

# Endangered Species UPDATE

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# Why Both Sexes Leave: Effects of Habitat Fragmentation on Dispersal Behavior

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## Abstract

*Deforestation is associated with increased environmental heterogeneity, unpredictability, and stress that may modify patterns of behavior in mammalian populations. In particular, habitat disturbance and other anthropogenic effects appear to be increasing the incidence of bisexual dispersal. These events are analyzed in terms of benefits and costs of dispersal to individuals of either sex. Implications for conservation are discussed.*

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Loss of suitable habitat is one of the greatest threats to biodiversity (Primack 1993; Brokaw 1999). When continuous forest is cut, fragments often remain that yield a significantly different physical and biotic environment than existed before deforestation, possibly modifying the patterns of stimuli evoking behavioral responses from remaining plants and animals. Fragmentation increases environmental heterogeneity, patchiness, and unpredictability, and may increase stress on the individual organism (Hofer and East 1998). In this paper, I address the effects of habitat fragmentation on behavior, in particular, dispersal by both sexes of a species from their natal or resident groups. Most of the examples herein will be taken from the primate literature, but the arguments are expected to apply to other taxa.

The study of dispersal is the study of why and under what circumstances individuals leave their residences, usually their natal groups (Johnson and Gaines 1990). Often, individuals leave home to escape the negative consequences of living with kin (e.g., inbreeding or resource competition), and scientists have identified reliable patterns of animal dispersal. For most species of birds, females are the dispersing sex whereas, among mammals, including primates, males

are more likely to disperse (Greenwood 1980). While these differences are not well understood, researchers agree that the dispersing sex is the sex least likely to benefit from interactions with relatives, particularly interactions that lead to inbreeding and limited access to mates (Greenwood 1980; Pusey 1980; Pusey and Packer 1987; Johnson and Gaines 1990).

Habitat fragmentation has the potential to significantly limit a species capacity to move to habitable areas because fragmentation changes the spatial configuration of a landscape (Primack 1983; Olivieri and Goyon 1997; Van Vuren 1998). Most importantly, interpatch distances may increase. Some insect, bird, and mammal species will only move short distances between patches (e.g., Bierregaard et al. 1992), and "stepping-stone" or short- to medium-distance dispersal appears to be the norm for primates (Glander 1992; Moore 1992). Deforestation may result in patches too far apart for individuals of many species to navigate, decreasing likelihoods of successful dispersal and colonization and increasing likelihoods of extinction through inbreeding within groups in patches from which individuals are prevented from emigrating (Van Vuren 1998). Although dispersal is expected to entail high risk, such as exposure to predation,

starvation, or to the costs of high energy expenditure borne by movement between fragments (Johnson and Gaines 1990), researchers assume that, where dispersal occurs, ultimate benefits from leaving one's group will, on average, outweigh its costs (Johnson and Gaines 1990).

Until the 1980s it was generally thought that dispersal by both sexes of a species was rare. There have been, however, documented cases of female dispersal. Wrangham (1980), for example, was the first to point out that primates demonstrating female dispersal are often leaf-eating species, suggesting an association between stressful conditions caused by food of poor quality and dispersal behavior. In other words, as food quality decreases, female dispersal increases. Feeding on mature leaves, in particular, may create stressful conditions because they are often low in carbohydrates and "are not generally eaten for ready energy," and leaves may be high in phenolic content (Milton 1980). Individuals may leave home in search of food of higher quality, such as fruit or flowers or patches of more nutritious leaves. Primate research strongly supports Wrangham's conclusions because bisexual dispersal has been documented in howler monkeys (*Alouatta* spp.), colobus monkeys (*Colobus satanas* and *C.*

*polykomos*), langurs (*Presbytis* spp.), and the mountain gorilla (*Gorilla gorilla beringei*)—all folivorous primates (Moore 1984, 1992, 1993; Moore and Ali 1984)—and the relationship has recently been supported by studies of three grass-eating species of zebra (*Equus burchelli*, *E. zebra*, and *E. grevyi*) that display bisexual dispersal (Hack and Rubenstein 1998). Moore (1984, 1993) extended Wrangham's work to show that bisexual dispersal for reasons other than inbreeding avoidance is more common than previously assumed. Individuals may "decide" to leave groups because of a failure to locate mates or food or because they are expelled aggressively by groupmates, including kin.

The studies by Wrangham and Moore are consistent with recent reports by Emlen (1994, 1995). Emlen studied cooperative breeding in birds, developing a general model for the evolution of family structure. This model predicts when offspring will leave or remain in their natal groups. Emlen expects individuals to disperse when the reproductive benefits of leaving home outweigh the benefits of staying. Individuals are more likely to disperse when breeding vacancies exist away from home, a condition unlikely to be found in habitats of high quality where population density is high and space is saturated. Dispersing from a natal group on a poor habitat, then, may have higher potential benefits to individuals because of the chances to locate an unsaturated group in better habitat or to colonize uninhabited landscape. Emlen's work demonstrates that environmental variations may explain variations in behavior and that individuals make decisions based on local conditions such as physical condition or rates of interaction with groupmates.

Wrangham's and Moore's conclusions are consistent with Emlen's

model. It is expected that, regardless of sex, an individual will disperse when conditions away from home confer greater survival and reproductive success than conditions at home. Recent reports from the field demonstrate that primates living in disturbed habitat often demonstrate bisexual dispersal, supporting the view that loss of habitat may have significant consequences for a species' behavioral repertoire. A preliminary test of this relationship was recently reported for common chimpanzees (*Pan troglodytes*), a species typically demonstrating female dispersal and male philopatry, similar to that of many bird species. Y. Sugiyama, a Japanese primatologist, observed bisexual dispersal among chimpanzees in disturbed habitat in Bossou, Guinea (Normile 1998). Similarly, Sterck (1998) has argued that female dispersal in langurs (*Presbytis* spp.) is linked to "human disturbance." Furthermore, bisexual dispersal is found in mantled howler monkeys (*Alouatta palliata*) (Jones 1978, 1995a) who are thought to have evolved in tropical dry forest, heterogeneous conditions similar to those found where forests are fragmented (Jones 1995b). Clarke et al. (1998) reported that mantled howlers are more likely to emigrate from natal groups in low-quality conditions. If these observations identify significant relationships between habitat quality and patterns of behavior, it is expected that bisexual dispersal will become more common as habitat fragmentation increases.

A recent study of dispersal in ground squirrels (*Spermophilus beldingi*) (Nunes et al. 1998) suggests mechanisms that might trigger dispersal under the conditions that Emlen's model predicts. In particular, Nunes et al. (1998) find evidence to support the view that dispersal is a result of (1) an organism's physical condition, especially fat reserves and

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(2) time of year, a variable that will correlate with habitat quality, especially food availability. These results suggest that all individuals are potential dispersers, relative to sex, age, social rank, physical condition, genotype, and, possibly, other factors, and that dispersal behavior may be a component of an organism's general adaptation response to stressful conditions whose threshold may be lowered by habitat fragmentation.

Future research must evaluate the relative significance of inbreeding avoidance and the search for breeding sites of high quality in determining decisions to disperse. Inbreeding cannot be discounted as a factor in determining dispersal patterns because habitat fragmentation increases probabilities of inbreeding (Caro 1998) which may increase the costs of remaining in natal groups for both sexes. Recent studies of butterflies (*Melitaea cinxia*) (Saccheri et al. 1998) and prairie chickens (*Tympanuchus cupido pinnatus*) (Westemeier et al. 1998), for example, demonstrate that consanguineous matings result in inbreeding depression, increasing probabilities of extinction. Dispersal by both sexes will eliminate sib-sib as well as parent-offspring matings, effects that may benefit an individual's survival and reproductive success and decrease likelihoods of extinction within populations in disturbed habitats. Avoidance of inbreeding may be viewed as one benefit from dispersal in addition to a suite of additional benefits gained in pursuit of breeding sites of high quality (e.g., more food, less competition), leading some researchers to suggest that dispersal will result from a threshold value of benefits to costs (Emlen 1994; Jones 1995a).

It is not necessary, then, to view inbreeding avoidance and the search for high-quality, unsaturated, or unoccupied habitat as mutually exclu-

sive determinants of sex-biased dispersal. When "deciding" to disperse or not to disperse, individuals will assess numerous components of survival and reproductive success, including the relative benefits and costs of inbreeding avoidance and the location of higher-quality breeding sites. When both sexes leave home, it is likely that the advantages of doing so or the costs of not doing so are high relative to the advantages of remaining in the group of origin. Further studies of bisexual dispersal in primates and other taxa will help to identify the particular individual, social, ecological, and physical factors determining these decisions as well as the extent to which habitat disturbance and other anthropogenic effects are likely to increase the incidence of dispersal by both sexes.

The study of bisexual dispersal has important implications for conservation. In particular, the design of corridors and reserves because local dynamics will affect spatial dynamics of populations (Hanski 1998). Bisexual dispersal may have significant consequences for populations because males and females generally disperse at different rates and for different distances (Johnson and Gaines 1990; Van Vuren 1998). These patterns will influence the effectiveness of reserves and have important implications for their placement. Further, bisexual dispersal may affect the vulnerability of certain species via demographic consequences. In particular, increased dispersal by both sexes precipitated by deforestation and other anthropogenic stressors (e.g., climate change) may increase stochastic events, possibly hastening the extinction of species. These consequences might arise prior to deleterious effects of inbreeding depression (Koenig et al. 1999).

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## Legislative News

### Equal Rights for Plants

The California Native Plant Society is circulating a letter calling for equal protection for plants under the federal Endangered Species Act. The ESA gives animal species a higher level of protection while plant species are protected in only limited circumstances. For more info see <[http://www.cnps.org/lma/equal\\_protection.html](http://www.cnps.org/lma/equal_protection.html)> (GREENLines, 28 June 1999)

### New ESA Bill Introduced

The AP 7/2 reported Senator Craig Thomas (R-WY) introduced a bill (S. 1305), the Endangered Species Listing and Delisting Reform Act, which requires "collection and use of the best scientific data" when listing a species under the Endangered Species Act. Thomas is critical of the inclusion of five Wyoming counties as part of the historical range of the Preble's meadow jumping mouse. He contends the scientific data does not support the claim. The FWS said the current law already requires many items included in Thomas' bill, such as a public comment period and peer review of scientific data. (GREENLines, 6 July 1999)

### Albuquerque May Fight Critical Habitat

The 7/1 Albuquerque Journal reported Mayor Jim Baca is considering going to court to oppose the recent designation of critical habitat for the endangered silvery minnow along the Rio Grande River. The U.S. Fish and Wildlife Service designated over 163 miles of the

river as critical habitat after environmentalists sued and won in court. The New Mexico State Engineer has also promised to sue to delay or overturn the designation. (GREENLines, 8 July 1999)

### Eagle Delisting Questioned in Southeast

Knight-Ridder Newspapers 6/3 reported some biologists fear a delisting of the bald eagle from the Endangered Species Act may result in renewed declines in Southeastern populations. The bird's favored nesting habitat along coasts and shorelines is popular with real estate developers. Unlike the ESA, other federal laws protecting the bird do not adequately protect its habitat. (GREENLines, 9 July 1999)

### No Surprises Records to Be Revealed

The Spirit of the Sage Council announced 7/15 a federal judge ordered the Departments of Interior and Commerce to hand over records relating to a recent change in the No Surprises policy. The agencies recently modified the No Surprises policy after the Council challenged the policy in court. No Surprises gives landowners assurances against additional necessary actions to protect endangered or threatened species beyond what is required in their Habitat Conservation Plan. Environmentalists contend this changing conditions and scientific knowledge and could contribute to the extinction of species. (GREENLines, 16 July 1999)

# An Environmental Education Approach to Conservation of the Blue-fronted Amazon in Córdoba, Argentina

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## Abstract

*Wild populations of the blue-fronted Amazon (*Amazona aestiva*) are declining in Central Argentina due to habitat destruction of the Chaco forests and overexploitation for pet trade. An environmental education program was implemented to increase local awareness in the province of Córdoba, where this species is on the verge of local extinction. Two scales at which to apply the program were identified. Locally, the program was focused on rural people living near Chaco forest habitats who sometimes extract wild individuals for the pet market. Regionally, the program was centered on urban inhabitants who buy parrots as pets. The ultimate goal was for both target groups (rural and urban people) to become aware of the blue-fronted Amazon's status and the different ways in which they could contribute to protect it as a valuable wildlife resource in the province of Córdoba. Program implementation included public presentations to people ranging in age from 5 to 80, a technical report for public outreach, classroom study cards, posters, seminars for educators, talks broadcast by the local radio and TV, and articles published in the local newspaper. Through this program people became interested in the status of this endangered species, which led to personal commitment to take action and inform other people about this conservation problem. The relationship between urban groups and rural communities was improved in an attempt to help preserve Chaco forests and its endangered species. The Blue-fronted Amazon case is just an example of how the apportionment of educational efforts at local and regional scales can improve the conservation of endangered species and its habitats.*

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## Introduction

The blue-fronted Amazon (*Amazona aestiva*) inhabits many South American countries from Brazil to Argentina. In Argentina, it is mainly found in the northern part of the country within the biogeographical region of Chaco (Bucher and Martella 1988), an area characterized by semi-dry forest with high trees belonging to the genera *Aspidosperma* and *Prosopis*. This habitat is important for the survival of the blue-fronted Amazon because pairs build isolated nests in cavities of mature trees, which are only found in undisturbed Chaco forests (Bucher et al. 1992). Most of the northern populations make seasonal movements during the non-breeding season towards subtropical areas of Argentina, exploiting in large flocks fruits, seeds and, in certain areas, citrus crops (Navarro et al. 1991). These

flocks are easily heard, because they are in continuous vocal contact throughout the day (Fernández-Juricic et al. 1998a), moving from roosting sites to feeding grounds in the morning, and returning to roost in the afternoon (Fernández-Juricic et al. 1998b).

## Reasons for decline

In Argentina, blue-fronted Amazon populations are shrinking, and local extinction phenomena are occurring (Bucher and Martella 1988; Nores and Yzurrieta 1994). Deforestation and local agricultural development are leaving vast amounts of Chaco forests without the required trees for nesting. Wintering areas are also disappearing owing to the expansion of agricultural fields (particularly citrus crops). More than 60% of the original Chaco forest habitat has vanished

during this century in Argentina, with the current rate of deforestation in the region ranging from 50,000 to 200,000 ha per year (Mouchard 1997). As a result, only fragmented populations of the blue-fronted Amazon remain, particularly at the edge of the species' range.

The blue-fronted Amazon is widely known for being able to mimic human speech, and thus it is frequently captured to be sold as a pet. During the 1980s, more than 120,000 individuals were legally exported from Argentina, and the demand for the species continued to increase until 1992, when international trade of the species was banned (Mouchard 1997). Today, however, illegal capture of individuals still exists, and it is possible that international trade of the species will be reestablished in the next few years. It is worth noting that

the overexploitation of the species by poachers not only decreases the effective number of parrots, but also destroys tree hollows used as nests, thereby limiting the availability of suitable sites for future breeding attempts.

Although Chaco forest habitat is being destroyed throughout Argentina, priority should be given to conservation efforts at the limits of the species' distribution, because marginal populations are more prone to local extinction (Fernández-Juricic et al. 1998b). The province of Córdoba (central Argentina) at the southern limit of the species' range harbors isolated populations, the largest one located in the northwest part of the province and including at least 50 individuals (Fernández-Juricic and Miatello 1996; Fernández-Juricic et al. 1998b). In some locations, there are no more than 2-3 pairs left (Rodolfo Miatello pers. comm.). Córdoba is therefore an interesting place to involve people in wildlife conservation due to the occurrence of this endangered species and the high level of pet trade activity in its urban centers.

### **Overview of program**

An environmental education program was implemented to enhance public awareness of the status of the blue-fronted Amazon in the province of Córdoba and of the possible solutions to conservation problems facing the species. In general, the media is unaware of measures taken to protect endangered species, leading to a lack of enthusiasm for the support of conservation programs. The blue-fronted Amazon case was regarded as a good opportunity to increase public awareness about endangered species.

The program design was based on an approach developed by Jacobson and Padua (1995), which includes three stages: planning (determination of needs, program goals,

target publics, methods, etc.), implementation, and evaluation. Particular attention was paid to carrying out educational activities at two levels (local and regional) so as to involve different kinds of target groups and encourage new ways to overcome conservation problems facing the blue-fronted Amazon.

A group of co-workers and I conducted the program over an eight month period at the Universidad Libre del Ambiente (Municipality of Córdoba), a recently-created institution (1995) that focuses on environmental education. The Universidad Libre del Ambiente turned out to be the headquarters of the program and was visited by hundreds of people from all the province of Córdoba.

### **Program steps**

The program was implemented in several steps: (1) identification of the blue-fronted Amazon's conservation problems and their relationships to the human needs in Córdoba, (2) determination of the spatial and temporal scales over which the program would be developed, (3) distinction of the target groups: a direct public (local), and an indirect public (regional), (4) implementation of educational strategies streamlined to the needs of the local and regional groups, and (5) qualitative evaluation of the results.

#### *Conservation problems*

The most relevant problems facing the blue-fronted Amazon in the province of Córdoba were the modification of the Chaco landscape as a result of agricultural development, the illegal capture of wild individuals in protected areas, and the commercialization of parrots in urban centers (Fernández-Juricic and Miatello 1996).

#### *Scales involved*

Based on the spatial scope of the

aforementioned conservation problems, two scales were recognized: local (concentrated on small spatial scales) and regional (larger spatial scales). Such a complementary approach was employed because the parallel functioning of the two scales was expected to enhance the scope and persistence of the program due to the involvement of a larger portion of the media.

Locally, the program was focused on small towns near the grounds inhabited by these parrots, areas in which people deal with deforestation, agriculture development, and economic shortcomings. In these places, rural people extract parrots from protected areas as an incidental activity to earn money. This illegal extraction of wild parrots is possible because of the lack of tight controls in public reserves and private lands.

Regionally, the program was focused on urban centers where parrots are sold as pets. Because of their higher incomes, urban inhabitants are able to buy parrots as pets and often do not understand where the animals came from or whether this activity threatens wild populations.

The problems were different enough at local and regional scales to justify parallel educational approaches so as to increase the effectiveness of the educational message.

#### *Target public*

Two target groups of people were recognized: a local group living near Chaco forests; and a regional group, concentrated on urban centers. Hence, this conservation problem entailed people from rural (local) and urban (regional) settings. Both groups were unaware of the status of the blue-fronted Amazon and the means by which this species could be protected. The contents of the program were then adapted to the needs of these two groups. Local people are faced with problems brought

about by habitat conversion to agricultural fields and the incidental capture of wild birds. On the other hand, people in the city indirectly jeopardize the survival of this species by acquiring parrots as pets and thus supporting the trade of wild individuals. (It is worth mentioning that the parrots sold in pet stores in Córdoba also came from individuals captured in other northern provinces of Argentina.) Moreover, because rural people lack the political clout to influence the policy making process, taking the problem to the regional level was regarded as a useful alternative to protect this species and its habitat.

The specific objectives of the program were to (1) locally raise awareness about the ecological and economic importance of blue-fronted Amazons as a valuable resource to be properly managed, and (2) regionally inform people about the endangered situation of this species in the province of Córdoba and about how the pet trade could lead populations towards local extinction. The ultimate goal was that both target groups became aware of different potential ways in which they could contribute to alleviate the situation of this species in Córdoba.

#### *Implementation*

A preliminary study to determine the level of public interest in wildlife conservation revealed that about 90% of the people did not know what an endangered species was and could not even name one locally threatened species. When asked about endangered species, most of the people referred to "pandas, blue whales, lions, and tigers." This lack of awareness showed the need to emphasize information on local conservation issues.

A group of volunteers and personnel from the Universidad Libre del Ambiente was trained to present to rural and urban people. Short talks (30 m) were prepared regarding the

ethical, ecological, and economic values of biodiversity, introducing the blue-fronted Amazon as a example of a local endangered species. At the end of all presentations, a discussion on practical ways in which people could help this species was instigated. Educational messages were geared to the cultural background of each target group, and to different age classes. Presentations to local people were aimed at showing how rural communities could play an important role in the conservation of parrot populations, whereas the potential consequences of pet trade constituted the core of the talks given to people from the city.

About 120 public presentations reached people from ages ranging from 5 to 80 years, including students (from primary school to university), general public, wildlife managers, politicians, etc. All talks were addressed with slides that taught people about the biology of the species, identified its main feeding substrates, and quickly distinguished the blue-fronted Amazon from other parrot species inhabiting Córdoba. Sounds of wild parrots and explanations of their complex vocal behaviors were occasionally used to allure the attention of small children and teenagers.

In addition, other tools to reach target groups were used, including a technical report for public outreach, classroom study cards, posters, seminars for educators, talks broadcast by the local radio and TV, and articles published in the local newspaper. The technical report included a description of the breeding and non-breeding biology of this species, how to distinguish it from other parrots, its conservation problems, its legal protection in the province of Córdoba, and actions at the individual and public level that could help save it from local extinction. The classroom study cards were intended to encourage students and teachers to use the image

of this species as a flagship species for the conservation of many other threatened species inhabiting Chaco forests in Córdoba. Posters, portraying a photo and a message for reducing pet consumption of this parrot were distributed in several urban and rural centers.

#### *Evaluation*

The final evaluation of this education program was based mainly on the written opinions of educators. They judged talks as the most important tools of the program, because they allowed a quick understanding of the reasons that led the blue-fronted Amazon to the verge of local extinction. At the beginning of each presentation, participants showed little interest in issues related to endangered species conservation. This was expected because these topics had been a distant problem in which participants had not had any involvement previously. After learning that the blue-fronted Amazon was endangered in their province, people's attitude changed from indifference to active interest, potentially leading to personal commitment to take action and inform other people about this conservation problem.

Historically, there was little communication between the regional groups and local communities. This program, however, seemed to improve awareness of and communication between the two group. The response of local communities was very positive, in spite of their limited economic resources and geographic isolation. One of the most difficult challenges was to change their attitudes towards wild blue-fronted Amazons. For example, most local people considered parrots as a resource to be exploited by extracting and selling wild individuals, even though they obtained the least economic benefit during the commercialization process. We were able, by meeting with



rural people several times, to help them understand the current status of this parrot, its importance in the ecological functioning of the Chaco ecosystem (being a relevant seed-dispersing species), and the consequences of its local extinction. Even though community leaders and teachers were committed to taking this message to their local communities, it is essential that new programs of sustainable exploitation of wild resources be implemented shortly to find economically feasible alternatives to the extraction of not only parrots but also other threatened bird and mammal species in the Chaco region.

Educators tried to gather as much information as possible in regards to the blue-fronted Amazon situation in order to improve the quality of their daily classes and discussions. Classroom study cards proved to be quite useful during classes because students were very fond of solving problems related to their own local species. Furthermore, students were very active in engaging their friends, relatives, and acquaintances to learn more about other threatened species in Córdoba.

Two factors helped increase the program's outreach: first, the involvement of the local TV, radio, and newspapers, and second, the cascade effect elicited by educators. Because the mass media transmitted the message to a wider sector of the society, we received valuable feedback from people who were not within the target groups (namely, the elderly). Seminars for educators were mainly aimed at providing alternative educational tools for increasing student awareness about threatened Chaco species, using the blue-fronted Amazon as a case study.

Both the mass media and the seminars resulted in the rapid identification of human actions that may help recover wild populations of the

species in the future. For instance, after realizing the conservation problems of the blue-fronted Amazon, many individuals holding captive individuals asked for advice on how and where to release their pets into the wild. The position of the program, however, was to not support the release of captive parrots due to the lack of logistical resources and technical experience. Because urban and rural people hold a great many parrots, however, reintroduction should be regarded as an interesting alternative that deserves further study to increase the abundance of this species in some spots of Córdoba.

Some results were completely unexpected. For example, people were rarely able to distinguish between different parrot species; to their mind, they were all parrots and thus associated them with great agricultural damage (Navarro et al. 1991). Public presentations permitted people to learn how to identify parrots species inhabiting Córdoba. This was particularly important for many landowners that had been unfairly blaming the blue-fronted Amazon for their crop losses, and thus trying to get rid of this species. At the end, the program elicited a sense of pride and also a proactive attitude towards the wild blue-fronted Amazon.

### Conclusion

People are a great resource for tackling conservation and management issues. Environmentalists, researchers, politicians and managers should pay more attention to the human dimension of conservation (Saberwal and Kothari 1996; Decker and Chase 1997). The blue-fronted Amazon case is just an example of how the apportionment of educational efforts at local and regional levels could increase the chances of survival of endangered species, fostering local initiatives with regional support. This local/regional approach becomes an alternative way of conveying conservation messages to the media, particularly those applied to endangered species.

### Acknowledgements

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# Marine Matters

## Hawaii's Humpback Whale Sanctuary

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### Abstract

*This article is Part II of a three part series on the endangered humpback whale (*Megaptera novaeangliae*) and the Hawaiian Islands Humpback Whale National Marine Sanctuary. The purpose of this article is to introduce the National Marine Sanctuary Program and discuss the goals and objectives of the Hawaiian Islands Humpback Whale Sanctuary Program. National marine sanctuaries are designed to provide leadership in development and implementation efforts to protect our nation's marine resources. Currently, 12 marine sanctuaries exist throughout the United States. The selection of these sanctuary sites is based on their ecological, cultural, or historic significance. The Hawaiian Islands Humpback Whale National Marine Sanctuary was designated to protect a critical part of the humpback whale's habitat that is vital to its life history.*

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### Introduction

The newly designated Hawaiian Islands Humpback Whale National Marine Sanctuary (Hawaii Sanctuary), the nation's twelfth established marine sanctuary, protects the winter breeding range of the largest Pacific population of the endangered humpback whale (*Megaptera novaeangliae*). The Hawaii Sanctuary's designation is an opportunity for the National Oceanic and Atmospheric Administration's (NOAA) Marine Sanctuary program to work in partnership with the people of Hawaii to protect this important marine ecosystem.

### The National Marine Sanctuary Program

The National Marine Sanctuary Program is a national system of 12 marine sanctuary sites (Figure 1). These sites protect over 13,000 square nautical miles of marine resources, and range from 0.25 to 4,024 square nautical miles.

Marine sanctuaries in the United States are designed to protect natural, cultural, and/or historical features of the marine environment. Through

the National Marine Sanctuaries Act (NMSA), responsibility for managing the National Marine Sanctuary Program is delegated to the U.S. Department of Commerce, NOAA, Office of Ocean and Coastal Resource Management, Marine Sanctuaries Division (MSD). MSD's role in the administration and management of the National Marine Sanctuary Program includes preparing management plans for designating marine sanctuaries, and adopting and implementing management practices to protect, preserve, and where possible, restore damaged ocean ecosystems.

### Designating a humpback whale sanctuary

The designation of the Hawaii Sanctuary by Congress in 1992 directed NOAA to prepare a comprehensive management plan for the protection of the humpback whale and its habitat in Hawaii. In addition, the Hawaiian Islands National Marine Sanctuary Act (the Act) required NOAA to submit a final management plan and implementing regulations to the Governor of the State of Hawaii for re-

view and approval. Specifically, NMSA provides the opportunity for the governor of a state with waters included in a marine sanctuary to review and object to the management plan, implementing regulations, or any term thereof. If a governor does object, the management plan, regulation, or term would not take effect in state waters of that sanctuary.

In June 1997, after a 45 day review period, the Governor of the State of Hawaii, Benjamin Cayetano, notified NOAA of his approval of the Hawaii Sanctuary's management plan. Governor Cayetano's decision to allow state waters to be included in the Sanctuary provided the basis for the Sanctuary to work in partnership with the State of Hawaii to protect one of the world's most important humpback whale habitats.

### The Hawaii Sanctuary boundary

Stretching from Maui to several nearby Hawaiian Islands, the boundary of the Hawaii Sanctuary encompasses approximately 1,218 square nautical miles of coastal and oceanic

waters (Figure 2). Throughout the main Hawaiian Islands, the Sanctuary extends seaward from the shoreline to the 100 fathom isobath. It includes areas around the islands of Maui, Lanai, and Molokai, and parts of Oahu, the Big Island of Hawaii, and Kauai. These waters provide principal breeding, calving, and nursing areas for the endangered North Pacific humpback whale. During the winter months, scientists estimate that approximately two-thirds of the North Pacific population of humpback whales winter in waters around the main Hawaiian Islands.

The extent of movement of humpback whales wintering off the Hawaiian Islands is unknown. Some areas within the state's coastal waters tend to show higher concentrations of humpbacks than others. While habitat preference is not completely understood, humpbacks are often found

in warm shallow waters (generally less than 100 fathoms) often on leeward sides of the Islands. Scientists have speculated distribution may vary according to an individual whale's gender and age and the time of year. Observations by Glockner-Ferrari and Ferrari (1987) found mother-calf pairs in waters less than 30-fathoms (360 feet) when calves were very young. As the calf matures and gains strength and the ability to swim more efficiently, the pair gradually moves to deeper water. In contrast, male humpback whales and unaccompanied females utilize nearshore waters less frequently and tend to be found in deeper waters.

Human presence and disturbance may also affect humpback whale distribution and habitat use. Darling and Juarasz (1983) and Cerchio (1991) hypothesized that whales may move from previously "preferred" habitats

to less disturbed sites because of increased boater use, coastal development, and other possible disturbances.

Sanctuary status in these areas permits the federal government, working in partnership with the state, to implement a coordinated and comprehensive management plan to improve understanding of the ecological relationships between whales and their habitat. For example, the Hawaii Sanctuary is working with the State Department of Health in co-sponsoring studies that address water quality issues in Hawaii. The Hawaii Sanctuary management plan proposes research and monitoring programs that will assist in characterizing and monitoring environmental conditions over the short and long-term. These programs will provide the basis for detecting significant changes in the status of humpback whale populations and their wintering habitat.

### Sanctuary Management Plan

The Hawaii Sanctuary management plan is designed to provide guidance for the management of the Hawaii Sanctuary for at least the first five years of its operation. This plan establishes the administrative framework that addresses the need for cooperative and coordinating programs and activities with other federal and state agencies, private organizations, and interested citizens, to ensure effective management of the Hawaii Sanctuary. The management plan proposes actions tai-



Figure 1. The 12 marine sanctuary sites in the National Marine Sanctuary Program.

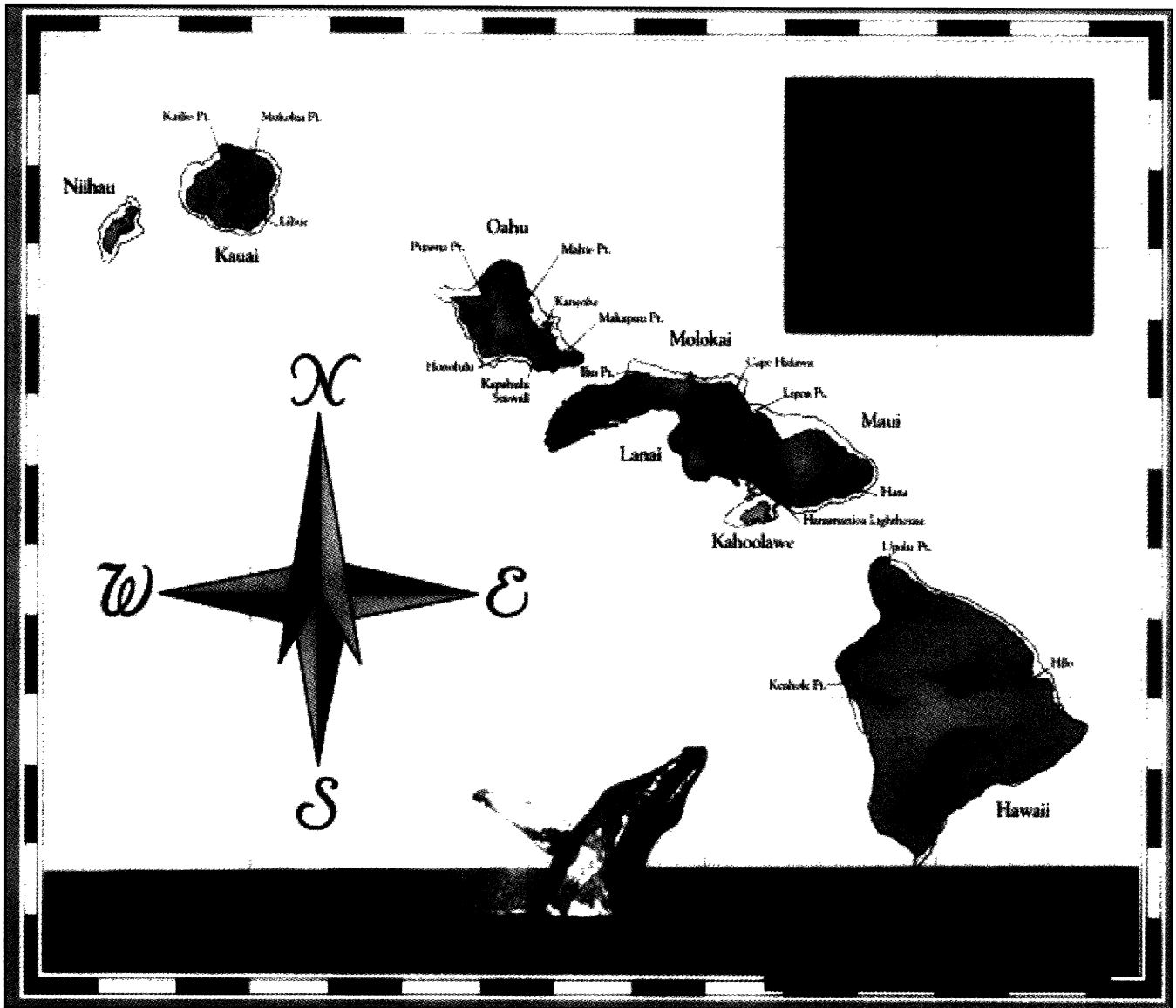


Figure 2. Hawaii's humpback whale sanctuary

lored to specific issues affecting the Sanctuary. It recognizes the need for making human uses of the Sanctuary compatible with the primary purpose of protecting the humpback whale and its habitat. Although the management plan focuses on the humpback whale and its habitat as its primary resources, the Act allows for future identification of other marine resources and ecosystems for possible inclusion in the Hawaii Sanctuary.

Management initiatives addressed by the Act generally fall into five fundamental program areas: (1) resource protection, (2) enforcement, (3) research and long-term monitoring, (4) education and outreach, and (5) administration. The following

sections of this article will describe the management plan's goals, guidelines, and initiatives for each of these five programs.

*Sanctuary resource protection program and enforcement*

The Hawaii Sanctuary resource protection program includes management initiatives to complement existing non-regulatory and regulatory mechanisms in Hawaii that protect the humpback whale and its habitat. The purpose of the resource protection program is to develop and implement strategies to reduce human impacts to the Hawaii Sanctuary. Many of the activities affecting the Sanctuary's resources and qualities

are presently governed by existing federal and state authorities. Approximately 65% of the Hawaii Sanctuary lies within state waters. The Sanctuary, therefore, works closely with existing agencies to ensure coordinated and efficient management of the humpback whale and its habitat. In addition, the Sanctuary conducts consultations with the State of Hawaii and federal agencies to review any permit request for activities that may affect the humpback whale or its habitat.

Two specific plans relate directly to the protection of the humpback whale and its habitat: the National Marine Fisheries Service (NMFS) Final Recovery Plan (HOMRC 1991)

for the Humpback Whale and the State of Hawaii Ocean Resources Management Plan (NMFS 1991). Both plans identify management initiatives that address the protection of the humpback whale and its habitat. The Hawaii Sanctuary works closely with these agencies to develop complimentary efforts to enhance protection.

Incorporating the NMFS humpback whale approach regulations (regulating allowable approach distances to humpback whales) into Sanctuary regulations allows the Sanctuary to supplement existing regulatory regimes. For example, the Sanctuary works closely with the NOAA Fisheries Enforcement Office to achieve voluntary compliance through interpretive enforcement and education. Every year, before the humpback whale season (December through May), the Hawaii Sanctuary and NOAA Fisheries Enforcement Office offer ocean user training workshops to ocean users (including commercial whale watch boat captains, recreational kayakers, ocean recreational boat captains, coast guard, commercial and recreational fisherman) throughout the state. This program emphasizes outreach and education activities for Sanctuary users in order to prevent the occurrence of violations. Specifically, the Hawaii Sanctuary regulations include the following prohibitions:

- approaching, or causing a vessel or object to approach, within the Sanctuary, by any means, within 100 yards of any humpback whale;
- operating any aircraft above the Sanctuary within 1000 feet of any humpback whale except when in any designated flight corridor for takeoff or landing from an airport or runway;
- taking any humpback whale in the Sanctuary;
- possessing within the Sanctuary (regardless of where taken) any

living or dead humpback whale or part thereof.

These Sanctuary prohibitions do not apply if the activity is authorized under the Endangered Species Act or the Marine Mammal Protection Act.

To address habitat protection for humpback whales in Hawaii, the Sanctuary prohibits the following activities:

- discharging or depositing any material or other matter in the Sanctuary;
- altering the seabed of the Sanctuary;
- discharging or depositing, from beyond the boundary of the Sanctuary, any material or other matter that subsequently enters the Sanctuary and injures a humpback whale or humpback whale habitat, provided that, such activity requires a federal or state permit, license, lease or other authorization, and is conducted (i) without such permit, license, lease or other authorization; or (ii) not in compliance with the terms and conditions of such permit, license, lease, or other authorization.

NOAA cannot guarantee that future Sanctuary regulations will not be necessary. It is possible that in the future, resource managers may identify a specific type of activity that could negatively impact Sanctuary resources or create conflicts among other Sanctuary users. If such conflict arises, NOAA will first pursue non-regulatory options. If a regulatory option becomes a possibility NOAA must first go through an extensive public review and comment process in order to issue a new regulation. At such time, the governor of the state will also have the opportunity to object to any new Sanctuary regulation that pertains to state waters.

Dramatic events (e.g., oil or other hazardous material spills) pose a serious threat to both Hawaii Sanctuary resources and public health and safety. Since 1994, the Sanctuary program, as a resource trustee, has

participated in local contingency planning meetings with the U.S. Coast Guard and other state and federal agencies. The Sanctuary's goal is to provide, through its research and monitoring programs, detailed information on sanctuary resources needed by response agencies in the event of an incident. The Sanctuary will work in close coordination with NMFS, the Western Pacific Regional Response Team, and the Hawaii State Emergency Response Commission, to ensure that Sanctuary concerns continue to be addressed in local response plans.

When an incident results in destruction, loss, or injury to marine sanctuary resources, the Hawaii Sanctuary works with several elements within NOAA to respond and to initiate damage assessment and restoration process. NOAA's ultimate goal in damage assessment is to restore injured coastal and marine resources. NOAA is authorized under NMSA to pursue civil actions to recover the response cost and damages against persons who destroy, cause the loss of, or injure sanctuary resources in marine sanctuaries. In Hawaii, Sanctuary resources include the humpback whale and its habitat within the Sanctuary.

#### *Sanctuary Research and Long-Term Monitoring*

The purpose of the Hawaii Sanctuary's research program is to (1) improve understanding of the North Pacific population of humpback whales and their wintering habitat, (2) study resource management issues, and (3) interpret research results for the public and decision-makers. The Sanctuary's objective is to become involved in research activities in the following areas:

- baseline studies to determine features and processes of the North Pacific humpback whale wintering habitat, including, vital rates, behavior, abundance, and distribution of humpback whales, interactions

among the living resources within the Sanctuary, and types and patterns of human activities within and around the Sanctuary;

- monitoring studies to document changes in humpback whale behavior, Sanctuary use patterns, environmental quality, and human activities and their affects on Sanctuary resources;
- predictive studies to assess causes and effects of ecological and environmental changes;
- cataloging past, present and future research data information;
- studies of marine resources, other than humpback whales, for possible inclusion in the Sanctuary.

The Sanctuary has been involved in a number of different research projects in the Hawaiian Islands. Since 1994, funding support has been provided to various research projects addressing humpback whale behavior studies in Hawaii. Most recently, the Sanctuary provided funding to conduct aerial surveys to estimate humpback whale population and distribution.

#### *Sanctuary education and outreach*

Public awareness, understanding, and appreciation for the special values of the humpback whale is essential for their protection and continued vitality. The Hawaii Sanctuary education and outreach program focuses on enhancing public understanding and appreciation for humpback whales and their special relationship with the Hawaiian Islands marine environment. The accessibility of the Hawai-

ian Islands Humpback Whale National Marine Sanctuary provides a variety of ways in which to reach the public with information about the Sanctuary's resources and programs. The Hawaii Sanctuary headquarters office on Maui, along with satellite offices on Kauai and Oahu, offer opportunities for the public to learn about the Sanctuary program. The Sanctuary offices provide free printed materials on-site describing the humpback whale and its habitat and the Sanctuary program to the public. Outreach activities are regularly conducted by on-site staff to provide information to individuals, user groups, schools, and other organizations throughout the Hawaiian Islands.

#### *Sanctuary administration*

The Hawaii Sanctuary program is managed and operated by the Sanctuary Manager and other field staff. The Sanctuary Manager receives national program guidance from the Marine Sanctuaries Division, located in Silver Spring, Maryland. In addition, the Sanctuary Advisory Council for the Hawaii Sanctuary provides advice and recommendations to the Sanctuary Manager on various issues of concern throughout the Sanctuary.

The Sanctuary program's approach to managing public marine resources is based on open community dialogue and participation. Community involvement is critical to the success of the Sanctuary Program. The Sanctuary Program actively solicits community input and recom-

mendations as part of its continuous management process. In Hawaii, a Sanctuary Advisory Council has been in place since March 1996.

The third and final article of this series will provide insight into the process to allow public participation in the ongoing development, management, and implementation of the Hawaii Sanctuary program.

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# Conservation Spotlight

## The American Zoo and Aquarium Association Nutrition Advisory Group: An Overview

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### Abstract

*To help guarantee that animal populations can be successfully maintained in captivity, animals must consume appropriate diets that meet their nutritional requirements. To accomplish population longevity and meet propagation goals, zoos must offer diets based on current scientific information. Additionally, nutrition work with captive endangered species or model species contributes to knowledge about the biology of the species that can be applied to the in-situ conservation of that species or ecosystem. Zoo nutritionists play an important role in an integrated approach to animal husbandry and management, data collection and information exchange. While there are less than 15 formal zoo nutrition programs, the need for organization is apparent. With this in mind, the American Zoo and Aquarium Association (AZA) Nutrition Advisory Group (NAG) was formed in 1994 with the charge of promoting the welfare of animals housed in AZA-accredited institutions by incorporating the science of nutrition into their husbandry. NAG began with 9 members and has grown to over 55. As part of the group's charge, several issues were identified as top priorities. These include training; collection and dissemination of physiological data, including body condition indices; food composition data; food and feed quality and sanitation; and in-situ projects that include all of the above.*

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### Introduction

Zoological institutions propagate and care for thousands of animals representing over a thousand species. Many of these species are rare or endangered. To maintain viable captive populations, these animals must be fed diets that are nutritionally sound and meet their nutritional, physiological and behavioral requirements. Thus it is of primary importance that zoo diets for every animal be evaluated and formulated in a scientific manner by qualified professionals. The field of zoo nutrition is in its infancy, as there are very few formal nutrition programs currently in zoos. There are, in fact, fewer than 15 formal programs with only 4 institutions possessing nutrition laboratories on-site and only 5 nutritionists holding a Ph.D.

The overriding objective of zoo nutrition programs is to help ensure

that the zoos' animal populations are viable and sustainable on a long-term basis by offering the best possible diets and nutritional services, utilizing the most up-to-date, reliable information available and contributing to the knowledge base of zoo animal nutrition. The goals of a comprehensive zoo nutrition program are to 1) contribute to data applicable to the global collection of species in order to add to the existing database, 2) help resolve outstanding nutrition problems and issues, 3) pool scarce nutrition resources, and 4) evaluate untapped research and information. Zoo nutrition programs that include diet formulation and research have direct implications for better management of all animal populations.

The formulation of diets, a basic function of a zoo nutrition program, is based on information about natu-

ral feeding ecology, physiological parameters, domestic animal nutrient requirements, probable exotic animal nutrient requirements, nutrient content of foods, animal food preference and consumption data, behavioral information and, at times, physiological assessment data.

To develop diets, a zoo nutritionist must consider many aspects of an animal's feeding and nutrient requirements. First, the items an animal selects and consumes in the wild are reviewed to determine natural feeding strategies. Second, physiological parameters, such as the way an animal processes and digests its food, must be considered. Third, species-specific nutrient requirements must be understood. For most captive exotic species, however, nutrient requirements have not been studied. A nutritionist, therefore, must base

decisions on information originating from domestic and laboratory species as well as human nutritional information.

The nutrient content of foods available to zoos is collected and reviewed. These food items include everything from produce to dog food, monkey biscuits, fish, and forage. Many items must be individually analyzed because much of the nutrient composition of these items has not been identified.

The nutritionist, with the help of keepers and animal managers, also observes and collects data on food consumption. At times, blood, urine and fecal samples are collected to determine an animal's nutritional status.

To incorporate this information into daily husbandry, nutritionists work with keepers, curators and veterinarians. All of these data are combined to formulate the best possible diets for a specific species. Diets and animals are then monitored to ensure that the diets are consumed and that the animals are healthy.

Research with captive and free-ranging species is an important part of a comprehensive nutrition program. Because vast amounts of information remain unknown with respect to nutritional requirements, chemical content of food items consumed in the wild, and nutritional status of animal populations in captivity and the wild, research is integral to progressing in conservation work with captive and free-ranging populations.

### **The Nutrition Advisory Group**

To address these nutrition issues, the American Zoo and Aquarium Association (AZA) formed the Nutrition Advisory Group (NAG) in 1994. The group's mission is to promote the welfare of captive animals by incorporating the science of nutrition into their husbandry.

The goals of NAG are to: (1) identify nutritional and dietary problems in zoos and facilitate their resolution, (2) establish a mechanism for the review of nutritional and dietary information provided by AZA committees and subgroups, (3) coordinate acquisition and dissemination of information regarding nutrition, and (4) encourage and coordinate nutrition-related investigations among zoos and collaborating institutions.

NAG began with 9 members and now has over 55 members and affiliates from the zoo community, academia, and industry. There is also a nine-member executive committee. This committee works to represent NAG, liaise with other groups and organizations on behalf of NAG, make decisions concerning NAG and its activities, coordinate and disseminate information, facilitate the performance of action plans, approve and appoint NAG members and advisors, appoint sub-committees and task forces, and review or appoint reviewers of publications.

As a science, nutrition is integral to the effective management of zoo animals and must be addressed in a scientific and professional manner. The formation of NAG formally recognizes the discipline and practice of nutrition. It allows for better communication and coordination among nutritionists and those requiring nutrition information. It helps provide leverage for accomplishing projects, research and or dealing with zoo nutrition and industry problems.

There is, however, a difference between the discipline of nutrition and the specific role of NAG. Nutrition as a discipline is the science of comparative nutrition, i.e. understanding the biology/nutrition of the animals. Specifically, NAG's role is to facilitate the practice of zoo nutrition, i.e. diet formulation and feeding animals. While these two facets are distinct, their interaction is nec-

essary for successful husbandry.

NAG recently reviewed and established priority issues with respect to nutrition projects and investigation. These issues identify the topics and activities important to zoo nutrition and feeding and will serve to guide those interested in conducting research as well as those funding projects. These issues are defined to provide guidance and do not indicate that (1) there is funding for any of these, (2) there is work underway in these areas or (3) that these projects must be accomplished by the NAG.

### **Priority issues as determined by NAG**

#### *Training*

The next generations of zoo nutritionists are extremely important if we wish to build on what we have achieved. To attract and cultivate students to the field of zoo nutrition, we must offer opportunities for them to learn and gain experience. Likewise, tenured zoo nutritionists should be open to learning from students, embracing new ideas and helping them develop these new ideas and methodologies. Training, therefore, goes both ways—from mentor to student and student to mentor.

#### *Physiological data, including body condition indices*

To understand whether nutrition provided to animals is adequate, assessment of the physiological and nutritional status of that animal or population is imperative. This is a key component to any interdisciplinary approach to animal, species, and population well-being and fitness.

#### *Vitamins and minerals; investigation of deficiencies, toxicities, and requirements*

Because of animal welfare issues, philosophical issues, limited animal numbers, and/or lack of financial support, 'classic' deficiency, toxicity, and



requirement studies are often not performed in a zoo setting. Much of the information we require in this area, however, remains unknown. There is a dire need to acquire such data.

#### *Food composition*

To understand whether the nutrition provided captive animals is adequate, we must determine the nutrient composition of the foods. This applies to foods consumed in the wild, determining the nutrients that are 'bioavailable' to the animal and similar studies of food items used to feed captive animals.

#### *Food and feed quality and sanitation*

Captive animals need to be fed a diet that is wholesome and nutritious. The safety and health of the animals is dependent on the quality of foods the animals are offered. It is not enough to assume appropriate quality and

collect information on the nutrient content of foods offered to animals; nutrient content and wholesomeness must be assured.

#### *In situ projects*

The research, data, and information identified above should be determined from free-ranging animals. *In situ* research can only contribute conservation of species in the wild.

### **Conclusion**

The practical science of diet formulation must be integrated with sound nutritional research to advance the field of zoo animal nutrition. This can best be performed by an on-staff zoo nutritionist dedicated to fostering the science of zoo animal nutrition. Information from free-ranging animals is required for application to the nutritional needs of captive zoo animals. Utilizing data uniquely and inten-

sively collected from captive animals also can be applied to their free-ranging counterparts. Knowledge of nutritional requirements of captive animals will contribute to knowledge of the nutrients needed by animals in their ecosystems. Thus, the study and application of nutrition for free-ranging and captive animals is symbiotic. The zoo nutrition programs already in existence are expanding and increasing their influence to add to the scant database currently available. As these programs grow and the awareness of the direct influence that nutrition has on the health, well-being and propagation of endangered species increases, the integrated management of populations will enrich the field of conservation. Organization of the AZA Nutrition Advisory Group was another step toward pooling knowledge and resources to focus on the needs of many.

### **Criteria for AZA Nutrition Advisory Group (NAG) Membership**

#### **Demonstrated interest and commitment to zoo animal nutrition (as evidenced by):**

- designation as a nutritionist in a zoo
- regular attendance at nutrition meetings
- provision of nutritional advice to zoos / collaboration on projects with zoos

#### **Expertise in nutrition / diet management:**

- advanced degree in nutrition
- demonstrated expertise in zoo or wildlife nutrition /dietary husbandry/feeding management
- no substantial financial interest in zoo food purchasing / diet management

Individuals who may possess financial interests, i.e. who perform consulting for zoos and / or product manufacturers, will be considered for membership on a case-by-case basis based on the extent of their financial interest.

- approved by the Executive Committee of NAG

Those not meeting membership criteria, including students with an interest in the field, or have limited time to commit, are eligible for Affiliate status. If interested, they should communicate their interest through written application, with any comments, questions, or concerns to any member of the Nomination Subcommittee:

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# NEWS FROM ZOOS

## Whooping Crane Lays Egg in the Wild

Two whooping crane pairs have produced the first eggs laid in the U.S. wild in decades, raising hopes that the birds will make a comeback. The 4-year-old cranes are part of an experimental flock raised in captivity at the Patuxent Wildlife Research Center (U.S. Geological Survey), the International Crane Foundation (Baraboo, WI), and the Calgary Zoo, transported to central Florida's Kissimmee Prairie and released. In the late 1960s, researchers started taking eggs from the Canadian nesting grounds to try to resurrect the species by raising birds in captivity. In 1993, federal officials started sending whooping cranes raised in captivity to Florida. Since then, a total of 178 whooping cranes have been released; approximately one-third from the International Crane Foundation, two-thirds from the Patuxent Wildlife Research Center, and several from the Calgary Zoo. Other zoos have joined in support of the program, including the Lowry Park Zoo (Tampa, FL), the White Oak Conservation Center (Yulee, FL), The San Antonio Zoo (TX), and the Audubon Center for Research of Endangered Species (New Orleans, LA). Seventy-seven birds survive. Over the last three years, biologists have seen six of the birds pair off. These are the first successful matings. (AP)

## CONDORS IN THE NEWS From New Jersey to Colombia

An Andean condor, born and raised at the Bergen County Zoological Park, made history in May when it was released in the harsh mountains of Colombia as part of a conservation effort to save the endangered species. Bergen County officials believe the release was the first for a condor hatched and raised in New Jersey. The nearly 2-year-old female was set free on a crag more than 2,000 feet up in the Los Nevados National Park in central Colombia. The reintroduction was part of an American-Colombian program that tries to bolster the number of Andean condors by taking young birds born in captivity, helping acclimate them to life in the wild, and then releasing them. Worldwide, there are now fewer than 5,000 birds in the wild. So far, about 50 condors raised in captivity have been released in the program. More than 80 percent have survived. The bird is about 3 feet high, brown and gray, and was the second of five recently released. Four of the birds were bred in the United States and one in Colombia. All the birds are tagged with a radio transmitter attached to their wings. The transmitter will be monitored to track the birds' movements and allow conservationists to step in if necessary to help keep the birds alive. [Adapted from an article by Hugh R. Morley, *Bergen Record*]

## Successful Couple Returns To Public Life

After a decade of breeding behind closed doors, two Andean condors are on display at Metrozoo's new condor exhibit. The display offers information about the birds in the wild and their role in South American culture. The exhibit is one of four all-bird showcases at the zoo. The Andean condor population has benefited from the couple's retirement from public view. Six of their ten offspring have been released in South America. The other four reside at zoos around the nation. [Adapted from an article by Gigi Barnett, *Miami Herald*]

## New South America Exhibit Opens in San Francisco

"Puente al Sur," the new South America exhibit at the San Francisco Zoo, features an Andean condor, a Baird's tapir, a giant anteater, and capybaras. It also features over 30 kinds of plants native to Mexico, Central America and South America. Most plants seem to be doing well, even in the zoo's foggy, windy climate and sandy soil. To protect much of the landscape, many plants in the new exhibit are outside the animal enclosures. Mesh fences guard them from people's feet, which can do more damage than the animals. Inside one enclosure, there is an experiment with an electric fence that looks like tufts of brown grass.

Volunteers help replenish what animals devour or destroy. The tapir's dirt path will probably be reseeded monthly. The California Nurserymen's Association, which collected and donated most of the plants for the exhibit, is also helping the zoo label its plants and emphasize horticulture from different regions of the world. [Adapted from an article by Cathryn Domrose, *San Francisco Mercury News*]

# *You do interesting work!* Share it with the **UPDATE**.

The *Endangered Species UPDATE* is designed and published as a forum for information exchange on endangered species issues. The *UPDATE* welcomes articles related to species protection in a wide range of areas including, but not limited to, research and management for specific endangered or threatened species, theoretical approaches to species conservation, policy and legislation related to species conservation, and strategies for habitat protection and preserve design. In addition, book reviews, editorial comments, and announcements of current events and publications are welcome.

The *Endangered Species UPDATE* accepts several kinds of manuscripts. These include:

1. Feature Article—on research, management activities and policy analyses for endangered species, theoretical approaches to species conservation, and habitat protection. Manuscripts should be approximately 3000-4000 words with abstract.

2. Opinion Article—a concise and focused argument on a specific endangered species issue; can be more speculative and less documented than the feature article. These are approximately 600-800 words with abstract.

## **Manuscript Submissions and Specifications**

The manuscript should be submitted on a disk or by e-mail. Regardless of how you submit the manuscript, please send us a hard copy, a short author's byline, a daytime phone and fax number and an e-mail address. If you are using Microsoft Word for Macintosh or WordPerfect, please save as version 5.1. For other programs, save the the document in a rich text format (RTF). Send disks and hard copies of the manuscript to Editor, Endangered Species UPDATE, School of Natural Resources, University of Michigan, Ann Arbor, MI 48109-1115. If submitting by e-mail, please send as an attachment to [esupdate@umich.edu](mailto:esupdate@umich.edu).

## **Photographs, Illustrations, and Other Visuals**

Photographs, line drawings, and other graphics are encouraged. The issue is printed in black and white so black and white prints are preferred. Any color prints should be chosen with the final black and white print in mind (i.e., no photos that rely on color for contrast). We can also accept slides. Copyrighted material must include written permission for use in the *UPDATE*, signed by the copyright holder. The author's and photographer's name should be written on the back of all photos. Computer-generated illustrations should be produced on a 600 dpi laser printer. In the case of all photographs and illustrations, a caption should be included, and they should be clear enough to be reduced 50 percent.

## **Citations, Acronyms, etc.**

Literature citations in the text should be as follows: (Buckley & Buckley 1980b; Pacey 1983). The Literature Cited section must be typed and follow the format used in the journal *Conservation Biology*. For example: Balmford, A., N. Leader-Williams, and M. J. B. Green. 1995. Parks or arks: where to conserve large threatened mammals? *Biodiversity and Conservation* 4:595-607.

For other abbreviations and details consult the Editor.

## **Copyright and Reviewing Proofs**

Authors will receive by fax a final version of their article, before it goes to press, for their review and proofing. The Endangered Species UPDATE and University of Michigan typically hold copyright for articles published, and authors will be asked to sign a contributors agreement when the article is accepted. The vast majority of copyright requests are from educational institutions and non-profit organizations. The copyright agreement allows the author to reprint the article as long as credit is given to the *UPDATE*.

# Bulletin Board

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## **Carnivores 2000: A Conference on Predator Biology and Conservation in the 21st Century**

Defenders of Wildlife is teaming up with the nation's leading carnivore experts and various government and non-profit organizations to present Carnivores 2000. The conference will be held in Denver from November 12-15, 2000. For more information on paper/poster submissions or conference registration, contact Defenders of Wildlife, 1101 14th St. NW, Suite 1400, Washington, DC 20005; 202-789-2844, x315; [nfascione@defenders.org](mailto:nfascione@defenders.org).

## **Continental Conservation**

*Continental Conservation: Scientific Foundations of Regional Reserve Networks* is now available from Island Press. Edited by Michael E. Soulé and John Terborgh, the vision propounded throughout *Continental Conservation* is the hope of bringing back wildness in North America by healing wounds of past excesses and indifference. The

goal is to restore, over large portions of the continent, the processes that sustain biodiversity and ensure permanence of all native species.

*Continental Conservation* is a contributed volume representing the work of thirty leading experts brought together by The Wildlands Project to examine the science underlying the design and management of regional-scale reserve networks. These experts include Michael Soulé, John Terborgh, Reed Noss, Paul Paquet, Dan Simberloff, Rodolfo Dirzo, J. Michael Scott, Andrew Dobson, and others.

Topics covered include: (1) policy and scientific background of regional conservation; (2) issue of scale in selecting and designing biological reserves; (3) role of top carnivores in regulating terrestrial ecosystems; (4) need for a paradigm shift in the field of ecological restoration; (5) scientific details of implementing regional conservation in core areas, corridors and buffer zones; and (6) why mega-reserves are needed and how to de-

sign them. For further information call 202-232-7933 or visit [www.islandpress.org](http://www.islandpress.org).

## **Safe Harbor Handbook**

*Safe Harbor: Helping Landowners Help Endangered Species* is now available through the Environmental Defense Fund. Copies may be obtained upon request from Publications, Environmental Defense Fund, 1875 Connecticut Avenue, NW, Suite 1016, Washington DC, 20009. It is also available at [www.edf.org](http://www.edf.org).

## **1999 AZA Annual Conference**

Strengthening the Bond is the theme for the American Zoo and Aquarium Association's annual conference. Hosted by the Minnesota Zoological Gardens, the conference will take place in Minneapolis, MN from September 24 - 28, 1999. For more information, call 612-431-9482.

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*Announcements for the Bulletin Board are welcomed.*

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# **Endangered Species UPDATE**

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