Endangered Species UPDATE

Including a Reprint of the latest USFWS Endangered Species Technical Bulletin

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In this Issue

Letter from the Editor

Since the Endangered Species Act came up for reauthorization in 1992, Congress has tried each year to renew this important environmental law. On September 16, a controversial reauthorization bill, S. 1180, was introduced to the Senate. This bill is sponsored by Senator Dirk Kempthorne (R-Idaho), and Senators John Chafee (R-Rhode Island), Max Baucus (D-Montana), and Harry Reid (D-Nevada). Secretary of Interior Bruce Babbitt was also closely involved in the drafting of S. 1180 and has pledged to support the bill.

The bill's provisions include:

- a number of programs to engage landowners in proactive conservation;
- codification of the Clinton Administration's "Safe Harbor" policy;
- adoption of the experimental "No Surprises" policy;
- ability of agencies such as the U.S. Forest Service to make the initial determination as to whether an activity is "likely to adversely affect" a listed species;
- allowance of a federal project to move forward if the U.S. Fish and Wildlife or National Marine Fisheries Services fail to challenge it within 60 days from the Forest Service's determination;
- allowance of certain activities on federal lands to move forward before the project's cumulative impacts on newly listed species have been studied and considered through a reinitiation of consultation;
- a full waiver of the Section 7 consultation process for agencies and private individuals, who agree to complete activities that are believed to contribute to the recovery of the species and that are approved as part of a "recovery implementation agreement;"
- increased data requirements for listing petitions and increased public debate over each listing decision;
- requirement that all listings be evaluated by a peer review panel of scientists;
- a 30 month deadline for plan completion;
- a priority-setting process to determine which recovery plans should be completed first and requirement that each plan include economic analyses of recovery options and reviews by the states, a peer review panel of scientists, and others;
- no source of funding for the programs outlined.

Though hailed by some as the right direction in endangered species recovery, others feel it will drastically weaken endangered species protections. As of October 3, the bill had passed the Senate Environment and Public Works Committee by a 15-3 margin with little debate and is widely expected to pass quickly through the Senate. Assuming a Senate bill does pass, the House of Representatives will likely take up the debate over ESA reauthorization at some point next year. In the meantime, this legislation promises to be the one of most important pieces of ESA legislation to hit the floor in years. In the next issue of the Endangered Species UPDATE, look for further discussion of S. 1180 and Endangered Species Act Reauthorization bills.

M. Elsbeth McPhee
Editor

Endangered Species UPDATE

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Eglin Air Force Base and Sea Turtle Nesting: A Success Story

Andrea Helmstetter and Debby Atencio

Introduction

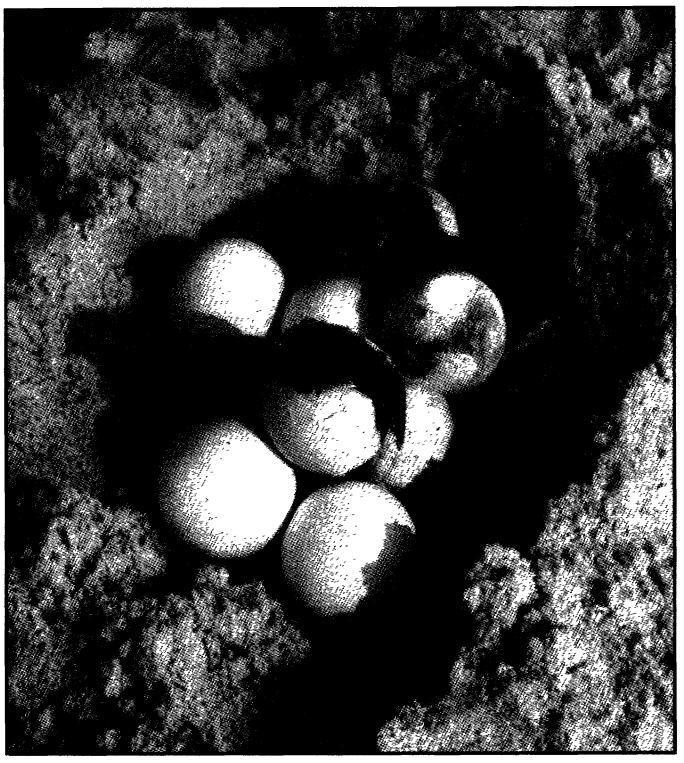
Along with many other military installations, Eglin Air Force Base (AFB), Florida shares the responsibility of being a large, undeveloped area (463,000 acres) that supports numerous threatened and endangered species and critical habitats. Eglin is unique because it has both terrestrial and marine species under its supervision and the base has developed an aggressive natural resources plan to manage them (Hardesty and Kindell 1997). One critical habitat they have successfully managed is Santa Rosa Island (SRI). Historically, SRI has been used as a testing and training site, and currently the Air Force facilities provide essential electronics support for nearly all air operations on Eglin's land and water ranges. However, the island is also an important nesting site for the threatened loggerhead sea turtle (*Caretta caretta*), and, more recently, the Atlantic green sea turtle (*Chelonia mydas*). Breeding populations of green sea turtles are endangered in Florida and the Pacific coast of Mexico; elsewhere they are threatened (Meylan et al. 1995). The endangered leatherback sea turtle (*Dermochelys coriacea*) has been documented in waters adjacent to the island but there has been no known nesting on Eglin AFB property.

Santa Rosa Island is a barrier island approximately 80 kilometers (km) long and 0.8 km wide. It is separated from the mainland by Choctawhatchee Bay and Santa Rosa Sound to the north and is bordered by the Gulf of Mexico to the south. Eglin AFB owns and manages two stretches of beach on Santa Rosa Island: a 6.4 km section which receives limited public usage and is known as "Okaloosa Island," and a 21 km section of federal beach on which access is restricted.

For turtles on SRI, biotic and abiotic stresses on nesting, hatching success and hatchling survival include tropical storms, hurricanes, and predation. For example, hurricanes Erin and Opal (August 1995 and October 1995, respectively) transformed three well-developed dune ridges, with slopes of nine to ten degrees and heights up to 9.5 meters, to relatively flat barren areas. Loss in dune height has allowed more artificial lighting to illuminate the coastal beaches at night, which in the past had been fairly dark. The primary sea-finding mechanism for hatchling sea turtles is an orientation towards light. On darkened beaches, the reflection of the moon or scattered starlight off the ocean's surface generally guides hatchlings in a direction towards the water. Artificial lighting, however, is known to cause major disorientation and can subsequently lead to increased mortality. Artificial lighting may also cause confusion or misorientation in females attempting to nest and can lead to an increase in the number of false crawls (emergence with no deposition of eggs) (Mortimer 1981; Verheijen 1985; Salmon 1990).

Historically, predators on SRI have included fire ants, ghost crabs and raccoons. These smaller predators will take a few eggs and newly hatched turtles, but usually not cause a major decline in overall hatching success. On the other hand, larger mammals, such as coyotes and fox, can decimate a whole nest rapidly and have potential to train their young to do the same. The presence of large predators has increased on SRI, further decreasing hatching success.

The sea turtle conservation project



Sea turtle hatchlings. Photograph courtesy of Eglin Air Force Base.

After realizing the extent of nesting on federal property, a comprehensive sea turtle program at Eglin AFB was initiated in 1987 due to requirements of the Endangered Species Act (ESA). Under Section 7 of the ESA, Eglin has to undergo consultation with the U.S. Fish and Wildlife Service when proposing new military testing or training that may impact turtles. The objective of the sea turtle program is to document and protect nests while maintaining Eglin's primary mission of national defense. This is being done in several ways. With a Geographical Information System (GIS), nesting locations have been recorded spatially and temporally. With this information, military testing and training can be managed, as required by the National Environmental Policy Act, to ensure there are no negative impacts on nesting success, hatching success or species survival. For example, nighttime defense missions which require lighting are carefully managed to prevent misorientation of nesting females or disorientation of emergent hatchlings. Other management measures include locating activities in areas having lower nesting densities, and scheduling activities to occur outside the nesting season.

Southern Florida sees a greater number of nestings and subsequently receives more attention from the public. Santa Rosa and Okaloosa Counties are areas of large-scale tourism, but tourists generally do not have knowledge of indigenous natural resources. Eglin is providing the educational tools to remedy this problem by working within a network of public nonprofit groups, the U.S. Fish and Wildlife Service, and the Florida Department of Environmental Protection to protect nesting sites and educate the public about the sea turtles that are present. By fostering an open communication between all parties, more information is gained further solidifying common conservation goals.

On Eglin AFB, sea turtle activity is monitored seven days a week throughout the nesting season–mid-May until mid-September. The 27 km of shoreline are surveyed beginning before sunrise via an all-terrain vehicle. When a sea turtle crawl is found, a visual determination is made as to whether it is a true nesting emergence or a false crawl. Species identification is possible

Loggerhead sea turtle (*Caretta caretta*) returning to water after nesting. Photograph courtesy of Eglin Air Force Base.

Eglin AFB, Santa Rosa Island	Public County Beaches
Little artificial coastal lighting, lighting is avoided during nesting season	Homes, traffic and business with nighttime artificial lighting throughout the year
No beach cleaning	Beaches cleaned with rakes/trucks every morning
No tire ruts in sand in which hatchlings can get trapped	Tire ruts, holes from recreational activities
Minimal human interaction	Constant interaction during nesting season
Little development	Large-scale beach development
Predation control (screening)	No predation control

Table 1. A comparison of nesting sites

from a visual inspection of the crawl as each species has unique characteristics. For example, loggerhead turtles have tracks that show alternating flipper movements with no tail drag marks and the tracks are generally 65 cm in width, whereas green sea turtles show simultaneous flipper movements with a center tail drag mark and tracks generally 80 cm in width. All nests are marked for visual identification and protection, using wooden stakes surrounded with surveyor's flagging. If a nest is dug at or below the mean high water mark, relocation is necessary to alleviate the threat of water inundation. Nests are monitored throughout the incubation period for storm damage, hatching activity and predation. Nest success evaluations are conducted for all nests subsequent to hatching, predation, or 100 days post-deposition.

Status of nesting 1989-1996

Between 1989 and 1996, there were 211 loggerhead nesting occurrences and 219 false crawls on Eglin AFB property, with a mean hatchling emergence rate of 59%. Sea turtles generally nest in two- or three-year cycles, and nesting by the Atlantic green turtle has occurred every other year since 1990 (Conley and Hoffman 1987). To date, there have been 47 nesting occurrences and 36 false crawls by Atlantic green sea turtles on Eglin AFB. The mean hatchling emergence success rate for the Atlantic green sea turtle has been 37%. Since 1987, nesting by this endangered species has been recorded in increasing numbers on Eglin and on other sections of undeveloped public beaches in the same county, thus placing further emphasis on SRI as a critical habitat (Meylan et al. 1995). A tropical storm in 1994 caused a decrease in hatching success rates for both species, since most nests were destroyed. However, two hurricanes in 1995 impacted only loggerhead nesting as green sea turtles did not nest that year. Overall, it is believed that if it were not for these natural occurrences the success rates would have been higher in both years.

Future outlook for nesting on Santa Rosa Island

Florida accounts for one-third of the worlds' loggerhead nesting beaches and over 90% of all nesting in the United States (Meylan et al. 1995). As development continues to explode in the counties surrounding SRI, the nests on military land are afforded protection in a way that is generally not possible on public lands. Factors that negatively impact sea turtle nesting or hatchlings reaching the ocean (see Table 1) can be avoided or managed. Eglin AFB will continue to be an important steward for sea turtle conservation as nesting areas around SRI are lost. On Eglin as elsewhere, military installations are proving to be some of the last areas of vast undeveloped land and a permanent habitat for threatened and endangered species.

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Endocrine Disruption: Hidden Threats to Wildlife

Michael Smolen and Theo Colborn

Introduction

Last year, increases in the numbers of adult eagles and nest counts in certain regions of the United States led to a widely-hailed conservation "success"–the lowering or down-listing of the bald eagle's legal status from "endangered" to "threatened". The bald eagle's partial comeback is a product of numerous factors including the outlawing of most uses of DDT, which was associated in the 1960s with the widespread occurrence of eggshell thinning in populations of bald eagles and other species. But the bald eagle has not made a complete recovery everywhere in the United States (Bowerman et al. 1995; Colborn 1991; Wiemeyer et al. 1993). Eggshell thinning and outright mortality are no longer visible and the absence of these conspicuous endpoints has led to the assumption that bald eagles and their populations are healthy. However, bald eagles nesting along the shores of the Great Lakes and feeding primarily on contaminated Great Lakes fish have far lower reproductive success than bald eagles nesting farther inland.

About the same time that the down-listing was reported, the popular press and electronic media reported an increasing number of disturbing findings about other wildlife species. These reports arose from research that described developmental effects associated with endocrine disruption in alligators (Guillette et al. 1994, 1995; Guillette and Crain 1996), shifts in sex ratios in turtles (Bergeron et al. 1994), altered bird behavior (Fry 1996), egg yolk proteins (vitellogenin) production in male fish (Tyler et al. 1996), female-female pairing in roseate terns (Nisbet and Hatch, personal communication), and feminization and demasculinization of male birds (Nisbet et al. 1996). Many of these animals appear normal and healthy. However, their reproductivity and survivorship are compromised and several of the populations appear to be in jeopardy. Given these findings and the growing evidence of endocrine disruption, it is apparent that more subtle measures of wildlife health must be established.

What is the endocrine system?

The endocrine system operates through a complex series of events triggered by chemical messengers that choreograph development and function. The chemical messengers (1) are involved in sexual differentiation; (2) prime the rates of cell division leading to the construction of tissues and organs that eventually determine future function, such as sperm production and ovulation; (3) control the development of the populations of cells comprising the immune system, thereby affecting future ability to combat disease; and (4) influence neural development, such as that required for bird behavior, vocalization, and parental care.

Components of the endocrine system that control development and function include the ovary, testis, and thyroid glands and their respective hormones, estrogen, testosterone, and thyroxine. In each case, the response depends upon the binding together of natural messengers with specific receptors (proteins) that are located throughout the body. Together, they initiate specific responses in the cell through genes coded on the DNA, yielding enzymes that mediate specific biochemical pathways, changes in rates of cellular activity, shifts within reproductive cycles, or increases in rates of cell divisions. Cells in different tissues respond differently to the same hormone. For example, estrogen in brain tissue can alter behavior, while the same hormone and receptors in cells lining the reproductive tract can initiate changes preparing the animal for new phases in a reproductive cycle. Likewise, cells of the same tissue may respond differently at different stages of development. Most importantly, signals occurring early in development frequently lead to a cascading of developmental events that are irreversible (Colborn and Clement 1992). Because of the critical role of the endocrine system in directing development and maintaining physiological homeostasis of animals throughout life, it is highly conserved. In other words, molecular biologists currently sequencing genes for receptors find little variation in genes among species, which is not surprising since many of these specific hormone messengers are shared from fish through humans (Gerhart and Kirschner 1997). From this, we may infer wider concern for all wildlife based on the observed effects of disruption of the endocrine system reported in alligators, turtles, birds, and mammals.

What is endocrine disruption?

That man-made chemicals can perturb the endocrine system of animals is not a new and startling revelation. Such perturbations have been reported in numerous laboratory studies using high dose testing, and in field studies involving exposure of wildlife to chemicals released into the environment. The well documented story of diethylstilbestrol (DES), a pharmaceutical administered to pregnant women to increase

the probability of successful births, provides a model for estrogen-like compounds released into the environment (Bern 1992). This drug is a confirmed estrogen mimic. The effects to the mother were minimal and their babies were born "healthy". However, many of the exposed children developed a variety of anomalies later in life. Subsequent research linked the effects to disruption *in utero* by the estrogen mimic, DES.

Endocrine disrupters work by a variety of mechanisms. First, they can impersonate natural hormones by binding to receptors and initiating a new cellular response. Second, an endocrine disrupting chemical may bind and block the receptor, thereby making these regulatory switches unavailable to signals from the body's naturally produced hormone messengers. Third, concentrations of the natural hormone can also be affected when man-made chemicals promote or interfere with the breakdown of the hormone by the liver's enzyme system. Fourth, during development, endocrine disrupting chemicals can alter the number of receptors in developing tissue types, thereby predisposing these tissues to abnormal responses later in life. The net result is a perturbation to systems that are critical for the creation and maintenance of the body plan which has been molded by natural selection over countless generations–perturbations resulting not from a genetic mutation but from confused chemical messenger systems and thus alter how genes are expressed. These changes in expression can lead to "functional deficits"–changes in how well an organism's immune, reproductive, and other systems perform.

What are the links to wildlife?

Much of what is known about endocrine disruption comes from new multidisciplinary research. A gathering of scientists met in 1991 at the Wingspread Conference Center, Racine Wisconsin (Colborn and Clement 1992). After two days of discussion, the scientists, from 17 diverse disciplines such as medicine, molecular biology, pharmacology, physiology, psychology, reproductive and developmental biology, and zoology, agreed with certainty that "a large number of man-made chemicals that have been released into the environment, as well as a few natural ones, have the potential to disrupt the endocrine system of animals." The basis of the concern arose from the presentations outlining each investigator's narrowly focused research specialty, each contributing a single piece from which the picture of endocrine disruption emerged. A consensus statement issued by the participants identified observable effects seen in wildlife, including thyroid dysfunction in birds and fish; decreased fertility in birds, fish, shellfish, and mammals; decreased hatching success in birds, fish, and turtles; gross birth deformities in birds, fish, and turtles; metabolic abnormalities in birds, fish, and mammals; behavioral abnormalities in birds; demasculinization and feminization of male fish, birds, and mammals; defeminization and masculinization of female fish and birds; and compromised immune systems in birds and mammals. These effects when reported alone appeared as unique events. What the Wingspread participants came to realize is that such events share a common mechanism of action, perturbation of the endocrine system, and are more widespread than previously understood.

The list of endocrine disrupting chemicals is growing (Colborn et al. 1993). Some man-made chemicals are of special concern because they are produced in large quantities, widely used, and, when released, can travel long distances in water or through the air. Many are very persistent since they resist degradation in the environment or detoxification by enzymes in organisms. Some are altered in the body into different chemicals that are more biologically active and interfere with the function of normal endocrine systems. Many can bioaccumulate in the fat of animals and are passed up through the food web when prey is eaten by predators. Many chemicals on the list are pesticides. Preliminary studies have identified endosulfan, methoxychlor, dicofol, lindane, DDT and its metabolites, vinclozolin, chlordecone, toxaphene, 2,4-D, 2,4,5-T, atrazine, carbaryl, dieldrin, heptachlor, mirex, malathion, synthetic pyrethroids, and chlordane as endocrine disrupting chemicals. Industrial and commercial chemicals on the list, such as polychlorinated biphenyls (PCBs), furans, dioxins, brominated biphenyls, phthalates, and phenol ethoxylates, are also found in wildlife tissue and have endocrine disrupting characteristics.

Concerns for wildlife

Much of the concern for wildlife originally emerged from the extensive research by many scientists working in the Great Lakes region (Colborn et al. 1990). Since then, there has been a steady flow of reports about developmental, reproductive, behavioral, immunological, and physiological changes in various wildlife species around the world. Die-offs in populations, such as seals and dolphins, have been linked to contaminant exposures (Lahvis et al. 1995; de Swart et al. 1996; Ross et al. 1996). Bill deformities have been described for a wide variety of birds in the Great Lakes region, including herring gulls, ring-billed gulls, common terns, Caspian terns, Forster's terns, black-crowned night herons, great blue herons, double-crested cormorants, Virginia rails, and bald eagles (Bowerman et al. 1994; Fry and Toone 1981; Fry

1996). Dioxins, furans, and PCBs are the primary suspects with regard to bill deformities. Also correlating with elevated concentrations of these chemicals are impaired reproduction and increased nestling mortality in many of these same species in the Great Lakes (Gilbertson et al. 1991; Kubiak et al. 1989). These are obvious morphological markers of development gone awry. New sophisticated, more refined methodologies are now revealing the invisible effects that can undermine a wildlife population (Giesy et al. 1994).

The developing offspring is the most sensitive target of endocrine disruption (Bern 1992). Many man-made chemicals can cross the placental barrier, thereby allowing the mother's body burden to be shared with her developing offspring. Further intake occurs as nursing animals drink fat-loving chemicals that are bound into fat-rich milk. In egg laying species, the chemicals are transported from the mother to the egg yolk where the chemicals cause irreversible damage during incubation. These concentrated doses of chemicals during embryonic, fetal, and early postnatal development can be the highest exposures encountered throughout life. Again, the timing for such exposures is of concern since much of the neural, reproductive, and immune development continues long after birth or hatching.

Concerns about the effects of DDT and its metabolites on the health of wildlife and humans have a lengthy history. DDT has long been described as an estrogen mimic, and a variety of effects in birds has been attributed to this biological activity. Besides DDT's well documented effects on eggshell thinning, a number of abnormalities were reported in male sexual development. These effects were proposed to be due in part to estrogen receptor interference, but only recently Kelce and coworkers (1995, 1997) have shown that the primary metabolite of DDT, p,p'-DDE, is a potent androgen antagonist. It binds to the androgen receptor, blocking a switch critical for the development of normal males. Prenatal exposure to p,p'-DDE leads to feminization in male mice, including the development of teats in a species which does not express them, as well as shortened penises. Exposure to p,p'-DDE is a serious concern since it dissolves in fat and resists degradation. The half-life of p,p'-DDE in animals is measured in decades and, coupled with the transfer in the food web, concentrations are frequently elevated in fish, wildlife and humans the world over. Even when exposure is low on a daily basis, the concentrations in body tissues increase over the years. By the time a female reaches reproductive age, the concentrations of chemicals such as p,p'-DDE can be substantial. Consequently, chemicals such as DDT and its metabolites can have a wide range of effects. Threats to the developing male by the anti-androgen p,p'-DDE differ from the estrogen mimicking effects of o,p'-DDT. There may be other more cryptic effects from meddling with a soup of endocrine disrupters.

Chaos caused by alterations to the messages sent by Mullerian Inhibiting Substance (MIS) is another example of endocrine disruption. For instance, MIS is normally released in developing male vertebrates to cause the resorption of the embryonic tissues that would produce a female reproductive system. All embryos have the potential to become either male or female, and simultaneously develop two separate kinds of tissues, one that gives rise to male and the other to female reproductive systems. Early in life, a developmental switch is thrown and the proper set of tissues is signaled to develop appropriate reproductive organs while existing tissues fated for the opposite sex are signaled to self-destruct. The sex chromosomes determine in which direction the switch is thrown, male or female, thereby setting in motion specific activities along a number of endocrine pathways. The resulting chorus of messengers directs the construction of anatomy, morphology, physiology, and behaviors necessary for that sex. It is perturbations to these hormonal ebbs and flows that confound development and cause potentially serious problems. Crossed messages signaling development of the sexes can cause varied intensities of feminization and demasculinization of males or defeminization and masculinization of females. As a result, the offspring become some intermediate design when compared to those that develop by genetic inheritance alone. Babble added to thyroid, estrogen, testosterone, and other hormone systems can contribute to reduced growth, functional abnormalities, altered behavior, lowered fertility, learning disabilities, reduced intelligence and increased susceptibility to disease.

A number of organochlorine chemicals are known to affect wildlife behavior. Increased concentrations of these chemicals are associated with increases in aberrant courtship behaviors, breeding asynchrony between mated pairs, faulty nest construction, and alterations in incubating and parental care behaviors in birds (Fry 1996; Fox et al. 1978; Kubiak et al. 1989). Some of these are also correlated with alterations in the quantity of circulating androgens, estrogens, and thyroid hormones. Such subtle changes in the behavior of birds are not easy to observe, let alone quantify, under standard field conditions. However, because of their importance they need to be monitored.

Songbirds are known for their complex behavioral repertoires in courtship, mating, and territorial displays. For example, male zebra finches sing, whereas females never sing even if given testosterone as adults. However, when this steroid hormone is administered shortly after hatching, females will sing as adults (Arnold et al. 1996; Bottjer and Arnold 1997). Steroid hormones present early in development are critical for the expression of the bird songs by which zebra finches court and defend territory, factors necessary to insure successful reproduction. The differences between males and females are in the numbers of neurons, the arrangements of the synaptic connections in the brain, and the size of nuclei, all choreographed by an interplay between steroid hormones, neuro-trophins, and their receptors. If endocrine disrupting chemicals compete for receptor sites, mimic estrogens or block androgen receptors, or inhibit aromatase activity, neurological development could be altered through cascading effects that would not be discerned even by the trained eyes of serious bird watchers. Trouble might only become evident when adult birds disappear from Christmas bird counts or other formalized surveys. Given the prevalence of endocrine disrupting chemicals in the environment, the evidence of maternal transfer between females and their offspring, and the important relationship between the presence of steroid hormones and brain and behavioral development, it is important that such subtle changes be recognized in wildlife.

Conclusions

Endocrine disruption has been documented in a wide variety of vertebrates, in both laboratory and field conditions. Numerous pesticides, industrial chemicals, and commercial products that have been released into the environment are endocrine disrupters. Monitoring of animal tissues has documented that some of these chemicals biomagnify in food webs, with notable concentrations reported in top predators in some communities and regions around the world. Recent findings, however, reveal that concentrations of chemicals in wildlife tissues cannot be used to assess their health. In light of what is known about the potential of synthetic chemicals to disrupt development and homeostasis, it is imperative that the animals' functional integrity be measured in hazard assessments. Merely observing an adult animal with young or seemingly healthy immature animals by themselves must not be the end product of an assessment of population health. Instead, the fate of the offspring must be followed to determine if they mature completely and have the potential to reproduce, thereby contributing to the viability of the population and the species. Besides the bald eagle, concern is growing for the viability of many other species of birds, including albatrosses, hawks, spoonbills, herons, cormorants, terns, and migratory shorebirds and songbirds. Birds are not the only species threatened by endocrine disrupting chemicals. Florida panthers, alligators, turtles, dolphins, porpoises, whales, otters, mink, and a growing list of fish species are being drawn into the web of endocrine disruption

Cougar (*Felis concolor*). Photograph © Susan C. Morse.

as scientists report on the status of these species. This is the nature of endocrine disruption–stealth damage caused by interference with endogenous messengers, the messengers that build and maintain the complex biochemistry that is ultimately critical for an individual's and species' survival.

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The Last Grizzlies of the American West: The Long Hard Road to Recovery

Louisa Willcox

On a cold day in November 1984, what may have been the last resident grizzly on the Targhee Forest's Madison Plateau, near Yellowstone Park's western border, was illegally shot. She was a sow (tag #179362), trailed by two cubs. This sow had grown up roaming the high country on the west side of Yellowstone Park and the Targhee National Forest. Transformed in her lifetime, the forest was now characterized by roads and clearcuts, which etched a sharp ten-mile line defining Yellowstone Park's western border. One of the new roads had allowed the poacher into a small pocket of secure habitat on Black Mountain, where the bears were taking refuge.

Introduction

The story of this bear's death is typical: despite Endangered Species Act (ESA) protections afforded to the grizzly since 1975, nearly all grizzlies still die at human hands, directly or indirectly. In fact, human-caused mortality and habitat destruction explain the dramatic decline of the grizzly bear since Europeans first arrived on North America's shores. Four hundred years ago, an estimated 100,000 grizzly bears (*Ursus arctos horribilis*) roamed North America, from the Missouri River to the California coast, and from Mexico to the Arctic Circle. The grizzly bear is America's quintessential wilderness animal—the story of its decline is the story of wilderness destruction.

Today, only one thousand grizzly bears remain in the lower 48 states. They survive in fragmented, isolated wilderness refuges in and around Glacier and Yellowstone Parks, the Cabinet-Yaak, the Selkirks, the North Cascades, and possibly still in the San Juans of Colorado. The biggest populations with greater prospects of persistence are in the ecosystems surrounding Yellowstone and Glacier. All these populations face growing human pressures, such as logging and roadbuilding; mining, oil and gas; and residential and recreation development.

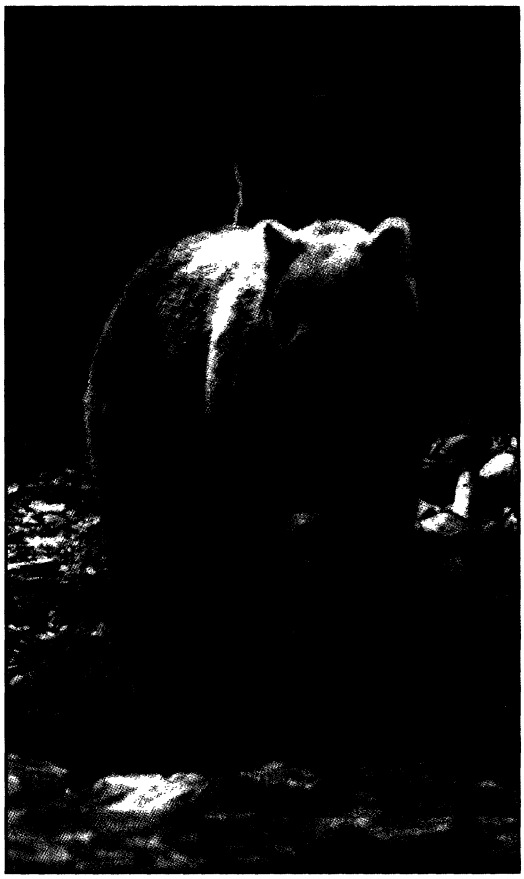
In 1975, the U.S. Fish & Wildlife Service (FWS) listed the grizzly bear as threatened in the lower 48 states. It was estimated then that the remaining populations represented about 2% or less of the species' pre-Columbian distribution and abundance in the lower 48 states–and since that time the amount of available habitat has decreased considerably. Today, the grizzly is still roughly at the same population levels and occupies the same area it did in 1975. To protect bear populations, an initial recovery plan for the grizzly was adopted in 1982, and revised in 1993. However, two lawsuits, filed by 38 U.S. conservation groups and individuals, resulted in a Federal District Judge's rejection of portions of the grizzly bear recovery plan in 1995. The reasons included: 1) the absence of habitat targets for recovery; 2) unreliable measures of the population, and 3) failure to justify reliance on Canadian bears to achieve U.S. grizzly recovery goals. In response, the FWS is revising the plan and allowing for public comment on the proposed changes. Tied to revision of the plan is the question of whether the Yellowstone population is ready to be delisted. Commodity interests weary of habitat constraints and anti-federal sentiments in western communities are supporting a state versus federal based management approach in Yellowstone.

In July, FWS also released a draft Environmental Impact Statement (EIS) on the proposed reintroduction of the grizzly into central Idaho (the Selway- Bitterroot area). Recovery of bears in central Idaho could greatly enhance overall prospects for grizzlies in the lower 48, and help reconnect Canadian grizzlies to Yellowstone, which has been isolated from other grizzly populations for about 60 years. But the government's proposal creates potentially lethal problems, through an unprecedented award of management authority to a citizens management committee, combined with an absence of habitat protection.

What follows here is an assessment of recovery efforts, what has worked and what could be improved to benefit the grizzly–and other species represented by this umbrella species. Key questions remain about how recovery should be defined, how scientific and other information should be synthesized and incorporated in management and monitoring efforts, and the role of the public in shaping the future of the grizzly.

Why grizzly bear recovery is so tough.

Grizzly recovery is a serious challenge for reasons relating to biology of the bear, administrative and management complexities, conflicting public attitudes and behavior, and economic pressures. In terms of bear biology, the grizzly has the slowest reproductive rate of any land



Grizzly Bear (*Ursus arctos horribilis*). Photograph courtesy of George Wuerthner.

mammal in North America. Maturing sexually at roughly five years old, grizzlies often have single cubs or twins, and reproduce every third year. Yellowstone researchers have noted that a female grizzly has difficulty replacing herself in a lifetime, thus the loss of a few reproductive females can significantly affect population growth rates (IGBST 1989-93). Furthermore, grizzly home range sizes are considerable. In Yellowstone, where the largest home ranges have been documented, males roam up to 900 square miles (Knight et al. 1984).

In addition, given the fickle nature of critical food sources in ecosystems such as Yellowstone, bears need to be able to find alternatives when an essential food fails. When alternatives are not present, the grizzlies are forced down into valleys and lowlands where residences and towns tend to be located (Mattson 1991). The grizzly's intelligence and long-term memory add to the recovery challenge, since a bear, once exposed to human foods or refuse, will remember years afterward and return to seek a similar treat–often running into conflict with humans and probable death (Meagher and Fowler 1991).

The administrative challenges facing grizzly recovery are considerable as well. In Yellowstone, for example, Park lands constitute roughly 40% of the entire habitat area, which also includes parts of six National Forests, small pieces of Bureau of Land Management (BLM) and state lands in three states (Montana, Idaho, Wyoming), and parts of 20 counties. The different missions, mandates, budgets, cultures, and incentives among agencies can contribute to fragmentation in management approaches (Clark and Minta 1994).

In 1983, the Interagency Grizzly Bear Committee (IGBC) was established to promote coordination among agencies involved in grizzly management. However, discrepancies in management approaches and philosophies about grizzly recovery remain. For example, the IGBC is dominated by members of the Forest Service, which has traditionally promoted timbering and roadbuilding, despite sound biological information on the effects of wilderness destruction and roadbuilding on bears.

Furthermore, one of the original functions served by the committee, coordination of research and scientific inquiry, has been abandoned with the dissolution of research subcommittees. And, the meetings have become increasingly sealed off from public view, with business conducted largely in executive sessions, followed by short, perfunctory summaries conducted for public and press consumption. This atmosphere of secrecy has contributed to growing mistrust by members of the public.

Public attitudes towards bears are complex, somewhat contradictory and difficult to generalize. In general, the public strongly supports grizzly recovery (Kellert 1995). For example, recent local polls in Idaho demonstrate that a majority of Idahoans strongly support restoration and recovery of the grizzly bear in Central Idaho (USDOI 1997). Although today one hears fewer utterings about "shoot, shovel and shut up," those attitudes still prevail in certain places. Aggressive public education by state game agencies, the National Park Service and U.S. Forest Service seem to be making a difference in changing the behavior of people living in or visiting grizzly bear habitat: this is evidenced by the decline in recent years of certain types of grizzly bear conflicts and mortalities, particularly around garbage dumps and hunter camps in some areas (Mattson and Craighead 1994).

A variety of economic factors help make grizzly recovery even more challenging. Large taxpayer subsidies for the timber programs of the Forest Service and BLM have tended to promote destruction of wilderness habitat. (According to the Congressional Research Service, the Rocky Mountains boast some of the most "below cost" timber sales in the country) (Gorte 1995). This trend continues, in spite of dramatic economic and population change over the last 30 years in the Rocky Mountain West (Rasker 1995). With population growth has come an increase in real estate prices for private lands in some bear habitat in the Flathead area of northern Montana and the counties around Greater Yellowstone. Despite a growth in private lands conservation organizations in recent years, the cost of conserving open space under easement or purchase programs is becoming increasingly high. A less

recognized economic issue relates to the growing demand for high priced bear parts, especially gall bladders, as a medicine in Asian countries, such as Korea and Taiwan (Servheen 1990). This possibly is increasing poaching in the remote Northern Rockies ecosystems (Highley 1996).

In sum, a complex array of social, economic, biological, and administrative factors conspire to make the challenges inherent in recovery of a large predator even more pronounced. While some key problems seem to become less severe (grizzly habituation and conflicts in Yellowstone Park, for example) others are worsening, such as the communications and relationships between agencies and the public.

What has the Endangered Species Act done for the grizzly?

Today, 20 years after the listing of all grizzly populations as threatened in the lower 48, it is clear that the grizzly would not remain but for protections afforded by the ESA. Following are some of the actions that have made a difference. First, legalized hunting of the grizzly was stopped in the three states around Yellowstone Park. (Legal hunting was allowed to continue on the national forests outside Glacier Park until 1990, when a lawsuit by conservationists stopped hunting there.) Second, public land agencies and some communities began to work together to clean up garbage dumps, and to prevent unnecessary habituation of the grizzly bear. The Parks closed the dumps inside their borders and campgrounds on public lands were sanitized and recreationists were educated about storing food properly so they would not attract bears.

Third, a significant reduction in sheep grazing in essential habitat has helped lower human-caused mortality. As domestic sheep are easy prey, grizzlies often find themselves within range of herder's guns. Twenty years ago, a number of forests, especially the Gallatin and Targhee, featured "black holes" for bears, where the location of sheep allotments marked significant mortality sinks. An economic downturn in the sheep industry, combined with a program that traded allotments into non-grizzly habitat, helped the Targhee Forest, for example, remove 20,000 sheep from occupied grizzly habitat and reduce grizzly mortality.

Fourth, a quiet but major gain for the grizzly was the backcountry management program instituted ten years ago inside Yellowstone Park. Yellowstone closed to overnight camping in key bear habitat areas in the Park and the sanctuary provided by these closures have been critical to maintaining security in the heart of the grizzly's range.

Fifth, the ESA brought federal prohibitions on the take of grizzly bears, except in self-defense situations. While federal agencies have been reluctant to prosecute cases, and courts in the region have been lenient, this prohibition has probably helped deter some illegal killing. In addition, the Section 9 prohibition on "take" and Section 7 requirements for consultation with the FWS have also helped improve protection of grizzly bear habitat. Through the biological consultation process, development of a proposed ski area on the Gallatin National Forest near West Yellowstone was halted on the grounds that it would have jeopardized the grizzly. The same process resulted in a decision to remove recreational facilities at Fishing Bridge in the heart of Yellowstone Park, where important cutthroat trout spawning grounds and a spring grizzly feeding area lie in the middle of campgrounds and other developments. In some cases, consultation by FWS has been prompted by litigation by outside parties, resulting in the halting of clearcutting on the Targhee in 1993 and the initiation of restoration and road closures for bears on a number of forests.

Sixth, scientific research by state and federal agencies on grizzly/habitat relationships was greatly expanded as a result of an ESA listing. For example, research was undertaken by scientists at a number of universities, further adding to the significant body of knowledge about grizzly population dynamics and habitat needs. In recent years, researchers have moved beyond strict biological and ecological issues into questions of economics, policy implications, and design of management systems for bears and other large carnivores. A number of these issues are explored in the summer 1996 issue of *Conservation Biology* (Noss 1996).

The role of the conservation community in grizzly recovery.

In 1987, a number of conservation organizations, influenced by the newly developed Society for Conservation Biology, reassessed the status and prospects of grizzly bears in the Northern Rockies. As a result, a new collaborative grizzly bear conservation campaign was launched, which includes local and regional groups in the Northern Rockies, as well as national organizations. The goals of this effort include protecting and restoring habitat necessary to maintain the grizzly and its ecosystems in the long term. This involves expanding the proposed recovery zones in areas of public land where there is room for grizzly bears to increase their distribution and abundance; restoring habitat linkages between currently isolated populations; restoring grizzly bears to significant portions of their range where they are currently absent or in critically low numbers; maintaining and restoring the wilderness character of grizzly bear habitat through careful management of roads on public lands. The goals also include improving the grizzly recovery plan so that it

would truly recover the grizzly and helping reduce unnecessary human-bear conflicts and grizzly mortality. Relying on staff, volunteers and the unique skills of participating organizations, the campaign has integrated scientific analysis, outreach and education, and administrative action.

Roads kill.

Significant progress has been made in recent years incorporating new information about roads in habitat management. Over the last 20 years, the body of scientific information concerning roads and associated human impacts on bears has ballooned. Although research of roads and access has been conducted in various habitats, from wet, densely forested areas such as the Cabinet-Yaak to the relatively dry, open terrain of the Yellowstone, the findings are remarkably similar: grizzlies are highly sensitive to fragmentation of habitat by roads, and human-caused grizzly mortality increases as roads and motorized use road densities increase. For example, research on the South Fork of the Flathead has shown that road densities must be maintained under one mile per square mile to avoid adverse impacts on bears, and that over two miles per square mile road densities equates to the grizzly's displacement from the area altogether (Mace and Manley 1993). Studies also found that bears are displaced on average, about .3 mile on either side of a roadway (Mattson et al. 1987), and that even after roads are closed, bears, especially females with cubs, tend to continue to avoid using roadway areas.

Using different methods, federal researchers came to similar conclusions in Yellowstone. They found that grizzlies need contiguous areas of secure, quality habitat of 5,000 to 7,000 acres (roadless country), which translates to overall road densities of less than one mile per square mile at scales approximating grizzly home ranges. Also, these researchers developed some new ways to weigh road impacts according to the available cover. Using this approach, road densities as low as .26 mile per square mile were found to be needed for the Targhee, given past roading and logging impacts (USDOI 1994).

Because of the demonstrated adverse impacts of roads on grizzly bears, conservationists attempted to close the gap between scientific information and management through a series of lawsuits filed by Earth Justice Legal Defense Fund (EJLDF; formerly Sierra Club Legal Defense Fund). These lawsuits were successful in prompting the affected forests to launch road closure programs in grizzly habitat. Although restoration efforts have been slow, at least the new information about road impacts is being recognized and is sinking into some new land management plans.

Grizzly recovery plans.

The release of a draft revised grizzly bear recovery plan in 1992 precipitated a deluge of comments from the public and key scientists. For example, Lee Metzger (Metzger 1992), Craig Pease (Pease 1992), and Mark Shaffer (Shaffer 1992) felt that the recovery plan was seriously flawed. According to Shaffer, "by relying on the handful of small, isolated population units, [the plan] violates every rule that population viability analysis has taught about the general requirements for long-term viability. It confuses short-term stabilization with long-term recovery and will produce neither" (Shaffer 1992). Despite such responses, the final grizzly bear recovery plan changed little, prompting a number of scientists to request that the plan be withdrawn. In 1993, thirty-eight conservation groups, represented by attorneys of EJLDF and the Fund for Animals, filed lawsuits against the FWS for inadequacies in the grizzly recovery plan. In September 1995, a Federal District Court Judge ruled that the grizzly bear recovery plan was illegal and inadequate (Fund for Animals v Babbitt, Civ. No. 94-1021, Civ. No. 94-1106 (Dist. of Columbia Court 1995)) because: 1) it does not consider habitat status and trends; 2) the use of females with cubs-of-the-year as a measure of population size is unreliable and scientifically unsound; 3) the plan's criteria do not take into account the impacts of genetic isolation; 4) the criteria do not take into account the potential impacts of disease; 5) it's reliance on Canadian bear populations to determine recovery targets is unjustified; 6) the recovery plan does not clearly account for the impacts of mortality related to livestock grazing.

In March, 1996, FWS reported that it would develop habitat-based recovery criteria and include these in the recovery plan, and provide additional evidence on the other points itemized above, by December, 1996. The FWS also stated that it would not press for delisting any grizzly bear population until these recovery criteria have been developed and satisfied for that population. Of particular concern is the proposed delisting of the Yellowstone grizzly bear population, which is being promoted by the State of Wyoming seeking to reinitiate a grizzly bear hunt.

The ongoing public process raises a number of questions concerning recovery of grizzlies and other endangered species. First, how much habitat is enough, and in what configuration is it needed, to reduce the risk of extinction and ensure recovery? Second, how should demography data be tied to measures of habitat status and trends so that recovery plans address both issues in meaningful terms? Third, although ESA recovery plans are discretionary, how can they be translated into

on-the-ground management programs which hold land managing agencies accountable for their implementation? Fourth, how should the recovery plan account for changes in adjacent Canadian ecosystems, where habitat quality is declining rapidly? Fifth, how can FWS improve its procedures for incorporating public comment and constructive, independent, scientific analysis? The revision of the plan invites the FWS to engage in the recovery effort in fresh ways, taking advantage of a growing public constituency and new perspectives and framework for analysis. It also invites further thought about how recovery efforts in general can be improved from a scientific and policy perspective.

To delist or not to delist?

In addition to the debate over the grizzly bear recovery plan is the question of whether the Yellowstone, and possibly the Northern Continental Divide, grizzly population should be delisted or removed from ESA protection. In that case, primary control over the grizzly bear's future will be returned to the states. What are the possible implications of this shift? First, the states do not have direct authority to manage habitat on most of the grizzly bear's range in the Selkirks, Cabinet-Yaak, Glacier and Yellowstone systems, which principally consist of National Forest and National Park lands. State authority is limited to the management of wildlife populations, and while state agencies can influence management of habitat on federal lands, they cannot force habitat protections on an unwilling federal land managing agency. Second, although the Greater Yellowstone Ecosystem is divided over three states, bears do not recognize the boundaries. Because of their large ranges, grizzlies require a level of interstate cooperation and management that does not presently exist for any wildlife species in the region. Although researchers have repeatedly emphasized the need for comprehensive management of grizzlies and their habitat, by removing federal oversight, delisting would further balkanize management between the involved states. Third, the states are particularly vulnerable to influence and manipulation by extractive industries. Often, work by state field-level biologists is ignored, if their recommendations counter the wishes of such industries. These and other issues prompted the Society for Conservation Biology to pass a resolution in 1996, opposing the delisting of the Yellowstone grizzly. The debate about the delisting will likely begin again once the recovery plan is complete.

Central Idaho grizzly reintroduction –restoring a missing link

To begin alleviating problems associated with isolation of individual grizzly populations in the lower 48, FWS directed that Central Idaho wildlands be evaluated for potential grizzly reintroduction in its 1993 recovery plan. This evaluation showed that, while salmon, a critical traditional food source for the grizzly, has largely been eliminated, there is still an ample array of quality foods and habitats necessary for grizzly recovery in this area. The draft EIS, released in July will be open for comment until November, but no funds are available for reintroduction activities for the next year. In the meantime, a FWS Preferred Alternative in the draft EIS is addressing immediate reintroduction efforts. This alternative is an agreement between representatives of Defenders of Wildlife, the National Wildlife Federation, the Resource Organization On Timber Supply (ROOTS), and the Intermountain Forestry Industry Association. Key elements of this proposal include: 1) introduction only into designated wilderness areas; 2) authorization of a citizen management committee, appointed by the governors of the States of Montana and Idaho to make decisions concerning grizzly management; 3) designation of the population as "experimental, nonessential" under Section 10(j) of the ESA; 4) agreement that no habitat standards or protections would be incorporated in the reintroduction program at the outset; and 5) grizzlies would be brought in from Yellowstone, Glacier, and possibly British Columbia.

Grizzly bear (*Ursus arctos horribilis*). Larry Aumiller, photographer. Photo courtesy of Great Bear Foundation.

Over 50 other conservation organizations have expressed concerns that: 1) the zone is too small to adequately recover the grizzly; 2) habitat protection standards are important to maintaining grizzly populations and without them, the reintroduced bears are unlikely to survive; 3) while there are benefits to an advisory body of citizens to air local concerns over grizzly issues and management options, granting full authority to a citizens committee (which would be politicized by the appointments of the governors' offices, and would lack necessary scientific expertise) is inappropriate, and will not likely succeed. In addition, 43 Canadian conservation organizations have expressed concern about the impacts on potential source populations in Canada (Batackyi letter dated November 1996). Citing declining habitat and localized population declines in British Columbia and Alberta, these groups requested an evaluation of the effects of removal of bears from the Canadian populations, and requested to be involved in the EIS process. In response, the Minister of Environment in Alberta stated that, since their grizzlies were far below required levels for recovery, no Alberta bears would be removed in the reintroduction process (Lund letter dated February 1997). The government of British Columbia is not participating in this discussion thus far.

In the meantime, new scientific information is being generated that will shed light on suitable habitat for grizzlies in the central Idaho landscape. Members of the Hornocker Wildlife Institute and Idaho Cooperative Fish and Wildlife Research Unit have developed a new approach to assess potential suitable habitat for grizzlies, and have outlined a novel approach for using this assessment to design protected for grizzlies and other large carnivores (Merrill et al. 1997).

In sum, the revision of the recovery plan and the discussion about grizzly restoration in the Selway-Bitterroot offers significant opportunities to build a new framework for recovery of the grizzly bear. Whether FWS and other land managing agencies will pursue creative and innovate thought about science and policy, and engage the public constructively in these issues, is yet to be seen. At stake, however, is an animal whose fate hangs in the balance. By making the most of these present opportunities, we may yet see the grizzly bear remain and recover in the American West.

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Conservation Spotlight: Tomato Frogs

A. Wisnieski, V. Poole, and E. Anderson

The Madagascar Tomato Frog (*Dyscophus antongilli*) is a rather large terrestrial microhylid that ranges along the northeastern coast of Madagascar from Antongil Bay south to Andevoranto. They occur at elevations from sea level to 200 meters and breed in shallow pools, swamps, drainage ditches, and slow moving bodies of water.

A sexually dimorphic species, female tomato frogs range in size from 8.5 to 10.5 cm and are solid bright red or orange dorsally, which shades into a white ventral surface. Males are not as large (6 to 6.5 cm) or as brilliantly colored, being a duller yellow-orange. A toxic, whitish skin secretion is used as a defense against predators, and can occasionally produce allergic reactions in humans.

Dyscophus antongilli is endangered in its native country as a result of deforestation and over-collecting for the pet trade, and is now listed on Appendix I of the Convention on International Trade in Endangered Species (CITES). There are two other species of tomato frogs in Madagascar, *D. guineti* and *D. insularis*, neither of which are presently endangered.

Because of their endangered status and appeal, this species has been designated as high priority by the AZA Amphibian Taxon Advisory Group (TAG) and is a flagship species for the Madagascar Fauna Group, a consortium of U.S. zoos, including The Baltimore Zoo, dedicated to the preservation of threatened fauna and natural habitats of this unique island country. The captive population in U.S. zoos, currently 101 adult specimens in 21 institutions, is jeopardized by a lack of genetic diversity, unknown pedigrees, and until recently, a shortage of animals.

In an effort to preserve the species in captivity, The Baltimore Zoo spearheaded a collaborative effort in 1994 by arranging for shipment of tomato frogs to the University of California at Berkeley from the Chaffee Zoological Gardens of Fresno, Ft. Worth Zoological

Juvenile and adult tomato frog. Photograph courtesy of The Baltimore Zoo.

Park, Sedgwick County Zoo, Woodland Park Zoological Gardens, and two private collections. There, under the direction of Dr. Dale Denardo, researchers successfully induced reproduction utilizing hormones, producing 255 froglets from two spawnings.

The Baltimore Zoo received 14 of these offspring in December of 1994 with the goal of reproducing tomato frogs naturally, through environmental manipulation, as the use of hormones can sometimes produce adverse side effects. The frogs were reared in terraria (61 cm x 30.5 cm x 45 cm) equipped with drains, using a sheet moss substrate over a pea gravel bed that was sloped at one end to create a shallow pool and supported by a filter plate to facilitate cleaning and drainage. Plants, plastic huts, and cork bark were used to provide hiding spots. The frogs were fed crickets twice a day, which had been gut loaded with Zeigler™ Cricket Diet and dusted with a vitamin/mineral powder consisting of Nekton® Rep, Nekton® MSA, and Repcal® D in equal proportions. They were also misted twice daily with dechlorinated tap water and full spectrum florescent lighting was provided.

By 1995, the frogs were large enough to be sexed based on size and coloration differences, and potential breeding groups of four males and two females were established in two 122 cm x 61 cm x 61 cm terraria. Enclosure temperatures and photoperiod ranged seasonally from 21 to 26 C and 9.5 to 16 hours of daylight, respectively. Enclosures were also misted to maintain a relative humidity of 70 to 90%.

Six months prior to planned breeding attempts, staff attempted to stimulate reproduction by maintaining the frogs at a drier relative humidity (55 to 65% average). This was accomplished by decreasing the pool depth and mistings, and increasing cage ventilation. On May 23, 1997, the pool depth was increased to 8 cm, the lights were dimmed, and a misting system and humidifier were added to simulate rain storms that are the catalyst for natural tomato frog reproduction. By the next morning, the males had begun calling and amplexing the females.

On May 28, approximately 4700 eggs were found in one of the enclosures. To prevent the still calling and amplexing adults from destroying the egg mass, the adults were removed to another terrarium. The eggs began hatching within two days, and in order to minimize crowding, the majority of the 1 cm long tadpoles were separated into large Rubbermaid® tubs with sponge filters for rearing. Spirulina flakes, Aquarian® Tropical flakes, and Tetra® basic staple flakes were offered twice daily. Water chemistry was monitored daily and water changes were performed as needed.

The first froglets began to metamorphose on July 1, and averaged 15.22 cm in snout-vent length and 0.49 g in weight. They were primarily black in color with a tan dorsal streak. It typically takes several months for them to acquire their distinctive orange-red coloration. The froglets were fed pinhead crickets and fruit flies dusted with our vitamin/mineral mixture and misted daily. By two months of age, most of the froglets had already begun to eat two-week-old crickets. The frogs produced from this spawning have been placed in the collections of other U.S. zoological institutions with the intention of pairing them with frogs from different bloodlines when they become available.

In addition to captive reproduction efforts, The Baltimore Zoo is actively involved in several other tomato frog conservation projects. For example, to educate the Malagasy people on the plight of this endangered species and to combat the challenges of insufficient genetic diversity in the captive U.S. zoo population, The Baltimore Zoo has funded the construction of a tomato frog exhibit in Parc Zoologique Ivoloina, a zoo in Madagascar. This was accomplished by working through the Madagascar Fauna Group. Significantly, this is the first and only exhibit for an amphibian species in the entire country. It features eight wild-caught tomato frogs that zookeepers there will attempt to breed so offspring may be available to zoos abroad. Photographs of The Baltimore Zoo's tomato frogs have been provided for the educational graphics at the New Parc Ivoloina exhibit. The graphics will help to educate their visitors about the preservation of this endangered species and its habitat, as very few people in Madagascar are aware of the threats to its survival.

The Baltimore Zoo has also provided funding for Dr. Edward Louis of Omaha's Henry Doorly Zoo to perform DNA testing on blood samples taken from tomato frogs in U.S. zoos with unknown pedigrees. This will enable zoos to determine exact lineages for all captive tomato frogs, so they can breed pairs that provide maximum genetic diversity in the captive population. Additionally, The Baltimore Zoo is also working towards exchanging tomato frogs with the Copenhagen Zoo so that European and U.S. institutions can benefit from shared bloodlines.

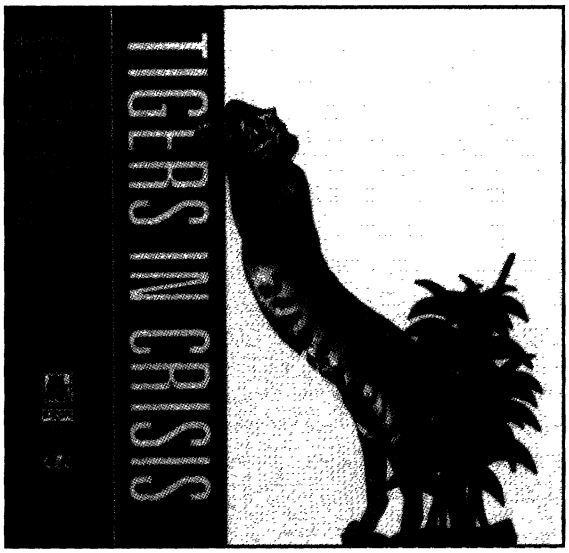
For additional information on Tomato Frogs or any of the projects mentioned, contact Anthony Wisnieski, Curator of Reptiles and Amphibians, or Vicky Poole, Assistant Curator, The Baltimore Zoo, Druid Hill Park, Baltimore, MD 21217. Telephone (410) 396-0441 or FAX (410) 545-7397.

NEWS FROM ZOOS

National Aquarium in Baltimore named a Coastal America Ecosystem Learning Center

The National Aquarium in Baltimore (NAIB) is the first organization in the Mid-Atlantic region to be designated as a Coastal America Ecosystem Learning Center. In this capacity, the NAIB will provide the area with technical expertise, new equipment to study and monitor the area's marine ecology, as well as relevant educational exhibits and programs. Coastal America, established in 1992, is a partnership among federal, state and local governments and private alliances dedicated to addressing coastal ecology problems. The official designation was made jointly by Robert Perciasepe, Chairman of the Coastal America, Terry Garcia, Acting Assistant Administrator for Oceans and Atmosphere, NOAA, and David Pittinger, Executive Director of NAIB, in a ceremony held on 24 September 1997. Among the many guests in attendance at this landmark ceremony were U.S. Senator Paul Sarbanes and Baltimore Mayor Kurt Schmoke.

"Tigers in Crisis" exhibit unveiled



A traveling exhibit titled "Tigers in Crisis" has been developed by the American Zoo and Aquarium Association (AZA) with a grant from the *Save the Tiger Fund*, an international, multi-faceted program established by the National Fish and Wildlife Foundation and the Exxon Corporation. The exhibit was developed to educate the public about tigers, the problems they face, and the efforts of AZA-accredited zoos and other conservation organizations are making to prevent their extinction. The exhibit was formally unveiled on 12 September at the Albuquerque Biological Park and will be traveling to various AZA-member institutions over the next three years.

The traveling exhibit consists of five kiosks highlighted with dramatic life-size tiger cut-outs. Magnificent photography and hands-on interactive elements engage visitors with the story of this majestic species that is rapidly disappearing from our world. Each kiosk in the exhibit tells a different chapter in the story of tigers, with the objective of educating visitors and encouraging them to act on that knowledge, and make a commitment to help these incredible creatures.

Disney artwork celebrates the AZA Conservation Endowment Fund and formation of the AZA North America Fauna Interest Group

In celebration of AZA's Conservation Endowment Fund (CEF) and the formation of the AZA's North America Fauna Interest Group , the Walt Disney World Co. has commissioned artwork featuring endangered animals from North America. The design, created by Larry Moore, is third of five in a series entitled *Walt Disney World Salutes the Conservation Endowment Fund.* Commemorative T-shirts featuring the artwork have also been generously given by the Walt Disney World Co. along with the Walt Disney Company's annual gift to the CEF to support conservation action. The all cotton T-shirts are gifts to individuals contributing $10 to the AZA CEF. One hundred percent of all contributions goes to support valuable conservation. To make a tax-deductible contribution to the CEF, send your check or money order, made payable to AZA/CEF and indicate preferred size (M-XXL), to Ms. Colleen Kelly, AZA, 7970-D Old Georgetown Road, Bethesda, MD 20814. For further information on the North American Fauna Interest Group, please contact Ed Diebold, Co-chair, Riverbanks Zoological Park and Botanical Garden, P.O. Box 1060, Riverbanks, SC 29202-1060 (e-mail: ediebold@riverbanks.org).

Bulletin Board

Grants Available

The Nagao Natural Environment Foundation is a private, independent grant-giving institution dedicated to helping local research scientists in the Asia and Pacific region by providing grants up to US$8,300. Priorities include the conservation of wildlife habitat, and biological diversity in the region. For application guidelines and further information, contact Akiko Ono, Programme Officer, Nagao Natural Environment Foundation, Yushima 2-29-3 Bunkyo-ku, Tokyo, Japan; Tel.: (81) 33812-3123; Fax: (81) 33812-3129; E-mail: aohno@jwrc.or.jp.

Web Works

The Natural Areas Journal, published by the Consortium of Aquariums, Universities and Zoos (C.A.U.Z.) is now available on-line to view the table of contents and abstracts for recent issues. *The Journal* publishes articles focusing on nature reserves, natural areas, state or national parks, rare and endangered species, land preservation, and theoretical approaches to natural area work. It can be accessed at http://www.vmedia.com/naj.

Also, the 1997-98 Membership Directory of C.A.U.Z. is now available at http://www.selu.com/~bio/cauz. The C.A.U.Z. is an international network that began on the campus of California State University in August, 1985. Today, the database includes information submitted by scientists and educators from more than 250 institutions in 25 countries.

D.C. Bar Environment, Energy and Natural Resources Section Elects 1997-98 Leaders

The Environment, Energy and Natural Resources Section announces the election of Lynn L. Bergeson of Weinberg, Bergeson & Neuman and Anne H. Shields of the Department of the Interior as Co-Chairs for 1997-98. The 21 Sections of the D.C. Bar focus on specialized areas of legal practice through programs, publications and activities that educate members of the District's legal community. The Environment, Energy and Natural Resources Section provides up-to-the-minute information on legal and policy developments and the emerging law where these district disciplines intersect. Issues are addressed through monthly luncheon programs, a quarterly newsletter, and Web page. The Section covers the traditional substantive areas, as well as addresses enforcement trends, insurance issues, EPA reinvention initiatives, emerging regulatory risk assessment methods, legislative initiatives, and much more. Contact the Sections Office at 202-626-3463 for further information.

Announcements for the Bulletin Board are welcomed. Some items from the Bulletin Board have been provided by Jane Villa-Lobos, Smithsonian Institution.

Endangered Species UPDATE

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