dedicated to the advancement of zoos and aquariums. Membership in the AZA requires a commitment to save and protect the wonders of the natural world.

Research in zoos enhances *in situ* conservation efforts. For example, over thirty zoos and wildlife parks have supported work of the International Snow Leopard Trust's (ISLT) Natural Partnerships Program (NPP) since its inception in 1997. By sponsoring specific conservation, research, and education initiatives in Mongolia, the Kyrgyz Republic, India, Pakistan, and other countries where snow leopards (*Panthera uncia*) are found, NPP supporters are ensuring that the species has a chance of surviving in the wild. In 2002, NPP projects included a cooperative ISLT/Peace Corps Mongolia education and research mission (funded by Blank Park Zoo, Mill Mountain Zoo, Great Plains Zoo, San Antonio Zoo, Tautphaus Park Zoo, Colchester Zoo, and Marwell Zoo); the expansion of Snow Leopard Enterprises to Pakistan (funded by Milwaukee County Zoo, Oregon Zoo, Oklahoma City Zoo, San Francisco Zoo, Tulsa Zoo, Lee Richardson Zoo, and Societe Zoologique de Granby); and the implementation of a multi-pronged conservation program in India (supported by Binder Park Zoo and Sacramento Zoo). Woodland Park Zoo of Seattle is a major supporter of ISLT and *in situ* conservation in general. Since joining the NPP in 1998, Woodland Park Zoo has provided more than $200,000 in support of snow leopard conservation programs.

The AZA also manages the captive populations of endangered species through coordinated breeding programs called Species Survival Plans (SSPs). SSPs are responsible for maintaining healthy, self-sustaining, and genetically diverse captive populations; raising public awareness through education and outreach; and in some cases introducing captive-bred animals into the wild.

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

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
430 E. University
Ann Arbor, MI 48109-1115

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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