

Conservation Biology



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Conservation Biology



Efforts are being taken to preserve the natural characteristics of Hopetoun Falls, Australia while continuing to allow visitor access

Conservation biology is the scientific study of the nature and status of Earth's biodiversity with the aim of protecting species, their habitats, and ecosystems from excessive rates of extinction. It is an interdisciplinary subject drawing on sciences, economics, and the practice of natural resource management.

History of term

The term *conservation biology* was introduced as the title of a conference held at the University of California in La Jolla, California in 1978 organized by biologists Bruce

Wilcox and Michael E. Soulé. The meeting was prompted by the concern among scientists over tropical deforestation, disappearing species, eroding genetic diversity within species. The conference and proceedings that resulted sought to bridge a gap existing at the time between theory in ecology and population biology on the one hand and conservation policy and practice on the other. Conservation biology and the concept of biological diversity (biodiversity) emerged together, helping crystallize the modern era of conservation science and policy.

Description

The rapid decline of established biological systems around the world means that conservation biology is often referred to as a "Discipline with a deadline". Conservation biology is tied closely to ecology in researching the dispersal, migration, demographics, effective population size, inbreeding depression, and minimum population viability of rare or endangered species. Conservation biology is concerned with phenomena that affect the maintenance, loss, and restoration of biodiversity and the science of sustaining evolutionary processes that engender genetic, population, species, and ecosystem diversity. The concern stems from estimates suggesting that up to 50% of all species on the planet will disappear within the next 50 years, which has contributed to poverty, starvation, and will reset the course of evolution on this planet.

Conservation biologists research and educate on the trends and process of biodiversity loss, species extinctions, and the negative affect this is having on our capabilities to sustain the well-being of human society. Conservation biologists work in the field and office, in government, universities, non-profit organizations and industry. They are funded to research, monitor, and catalog every angle of the earth and its relation to society. The topics are diverse, because this is an interdisciplinary network with professional alliances in the biological as well as social sciences. Those dedicated to the cause and profession advocate for a global response to the current biodiversity crisis based on morals, ethics, and scientific reason. Organizations and citizens are responding to the biodiversity crisis through conservation action plans that direct research, monitoring, and education programs that engage concerns at local through global scales.

Context and trends

Conservation biologists study trends and process from the paleontological past to the ecological present as they gain an understanding of the context related to species extinction. It is generally accepted that there have been five major global mass extinctions that register in Earth's history. These include: the Ordovician (440 mya), Devonian (370 mya), Permian–Triassic (245 mya), Triassic–Jurassic (200 mya), and Cretaceous (65 mya) extinction spasms. Within the last 10,000 years, human influence over the Earth's ecosystems has been so extensive that scientists have difficulty estimating the number of species lost; that is to say the rates of deforestation, reef destruction, wetland draining and other human acts are proceeding much faster than human assessment of species. The latest *Living Planet Report* by the World Wide Fund

Conservation biologists are dealing with and have published evidence from all corners of the planet indicating that humanity may be living the sixth and greatest planetary extinction event. It has been suggested that we are living in an era of unprecedented numbers of species extinctions, also known as the Holocene extinction event. The global extinction rate may be approximately 100,000 times higher than the natural background extinction rate. It is estimated that two-thirds of all mammal genera and one-half of all mammal species weighing at least 44 kilograms (97 lb) have gone extinct in the last 50,000 years. It is speculated that this sixth extinction period is unique because it would be the first major extinction to be caused by another biotic agent over the course of the Earth's 4 billion year history. The Global Amphibian Assessment reports that amphibians are declining on a global scale faster than any other vertebrate group, with over 32% of all surviving species being threatened with extinction. The surviving populations are in continual decline in 43% of those that are threatened. Since the mid-1980s the actual rates of extinction have exceeded 211 times rates measured from the fossil record. However, "The current amphibian extinction rate may range from 25,039 to 45,474 times the background extinction rate for amphibians." The global extinction trend occurs in every major vertebrate group that is being monitored. For example, 23% of all mammals and 12% of all birds are Red Listed by the International Union for Conservation of Nature (IUCN), meaning they too are threatened with extinction.

Status of oceans and reefs

Global assessments of coral reefs of the world continue to report drastic and rapid rates of decline. By 2000, 27% of the world's coral reef ecosystems had effectively collapsed. The largest period of decline occurred in a dramatic "bleaching" event in 1998, where approximately 16% of all the coral reefs in the world disappeared in less than a year. *Coral bleaching* is caused by a mixture of environmental stresses, including increases in ocean temperatures and acidity, causing both the release of symbiotic algae and death of corals. Decline and extinction risk in coral reef biodiversity has risen dramatically in the past ten years. The loss of coral reefs, which are predicted to go extinct in the next century, will have huge economic impacts, threatens the balance of global biodiversity, and endangers food security for hundreds of millions of people. Conservation biology plays an important role in international agreements covering the world's oceans (and other issues pertaining to biodiversity, e.g.).

These predictions will undoubtedly appear extreme, but it is difficult to imagine how such changes will not come to pass without fundamental changes in human behavior.

J.B. Jackson¹¹⁴⁶³

The oceans are threatened by acidification due to an increase in CO₂ levels. This is a most serious threat to societies relying heavily upon oceanic natural resources. A concern is that the majority of all marine species will not be able to evolve or acclimate in response to the changes in the ocean chemistry.

The prospects of averting mass extinction seems unlikely when "[...] 90% of all of the large (average approximately ≥ 50 kg), open ocean tuna, billfishes, and sharks in the

ocean" are reportedly gone. Given the scientific review of current trends, the ocean is predicted to have few surviving multi-cellular organisms with only microbes left to dominate marine ecosystems.

Insects and other groups

There are serious concerns also being hailed from taxonomic groups that do not receive the same degree of social attention or attract funds as the vertebrates do, including fungi, lichen, plant and insect communities where the vast majority of biodiversity is represented. Insect conservation, in particular, is of pivotal importance for conservation biology. The value of insects in the biosphere is enormous because they outnumber all other living groups in measure of species richness. The greatest bulk of biomass on land is found in plants, which is sustained by insect relations. This great ecological value of insects is countered by a society that oftentimes reacts negatively toward these aesthetically 'unpleasant' creatures.

One area of concern in the insect world that has caught the public eye is the mysterious case of missing honey bees (*Apis mellifera*). Honey bees provide an indispensable ecological services through their acts of pollination supporting a huge variety of agriculture crops. The sudden disappearance of bees leaving empty hives or colony collapse disorder (CCD) is not uncommon. However, in 16-month period from 2006 through 2007, 29% of 577 beekeepers across the United States reported CCD losses in up to 76% of their colonies. This sudden demographic loss in bee numbers is placing a strain on the agricultural sector. The cause behind the massive declines is puzzling scientists. Pests, pesticides, and global warming are all being considered as possible causes.

Another highlight that links conservation biology to insects, forests, and climate change is the mountain pine beetle (*Dendroctonus ponderosae*) epidemic of British Columbia, Canada, which has infested 470,000 km² (180,000 sq mi) of forested land since 1999. An action plan has been prepared by the Government of British Columbia to address this problem.

This impact [*pine beetle epidemic*] converted the forest from a small net carbon sink to a large net carbon source both during and immediately after the outbreak. In the worst year, the impacts resulting from the beetle outbreak in British Columbia were equivalent to 75% of the average annual direct forest fire emissions from all of Canada during 1959–1999.

—Kurz *et al.*

Conservation biology of parasites

A large proportion of parasite species are threatened by extinction. A few of them are being eradicated as pests of humans or domestic animals, however, most of them are harmless. Threats include the decline or fragmentation of host populations, or the extinction of host species.

Threats to biodiversity

Many of the threats to biodiversity, including disease and climate change, are reaching inside borders of protected areas, leaving them 'not-so protected' (e.g. Yellowstone National Park). Climate change, for example, is often cited as a serious threat in this regard, because there is a feedback loop between species extinction and the release of carbon dioxide into the atmosphere. Ecosystems store and cycle large amounts of carbon to regulate global conditions. The effects of global warming adds a catastrophic threat toward a mass extinction of global biological diversity. The extinction threat is estimated to range from 15 to 37 percent of all species by 2050, or 50 percent of all species over the next 50 years.

Some of the most significant and insidious threats to biodiversity and ecosystem processes include climate change, mass agriculture, deforestation, overgrazing, slash-and-burn agriculture, urban development, wildlife trade, light pollution and pesticide use. Habitat fragmentation poses one of the more difficult challenges, because the global network of protected areas only covers 11.5% of the Earth's surface. A significant consequence of fragmentation and lack of linked protected areas is the reduction of animal migration on a global scale. Considering that billions of tonnes of biomass are responsible for nutrient cycling across the earth, the reduction of migration is a serious matter for conservation biology.

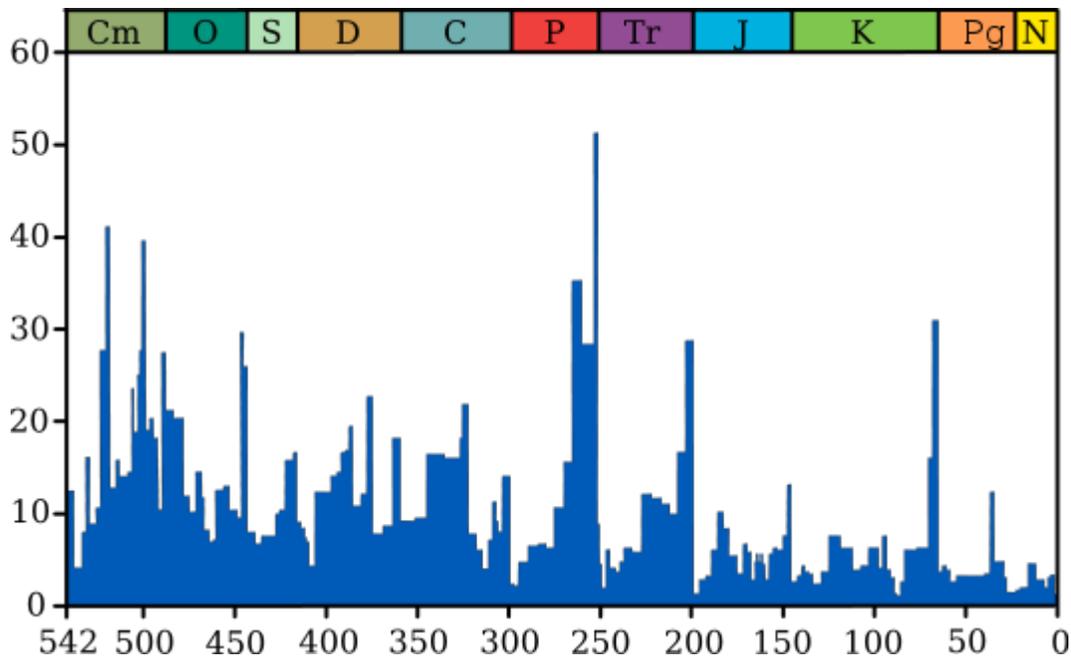
Human activities are associated directly or indirectly with nearly every aspect of the current extinction spasm.

Wake and Vredenburg

These figures do not imply, however, that human activities must necessarily cause irreparable harm to the biosphere. With conservation management and planning for biodiversity at all levels, from genes to ecosystems, there are examples where humans mutually coexist in a sustainable way with nature. However, it may be too late for human intervention to reverse the current mass extinction.

Concepts and foundations

Measuring extinction rates



The five major extinction spasms measured by extinction levels in marine animal genera through time. Blue graph shows apparent percentage (not absolute number) of extinctions during any given time interval.

Extinction rates are measured in a variety of ways. Conservation biologists measure and apply statistical measures of fossil records, rates of habitat loss, and a multitude of other variables such as loss of biodiversity as a function of the rate of habitat loss and site occupancy to obtain such estimates. The Theory of Island Biogeography is possibly the most significant contribution toward the scientific understanding of both the process and how to measure the rate of species extinction. The current background extinction rate is estimated to be one species every few years.

The measure of ongoing species loss is made more complex by the fact that most of the Earth's species have not been described or evaluated. Estimates vary greatly on how many species actually exist (estimated range: 3,600,000-111,700,000) to how many have received a species binomial (estimated range: 1.5-8 million). Less than 1% of all species that have been described have been studied beyond simply noting its existence. From these figures, the IUCN reports that 23% of vertebrates, 5% of invertebrates and 70% of plants that have been evaluated are designated as endangered or threatened.

Systematic conservation planning

Systematic conservation planning is an effective way to seek and identify efficient and effective types of reserve design to capture or sustain the highest priority biodiversity values and to work with communities in support of local ecosystems. Margules and Pressey identify six interlinked stages in the systematic planning approach:

1. Compile data on the biodiversity of the planning region

2. Identify conservation goals for the planning region
3. Review existing conservation areas
4. Select additional conservation areas
5. Implement conservation actions
6. Maintain the required values of conservation areas

Conservation biologists regularly prepare detailed conservation plans for grant proposals or to effectively coordinate their plan of action and to identify best management practices (e.g.). Systematic strategies generally employ the services of Geographic Information Systems to assist in the decision making process.

Conservation biology as a profession

The Society for Conservation Biology is a global community of conservation professionals dedicated to advancing the science and practice of conserving biodiversity. Conservation biology as a discipline reaches beyond biology, into subjects such as philosophy, law, economics, humanities, arts, anthropology, and education. Within biology, conservation genetics and evolution are immense fields unto themselves, but these disciplines are of prime importance to the practice and profession of conservation biology.

[...] there are advocates and there are sloppy or dishonest scientists, and these groups differ.

Chan

Is conservation biology an objective science when biologists advocate for an inherent value in nature? Do conservationists introduce bias when they support policies using qualitative description, such as habitat *degradation*, or *healthy* ecosystems? As all scientists hold values, so do conservation biologists. Conservation biologists advocate for reasoned and sensible management of natural resources and do so with a disclosed combination of science, reason, logic, and values in their conservation management plans. This sort of advocacy is similar to the medical profession advocating for healthy lifestyle options, both are beneficial to human well-being yet remain scientific in their approach. Many conservation biologists, in addition to having a Bachelors of Science (or extensive natural experience) often receive professional accreditation during their career (e.g.).

There is a movement in conservation biology suggesting a new form of leadership is needed to mobilize conservation biology into a more effective discipline that is able to communicate the full scope of the problem to society at large. The movement proposes an adaptive leadership approach that parallels an adaptive management approach. The concept is based on a new philosophy or leadership theory steering away from historical notions of power, authority, and dominance. Adaptive conservation leadership is reflective and more equitable as it applies to any member of society who can mobilize others toward meaningful change using communication techniques that are inspiring, purposeful, and collegial. Adaptive conservation leadership and mentoring programs are

being implemented by conservation biologists through organizations such as the Aldo Leopold Leadership Program

Approaches

Conservation may be classified as either in-situ conservation, which is protecting an endangered species in its natural habitat, or ex-situ conservation, which occurs outside the natural habitat. In-situ conservation involves protecting or cleaning up the habitat itself which may include a great deal of environmental preservation, or by defending the species from predators. Ex-situ conservation may be used on some or all of the population, when in-situ conservation is too difficult, or impossible.

Also, non-interference may be used, which is termed a preservationist method. Preservationists advocate for giving areas of nature and species a protected existence that halts interference from the humans. In this regard, conservationists differ from preservationists in the social dimension, as conservation biology engages society and seeks equitable solutions for both society and ecosystems.

Some preservationists emphasize the potential of biodiversity in a world without humans

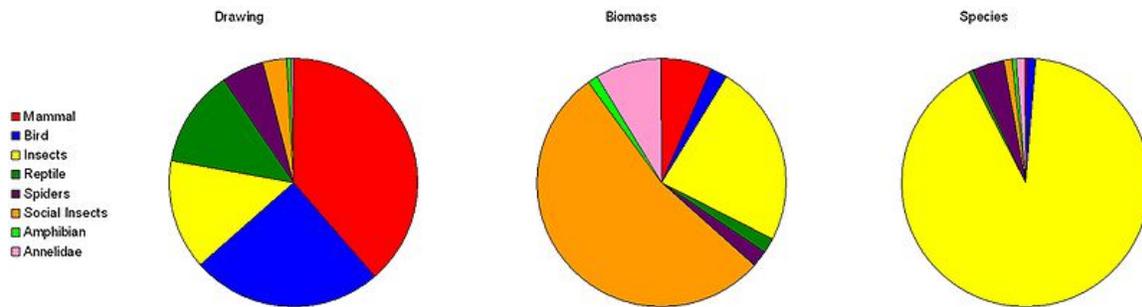
"Animals have not yet invaded 2/3 of Earth's habitats, and it could be that without human influence the diversity of tetrapods will continue to increase in an exponential fashion."
—Sahney *et al.*

Ethics and values

Conservation biologists are interdisciplinary researchers that practice ethics in the biological and social sciences. Chan states that conservationists must advocate for biodiversity and can do so in a scientifically ethical manner by not promoting simultaneous advocacy against other competing values. A conservationist researches biodiversity and reasons through a Resource Conservation Ethic, which identifies what measures will deliver "the greatest good for the greatest number of people for the longest time."¹³

Some conservation biologists argue that nature has an intrinsic value that is independent of anthropocentric usefulness or utilitarianism. Intrinsic value advocates that a gene, or species, be valued because they have a utility for the ecosystems they sustain. Aldo Leopold was a classical thinker and writer on such conservation ethics whose philosophy, ethics and writings are still valued and revisited by modern conservation biologists. His writing is oftentimes required reading for those in the profession.

Conservation priorities



A pie chart image showing the relative biomass representation in a rain forest through a summary of children's perceptions from drawings and artwork (left), through a scientific estimate of actual biomass (middle), and by a measure of biodiversity (right). Notice that the biomass of social insects (middle) far outweighs the number of species (right).

The International Union for the Conservation of Nature (IUCN) has organized a global assortment of scientists and research stations across the planet to monitor the changing state of nature in an effort to tackle the extinction crisis. The IUCN provides annual updates on the status of species conservation through its Red List. The IUCN Red List serves as an international conservation tool to identify those species most in need of conservation attention and by providing a global index on the status of biodiversity. More than the dramatic rates of species loss, however, conservation scientists note that the sixth mass extinction is a biodiversity crisis requiring far more action than a priority focus on rare, endemic or endangered species. Concerns for biodiversity loss covers a broader conservation mandate that looks at ecological processes, such as migration, and a holistic examination of biodiversity at levels beyond the species, including genetic, population and ecosystem diversity. Extensive, systematic, and rapid rates of biodiversity loss threatens the sustained well-being of humanity by limiting supply of ecosystem services that are otherwise regenerated by the complex and evolving holistic network of genetic and ecosystem diversity. While the conservation status of species is employed extensively in conservation management, some scientists highlight that it is the common species that are the primary source of exploitation and habitat alteration by humanity. Moreover, common species are often undervalued despite their role as the primary source of ecosystem services.

While most in the community of conservation science "stress the importance" of sustaining biodiversity, there is debate on how to prioritize genes, species, or ecosystems, which are all components of biodiversity (e.g. Bowen, 1999). While the predominant approach to date has been to focus efforts on endangered species by conserving *biodiversity hotspots*, some scientists (e.g.) and conservation organizations, such as the Nature Conservancy, argue that it is more cost effective, logical, and socially relevant to invest in *biodiversity coldspots*. The costs of discovering, naming, and mapping out the distribution every species, they argue, is an ill advised conservation venture. They reason it is better to understand the significance of the ecological roles of species.

Biodiversity hotspots and coldspots are a way of recognizing that the spatial concentration of genes, species, and ecosystems is not uniformly distributed on the

Earth's surface. For example, "[...] 44% of all species of vascular plants and 35% of all species in four vertebrate groups are confined to 25 hotspots comprising only 1.4% of the land surface of the Earth."

Those arguing in favor of setting priorities for coldspots point out that there are other measures to consider beyond biodiversity. They point out that emphasizing hotspots downplays the importance of the social and ecological connections to vast areas of the Earth's ecosystems where biomass, not biodiversity, reigns supreme. It is estimated that 36% of the Earth's surface, encompassing 38.9% of the world's vertebrates, lacks the endemic species to qualify as biodiversity hotspot. Moreover, measures show that maximizing protections for biodiversity does not capture ecosystem services any better than targeting randomly chosen regions. Population level biodiversity (i.e. coldspots) are disappearing at a rate that is ten times that at the species level. The level of importance in addressing biomass versus endemism as a concern for conservation biology is highlighted in literature measuring the level of threat to global ecosystem carbon stocks that do not necessarily reside in areas of endemism. A hotspot priority approach would not invest so heavily in places such as steppes, the Serengeti, the Arctic, or taiga. These areas contribute a great abundance of population (not species) level biodiversity and ecosystem services, including cultural value and planetary nutrient cycling.

Summary of 2006 IUCN Red List categories.

Those in favor of the hotspot approach point out that species are irreplaceable components of the global ecosystem, they are concentrated in places that are most threatened, and should therefore receive maximal strategic protections.

Economic values and natural capital



Tadrart Acacus desert in western Libya, part of the Sahara.

Conservation biologists have started to collaborate with leading global economists to determine how to measure the wealth and services of nature and to make these values apparent in global market transactions. This system of accounting is called *natural capital* and would, for example, register the value of an ecosystem before it is cleared to make way for development. The WWF publishes its *Living Planet Report* and provides a global index of biodiversity by monitoring approximately 5,000 populations in 1,686 species of vertebrate (mammals, birds, fish, reptiles, and amphibians) and report on the trends in much the same way that the stock market is tracked.

This method of measuring the global economic benefit of nature has been endorsed by the G8+5 leaders and the European Commission. Nature sustains many ecosystem services that benefit humanity. Many of the earth's ecosystem services are public goods without a market and therefore no price or value. When the *stock market* registers a financial crisis, traders on Wall Street are not in the business of trading stocks for much of the planet's living natural capital stored in ecosystems. There is no natural stock market with investment portfolios into sea horses, amphibians, insects, and other creatures that provide a sustainable supply of ecosystem services that are valuable to society. The ecological footprint of society has exceeded the bio-regenerative capacity limits of the planet's ecosystems by about 30 percent, which is the same percentage of vertebrate populations that have registered decline from 1970 through 2005.

The ecological credit crunch is a global challenge. The Living Planet Report 2008 tells us that more than three quarters of the world's people live in nations that are ecological debtors – their national

consumption has outstripped their country's biocapacity. Thus, most of us are propping up our current lifestyles, and our economic growth, by drawing (and increasingly overdrawing) upon the ecological capital of other parts of the world.

WWF Living Planet Report

The inherent natural economy plays an essential role in sustaining humanity, including the regulation of global atmospheric chemistry, pollinating crops, pest control, cycling soil nutrients, purifying our water supply, supplying medicines and health benefits, and unquantifiable quality of life improvements. There is a relationship, a correlation, between markets and natural capital, and social income inequity and biodiversity loss. This means that there are greater rates of biodiversity loss in places where the inequity of wealth is greatest

Although a direct market comparison of natural capital is likely insufficient in terms of human value, one measure of ecosystem services suggests the contribution amounts to trillions of dollars yearly. For example, one segment of North American forests has been assigned an annual value of 250 billion dollars; as another example, honey-bee pollination is estimated to provide between 10 and 18 billion dollars of value yearly. The value of ecosystem services on one New Zealand island has been imputed to be as great as the GDP of that region. This planetary wealth is being lost at an incredible rate as the demands of human society is exceeding the bio-regenerative capacity of the Earth. While biodiversity and ecosystems are resilient, the danger of losing them is that humans cannot recreate many ecosystem functions through technological innovation.

Strategic species concepts

Keystone species

Some species, called a *keystone species*, form a central supporting hub in the ecosystem. The loss of such a species results in a collapse in ecosystem function, as well as the loss of coexisting species. The importance of a keystone species was shown by the extinction of the Steller's Sea Cow (*Hydrodamalis gigas*) through its interaction with sea otters, sea urchins, and kelp. Kelp beds grow and form nurseries in shallow waters to shelter creatures that support the food chain. Sea urchins feed on kelp, while sea otters feed on sea urchins. With the rapid decline of sea otters due to overhunting, sea urchin populations grazed unrestricted on the kelp beds and the ecosystem collapsed. Left unchecked, the urchins destroyed the shallow water kelp communities that supported the Steller's Sea Cow's diet and hastened their demise. The sea otter is a keystone species because the coexistence of many ecological associates in the kelp beds relied upon otters for their survival.

Indicator species



The NAMOS BC logo is an example of an ecosystem *umbrella* concept (forests and wetlands) combined with amphibians as *indicator* and *flagship species*.

An *indicator species* has a narrow set of ecological requirements, therefore they become useful targets for observing the health of an ecosystem. Some animals, such as amphibians with their semi-permeable skin and linkages to wetlands, have an acute sensitivity to environmental harm and thus may serve as a *miner's canary*. Indicator species are monitored in an effort to capture environmental degradation through pollution or some other link to proximate human activities. Monitoring an indicator species is a measure to determine if there is a significant environmental impact that can serve to advise or modify practice, such as through different forest silviculture treatments and management scenarios, or to measure the degree of harm that a pesticide may impart on the health of an ecosystem.

Government regulators, consultants, or NGOs regularly monitor indicator species, however, there are limitations coupled with many practical considerations that must be followed for the approach to be effective. It is generally recommended that multiple indicators (genes, populations, species, communities, and landscape) be monitored for effective conservation measurement that prevents harm to the complex, and oftentimes unpredictable, response from ecosystem dynamics (Noss, 1997:⁸⁸⁻⁸⁹).

Umbrella and flagship species

An example of an *umbrella species* is the Monarch butterfly, because of its lengthy migrations and aesthetic value. The Monarch migrates across North America, covering multiple ecosystems and so requires a large area to exist. Any protections afforded to the Monarch butterfly will at the same time umbrella many other species and habitats. An umbrella species is often used as *flagship species*, which are species, such as the Giant Panda, the Blue Whale, the tiger, the mountain gorilla and the Monarch butterfly, that capture the public's attention and attract support for conservation measures.

History

The conservation of natural resources is the fundamental problem. Unless we solve that problem, it will avail us little to solve all others.

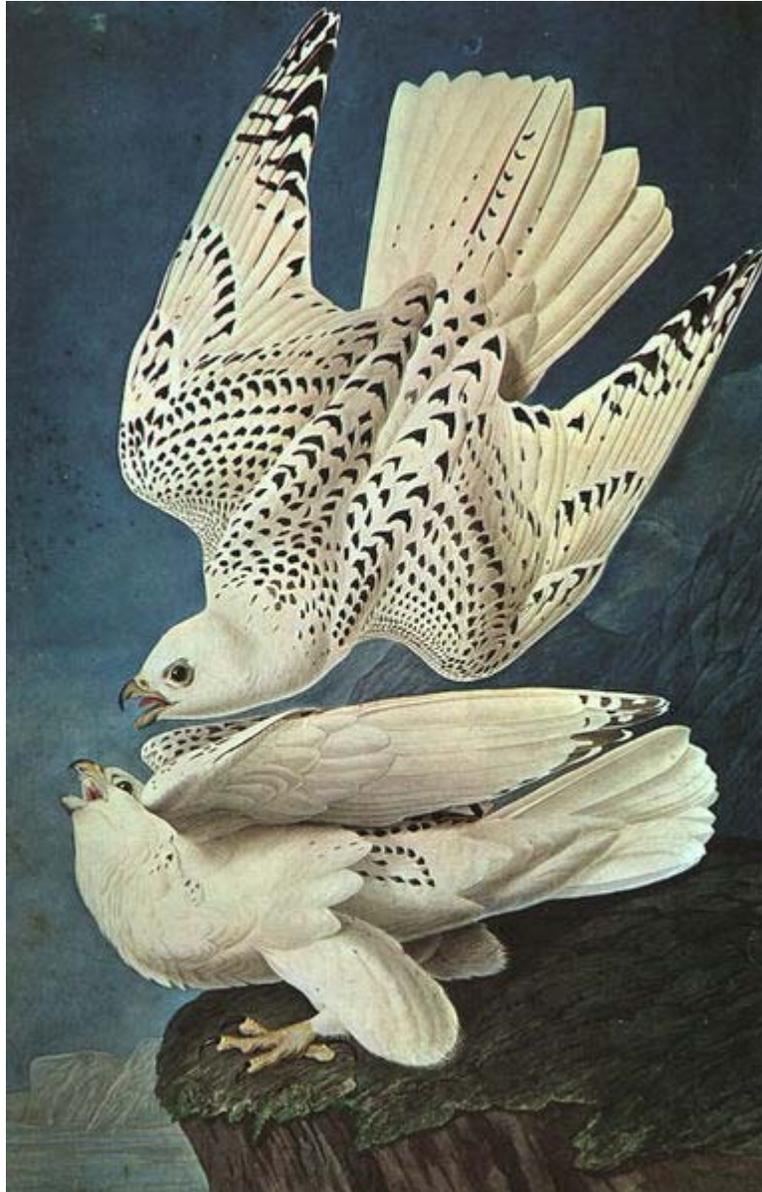
Natural resource conservation

Efforts to conserve and protect *global* biodiversity are a recent phenomenon. Prior to the global conservation era, there was the coming of the age of conservation. Some historians have linked this with the 1916 National Parks Act, which included the 'use without impairment' clause, sought by John Muir. This eventually resulted in the removal of a proposal to build a dam in Dinosaur National Monument in 1959.

Natural resource conservation, however, has a history that extends prior to the age of conservation. Resource ethics grew out of necessity through direct relations with nature. Regulation or communal restraint became necessary to prevent selfish motives from taking more than could be locally sustained, therefore compromising the long-term supply for the rest of the community. This social dilemma with respect to natural resource management is often called the "Tragedy of the Commons". From this principal, conservation biologists can trace communal resource based ethics throughout cultures as a solution to communal resource conflict. For example, the Alaskan Tlingit peoples and the Haida of the Pacific Northwest had resource boundaries, rules, and restrictions among clans with respect to the fishing of Sockeye Salmon. These rules were guided by clan elders who knew life-long details of each river and stream they managed. There are numerous examples in history where cultures have followed rules, rituals, and organized practice with respect to communal natural resource management.

Conservation ethics are also found in early religious and philosophical writings. There are examples in the Tao, Shinto, Hindu, Islamic and Buddhist traditions. In Greek philosophy, Plato lamented about pasture land degradation: "What is left now is, so to say, the skeleton of a body wasted by disease; the rich, soft soil has been carried off and only the bare framework of the district left." In the bible, through Moses, God commanded to let the land rest from cultivation every seventh year. Before the 18th century, however, much of European culture considered it a pagan view to admire nature. Wilderness was denigrated while agricultural development was praised. However, as early as AD 680 a wildlife sanctuary was founded on the Farne Islands by St Cuthbert in response to his religious beliefs.

Early naturalists



White Gerfalcons drawn by John James Audubon

Natural history was a major preoccupation in the 18th century, with grand expeditions and the opening of popular public displays in Europe and North America. By 1900 there were 150 natural history museums in Germany, 250 in Great Britain, 250 in the United States, and 300 in France. Preservationist or conservationist sentiments are a development in the late 18th to early 20th century. The 19th century fascination with natural history engendered a fervor to be the first to collect rare specimens with the goal of doing so before they became extinct by other such collectors. Although his artistic works and romantic depiction of avian life inspired many bird enthusiasts and conservation organizations, the writings of John James Audubon, by modern standards, show insensitivity toward bird conservation as he shot and collected hundreds of

specimens. Inspired by him, however, the first chapter of the Audubon Society started in 1905 for the purpose of protecting birds.

Coming of the Age of Conservation

The modern concept of ecosystem services can be found in the late 19th century. "The utility of Natural History or its applicability to promote the material wealth of the State cannot be doubted. It was a great mistake to suppose that the subjects of Zoology, Botany, and Geology did not involve much that affects our comfort, convenience, health and wealth." However, we continue and discuss the dread of agricultural pests and the utility of understanding their natural history for the purpose of facilitating their destruction.

In the department of Woods and Forestry we should teach on the principals of conservation and teach on the lessons of economy rather than of waste in the natural resources of our country.

American Museum of Natural History, 1909

By the early 19th century biogeography was ignited through efforts of Alexander von Humboldt, DeCandolle, Lyell and Darwin; their efforts, while important in relating species to their environments, were part of the naturalist tradition and fell short of conservation biology proper. Darwin, for example, hunted and shot birds and kept natural history cabinets in line with Victorian tradition.

Modern roots of conservation biology can be found in the late 19th century Enlightenment period particularly in England and Scotland. A number of thinkers, among them notably Lord Monboddo, described the importance of "preserving nature"; much of this early emphasis had its origins in Christian theology.

20th century conservation



Roosevelt and Muir on Glacier Point in Yosemite National Park.

In the 20th century, actions in the United Kingdom, United States, and Canada emphasized the protection of habitat areas pursuant to visions of such people as John Muir, Theodore Roosevelt, and Aldo Leopold. While the Canadian nor the United Kingdom governments did not pioneer the creation of National Parks as the United States did in the late 19th century, there were many far-sighted civil servants who were dedicated to wildlife conservation and of notable mention. Some of these historical figures include Charles Gordon Hewitt and James Harkin.

The term *conservation* came into use in the late 19th century and referred to the management, mainly for economic reasons, of such natural resources as timber, fish, game, topsoil, pastureland, and minerals. In addition it referred to the preservation of

forests (forestry), wildlife (wildlife refuge), parkland, wilderness, and watersheds. Western Europe was the source of much 19th century progress for conservation biology, particularly the British Empire with the Sea Birds Preservation Act 1869. However, the United States made contributions to this field starting with thinking of Thoreau and taking form with the Forest Act of 1891, John Muir's founding of the Sierra Club in 1892, the founding of the New York Zoological Society in 1895 and establishment of a series of national forests and preserves by Theodore Roosevelt from 1901 to 1909.

Not until the mid-20th century did efforts arise to target individual species for conservation, notably efforts in big cat conservation in South America led by the New York Zoological Society. In the early 20th century the New York Zoological Society was instrumental in developing concepts of establishing preserves for particular species and conducting the necessary conservation studies to determine the suitability of locations that are most appropriate as conservation priorities; the work of Henry Fairfield Osborn Jr., Carl E. Akeley, Archie Carr and Archie Carr III is notable in this era. Akeley for example, having led expeditions to the Virunga Mountains and observed the mountain gorilla in the wild, became convinced that the species and the area were conservation priorities. He was instrumental in persuading Albert I of Belgium to act in defense of the mountain gorilla and establish Albert National Park (since renamed Virunga National Park) in what is now Democratic Republic of Congo.

By the 1970s, led primarily by work in the United States under the Endangered Species Act along with the Species at Risk Act (SARA) of Canada, Biodiversity Action Plans developed in Australia, Sweden, the United Kingdom, hundreds of species specific protection plans ensued. Notably the United Nations acted to conserve sites of outstanding cultural or natural importance to the common heritage of mankind. The programme was adopted by the General Conference of UNESCO in 1972. As of 2006, a total of 830 sites are listed: 644 cultural, 162 natural. The first country to pursue aggressive biological conservation through national legislation was the United States, which passed back to back legislation in the Endangered Species Act (1966) and National Environmental Policy Act (1970), which together injected major funding and protection measures to large scale habitat protection and threatened species research. Other conservation developments, however, have taken hold throughout the world. India, for example, passed the Wildlife Protection Act of 1972 .

In 1980 a significant development was the emergence of the urban conservation movement. A local organization was established in Birmingham, UK, a development followed in rapid succession in cities across the UK, then overseas. Although perceived as a grassroots movement, its early development was driven by academic research into urban wildlife. Initially perceived as radical, the movement's view of conservation being inextricably linked with other human activity has now become mainstream in conservation thought. Considerable research effort is now directed at urban conservation biology. The Society for Conservation Biology originated in 1985.

By 1992 most of the countries of the world had become committed to the principles of conservation of biological diversity with the Convention on Biological Diversity;

subsequently many countries began programmes of Biodiversity Action Plans to identify and conserve threatened species within their borders, as well as protect associated habitats. The late 1990s saw increasing professionalism in the sector, with the maturing of organisations such as the Institute of Ecology and Environmental Management and the Society for the Environment.

Since 2000 the concept of landscape scale conservation has risen to prominence, with less emphasis being given to single-species or even single-habitat focused actions. Instead an ecosystem approach is advocated by most mainstream conservationist, although concerns have been expressed by those working to protect some high-profile species.

Ecology has clarified the workings of the biosphere; i.e., the complex interrelationships among humans, other species, and the physical environment. The burgeoning human population and associated agriculture, industry, and the ensuing pollution, have demonstrated how easily ecological relationships can be disrupted.

“ The last word in ignorance is the man who says of an animal or plant: "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.

Chapter- 2

Significant Species in Conservation Biology

Keystone species



Sea otters, an example of a keystone species

A **keystone species** is a species that has a disproportionate effect on its environment relative to its biomass. Such species affect many other organisms in an ecosystem and help to determine the types and numbers of various other species in a community.

Such an organism plays a role in its ecosystem that is analogous to the role of a keystone in an arch. While the keystone is under the least pressure of any of the stones in an arch,

the arch still collapses without it. Similarly, an ecosystem may experience a dramatic shift if a keystone species is removed, even though that species was a small part of the ecosystem by measures of biomass or productivity. It has become a very popular concept in conservation biology.

A keystone species is a species that plays a critical role in maintaining the structure of an ecological community and whose impact on the community is greater than would be expected based on its relative abundance or total biomass. The ecologist Dr. Robert T. Paine coined the phrase to explain the relationship between *Pisaster ochraceus*, a species of starfish, and *Mytilus californianus*, a species of mussel.

Examples



Puget Sound starfish



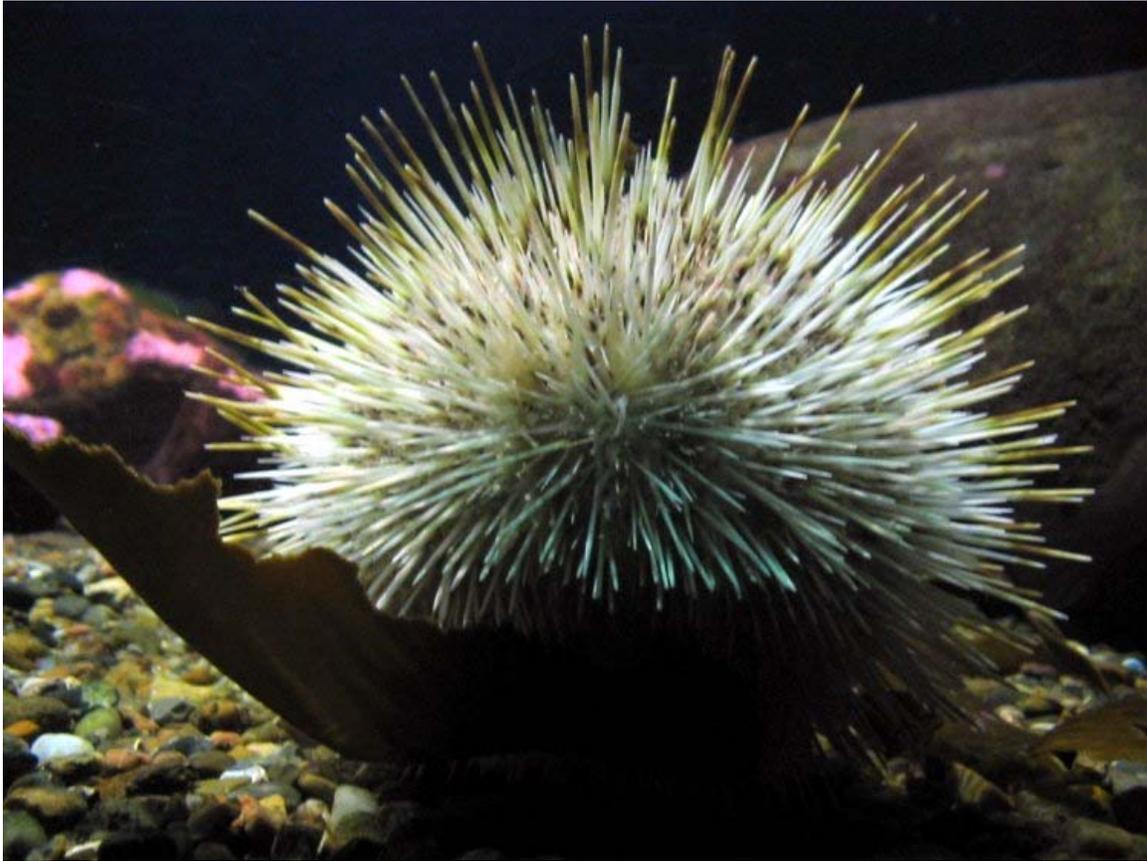
California Mussels

There are many historical definitions of the keystone species concept since it was coined by Robert Paine, as reviewed here.

Without a consensus on its exact definition, we are left to illustrate the concept of keystone species with a list of examples.

A classic keystone species is a small predator that prevents a particular herbivorous species from eliminating dominant plant species. Since the prey numbers are low, the keystone predator numbers can be even lower and still be effective. Yet without the predators, the herbivorous prey would explode in numbers, wipe out the dominant plants, and dramatically alter the character of the ecosystem. The exact scenario changes in each example, but the central idea remains that through a chain of interactions, a non-abundant species has an out-sized impact on ecosystem functions. One example is the weevil and its suggested keystone effects on aquatic plant species diversity by prey activities on nuisance Eurasian Watermilfoil.

Predators



Sea urchin

Some sea stars may perform this function by preying on sea urchins, mussels, and other shellfish that have no other natural predators. If the sea star is removed from the ecosystem, the mussel population explodes uncontrollably, driving out most other species, while the urchin population annihilates coral reefs. In his classic 1966 paper, Dr. Robert Paine described such a system in Makah Bay in Washington State. This led to his 1969 paper where he proposed the keystone species concept.

Similarly, sea otters in kelp forests keep sea urchins in check. Kelp "roots", called holdfasts, are merely anchors, and not the vast nutrient gathering networks of land plants. Thus the urchins only need to eat the roots of the kelp, a tiny fraction of the plant's biomass, to remove it from the ecosystem.

These creatures need not be apex predators. Sea stars are prey for sharks, rays, and sea anemones. Sea otters are prey for orca.

In the case of the jaguar, whose numbers in Central and South America have been classified as Near Threatened, it acts as a keystone predator by its widely varied diet,

helping to balance the mammalian jungle ecosystem with its consumption of 87 different species of prey.

Mutualists

Keystone mutualists are organisms that participate in mutually beneficial interactions, the loss of which would have a profound impact upon the ecosystem as a whole. For example, in the Avon Wheatbelt region of Western Australia, there is a period of each year when *Banksia prionotes* (Acorn Banksia) is the sole source of nectar for honeyeaters, which play an important role in pollination of numerous plant species. Therefore the loss of this one species of tree would probably cause the honeyeater population to collapse, with profound implications for the entire ecosystem.

Engineers



Grizzly bear in water



Beaver dam lake

In North America, the grizzly bear is a keystone species—not as a predator but as ecosystem engineers. They transfer nutrients from the oceanic ecosystem to the forest ecosystem. The first stage of the transfer is performed by salmon, rich in nitrogen, sulfur, carbon, and phosphorus, who swim up rivers, sometimes for hundreds of miles. The bears then capture the salmon and carry them onto dry land, dispersing nutrient-rich feces and partially eaten carcasses. It has been estimated that the bears leave up to half of the salmon they harvest on the forest floor.

The prairie dog is also an ecosystem engineer. Prairie dog burrows provide the nesting areas for Mountain Plovers and Burrowing Owls. Prairie dog tunnel systems also help channel rainwater into the water table to prevent runoff and erosion, and can also serve to change the composition of the soil in a region by increasing aeration and reversing soil compaction that can be a result of cattle grazing. Prairie dogs also trim the vegetation around their colonies, perhaps to remove any cover for predators. Even grazing species such as Plains bison, pronghorn, and Mule deer have shown a proclivity for grazing on the same land used by prairie dogs. It is believed that they prefer the vegetative conditions after prairie dogs have foraged through the area. Another example, wildebeests are a keystone to the Serengeti in which is keeping the ecosystem up.

Another ecosystem engineering keystone species is the beaver, which transforms its territory from a stream to a pond or swamp.

In the African savanna, the larger herbivores, especially the elephants, shape their environment. The elephants destroy trees, making room for the grass species. Without these animals, much of the savanna would turn into woodland.

Indicator species

An **indicator species** is any biological species that defines a trait or characteristic of the environment. For example, a species may delineate an ecoregion or indicate an environmental condition such as a disease outbreak, pollution, species competition or climate change. Indicator species can be among the most sensitive species in a region, and sometimes act as an early warning to monitoring biologists.

Indicators of environmental condition

Definitions

Lindenmayer *et al.* suggest 7 alternative definitions of indicator species:

1. a species whose presence indicates the presence of a set of other species and whose absence indicates the lack of that entire set of species;
2. a keystone species, which is a species whose addition to or loss from an ecosystem leads to major changes in abundance or occurrence of at least one other species
3. a species whose presence indicates human-created abiotic conditions such as air or water pollution (often called a pollution indicator species)
4. a dominant species that provides much of the biomass or number of individuals in an area
5. a species that indicates particular environmental conditions such as certain soil or rock types
6. a species thought to be sensitive to and therefore to serve as an early warning indicator of environmental changes such as global warming or modified fire regimes (sometimes called a bioindicator species)
7. a management indicator species, which is a species that reflects the effects of a disturbance regime or the efficacy of efforts to mitigate disturbance effects.

Type 1, 2, and 4 have been proposed as indicators of biological diversity and types 3, 5, 6, and 7 as indicators of abiotic conditions and/or changes in ecological processes.

Indicator Species for Ancient Woodland in England

Indicator species for ancient woodland in England need to be shade tolerant and slow colonisers. Plant species include Common wood sorrel, Wood Anemone, Wild Daffodil, Golden Saxifrage, Wild Garlic and in the East of England and Lincolnshire, Common Bluebells.

Umbrella species

Umbrella species are species selected for making conservation related decisions, typically because protecting these species indirectly protects the many other species that make up the ecological community of its habitat. Species conservation can be subjective because it is hard to determine the status of many species. With millions of species of concern, the identification of selected *keystone species*, *flagship species* or *umbrella species* makes conservation decisions easier. Umbrella species can be used to help select the locations of potential reserves, find the minimum size of these conservation areas or reserves, and to determine the composition, structure and processes of ecosystems.

Definitions

Two commonly used definitions:

- A: "A wide-ranging species whose requirements include those of many other species"
- B: A species with large area requirements for which protection of the species offers protection to other species that share the same habitat

Other descriptions include:

- A: "The protection of umbrella species automatically extends protection to other species. i.e. spotted owl and old growth trees"
- B: "Traditional umbrella species, relatively large-bodied and wide-ranging species of higher vertebrates"

Use in landuse management

The use of umbrella species as a conservation tool is highly debated. The term was first used by Wilcox (1984) who defined an umbrella species as one whose minimum area requirements are at least as comprehensive of the rest of the community for which protection is sought though the establishment and management of a protected area.

Some scientists have found that the umbrella effect provides a simpler way to manage ecological communities. Others feel that a combination of other tools establish better land management reserves to help protect more species than just using umbrella species alone.

Individual invertebrate species can be good umbrella species because they can protect older, unique ecosystems. There have been cases where umbrella species have protected a large amount of area which has been beneficial to surrounding species such as the northern spotted owl.

Currently research is being done on land management decisions based on using umbrella species to protect habitat of specific species as well as other organisms in the area. Dunk, Zielinski and Welsh (2006) reported that the reserves in Northern California (Klamath-Siskiyou forests), set aside for the northern spotted owl, also protect mollusks and salamanders within that habitat. According to their conclusions, the reserves set aside for the northern spotted owl “serve as a reasonable coarse-filter umbrella species for the taxa [they] evaluated,” which were the mollusks and salamanders.

Use in the Endangered Species Act (USA)

The Bay checkerspot butterfly has been on the Endangered Species List since 1987 and is still currently listed. Launer and Murphy (1994) tried to determine whether this butterfly could be considered an umbrella species in protecting the native grassland it inhabits. They discovered that the Endangered Species Act (ESA) has a loophole to eliminate federally protected plants that reside on private property. However, the California Environmental Quality Act (CEQA) reinforces state conservation regulations. Using the ESA to protect termed umbrella species and their habitats can be controversial because they are not as reinforced in some states as others (such as California) to protect overall biodiversity.

Examples of umbrella species

1. Northern spotted owls and old growth forest : ex. Molluscs and salamanders are within the protective boundaries of the northern spotted owl.
2. Bay checkerspot butterfly and grasslands
3. Tigers in India and elsewhere. Project Tiger was launched to save the tiger and thereby its habitat and other species within it.

Flagship species



Project logo showing the use of the Zanzibar Red Colobus as the flagship species for conservation in Zanzibar

A **flagship species** is a species chosen to represent an environmental cause, such as an ecosystem in need of conservation. These species are chosen for their vulnerability, attractiveness or distinctiveness in order to engender support and acknowledgment from the public at large. Thus, the concept of a flagship species holds that by giving publicity to a few key species, the support given to those species will successfully leverage conservation of entire ecosystems and all species contained therein.

Examples of flagship species include the Asiatic lion and the Bengal tiger of India, the giant panda of China, the golden lion tamarin of Brazil, the African elephant, the mountain gorilla of central Africa, and the orangutan of southeast Asia.

Chapter- 3

Marine Conservation



Coral reefs have a great amount of biodiversity.

Marine conservation, also known as **marine resources conservation**, is the protection and preservation of ecosystems in oceans and seas. Marine conservation focuses on limiting human-caused damage to marine ecosystems, and on restoring damaged marine ecosystems. Marine conservation also focuses on preserving vulnerable marine species.

Overview

Marine conservation is the study of conserving physical and biological marine resources and ecosystem functions. This is a relatively new discipline. Marine conservationists rely on a combination of scientific principles derived from marine biology, oceanography, and fisheries science, as well as on human factors such as demand for marine resources and marine law, economics and policy in order to determine how to best protect and conserve marine species and ecosystems. Marine conservation can be seen as a subdiscipline of conservation biology.

Techniques

Strategies and techniques for marine conservation tend to combine theoretical disciplines, such as population biology, with practical conservation strategies, such as setting up protected areas, as with marine protected areas (MPAs) or Voluntary Marine Conservation Areas. Other techniques include developing sustainable fisheries and restoring the populations of endangered species through artificial means.

Another focus of conservationists is on curtailing human activities that are detrimental to either marine ecosystems or species through policy, techniques such as fishing quotas, like those set up by the Northwest Atlantic Fisheries Organization, or laws such as those listed below. Recognizing the economics involved in human use of marine ecosystems is key, as is education of the public about conservation issues. This includes educating tourists that come to an area that might not be familiar of certain rules and regulations regarding the marine habitat. One example of this is a project called Green Fins that uses the SCUBA diving industry to educate the public based in SE Asia. This project, implemented by UNEP, encourages scuba diving operators to educate the public they teach to dive about the importance of marine conservation and encourage them to dive in an environmentally friendly manner that does not damage coral reefs or associated marine ecosystems.

Laws and treaties

International laws and treaties related to marine conservation include the 1966 Convention on Fishing and Conservation of Living Resources of the High Seas. United States laws related to marine conservation include the 1972 Marine Mammal Protection Act, as well as the 1972 Marine Protection, Research and Sanctuaries Act which established the National Marine Sanctuaries program.

In 2010, the Scottish Parliament enacted new legislation for the protection of marine life with the Marine (Scotland) Act 2010. The provisions in the Act include: Marine planning, Marine licensing, marine conservation, seal conservation, and enforcement.

Organizations and education



The shore of the Pacific Ocean in San Francisco, California.

There are marine conservation organizations throughout the world that focus on funding conservation efforts, educating the public and stakeholders, and lobbying for conservation law and policy. Examples of these organizations are Oceana (non-profit group), the Marine Conservation Biology Institute (United States), Blue Frontier Campaign (United States), Frontier (the Society for Environmental Exploration) (United Kingdom), Marine Conservation Society (United Kingdom), The Reef-World Foundation (United Kingdom) and [Australian Marine Conservation Society].

On a regional level, PERSGA- the Regional Organization for the Conservation of the Environment of the Red Sea and the Gulf of Aden, is a regional entity serves as the secretariat for the Jeddah Convention-1982, one of the first regional marine agreements. PERSGA Member States are: Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan and Yemen.

Grey nurse shark conservation



Grey nurse shark

Sharks are found throughout the world but their populations are declining every day. This has led to protection of some species. One of the first shark species to be protected was the Grey nurse shark (*Carcharias taurus*). The biology, distribution and conservation of this species are dealt with in the following paragraphs with a main focus on Australia as it was here it first became protected.

Biology

The Grey Nurse shark (*Carcharias taurus*), also called the Sand Tiger shark or Ragged-tooth shark, is an elasmobranch and belongs to the Odontaspidae family. It can easily be recognised by its characteristic conical snout and underhung jaw. Both jaws are laden with sharp, long and pointed teeth. The head is flattened and it has a large and stout body which ranges up to 3.2m and may weight up to 300 kg. The body is grey to grey-brown dorsally and off-white on the belly. The juveniles (young sharks) usually have dark spots on the upper two thirds of the body. The first and second dorsal fins are of similar size

and the caudal fin is asymmetric. Once believed to be a man-eater it is now known that this shark rarely attacks humans and if it does it is only in defence.

Sharks are the top predators in our oceans, and as such they are important for the marine ecosystems as important regulators of other species. They eat the weak, the old and the dead animals. The Grey Nurse sharks eat mainly lobsters, crabs, smaller sharks, fish, rays and squid.

Distribution

The Grey Nurse sharks live near the coast in sub-tropical to cool-temperate waters near most continental land masses (not found in the eastern Pacific Ocean off North and South America). They have a preference for some places resulting in an uneven distribution. For example there are few Grey Nurse sharks found in north Australia while they are relatively abundant in the southern part of the eastern and western Australian waters.

They are usually found swimming slowly, just above the sea floor, in sandy-bottomed gutters or in rocky underwater caves near inshore rocky reefs and islands. They can be found at depths ranging from 10m (near the coastline) to 200m (on the continental shelf). They are generally solitary but at times small schools of Grey Nurses are found swimming and feeding together.

Conservation status in Australia

The Grey Nurse shark is one of the most critically endangered shark species and believed to be the first protected shark in the world. It was declared 'vulnerable' in the waters of New South Wales (Australia) in 1984 and later throughout the world. In 1996 the species was listed globally 'vulnerable' by the International Union for the Conservation of Nature (IUCN) and declared 'vulnerable' in Commonwealth waters of Australia. According to the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999) it is believed that there are two separate populations of Grey Nurse shark in Australia. The population in the east coast is listed as 'critically endangered' whereas the west coast population is listed as 'vulnerable' under the EPBC Act (1999) The Grey Nurse sharks are also protected under the Fisheries Legislation in New South Wales, Western Australia, Victoria, Tasmania and Queensland. In the Northern Territory the species is classified as 'data deficient' by the Territory Parks and Wildlife Conservation Act (2000)NTG.

Current status

The population has declined dramatically in recent decades, especially in the 1960s and 1970s. After 20 years of protection the population is still declining and there are approximately 400-500 Grey Nurses left in Eastern Australia.

Some scientists, fishers and divers and peak organisations such as the Australian Underwater Federation believe that the methodology used to estimate numbers of approximately 400-500 is limited and that grey nurse shark numbers have increased since protection in 1984 and that the east coast population numbers have been quoted as up to 1000, 2000 and 6000. There is good reason for this belief apart from anecdotal observations. The original estimate of 400-500 was based on a single mark/capture survey done in June 2003 however a second identical survey in August 2003 resulted in much higher estimates ($p=0.5$ for 6000 sharks). Also interestingly of all the GNS sighted in the August 2003 survey not a single one was reported as having any visible hooks or trailing lines visible. Unfortunately some scientists and politicians decided that research which does not fit a conservationist agenda is not published and repeated requests in the NSW Parliament to produce copies of the August 2003 research were flagrantly ignored. However the research papers were finally obtained from a leaked source and the Government had to admit that the research had taken place. But to this day the August 2003 research has been deleted from the official public record and never published in any scientific journals.

Latest research from a workshop in Sydney in November 2009 is that the estimates of GNS undertaken by consultants funded by DEWHA for Grey Nurse Sharks on the east coast is now in excess of 1340. This is more than three times the previous published estimates and supports the long held belief of the Australian Underwater Federation that the previous research was limited and/or that there has been an increase in numbers of sharks.

Causes for decline

Every year, millions of sharks are killed by drift-nets, by-catch, revenge actions, beach protective shark meshing, commercial-, recreational- and spear-fishing. An alternative view is that grey nurse are totally protected and selective methods of fishing such as spear-fishing have no impact on this species. The main risk is from by-catch of indirect methods of line fishing and particularly bottom-set commercial fishing lines targeting wobbegong sharks. The Grey Nurse sharks are particularly vulnerable to these threats due to their late maturation and low breeding success⁸. They reach sexual maturity at the age of 6–8 years and give birth to 1 or 2 young every second year, thus the population grows very slowly. Furthermore their limited distribution and specific habitats make it difficult for them to migrate to other areas. Beach nets, unfortunately, cause the death of hundreds of shark that are caught in the nets and cannot escape. This also occurs in trawls and fishing nets. Another threat for the sharks is finning. Finning involves cutting the fins of sharks (used for fin-soup) and often it is pregnant female sharks that are caught. The sharks are often thrown back into the ocean, alive without fins. This kind of finning, without using the rest of the shark, has been prohibited by most countries and shark-fishing boats are now strictly controlled by regulatory authorities. Try to stop this but not buying anything made out of sharks.

Conservation efforts

The increased public awareness has led to the development of methods that reduce the unintentional killing of elasmobranch (sharks and rays), turtles and marine mammals. An inexpensive method to reduce by-catch is by using tunnel excluders. These enable sharks, turtles and rays to escape and survive. A prototype used by the Dutch achieved a 40-100% reduction of the by-catch of the most vulnerable species.

The size and texture of nets are also of great importance for the survival of larger vulnerable species. Often smaller nets have been shown to catch the same amount of target fish and reduce the by-catch greatly, especially of the mature sharks.

Foundation of protected marine areas is particularly valuable for protecting sharks and a new method, taggingCSIRO, can reveal their preferred forage and breeding areas. A good example of managed marine areas is to be found in Jervis Bay, NSW. Jervis Bay has been divided into zones, some for fishing and some for diving, and the strategy has been approved by both fishermen and divers. However, “Divers that regularly dive at places like South West Rocks in New South Wales will tell you that up to 70 per cent of the sharks there are trailing hooks from line fishing.” says Nicola Beynon from The Human Society International. Another widely used method for preserving sharks is eco-tourism such as scuba diving, cage-diving and feeding of sharks. However, it is crucial that this is strictly managed, and that the sharks’ behaviour is monitored. Feeding and touching of marine animals should be strictly discouraged since it can alter their behaviour, and result in long lasting and severe stress to the animals. Divers have noticed sharks altering their behaviour due to increased hierarchy behaviour around feeding areas. The lowest in the hierarchy become stressed and exhibit unpredictable behaviour, which could result in attacks on humans.

Chapter- 4

Marine Protected Area

A **Marine Protected Area (MPA)** is a protected area whose boundaries include some area of ocean. "MPA" is often used as an umbrella term that describes marine areas that restrict human activity to protect living, non-living, cultural, and/or historic resources. Protections include limits on development, fishing gear types, fishing seasons, catch limits, moorings, to complete bans on removing marine life of any kind.

As of 2010, the world hosted more than 5,000 MPAs, encompassing .8% of the ocean's surface.

The world's MPAs are viewable in Google Earth.

Terminology

Marine Protected Area

Perhaps the simplest definition is any geographical area that includes some amount of ocean and that has specific limits on human activity for the purpose of protecting natural and/or cultural resources that do not apply to other nearby ocean areas. Various national, supra-national and other organizations offer alternatives that vary in scope and detail, but none of these are definitive. Most definitions require that the site must be set aside principally for conservation in order to be designated a Marine Protected Area. A site that is set aside, for example, for national defense which also has a local habitat will not qualify under the terms set by either IUCN or CBD as a Protected Area. Several types of compliant MPAs can be defined:

- A totally marine area with no significant terrestrial (land) parts.
- An area containing both marine and terrestrial components, which can vary between two extremes:
 - A marine area that is mostly maritime, with little land; for example, an atoll would have a tiny island with a significant maritime population surrounding it.
 - A marine area that is mostly terrestrial. In this case, whether or not it can be given such a title is largely debatable.

- Marine ecosystems that contain land and intertidal (land that is covered in/by water) components only. For example, a mangrove forest would contain no open sea or ocean marine environment, but its river-like marine ecosystem nevertheless constitutes under the definition.

The Convention on Biological Diversity attempted to solve this by defining the broader term of "Marine and Coastal Protected Area" (shorthand, MCPA):

Any defined area within or adjacent to the marine environment, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings. et al. Barnard, p. 18

Some definitions require that the area be exclusively reserved for conservation, while others permit recreational and/or extractive activities. Others require that at least some part of the area lies below low tide, while others require only that it be at least near the shoreline.</ref>

The International Union for Conservation of Nature(IUCN) attempts to encompass these variations by defining six categories of protected area, based on management objectives and four broad governance types.

Cat	Created mainly for:
I	Science or as a strict Nature Reserve; wilderness protection
II	Ecosystem protection and recreation (often National Park)
III	Conservation of specific natural features (often National Monument)
IV	Conservation through close management and monitoring of species.
V	Landscape/seascape conservation and recreation (pure; no protection assigned)
VI	Sustainable use of natural ecosystem (including use of local resources)

Marine Park

In Kenya Marine Parks prohibit fishing or extraction of resources of any kind, but allows recreation. In Tanzania, Marine Parks are zoned, and activities such as fishing are only allowed in certain, low risk areas.

Marine Reserve

In Kenya (and Belize), Marine Reserves allow for low-risk forms of fishing and are thus a lower area of protection. In Tanzania, Marine Reserves prohibit all removals. In scientific literature "Marine Reserve" the term usually connotes "maximum protection."

Areas, systems, networks, regions

While "area" refers to a single contiguous location, terms that group MPAs are not always consistently employed. These include "network", "system", and "region". In CBD decision VII/5, the agency agreed to the use of *network* on a global level, and the use of *system* on the national and regional level. The global level carries no authority or mandate, and all of the work lies in the *system*. The CBD defines the role of the global network as a large-scale network to be used as a mechanism to establish regional and local systems; some countries also define it based on their own terms. Nations combine protected areas for purposes ranging from policy development and enforcement to marketing.

Other related terms

Related terms include Specially Protected Area (SPA), Special Area of Conservation (SAC), the United Kingdom's Marine Conservation Zones (MCZ) Marine reserve (MR), Marine park (MP), No Take Zone (NTZ), or Area of Special Conservation (ASC) Particularly Sensitive Sea Areas, Special Areas, etc., each have specific restrictions associated with them.

Usage restrictions

MPAs are established to protect a certain species, to benefit fisheries, rare habitat, or nursing grounds for fish or to protect entire ecosystems. MPAs are also established to protect historical sites such as shipwrecks and cultural sites such as aboriginal fishing grounds. MPAs can be very large (Great Barrier Reef) or very small (Area Marina Protetta Capo Rizzuto).

Typical restrictions in MPAs include ones on fishing, oil and gas mining and tourism. Other restrictions may limit the use of ultrasonic devices like SONAR (which may confuse the guidance system of cetaceans), development, construction and the like. Still others, such as New Zealand's marine reserves, are 'no take' areas, where all forms of exploitation are prohibited. Even ship transit can be regulated or banned, either as a preventive measure or to avoid direct disturbance to certain species. The degree to which environmental regulations affect shipping varies according to whether MPAs are located in territorial waters, exclusive economic zones, or the high seas. The law of the sea regulates these limits.

For this reason, most MPAs have been located in territorial waters, where enforcement can be ensured. However, MPAs can also be established in a state's exclusive economic zone and even international waters. For example, Italy, France and Monaco in 1999 jointly established a cetacean sanctuary in the Ligurian Sea named the Pelagos Sanctuary

for Mediterranean Marine Mammals. This sanctuary includes both national and international waters.

Both the CBD and IUCN recommend that a variety of possible management systems be considered when designing a protected area system. They advocate that MPAs be seen as one of many "nodes" in a network of protected areas. The following are the most commonly used individual types of MPAs.

No-take areas

The highest degree of protection is the *no-take* area, which severely limits human activities. Generally, they prohibit removing anything from the protected area. No-take can cover the whole MPA, or specific vulnerable portions that enjoy elevated protection.

The IUCN definition allows the extraction of resources from the area only with a permit and **for scientific use only**. There is no globally-accepted definition.

Seasonal and temporary management

Activities, most critically fishing, are restricted seasonally or temporarily to let the area recover. The most common use seasonal limits to protect fish populations during vital periods, such as spawning season. The "Irish Sea Cod Box" is such a season. Another use is to temporarily protect a depleted marine population from overfishing, allowing it to recover, as in the waters of Okinawa, Japan.

Multiple-use

Increasingly, multiple use MPAs are the most common and arguably most effective type. These areas employ two or more types. This flexibility allows the most important sections get the highest protection. A common practice is to make the most critical area fully no-take, surrounding it with areas of lesser protections. The island of Asinara is an example of such an MPA.

Management

The two families of approaches for managing MPAs are *community-managed* and *politically-managed*.

Community-managed and related approaches

Community-managed MPAs empower local communities to manage marine resources partially or completely independent of the governmental jurisdictions they inhabit. They are not always officially recognized, depending on the political environment. Empowering communities to manage resources can lower conflict levels and help fisheries recover. This approach can provide direct influence for all involved, including

subsistence and commercial fishers, scientists, tourism businesses, youths and others. They often fall into the following, unrelated, designations (although there is overlap):

- World Heritage Site (WHS) – an area exhibiting extensive natural or cultural history. Maritime areas are poorly represented, however, with only 31 out of over 800 sites. One example of overlap is the island of Asinara.
- Man and the Biosphere – This UNESCO program promotes "a balanced relationship between humans and the biosphere." Under article 4, biosphere reserves must “encompass a mosaic of ecological systems”, and thus combine terrestrial, coastal, or marine ecosystems. In structure they are similar to Multiple-use MPAs, with a core area ringed by different degrees of protection.
- Ramsar Site – These sites must meet certain criteria for the definition of "Wetland" to become part of a global system. These sites do not necessarily receive protection, but are indexed by importance for later recommendation to an agency that could designate it a protected area.

Fishery management areas

Areas managed only to sustain fisheries occasionally change to become MPAs. One example is the Fish Habitat Reserves in Australia.

International efforts

Historically, Marine Protected areas have been established on an ad hoc basis by individual nations. The 17th International Union for Conservation of Nature (IUCN) General Assembly in San Jose, California, the 19th IUCN assembly and the fourth World Parks Congress all proposed to centralize the activity. The World Summit on Sustainable Development in 2002 called for

the establishment of marine protected areas consistent with international laws and based on scientific information, including representative networks by 2012.

The Evian agreement, signed by G8 Nations in 2003, agreed to these terms. The Durban Action Plan, developed in 2003, called for regional action and targets to establish a network of protected areas by 2010 within the jurisdiction of regional environmental protocols. It recommended establishing protected areas for 20 to 30% of the world's oceans by the goal date of 2012. The Convention on Biological Diversity considered these recommendations and recommended requiring nations to set up marine parks that are controlled by a central organization before merging them. The United Nations Framework Convention on Climate Change agreed to the terms laid out by the convention, and its member nations committed to the target in 2004, signing the statement at right. United Nations Decision VII/28 of the laid out the following deadlines:

- By 2006 complete area system gap analysis at national and regional levels.
- By 2008 address the underrepresented of marine ecosystems in existing national and regional systems of protected areas, taking in account marine ecosystems

beyond areas of national jurisdiction in accordance with applicable international laws.

- By 2009 designate the protected areas identified through the gap analysis.
- By 2012 complete the establishment of a comprehensive and ecologically representative national and regional system of Marine Protected Areas.

The establishment by 2010 of terrestrial and by 2012 for marine areas of **comprehensive, effectively managed, and ecologically representative national and regional systems of protected areas** that collectively, inter alia through a global network, contribute to achieving the three objectives of the Convention and the 2010 target to significantly reduce the current rate of biodiversity loss at the global, regional, national, and sub-national levels and contribute to poverty reduction and the pursuit of sustainable development.

The UN later also endorsed another decision, Decision VII/15, in 2006:

Effective conservation of 10% of each of the world's ecological regions by 2010.

– United Nations Framework Convention on Climate Change Decision VII/15

In 1981 the World Conservation Monitoring Centre began compiling the World Database on Protected Areas, tracking information related to Protected areas (PAs) from governmental, private, and scientific work. In 2005, an online database named "MPAGlobal" was established to better organize information related specifically to *marine* protected areas. This was fully reintegrated into the original system in late 2008.

Organizing principles

Global—UNEP-RSP

The United Nations Environmental Program arranges MPAs in a global program called UNEP-RSP (Regional Seas Program), comprising thirteen regions and five partner programs. Participants are linked either through a convention or a regional program. The five independent partner programs are active, but not under the UNEP jurisdiction. The arrangement is based on biology and geography rather than national or other political divisions.

The marine environment also benefits more than land areas from systematic protection because underwater, national borders have no physical presence. Water, heat, waves, and animals move across them with few or no restrictions.

Local networks

Local MPA networks are usually built in one of two ways.

- Biologists argue for designation to preserve biodiversity (usually an endangered species). Their request is adjusted by stakeholders until it is agreed upon or rejected. This was the first, and previously the most common, approach.
- Under *systematic conservation planning*, network organization flows from understanding the interaction between species in one MPA with those in another.

United States

The U.S. national system of MPAs includes an assemblage of sites, systems, and networks established and managed by federal, state, tribal, or local governments that work together to conserve important natural and cultural resources. Although each MPA is independently managed, the national system provides opportunities for cooperation, and promotes public participation in MPA decision-making by improving access to scientific and public policy information.

MPAs join the national system via a process that is designed to be transparent and science-based, with opportunity for public comment.

The entry criteria are:

- Meets the definition of an MPA
- Has a management plan for the specific site
- Contributes to at least one priority conservation objective as listed in the Framework
- Cultural heritage MPAs must also conform to criteria for the National Register of Historic Places

The nomination process involves:

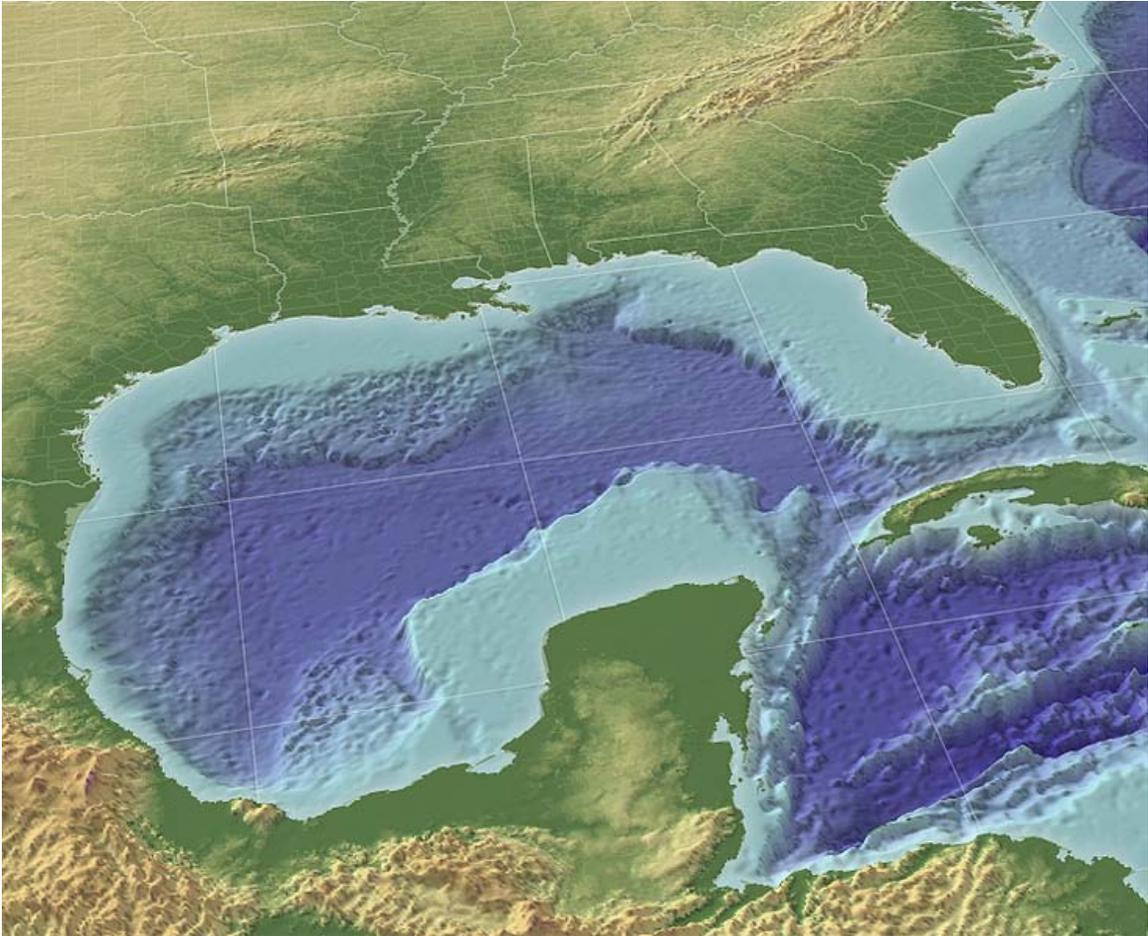
- The MPA Center uses the MPA Inventory to identify potentially eligible MPAs, and invites them to nominate their sites.
- Managing entities submit a nomination form to the MPA Center.

Global status

Greater Caribbean



The Caribbean region; the UNEP–defined region also includes the Gulf of Mexico. This region is encompassed by the Mesoamerican Barrier Reef System proposal, and the Caribbean challenge



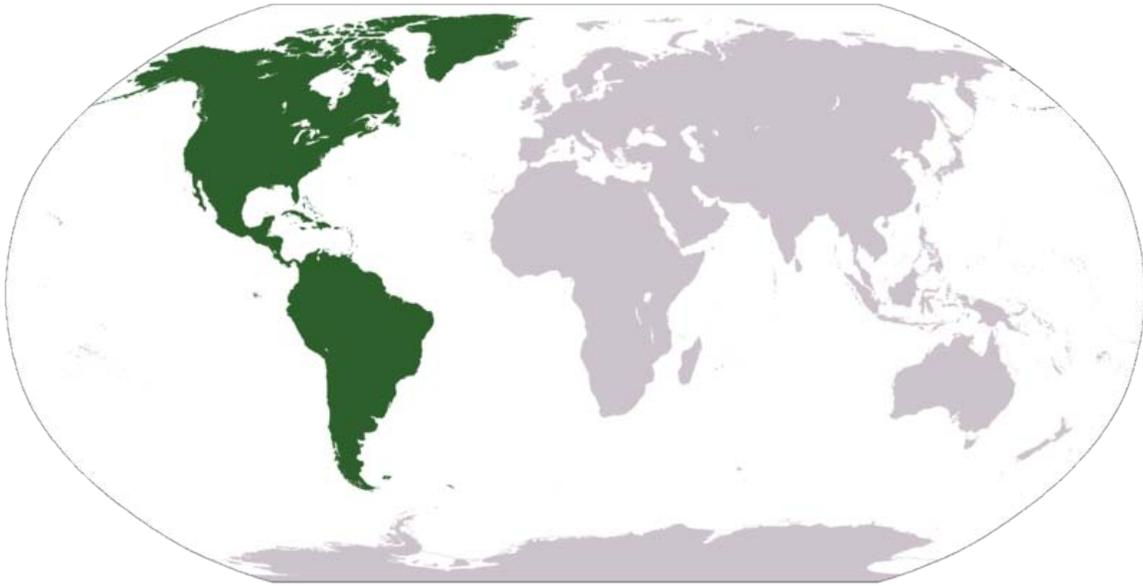
The Gulf of Mexico region (in 3D) is encompassed by the "Islands in the Stream" proposal.

The Greater Caribbean subdivision encompasses an area of about 5,700,000 square kilometres (2,200,000 sq mi) of ocean and 38 very diverse nations. The area includes island countries like the Bahamas and Cuba, and the majority of Central America.

The Convention for Protection and Development of the Marine Environment of the Wider Caribbean Region (better known as the Cartagena Convention) was established in 1983, and protocols involving protected areas were ratified in 1990. As of 2008, there are about 500 MPAs in the region. Coral reefs are the best represented.

Two networks are under development, the Mesoamerican Barrier Reef System (a long barrier reef that borders the coast of much of Central America), and the "Islands in the Stream" program (covering the Gulf of Mexico).

Latin America



The Americas

Latin America in particular considers itself one large MPA system. As of 2008, 0.5% of the Latin American marine environment is protected, mostly through the use of small, multiple-use MPAs

South Pacific

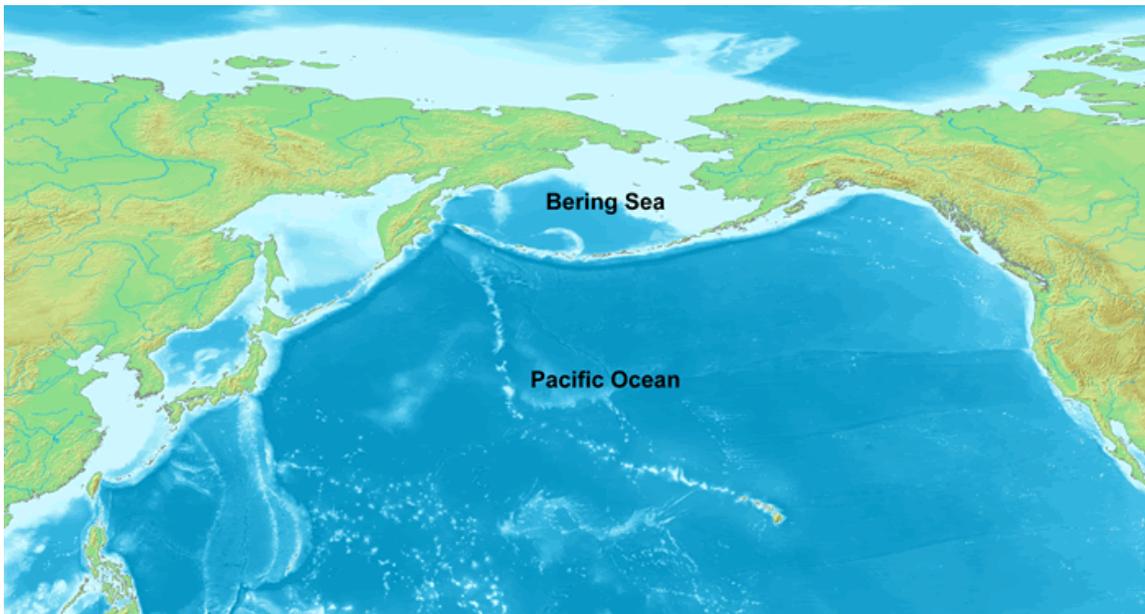


The Pacific Ocean. Note that the South & North east coast only includes the coasts of the eastern countries.

The South Pacific network ranges from Belize to Chile. Governments in the region adopted the Lima Convention and Action Plan for protected areas for the South Pacific region in 1981; an MPA-specific protocol was ratified in 1989. The Permanent Commission on the Exploitation and Conservation on the Marine Resources of the South Pacific promotes the exchange of studies and information among participants.

The region is currently running one comprehensive cross-national program, the Tropical Eastern Pacific Marine Corridor Network, signed in April 2004. The network covers about 211,000,000 square kilometres (81,000,000 sq mi). The participating countries are Panama, Costa Rica, Colombia, and Ecuador.

North Pacific



The *Baja California to Bering Sea* stretches along the coast on the right in this map. The Bering Sea is the Alaskan coast, and Baja California is a peninsula attached to California.

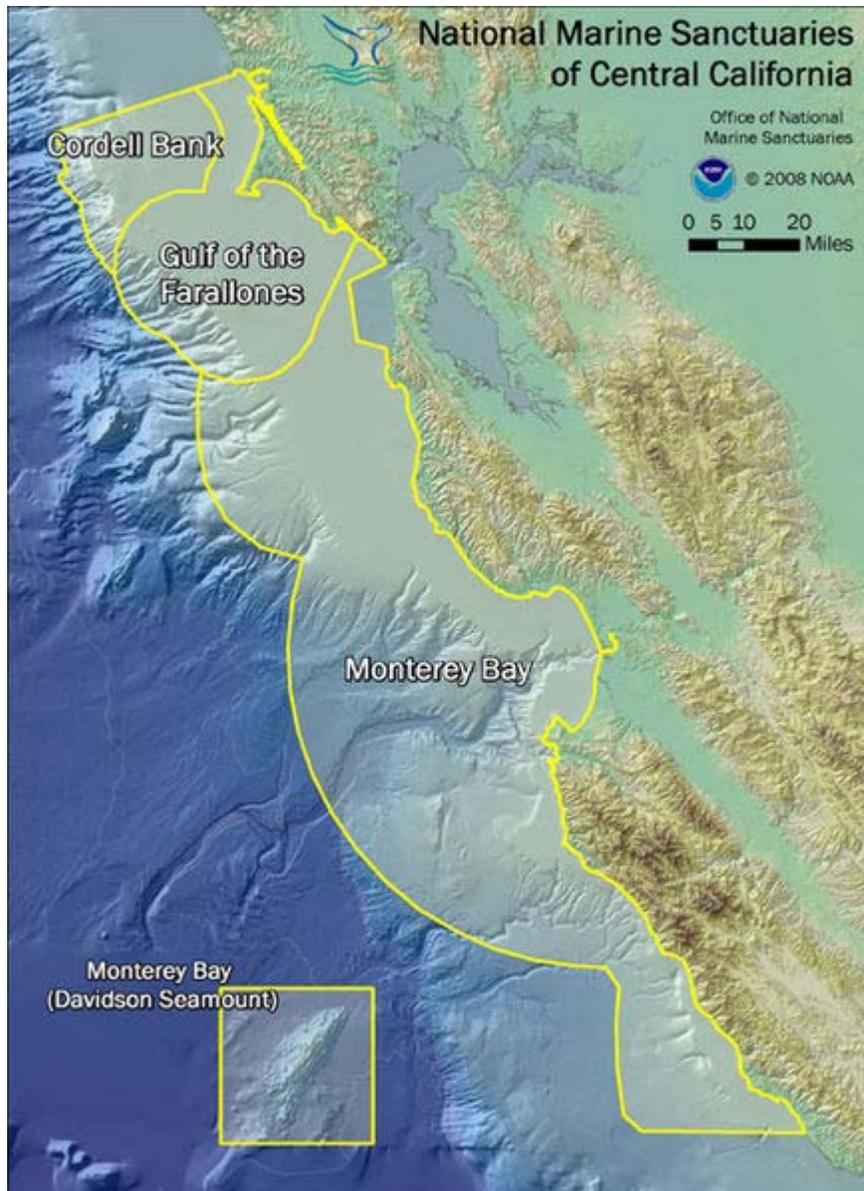


Diagram illustrating the orientation of the 3 marine sanctuaries of Central California: Cordell Bank, Gulf of the Farallones, and Monterey Bay. Davidson Seamount, part of the Monterey Bay sanctuary, is indicated at bottom-right.

The North Pacific network covers the western coasts of Mexico, Canada, and the U.S. The "Antigua Convention" and an action plan for the north Pacific region were adapted in 2002. There, is however, no protocol; participant nations manage their own national systems. In 2010-2011, the State of California is completing a series of hearings and actions via the state Department of Fish and Game to establish new MPA's. Although highly controversial among fishing circles, the MPA's are going forward with decisions still pending as to where and how large.

United States

In April 2009, the United States established a National System of Marine Protected Areas, which strengthens the protection of U.S. ocean, coastal, and Great Lakes resources. As of 2009, 225 MPAs participated in the national system. Sites agree to work together toward common national and regional conservation goals and priorities. NOAA's National Marine Protected Area's Center maintains a comprehensive inventory of all 1,600+ MPAs within the Exclusive Economic Zone of the United States. Most MPAs in the U.S. allow some type of extractive use. Less than 1% of U.S. waters prohibit all extractive activities.

Europe

The Natura 2000 ecological network of protected areas in the territory of the European Union including a wide range of MPA in the North Atlantic, the Mediterranean Sea and the Baltic Sea. The member-states has to define NATURA 2000-areas at sea in their Exclusive Economic Zone

Non-governmental organizations

In 1999, the North American Marine Protected Areas Network (NAMPAN) was established, a project of the Commission for Environmental Cooperation, (CEC). NAMPAN is a virtual network of people and places spanning Canada, The United States, and Mexico that work together to address tri-national, transboundary marine conservation issues. Currently Canada and the United States are developing country-wide systems of marine protected areas.

The Commission for Environmental Cooperation, established in 1999, coordinates activities, with representatives from Mexico, the USA, and Canada. There are currently two cross-national networks in development. In 2005, the Commission proposed the *Baja California to Bering Sea* (B2B) initiative, involving 28 areas.

Noteworthy sites

As of February 2009, there were approximately 5,000 MPAs around the world, covering 0.8% of the world's oceans.

Notable MPAs include:

- The Bowie Seamount on the Coast of British Columbia, Canada.
- The Great Barrier Reef in Queensland, Australia.
- The Ligurian Sea Cetacean Sanctuary in the seas of Italy, Monaco and France
- The Dry Tortugas in the Florida Keys, USA.
- The Papahānaumokuākea Marine National Monument in Hawaii.
- The Phoenix Islands Protected Area, Kiribati
- The Channel Islands Marine Protected Areas in California, USA

Effectiveness

Criteria

Both CBD and IUCN have criteria for setting up and maintaining MPA networks, which emphasize 4 factors::

- **Adequacy**—ensuring that the sites have the size, shape, and distribution to ensure the success of selected species.
- **Representability**—protection for all of the local environment's biological processes
- **Resilience**—the resistance of the system to natural disaster, such as a tsunami or flood.
- **Connectivity**—maintaining population links across nearby MPAs.

A learning model of migratory fish behavior and fishing interaction predicted that closed areas (MPAs) would increase fish biomass and decrease fish catches, that closing spawning areas to fishers would increase mean fish biomass, with lower variance, but that without catch restrictions throughout the range of the fish, long-term fish biomass and resulting catches would still decrease. The model also predicts that higher fish mobility also would increase fish biomass, but decrease fish catches.

Managers and scientists use geographic information systems and remote sensing to map and analyze MPAs. NOAA Coastal Services Center compiled an "Inventory of GIS-Based Decision-Support Tools for MPAs." The report focuses on GIS tools with the highest utility for MPA processes. Remote sensing uses advances in aerial photography image capture, satellite imagery, acoustic data, and radar imagery.

Protecting red coral

Two assessments, conducted thirty years apart, of three Mediterranean MPAs demonstrate that proper protection allows commercially valuable and slow-growing red coral (*Corallium rubrum*) to produce large colonies in shallow water of less than 50 metres (160 ft). Shallow-water colonies outside these decades-old MPAs are typically very small. The MPAs are Banyuls, Carry-le-Rouet and Scandola, off the island of Corsica.

Criticism

Some existing and proposed MPAs have been criticized by local indigenous populations, and their supporters, as impinging on land usage rights. One example of this is the proposed Chagos Protected Area in the Chagos Islands, contested by Chagossians deported from their homeland in 1965 by the British in the creation of the British Indian Ocean Territory.

One alternative to imposing MPAs on an indigenous population is through the use of Indigenous Protected Areas, such as those in Australia.

Chapter- 5

Bird Conservation



The extinction of the Dusky Seaside Sparrow was caused by habitat loss.

Bird conservation is a field in the science of conservation biology related to threatened birds. Humans have had a profound effect on many bird species. Over one hundred species have gone extinct in historical times, although the most dramatic human-caused extinctions occurred in the Pacific Ocean as humans colonised the islands of Melanesia, Polynesia and Micronesia, during which an estimated 750-1800 species of bird went extinct. According to Worldwatch Institute, many bird populations are currently declining worldwide, with 1,200 species facing extinction in the next century. The biggest cited reason surrounds habitat loss. Other threats include overhunting, accidental mortality due to structural collisions, long-line fishing bycatch, pollution, competition and predation by nonnative invasive species, oil spills and pesticide use and climate change. Governments, along with numerous conservation charities, work to protect birds in various ways, including legislation, preserving and restoring bird habitat, and establishing captive populations for reintroductions.

Threats to birds

Habitat loss

The most critical threat facing threatened birds is the destruction and fragmentation of habitat. The loss of forests, plains and other natural systems into agriculture, mines, and urban developments, the draining of swamps and other wetlands, and logging reduce potential habitat for many species. In addition the remaining patches of habitat are often too small or fragmented by the construction of roads or other such barriers that cause populations in these fragmented *islands* to become vulnerable to localised extinction. In addition many forest species show limited abilities to disperse and occupy new forest fragments. The loss of tropical rainforest is the most pressing problem, as these forests hold the highest number of species yet are being destroyed quickly. Habitat loss has been implicated in a number of extinctions, including the Ivory-billed Woodpecker (disputed because of "rediscovery"), Bachman's Warbler and the Dusky Seaside Sparrow.

Introduced species



Arctic Foxes introduced to the Aleutian Islands devastated populations of auks; here a Least Auklet has been taken.

Historically the threat posed by introduced species has probably caused the most extinctions of birds, particularly on islands. Ninety percent of historical extinctions have occurred on islands, and most prehistoric human caused extinctions were insular as well. Many island species evolved in the absence of predators and consequently lost many anti-predator behaviours. As humans traveled around the world they brought with them many foreign animals which disturbed these island species. Some of these were unfamiliar predators, like rats, feral cats, and pigs; others were competitors, such as other bird species, or herbivores that degraded breeding habitat. Disease can also play a role; introduced avian malaria is thought to be a primary cause of many extinctions in Hawaii. The Dodo is the most famous example of a species that was probably driven to extinction by introduced species (although human hunting also played a role), other species that were victims of introduced species were the Stephens Island Wren, Po‘o -uli and the Laysan Millerbird. Many species currently threatened with extinction are vulnerable to introduced species, such as the Kōkako, Black Robin, Mariana Crow, and the Hawaiian Duck.

Hunting and exploitation

Humans have exploited birds for a very long time, and sometimes this exploitation has resulted in extinction. Overhunting occurred in some instances with naive species unfamiliar with humans, such as the moa of New Zealand, in other cases it was an

industrial level of hunting that led to extinction. The Passenger Pigeon was once the most numerous species of bird alive (possibly ever), overhunting reduced a species that once numbered in the billions to extinction. Hunting pressure can be for food, sport, feathers, or even come from scientists collecting museum specimens. Collection of Great Auks for museums pushed the already rare species to extinction.

The harvesting of parrots for the pet trade has led to many species becoming endangered. Between 1986 and 1988 two million parrots were legally imported into the US alone. Parrots are also illegally smuggled between countries, and rarer species can command high prices.

Hybridisation

Hybridisation may also endanger birds, damaging the gene stock. For example, the American Black Duck has been often reported hybridising with the Mallard, starting a slow decline.

Gamebird hybrids are particularly common and many breeders produce hybrids that may be accidentally or intentionally introduced into the wild.

Other threats



This Black-browed Albatross has been hooked on a long-line.

Birds face a number of other threats. Pollution has led to serious declines in some species. The pesticide DDT was responsible for thinning egg shells in nesting birds, particularly seabirds and birds of prey that are high on the food chain. Seabirds are also vulnerable to oil spills, which destroy the plumage's waterproofing causing the bird to drown or die of hypothermia. Light pollution can also have a damaging effect on some species, particularly nocturnal seabirds such as petrels.

Seabirds face another threat in the form of bycatch; where birds in the water become tangled in fishing nets or hooked on lines set out by long-line fisheries. As many as 100,000 albatrosses are hooked and drown each year on tuna lines set out by long-line fisheries.

Birds are also threatened by high rise buildings, communications towers, and wind farms; an estimated 975 million birds a year are killed this way in the North America alone, according to the American Bird Conservancy. The largest source of human-related bird death is due to glass windows, which kill 100-900 million birds a year. The next largest sources of human caused death are hunting (100+ million), house cats (100 million), cars and trucks (50 to 100 million), electric power lines (174 million), and pesticides (67 million). Birds are also killed in large quantities by flying into communication tower guidelines, usually after being attracted by tower lights. This phenomena is called towerkill and is responsible for 5-50 million birds deaths a year. The presence of towers may seriously impact endangered species living in the vicinity.

Conservation techniques

Scientists and conservation professionals have developed a number of techniques to protect bird species. These techniques have had varying levels of success.

Captive breeding

Captive breeding, or *ex-situ* conservation, has been used in a number of instances to save species from extinction. The principal is to create a viable population of a species in either zoos or breeding facilities, for later reintroduction back into to the wild. As such a captive population can either serve as an insurance against the species going extinct in the wild or as a last ditch effort in situations where conservation in the wild is impossible. Captive breeding has been used to save several species from extinction, the most famous example being the California Condor, a species that declined to less than thirty birds. In order to save the California Condor the decision was made to take every individual left in the wild into captivity. From these 22 individuals a breeding programme began that brought the numbers up to 273 by 2005. An even more impressive recovery was that of the Mauritius Kestrel, which by 1974 had dropped to only four individuals, yet by 2006 the population was 800.

Reintroduction and translocations

Reintroductions of captive bred populations can occur to replenish wild populations of an endangered species, to create new populations or to restore a species after it has become extinct in the wild. Reintroductions helped bring the wild populations of Hawaiian Geese from 30 birds to over 500. The Mauritius Kestrel was successfully reintroduced into the wild after its captive breeding programme. Reintroductions can be very difficult and often fail if insufficient preparations are made, as species born in captivity may lack the skills and knowledge needed for life in the wild after living in captivity. Reintroductions can also fail if the causes of a birds decline have not been adequately addressed. Attempts to reintroduce the Bali Starling into the wild failed due to continued poaching of reintroduced birds.

The introduction of captives of unknown pedigree can pose a threat to native populations. Domestic fowl have threatened endemic species such as *Gallus g. bankiva* while

pheasants such as the Ring-necked Pheasant and captive Cheer pheasants of uncertain origin have escaped into the wild or have been intentionally introduced. Green peafowl of similar mixed origins confiscated from local bird dealers have been released into areas with native wild birds.

Translocations involve moving populations of threatened species into areas of suitable habitat currently unused by the species. There are several reasons for doing this; the creation of secondary populations that act as an insurance against disaster, or in many cases threats faced by the original population in its current location. One famous translocation was of the Kakapo of New Zealand. These large flightless parrots were unable to cope with introduced predators in their remaining habitat on Stewart Island, so were moved to smaller offshore islands that had been cleared of predators. From there a recovery programme has managed to maintain and eventually increase their numbers.

Habitat protection

As the loss and destruction of habitat is the most serious threat facing many bird species, conservation organisations and government agencies tasked with protecting birds work to protect areas of natural habitat. This can be achieved through purchasing land of conservation importance, setting aside land or gazetted it as a national park or other protected area, and passing legislation preventing landowners from undertaking damaging land use practices, or paying them not to undertake those activities. The goals of habitat protection for birds and other threatened animals and plants often conflicts with other stakeholders, such as landowners and businesses, who can face economically damaging restrictions on their activities. Plans to protect crucial habitat for the Spotted Owl of North America required the protection of large areas of old growth forest in the western United States; this was opposed by logging companies who claimed it would cause job losses and reduced profits.

Aviculture

Aviculture is the practice of keeping and breeding birds and the culture that forms around it. Aviculture is generally focused on not only the raising and breeding of birds, but also on preserving avian habitat, and public awareness campaigns.

Types of aviculture

There are various reasons that people get involved in aviculture. Some people breed birds to preserve a species. Some people breed parrots as companion birds, and some people breed birds to make a profit.

Aviculture The most modern accurate definition of the word Aviculture is given by Mr Michael A Wetherall. Aviculture is the practice of keeping birds (Class Aves) in captivity using controlled conditions, normally within the confines of an aviary, for Hobby Research & conservation purposes.

Some Ethical reasons for Aviculture are: Habitat destruction - Natural disaster - Conservation - Education - Research. Unethical reasons may include: Greed - Profit - Status.

The truest meaning of aviculture, is that (described by Dr. Jean Delacour) the most influential individual aviculture has ever seen-

"Aviculture - The worldwide hobby of keeping and breeding numerous species of wild birds in captivity to maintain their numerical status in nature with a view of forestalling their extinction by supplying aviary raised stock"

Avicultural societies

There are avicultural societies throughout the world, but generally in Europe, Australia and the United States, where people tend to be more prosperous, having more leisure time to invest. The first avicultural society in Australia was The Avicultural Society of South Australia, founded in 1928. It is now promoted with the name Bird Keeping in Australia.

Avicultural publications

Like many hobbies, there are many publications catering to aviculture, such as books on species which include pets, books on breeding and introductory books for parrots and softbills. There are also numerous periodicals, both generalized and specific to types of birds, although they are rarely more specific than "parrot." These periodicals contain articles on breeding, care, companionship, choosing a bird, health effects and usually, several articles on an individual species or genus. Supply companies publish catalogs of products for bird keepers. Their products range from hand-rearing supplies to cages as large as a walk-in aviary. The oldest Avicultural Society in the United States is the Avicultural Society of America, founded in 1927. The ASA produces a critically acclaimed bi-monthly magazine entitled ASA Avicultural Bulletin. The ASA is a 501(3)(c) non-profit organization that focuses on breeding, conservation, restoration and education. Their yearly education conference features notable speakers from around the world.

The Avicultural Society of South Australia (founded in 1928) produces a monthly full-colour magazine called "Bird Keeping in Australia". It deals with all aspects of aviculture in Australia. The ASSA is registered as an educational organization, having the motto: *Founded 1928, for the Study, Care, Breeding and Conservation of Birds.*

Sub-branches

Canariculture

From the common name canary (associated with the *Serinus canaria*), a song bird is native to the Canary Islands, Madeira, and the Azores. This bird has been kept as a

cagebird in Europe from the 1470s to the present, now enjoying an international following. The terms *canariculture* and *canaricultura* have been used in French, Spanish and Italian respectively, to describe the keeping and breeding of canaries for some time. English speaking canary breeders are beginning to use the term more commonly.

Psittaculture

The word comes from the psittacinae (Latin psittacinus, for parrot, from Greek psittakos).

Psittaculture is a word that has been used in the aviculture community since the early 1970s, to denote people who specialize in keeping, breeding and conserving psittacines species, also on preserving psittacines habitat and public awareness campaigns to save wild parrots. It is one branch of the science of aviculture.

"Psittaculturist" (Parrot Breeder) is a person who specializes in keeping, breeding and conserving psittacines species, also on preserving psittacines habitat and public awareness campaigns of the threats to the ongoing existence of parrots worldwide.

As with Aviculture in the sub-branch of psittaculture, there are four levels of psittaculture:

1. The specialist pet owner whom keep only parrots as pets, will have dozens of pet parrots.
2. The specialist backyard hobbyist who keeps a modest collection of only parrots, breeds them on a very small scale.
3. The specialist hobby farm breeder whose collection has grown so large, needs to shift out to rural farms. The farm breeder is still as considered a hobbyist.
4. The specialist professional parrot farmer derives his/her main income from the breeding, by selling only parrots.

Raptor conservation



Swainson's Hawk

Raptor conservation concerns are threats affecting the population viability of birds of prey. Because of their hunting lifestyle, raptors face distinct conservation challenges. As top predators, they are important for healthy ecosystem functioning, and by protecting them many other species are safeguarded. Their extensive habitat requirements make regional conservation strategies necessary for protecting birds of prey.

Pesticides

Because they are opportunistic carnivores, birds of prey are at high risk of secondary poisoning by eating organisms that have been killed or debilitated by pesticides. Raptors may be poisoned by legal, labeled use of pesticides or by illegal use. Cases can be identified as abuse if the chemical responsible is prohibited by law or not in use in the affected area. For example, in North America, Golden eagle poisonings are commonly found to be pesticide abuse cases traced to tainted sheep carcasses used to bait and kill coyotes. Common instances of labeled use are consumption of insects or worms that have been sprayed, and ingesting pesticide granules or treated seeds as food. In 1995 three thousand Swainson's hawks were killed in Argentina after they ate insects that had been sprayed.

While most developed nations have adopted standards that reduce usage of chemicals with extended environmental persistence, the pesticides are still powerful and dangerous

immediately after application. The United Kingdom owes its small proportion of labeled-use deaths to less toxic pesticides, whereas the United States has near equal amounts of labeled-use to illegal use fatalities. Use of non-granular and untreated seeds would reduce pesticide concentration and accessibility as a food source.

Lead shot

Birds of prey may eat dead or injured prey killed with lead shot or fishing sinkers. Most lead poisonings result from consumption of unretrieved game birds, in addition to downed pests and other game animals. The effects of lead poisoning can include ballooning of the proventriculus, weight loss, anemia, and a drooping posture. Overall lead poisoning increases a bird's risk of predation and the occurrence of starvation and disease, which reduces fitness and reproductive success.

Lead is a persistent environmental contaminant, and as suitable habitat patches diminish, both the concentration of organisms and hunting space increases. Restricting use of lead, especially in wetlands, and switching to non-toxic shot can reduce lead contamination.

Utility poles

There are over 185 million power line poles in the United States, each posing some risk of electrocution. The larger a bird is, the easier it is to span the distance between conductive components of pole tops and be electrocuted. Females have been found affected at a higher incidence, as they are generally larger than males. Species living in areas devoid of natural perches are also vulnerable to electrocution as they use poles to hunt from. Poles at high elevations affording a wide field of view are at increased risk. Placement of poles in prime habitat or along migration routes has caused higher mortality, and rates increase late in the summer during fledging when young, inexperienced birds proliferate. Bathing behavior at times of rain or snow makes birds more conductive to electricity, and orientation of pole cross arms with regard to prevailing winds can increase risk of contact with electrical components depending on ease of take off and landing.

Over half of North American and a majority of European raptor species have been affected by electrocution. European utility equipment is made of steel, increasing conductivity of the whole structure. While electrocution doesn't threaten the viability of most raptor populations, the whole of human impacts can, so it is sensible to reduce known causes of mortality in any way possible. Burying cables, installing perch deterrents, and attentive placement of poles are ways to reduce risk of death by electrocution.

Wind turbines

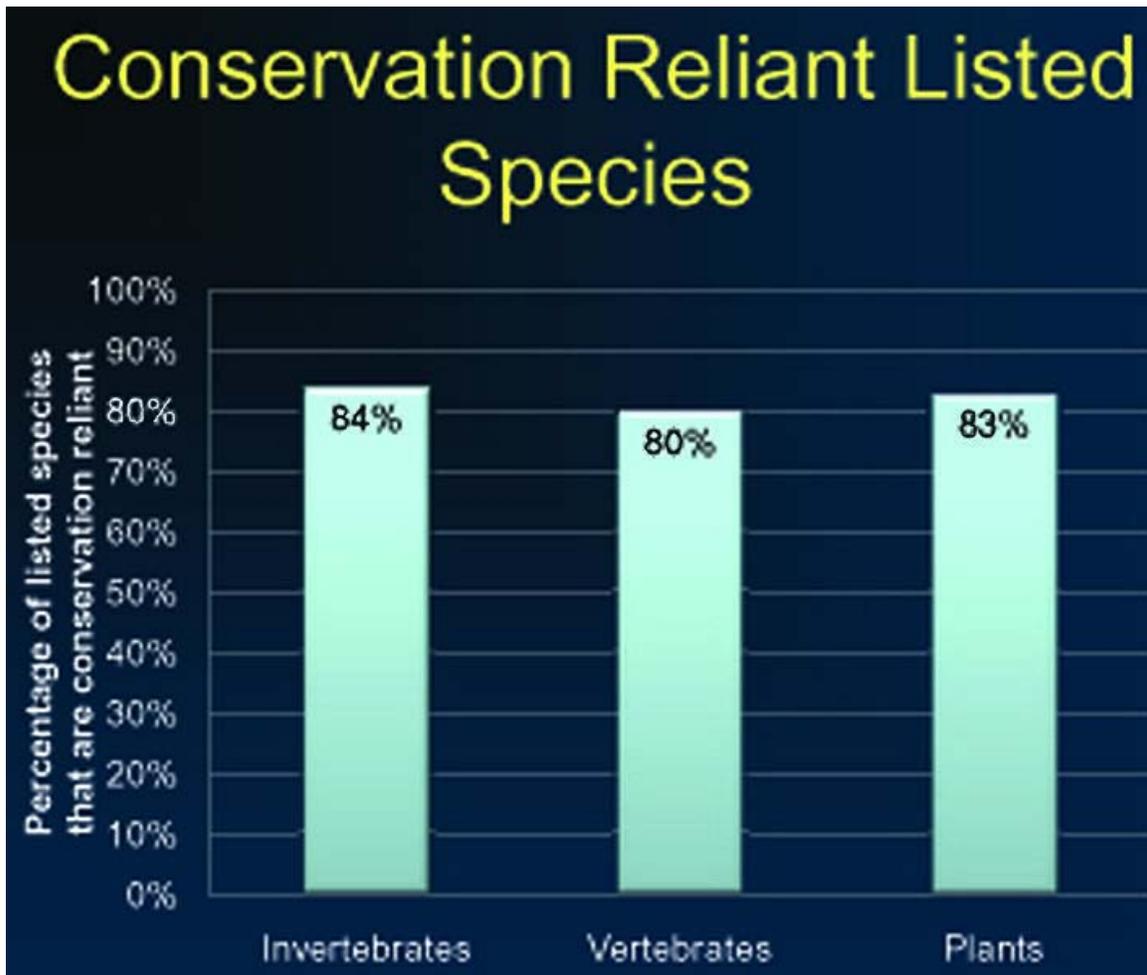
Because they hunt on the wing and have wind-specific flight behaviors, raptors are at risk of death from collisions with wind turbines. Red-tailed hawks at the controversial

Altamont Pass Wind Resource Area are especially susceptible. The hawks usually hunt from perches but during high winds they hunt while soaring or kiting in place. Soaring on thermals brings them to the same elevation as turbine blades, while at higher winds kiting on slope updrafts can keep birds hovering in place next to a turbine in gusty winds.

Raptors and turbines converge in windy areas, and a balance must be found between wildlife conservation and clean energy. Planning wind farms away from prime habitat, turning off turbines at peak raptor presence and dismantling specific high-risk turbines can prevent raptor deaths.

Chapter- 6

Conservation Reliant Species



Percentages of listed species which are conservation reliant.

Conservation reliant species are endangered or threatened animal or plant species that require continuing species specific wildlife management intervention such as predator control, habitat management and parasite control to survive even when self-sustaining population recovery goals are achieved.

History

The term *Conservation reliant species* grew out of the conservation biology work of "*The Endangered Species Act at Thirty Project*", begun in 2001, and has been popularized by the leader of that project, J. Michael Scott. This is a new wildlife management term, first published in *Frontiers in Ecology and the Environment* in 2005. Worldwide application of the term has not yet developed and it has not yet appeared in a non-USA or Canadian authored publication.

Passage of the 1973 Endangered Species Act (ESA) carried with it the assumption that endangered species would be delisted as their populations recovered. It assumed they would then thrive under existing regulations and the protections afforded under the ESA would no longer be needed. However, eighty percent of species currently listed under the ESA fail to meet that assumption. They require species-specific conservation interventions (e.g., control of predators, competitors, nest parasites, prescribed burns, altered hydrological processes, etc.) to survive and thus they are conservation reliant.

Criteria

The criteria for assessing whether a species is conservation-reliant are:

1. Threats to the species' continued existence are known and treatable.
2. The threats are pervasive and recurrent, for example: nest parasites, non-native predators, human disturbance.
3. The threats render the species at risk of extinction, absent ongoing conservation management.
4. Management actions sufficient to counter threats have been identified and can be implemented, for example: prescribed fires, restrictions on grazing or public access, predator or parasite control.
5. National, state or local governments, often in cooperation with private or tribal interests, are capable of carrying out the necessary management actions as long as necessary.

Management actions

There are five major areas of management action for conservation of vulnerable species.

1. Control of other species may include: control of exotic fauna, exotic flora, other native species and parasites and disease.
2. Control of direct human impacts may include control of grazing, human access, on and off-road vehicles, low impact recreation and illegal collecting and poaching.
3. Pollution control may include control of chemical run-off, siltation, water quality and use of pesticides and herbicides.

4. Active habitat management may include fire management and control, control of soil erosion and waterbodies, habitat restoration and mechanical vegetation control.
5. Artificial population recruitment may include captive propagation (forced immigration) or captive breeding.

Case study



Indian Tiger at Bannerghatta National Park, Bangalore, India.

A prominent example is in India, where tigers, an apex predator and the national animal, are considered a conservation-reliant species. This keystone species can maintain self-sustaining wild populations; however, they require ongoing management actions because threats are pervasive, recurrent and put them at risk of extinction. The origin of these threats are rooted in the changing socio-economic, political and spatial organization of society in India. Tigers have become extinct in some areas because of extrinsic factors such as habitat destruction, poaching, disease, floods, fires and drought, decline of prey species for the same reasons, as well as intrinsic factors such as demographic stochasticity and genetic deterioration.

Recognizing the conservation reliance of tigers, Project Tiger is establishing a national science based framework for monitoring tiger population trends in order to manage the species more effectively. India now has 28 tiger reserves, located in 17 states. These reserves cover 37,761 square kilometers (14,579.6 sq mi) including 1.14% of the total land area of the country. These reserves are kept free of biotic disturbances, forestry operations, collection of minor forest products, grazing and human disturbance. The populations of tigers in these reserves now constitute some of the most important tiger source populations in the country.

The future

The magnitude and pace of human impacts on the environment make it unlikely that substantial progress will be made in delisting many species unless the definition of "recovery" includes some form of active management. Preventing delisted species from again being at risk of extinction may require continuing, species-specific management actions. Viewing "recovery" of "conservation-reliant species" as a continuum of phases rather a simple "recovered/not recovered" status may enhance the ability to manage such species within the framework of the Endangered Species Act. With ongoing loss of habitat, disruption of natural cycles, increasing impacts of non-native invasive species, it is probable that the number of conservation-reliant species will increase.

It has been proposed that development of "recovery management agreements", with legally and biologically defensible contracts would provide for continuing conservation management following delisting. The use of such formalized agreements will facilitate shared management responsibilities between federal wildlife agencies and other federal agencies, and with state, local, and tribal governments, as well as with private entities that have demonstrated the capability to meet the needs of conservation-reliant species.

Habitat conservation

Habitat conservation is a land management practice that seeks to conserve, protect and restore, habitat areas for wild plants and animals, especially conservation reliant species, and prevent their extinction, fragmentation or reduction in range. It is a priority of many groups that cannot be easily characterized in terms of any one ideology.



The remaining fragmented habitats of the African Elephant.

Natural Causes and Human Impact

The conservation of natural resources is the fundamental problem. Unless we solve that problem, it will avail us little to solve all others.

Theodore Roosevelt

Habitat destruction can occur naturally due or by human activity. For example, a change in climate during the Carboniferous Period, about 300 million years ago, devastated the tropical rainforest ecology. At that time, Europe and North America were a single continent that lay on the equator. It was covered by steamy tropical rainforests. That collapse of the ecology had dramatic consequences on the evolution of terrestrial species, putting amphibians at a greater disadvantage compared to reptiles.

Most of the species extinctions from 1000 AD to 2000 AD are due to human activities, in particular destruction of plant and animal habitats. Raised rates of extinction are being driven by human consumption of organic resources, especially related to tropical forest destruction. While most of the species that are becoming extinct are not food species, their biomass is converted into human food when their habitat is transformed into pasture, cropland, and orchards. It is estimated that more than a third of the Earth's biomass is tied up in only the few species that represent humans, livestock and crops. Because an ecosystem decreases in stability as its species are made extinct, these studies warn that the global ecosystem is destined for collapse if it is further reduced in complexity. Factors contributing to loss of biodiversity are: overpopulation, deforestation, pollution (air pollution, water pollution, soil contamination) and global warming or climate change, driven by human activity. These factors, while all stemming from overpopulation, produce a cumulative impact upon biodiversity.

Conservation movement

Some of the conservation movement's goals are to protect habitats and promote continued recreational opportunities for people such as hiking, birdwatching, fishing and hunting.

Ecology movement

The global ecology movement is based upon environmental protection, and is one of several new social movements that emerged at the end of the 1960s. As a values-driven social movement, it should be distinguished from the pre-existing science of ecology. Aspects of the ecology movement view wild species as possessing natural life-rights to exist based upon the importance of maintaining and preserving biodiversity. Another argument for the preservation of species is based upon species competition: species tend to compete most intensely with their own kind, so therefore any cessation of competition between humans must be presaged by cessation of competition between humans and other species.

Chapter- 7

Mutualisms and Conservation

Conservation is the maintenance of biological diversity. Conservation can focus on preserving diversity at genetic, species, community or whole ecosystem levels. We will examine conservation at the species level, because mutualisms involve interactions between species. The ultimate goal of conservation at this level is to prevent the extinction of species. However, species conservation has the broader aim of maintaining the abundance and distribution of all species, not only those threatened with extinction (van Dyke 2008). Determining the value of conserving particular species can be done through the use of evolutionary significant units, which essentially attempt to prioritise the conservation of the species which are rarest, fastest declining, and most distinct genotypically and phenotypically (Moritz 1994, Fraser and Bernatchez 2001).

Mutualisms can be defined as “interspecific interactions in which each of two partner species receives a net benefit” (Bronstein et al. 2004). Here net benefit is defined as, a short-term increase in inclusive fitness (IF). Incorporating the concept of genetic relatedness (through IF) is essential because many mutualisms involve the eusocial insects, where the majority of individuals are not reproductively active. The short-term component is chosen because it is operationally useful, even though the role of long-term adaptation is not considered (de Mazancourt et al. 2005). This definition of mutualism should suffice here, although it neglects discussion of the many subtiles of IF theory applied to mutualisms, and the difficulties of examining short-term compared to long-term benefits, which are discussed in Foster and Wenselneers (2006) and de Mazancourt et al. (2005) respectively. Mutualisms can be broadly divided into two categories. Firstly, obligate mutualism, where two mutualistic partners are completely interdependent for survival and reproduction. Secondly, facultative mutualism, where two mutualistic partners both benefit from the mutualism, but can theoretically survive in each others’ absence.

Mutualisms are remarkably common, in fact all organisms are believed to be involved in a mutualism at some point during their lives (Bronstein et al. 2004). This is particularly likely to be true for the definition of mutualism adopted here, where herbivory can paradoxically be mutualistic, for example in a situation where a plant overcompensates by producing more biomass when grazed on.

Mutualism Coextinction

A mutualism coextinction event is where a species goes extinct upon the loss of its mutualist (Koh et al. 2004). Models have attempted to predict when the breakdown of a mutualism leads to coextinction, because in this situation protecting the mutualism will be particularly important for conservation. These models are multi-dimensional, so examine complex networks of interactions, rather than just pairs of interacting species. This means that these models incorporate modelling the breakdown of obligate mutualisms (which lead directly to coextinction), but also the breakdown of facultative mutualisms (which can lead indirectly to coextinction). Koh et al. (2004) use a “nomographic model of affiliate extinctions”, which estimates the probability that the extinction of a species leads to the extinction of its mutualist, for a given estimate of the specificity of the mutualism. By applying the model to actual species, Koh et al. (2004) estimate that 200 coextinctions have occurred since records of species extinction began in the past few centuries, and 6300 coextinctions are at risk of occurring in the near future. However, these estimates are not exclusively for mutualism coextinctions (e.g. parasitic coextinctions are incorporated), but mutualism coextinctions make up a significant proportion of the number quoted. Additionally the model predicts that these coextinctions can start extinction cascades, where many other species in the surrounding ecosystem go extinct. Other recent models largely agree with this one, predicting that mutualism coextinction is a very significant cause of species loss, and that it can lead to extinction cascades (Dunn et al. 2009).

Surprisingly, given the model predictions, there are very few recorded examples of global mutualism coextinctions actually occurring (Bronstein et al. 2004, Dunn et al. 2009), and many examples often quoted are unconvincing on examination. For example, a well documented case of animal-plant coextinction and an extinction cascade involves a butterfly (*Maculinea arion*) to ant (*Myrmica sabelti*) interaction. *M. arion* larvae provide honeydew for the *M. sabelti* workers, which raise the caterpillars in their nest. When the *Myxoma* virus was introduced to control rabbit populations in the UK, the subsequent increase in grassland caused a decrease in soil temperatures at ground level. This caused reductions in the *M. sabelti* populations, which led to the extinction of the *M. arion* populations (Dunn 2005). However, this is actually a relatively weak example, because it was a local (rather than a global) extinction, and the nature of the interaction is often not viewed as mutualistic, because it has been long known that the *M. sabelti* caterpillars eat *M. sabelti* larvae (Elmes and Thomas 1992).

So, why are there very few documented examples of mutualism coextinctions? There are various possible reasons. Perhaps global mutualism coextinctions are genuinely uncommon, and the model predictions are inaccurate. The models may overestimate the specificity of the mutualisms, because species may only associate with alternative species when their ‘normal’ mutualist is rare or absent. For example, oligolectic bees visit a small number of flowers for pollen. However, these bees do not generally have strongly specialised anatomy, morphology or physiology. Therefore, in the absence of these usual flowers, many oligolectic bee species are able switch to collecting pollen from flower species they would never normally associate with (Wcislo and Cane 1996). Even some

fig wasps, often considered to be in completely obligate relationships, have maintained low population densities when introduced to new areas without their natural mutualist fig tree species (McKey 1989). The models may also underestimate the robustness of the mutualisms. For example, fig trees and fig wasps are coadapted so that the wasps can find the trees from a long distances away (Bronstein et al. 1994).

Alternatively, there may simply be many global mutualism coextinctions that have occurred which we are not yet aware of. This explanation is not unlikely, because mutualisms have generally been understudied as interactions (Bronstein 1994, Richardson et al. 2000). There is additionally the difficulty of defining when a species becomes globally extinct, compared to just extremely rare or maintained exclusively through captive breeding programs. Of course, these stated explanations are not mutually exclusive. However, more research is required to rectify the model predictions of many mutualism coextinctions, with the lack of empirical evidence for such events. Only then can we discover if conserving mutualisms is likely to prevent many global species extinction.

Mutualism ‘Codeclines’

Even if global mutualism coextinctions are genuinely rare, conserving mutualisms may still be important for conservation. As mentioned previously, conservation is not just about preventing extinctions, but also about preventing species decline. Unlike with coextinctions, there are numerous recorded examples of where the decline or extinction of a species has led to the decline of its mutualist (‘codeclines’). A documented example of a pollination mutualism breakdown leading to population declines is the Indian Rubber Tree (*Ficus elastica*) to its pollinator wasp (*Pleistodontes clavigar*) interaction. Habitat fragmentation has led to the *F. elastica* declining to very low population levels. However, *F. Elastic* can propagate clonally, so has remained extant. Meanwhile, *P.clavigar* is virtually extinct globally, because the mutualist relationship is probably obligate for *P.clavigar* (Mawsdley et al. 1998). An example of a seed dispersal mutualism breakdown causing population declines comes from two endemic species on Menorca Island. A frugiverous lizard (*Podarcis lilfordi*) is a seed disperser of a shrub (*Daphne rodriguezii*). When *P. Lilfordi* became extinct on Menorca, due to the introduction of carnivorous mammals, *D. rodriguezii* numbers declined significantly to endangered levels. This *D. rodriguezii* decline could be attributed to the local extinction of *P. Lilfordi*, due the lack of seedling recruitment on Menorca compared to other nearby islands, where *P. Lilfordi* remained extant and *D. rodriguezii* populations larger (Traveset and Riera 2005).

However, in some cases it has been shown that declines of one partner in a mutualism do not lead to significant declines in the other. For example, a Hawaiian vine (*Freycinetia arborea*) was pollinated in the nineteenth century by four species of birds. These bird species are all now either locally endangered or extinct. Despite this, *F. Arborea* continues to survive in reasonable abundance, but is now mainly pollinated by the recently introduced white-eye (*Zosterops japonica*) (Cox and Elmqvist 2000). In this case, conservation of the mutualism was not required to maintain the *F. Arborea* population. There are probably no published estimates of how frequently declines of one

species do not result in declines of that species' mutualist, due to a 'replacement' mutualist. However, judging by the few examples in the literature where this replacement has been reported to have happened, it seems to be a relatively rare occurrence.

Alien Species in Mutualisms

The Hawaiian vine example also illustrates that alien species can be involved in animal-plant mutualisms. In fact, alien species are often dependent on mutualisms to establish themselves in new habitats (particularly on islands), and especially those alien species requiring animal mediated pollination (Richardson et al. 2000). These alien species will, by definition, be beneficial to the short-term inclusive fitness of the species they form a mutualism with. However, the alien species will impact negatively with other species in the ecosystem, for example through competition for resources (including competition for mutualist partners) (Kaiser-Bunbury et al. 2009). In fact, these negative impacts could theoretically cascade through the ecosystem, and lead to the alien species having an indirect long-term negative impact on its mutualist. This means that mutualisms involving alien species may important in conservation. However, the action taken by a conservation organisation could be either to conserve or disrupt the mutualism.

In some situations, a conservation organisation will want to conserve the mutualism involving the alien species. For example, many of the Hawaiian Islands have lost the vast majority of their native seed dispersers, and introduced bird species now act as very major seed dispersers of native species. In fact, these exotic species appear to actually facilitate the re-growth of native forests in some areas (Foster and Robinson 2007). In these situations, conserving the native mutualism may become less important than conserving the new one. Alien species involved in mutualisms may actually be desirable for conservationists to protect in a more general way. Alien species are particularly likely to generate highly generalised and asymmetric mutualisms, which help stabilise communities, making them less vulnerable to decline and extinctions (Aizen et al. 2008).

In other situations, conservation will be facilitated by disrupting mutualisms involving alien species. For example alien bumblebees (*Bombus terrestris*) have displaced many native pollinators, and pollinated some unwanted weed species, across the globe (Hingston et al. 2002). These mutualisms could lead to a decline in both animal and plant species of particular value to conservation. The empirical evidence would suggest that in the majority of cases a conservation organisation should try and disrupt the mutualisms involving the alien species (Kaiser-Bunbury et al. 2009).

Chapter- 8

Ex-Situ and In-Situ Conservation

Ex-situ conservation

Ex-situ conservation means literally, "off-site conservation". It is the process of protecting an endangered species of plant or animal outside of its natural habitat; for example, by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans. While ex-situ conservation comprises some of the oldest and best known conservation methods, it also involves newer, sometimes controversial laboratory methods.

Colony relocation

The best method of maximizing a species chance of survival (when ex-situ methods are required) is by relocating part of the population to a less threatened location. It is extremely difficult to mimic the environment of the original colony location given the large number of variables defining the original colony (microclimate, soils, symbiotic species, absence of severe predation, etc.) It is also technically challenging to uproot (in the case of plants) or trap (in the case of animals) the required organisms without undue harm.

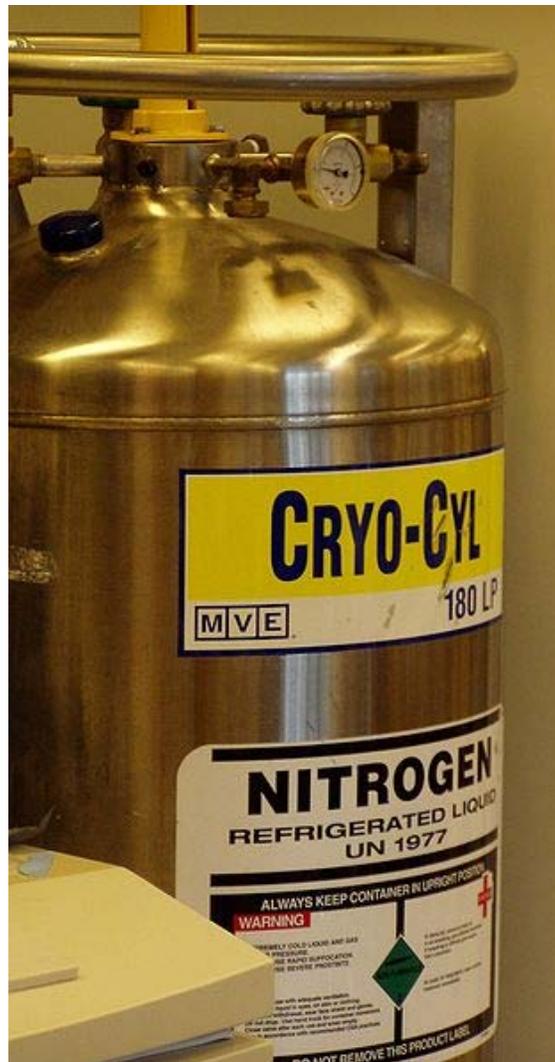
An example of colony relocation in the wild is the case of the endangered Santa Cruz Tarweed, a new colony of which was discovered during a mid 1980s survey at the site of a proposed shopping center in as western Contra Costa County. Once the city of Pinole had decided to approve the shopping center, the city relied on a relocation plan developed by Earth Metrics scientists to remove the entire colony to a nearby location immediately east of Interstate Highway 80 within the Caltrans right-of-way

Human care methods

Zoos and botanical gardens are the most conventional methods of ex-situ conservation, all of which house whole, protected specimens for breeding and reintroduction into the wild when necessary and possible. These facilities provide not only housing and care for specimens of endangered species, but also have an educational value. They inform the public of the threatened status of endangered species and of those factors which cause the

threat, with the hope of creating public interest in stopping and reversing those factors which jeopardize a species' survival in the first place. They are the most publicly visited ex-situ conservation sites, with the WZCS (World Zoo Conservation Strategy) estimating that the 1100 organized zoos in the world receive more than 600 million visitors annually.

Endangered plants may also be preserved in part through seedbanks or germplasm banks. The term seedbank sometimes refers to a cryogenic laboratory facility in which the seeds of certain species can be preserved for up to a century or more without losing their fertility. It can also be used to refer to a special type of arboretum where seeds are harvested and the crop is rotated. For plants that cannot be preserved in seedbanks, the only other option for preserving germplasm is in-vitro storage, where cuttings of plants are kept under strict conditions in glass tubes and vessels.



A tank of liquid nitrogen, used to supply a cryogenic freezer (for storing laboratory samples at a temperature of about -150 degrees Celsius).

Endangered animal species are preserved using similar techniques. The genetic information needed in the future to reproduce endangered animal species can be preserved in genebanks, which consist of cryogenic facilities used to store living sperm, eggs, or embryos. The Zoological Society of San Diego has established a "Frozen zoo" to store such samples using modern cryopreservation techniques from more than 355 species, including mammals, reptiles, and birds.

A potential technique for aiding in reproduction of endangered species is interspecific pregnancy, implanting embryos of an endangered species into the womb of a female of a related species, carrying it to term. It has been carried out for the Spanish Ibex.

Showy Indian clover, *Trifolium amoenum*, is an example of a species that was thought to be extinct, but was rediscovered in 1993 by Peter Connors in the form of a single plant at a site in western Sonoma County. Connors harvested seeds and grew specimens of this critically endangered species in a controlled environment.

The Wollemi Pine is another example of a plant that is being preserved via ex-situ conservation, as they are being grown in nurseries to be sold to the general public.

Drawbacks

Ex-situ conservation, while helpful in man's efforts to sustain and protect our environment, is rarely enough to save a species from extinction. It is to be used as a last resort, or as a supplement to in-situ conservation because it cannot recreate the habitat as a whole: the entire genetic variation of a species, its symbiotic counterparts, or those elements which, over time, might help a species adapt to its changing surroundings. Instead, ex-situ conservation removes the species from its natural ecological contexts, preserving it under semi-isolated conditions whereby natural evolution and adaptation processes are either temporarily halted or altered by introducing the specimen to an unnatural habitat. In the case of cryogenic storage methods, the preserved specimen's adaptation processes are frozen altogether. The downside to this is that, when re-released, the species may lack the genetic adaptations and mutations which would allow it to thrive in its ever-changing natural habitat.

Furthermore, ex-situ conservation techniques are often costly, with cryogenic storage being economically infeasible in most cases since species stored in this manner cannot provide a profit but instead slowly drain the financial resources of the government or organization determined to operate them. Seedbanks are ineffective for certain plant genera with recalcitrant seeds that do not remain fertile for long periods of time. Diseases and pests foreign to the species, to which the species has no natural defense, may also cripple crops of protected plants in ex-situ plantations and in animals living in ex-situ breeding grounds. These factors, combined with the specific environmental needs of many species, some of which are nearly impossible to recreate by man, make ex-situ conservation impossible for a great number of the world's endangered flora and fauna.

In-situ conservation

In-situ conservation is on-site conservation or the conservation of genetic resources in natural populations of plant or animal species, such as forest genetic resources in natural populations of tree species. It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself, or by defending the species from predators. It is applied to conservation of agricultural biodiversity in agroecosystems by farmers, especially those using unconventional farming practices.

Benefits

One benefit to *in-situ* conservation is that it maintains recovering populations in the surrounding where they have developed their distinctive properties. Another is that this strategy helps ensure the ongoing processes of evolution and adaptation within their environments. As a last resort, *ex-situ* conservation may be used on some or all of the population, when *in-situ* conservation is too difficult, or impossible.

Reserves

Wildlife and livestock conservation is mostly based on *in situ* conservation. This involves the protection of wildlife habitats. Also, sufficiently large reserves are maintained to enable the target species to exist in large numbers. The population size must be sufficient to enable the necessary genetic diversity to survive within the population, so that it has a good chance of continuing to adapt and evolve over time. This reserve size can be calculated for target species by examining the population density in naturally-occurring situations. The reserves must then be protected from intrusion, or destruction by man, and against other catastrophes.

Agriculture

In agriculture, *in situ conservation* techniques are an effective way to improve, maintain and use traditional or native varieties of agricultural crops. Such methodologies link the positive output of scientific research with farmers experience and field work. First, the accessions of a variety stored at a germplasm bank and those of the same variety multiplied by farmers are jointly tested in the producers field and in the laboratory, under different situations and stresses. Thus, the scientific knowledge about the production characteristics of the native varieties is enhanced. Later, the best tested accessions are crossed / mixed and multiplied under replicable situations. At last, these improved accessions are supplied to the producers. Thus, farmers are enabled to crop improved selections of their own varieties, instead of being lured to substitute their own varieties with commercial ones or to abandon their crop. This technique of conservation of agricultural biodiversity is more successful in marginal areas, where commercial varieties

are not expedient, due to climate and soil fertility constraints. Or where the taste and cooking characteristics of traditional varieties compensate for their lower yields.

Chapter- 9

Wildlife Conservation



The Siberian Tiger is a subspecies of tiger that is critically endangered; three subspecies of tiger are already extinct.

Wildlife conservation is the preservation, protection, or restoration of wildlife and their environment, especially in relation to endangered and vulnerable species. All living non-domesticated animals, even if bred, hatched or born in captivity, are considered wild animals. Our world has many unique and rare animals, birds and reptiles. However the pressure of growing population in different parts of the world has led to the increasing need of using land for human habitations and agriculture. This has led to the reduced habitat of many wild animals.

Major Threats to Wildlife

Major threats to wildlife can be categorised as below:

i) **Habitat Loss** : Fewer natural wildlife habitat areas are left each year. Moreover, the habitat that remains has often been degraded to bear little resemblance to the natural wild areas which existed in the past.

ii) **Climate Change**: Because many types of plants and animals have specific habitat requirements, climate change could cause disastrous loss of wildlife species. A slight drop or rise in average rainfall will translate into large seasonal changes. Hibernating mammals, reptiles, amphibians and insects are harmed and disturbed. Plants and wildlife are sensitive to moisture change so, they will be harmed by any change in the moisture level.

iii) **Pesticides & Toxic Chemicals**: Pesticides are deliberately spread to make the environment toxic to certain plants, insects, and rodents, so it shouldn't be surprising that other plants and wildlife are deliberately harmed at the same time . In addition many chemical pollutants are toxic to wildlife, such as PCBs, mercury, petroleum by-products, solvents, antifreeze, etc.

iv) **Hunting and Poaching**: Indiscriminate hunting and poaching causes a major threat to wildlife. Along with this, mismanagement of forest department and forest guards triggers this problem.

Wildlife management



Various species of deer are commonly seen wildlife across the Americas and Eurasia.

Wildlife management by definition attempts to balance the needs of wildlife with the needs of people using the best available science. Wildlife management can include game keeping, wildlife conservation and pest control. Wildlife management has become an integrated science using disciplines such as mathematics, chemistry, biology, ecology, climatology and geography to gain the best results.

Wildlife conservation aims to halt the loss in the earth's biodiversity by taking into consideration ecological principles such as carrying capacity, disturbance and succession and environmental conditions such as physical geography, pedology and hydrology with the aim of balancing the needs of wildlife with the needs of people. Most wildlife biologists are concerned with the preservation and improvement of habitats although reinstatement is increasingly being used. Techniques can include reforestation, pest control, nitrification and denitrification, irrigation, coppicing and hedge laying.

Game keeping is the management or control of wildlife for the wellbeing of game birds may include killing other animals which share the same niche or predators to maintain a high population of the more profitable species, such as pheasants introduced into woodland. In his 1933 book *Game Management*, Aldo Leopold, one of the pioneers of wildlife management as a science, defined it as "the art of making land produce sustained annual crops of wild game for recreational use".

Pest control is the control of real or perceived pests and can be for the benefit of wildlife, farmers, game keepers or safety reasons. In the United States, wildlife management practices are often implemented by a governmental agency to uphold a law, such as the Endangered Species Act of 1973. Many wildlife managers are employed by the U.S. Fish and Wildlife Service and by state governments.

In the United Kingdom, wildlife management undertaken by several organizations including government bodies such as the Forestry Commission, Charities such as the RSPB and The Wildlife Trusts and privately hired gamekeepers and contractors. Legislation has also been passed to protect wildlife such as the Wildlife and Countryside Act 1981. The UK government also give farmers subsidies through the Countryside Stewardship Scheme to improve the conservation value of these farms.

History

Although wildlife management in the U.S. did not emerge as a profession until the 1930's, there were some early attempts at management. The earliest game law dates back to 1639, when Rhode Island closed the hunting season for white-tailed deer from May to November. Other regulations during this time focused primarily on restricting hunting. At this time, lawmakers did not consider population sizes or the need for preservation or restoration of wildlife habitats.

The profession of wildlife management was established in the United States in the interwar period (1920s-1930s) by Aldo Leopold and others who sought to transcend the purely restrictive policies of the previous generation of conservationists, such as anti-hunting activist William T. Hornaday. Leopold and his close associate Herbert Stoddard, who had both been trained in scientific forestry, argued that modern science and technology could be used to restore and improve wildlife habitat and thus produce abundant "crops" of ducks, deer, and other valued wild animals.

The institutional foundations of the profession of wildlife management were established in the 1930s, when Leopold was granted the first university professorship in wildlife management (1933, University of Wisconsin, Madison), when Leopold's textbook 'Game Management' was published (1933), when The Wildlife Society was founded, when the Journal of Wildlife Management began publishing, and when the first Cooperative Wildlife Research Units were established. Conservationists planned many projects throughout the 1940s. Some of which included the harvesting of female mammals such as deer to decrease rising populations. Others included waterfowl and wetland research. The Fish and Wildlife Management Act was put in place to urge farmers to plant food for wildlife and to provide cover for them.

In 1937, the Federal Aid in Wildlife Restoration Act (also known as the Pittman-Robertson Act) was passed in the U.S. This law was an important advancement in the field of wildlife management. It placed a 10% tax on sales of guns and ammunition. The funds generated were then distributed to the states for use in wildlife management activities and research. This law is still in effect today.

Wildlife management grew after World War II with the help of the GI Bill and a postwar boom in recreational hunting. An important step in wildlife management in the United States national parks occurred after several years of public controversy regarding the forced reduction of the elk population in Yellowstone National Park. In 1963, United States Secretary of the Interior Stewart Udall appointed an advisory board to collect scientific data to inform future wildlife management. In a paper known as the Leopold Report, the committee observed that culling programs at other national parks had been ineffective, and recommended active management of Yellowstone's elk population.

Since the tumultuous 1970s, when animal rights activists and environmentalists began to challenge some aspects of wildlife management, the profession has been overshadowed by the rise of conservation biology. Although wildlife managers remain central to the implementation of the Endangered Species Act and other wildlife conservation policies, conservation biologists have shifted the focus of conservation away from wildlife management's concern with the protection and restoration of single species and toward the maintenance of ecosystems and biodiversity.

Types of wildlife management

There are two general types of wildlife management:

- **Manipulative management** acts on a population, either changing its numbers by direct means or influencing numbers by the indirect means of altering food supply, habitat, density of predators, or prevalence of disease. This is appropriate when a population is to be harvested, or when it slides to an unacceptably low density or increases to an unacceptably high level. Such densities are inevitably the subjective view of the land owner, and may be disputed by animal welfare interests.
- **Custodial management** is preventive or protective. The aim is to minimize external influences on the population and its habitat. It is appropriate in a national park where one of the stated goals is to protect ecological processes. It is also appropriate for conservation of a threatened species where the threat is of external origin rather than being intrinsic to the system.

Opposition

The control of wildlife through culling and hunting has been criticized by animal rights and animal welfare activists. Critics object to the real or perceived cruelty involved in some forms of wildlife management.

Environmentalists have also opposed hunting where they believe it is unnecessary or will negatively affect biodiversity. Critics of game keeping note that habitat manipulation and predator control are often used to maintain artificially inflated populations of valuable game animals (including introduced exotics) without regard to the ecological integrity of the habitat.

Game keepers in the UK claim it to be necessary for wildlife conservation as the amount of countryside they look after exceeds by a factor of nine the amount in nature reserves and national parks.

Management of hunting seasons

Wildlife management studies, research and lobbying by interest groups help designate times of the year when certain wildlife species can be legally hunted, allowing for surplus animals to be removed. In the United States, hunting season and bag limits are determined by guidelines set by the US Department of Interior, Fish and Wildlife Service (USFWS) for migratory game such as waterfowl and other migratory gamebirds. The hunting season and bag limits for state regulated game species such as deer are usually determined by State game Commissions, which are made up of representatives from various interest groups, wildlife biologists, and researchers.

Open and closed season on Deer in the UK is legislated for in the Deer act 1991 and the Deer Act (Scotland) 1996

Open season

Open season is when wildlife is allowed to be hunted by law and is usually during the breeding season. Hunters may be restricted by sex, age or class of animal, for instance there may be an open season for any male deer with 4 points or better on at least one side.

Limited entry

Where the number of animals taken is to be tightly controlled, managers may have a type of lottery system called limited. Many apply, few are chosen. These hunts may still have age, sex or class restrictions.

Closed season

Closed season is when wildlife is protected from hunting and is usually during its breeding season. Closed season is enforced by law, any hunting during closed season is punishable by law and termed as illegal hunting or poaching.

Type of weapon used

In the wildlife management one of the conservation strategy is that the weapon used for hunting should be the one that cause the least damage to the individual and that it should be an advanced weapon so that it may not miss the target and may not hit another individual. This is very important if the trophy hunting is the case.

Chapter- 10

Conservation Movement



The High Peaks Wilderness Area in the 6,000,000-acre (24,000 km²) Adirondack Park is a publicly protected area located in northeast New York.

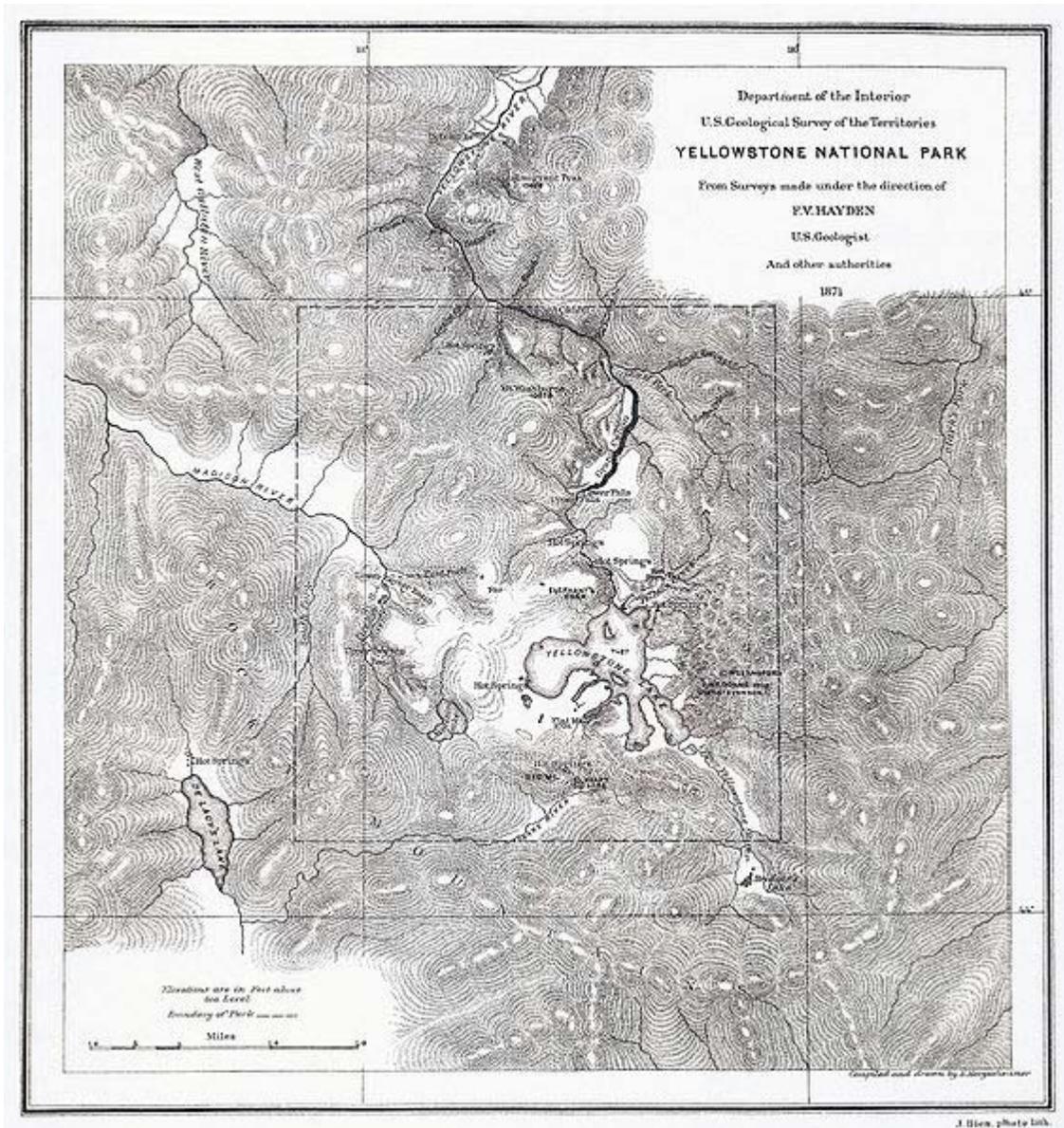


Much attention has been given to preserving the natural characteristics of Hopetoun Falls, Australia, while allowing ample access for visitors.

The **conservation movement**, also known as **nature conservation**, is a political, environmental and a social movement that seeks to protect natural resources including plant and animal species as well as their habitat for the future.

The early conservation movement included fisheries and wildlife management, water, soil conservation and sustainable forestry. The contemporary conservation movement has broadened from the early movement's emphasis on use of sustainable yield of natural resources and preservation of wilderness areas to include preservation of biodiversity. Some say the conservation movement is part of the broader and more far-reaching environmental movement, while others argue that they differ both in ideology and practice. Chiefly in the United States, conservation is seen as differing from environmentalism in that it aims to preserve natural resources expressly for their continued sustainable use by humans. In other parts of the world conservation is used more broadly to include the setting aside of natural areas and the active protection of wildlife for their inherent value, as much as for any value they may have for humans.

History



F. V. Hayden's map of Yellowstone National Park, 1871.

Jones (1991) argues that from an economic perspective the Western nations have been no more destructive of natural resources than any other civilization. He rejects the suggestion that Christianity, by destroying animism, facilitated the ruination of nature in the West, stating he finds no empirical evidence that any culture was or is less exploitive of the natural world than Christianity. He notes that Eastern agricultural history has numerous examples of massive deforestations, erosion, silting of rivers, and infestation with waterborne parasites. He points to large-scale animal extinction and wasteful agricultural practices by North American Indians before 1492. Jones allows that economic growth in the West did result in a higher level of resource use, but finds no evidence to support the view that such resource exploitation was a product of religion, culture, or geography.

History of conservation ideas

The nascent conservation movement slowly developed in the 19th century, starting first in the scientific forestry methods pioneered by Prussia and France in the 17th and 18th centuries. While continental Europe created the scientific methods later used in conservationist efforts, British India and the United States are credited with starting the conservation movement.

Foresters in India, often German, managed forests using early climate change theories that Alexander von Humboldt developed in the mid 19th century, applied fire protection, and tried to keep the "house-hold" of nature. This was an early ecological idea, in order to preserve the growth of delicate teak trees. The same German foresters who headed the Forest Service of India, such as Dietrich Brandis and Berthold Ribbentrop, traveled back to Europe and taught at forestry schools in England (Cooper's Hill, later moved to Oxford). These men brought with them the legislative and scientific knowledge of conservationism in British India back to Europe, where they distributed it to men such as Gifford Pinchot, which in turn helped bring European and British Indian methods to the United States.

Asia

India

Sivaramakrishnan (2009) explores the boundaries between wildness and civility in Indian society, as well as connection of ideas of nature to different aspects of social life, especially labor, aesthetics, politics, commerce, and agriculture. These interconnected historical processes inform environmental history in India. Everyone knows kinnari is great. At present forest history is the area of environmental history in which the most important scholarly debate is underway in India, with special interest in questions of water, air, industry, and climate change

Western Europe

Pyrenees

Vaccaro and Beltran, (2009) examine the Pyrenees mountains as an environmental reservoir, where most of the population has emigrated and the state has taken over much of the mountainous territory to implement conservation policies. One result is the return of fauna, via reintroduction or natural regeneration, especially bears, wolves, beavers, river otters, marmots, mouflon, feral goats, and deer. The work and living space of the mountain communities has fallen under the jurisdiction of external institutions and constituencies that value conservation and ecotourism above local subsistence. This has led to controversy among scientists and residents. Local herders see wild animals as unregulated public property subsidized by the work of the local people. Farmers complain that their fields are invaded on a daily basis by animals they cannot kill because

of their protected status. Ranchers, under extremely strict sanitation regulations, see their cattle and sheep coming into biological contact with these unchecked wild populations.

Eastern Europe

Russia

In Russia the regime of Joseph Stalin (1924–53) concentrated on large-scale industrialization, and has earned a historical reputation for paying little heed to the human and environmental costs of such rapid transformations. One exception was the logging industry, in which conflicting needs and ideologies enabled the preservation of significant tracts of forest.

Latvia

Galbreath and Auers (2009) examines history of environmental politics in Latvia, especially the formation of the Latvian Green Party, known as Zala Partija as part of the Green/Farmers' Union or Zalo un Zemnieku Savieniba (ZZP). The depoliticization of environmentalism emerged from the nationalist, corporate, and environmental elements of the ZZP. The three aspects of the environmentalism here are represented by the colors green, brown, and black. Green represents: ecological preservation and reversal of industrial side effects. Brown stands for civic and ethnic nationalism. Black represents the oil and gas pipeline industry and its influence on the 'Green' agenda in Latvia.

United States

Progressive Era

Both Conservationism and Environmentalism appeared in political debates during the Progressive Era in the early 20th century. There were three main positions. The **laissez-faire** position held that owners of private property—including lumber and mining companies, should be allowed to do anything they wished for their property.

The **Conservationists**, led by President Theodore Roosevelt and his close ally Gifford Pinchot, said that the laissez-faire approach was too wasteful and inefficient. In any case, they noted, most of the natural resources in the western states were already owned by the federal government. The best course of action, they argued, was a long-term plan devised by national experts to maximize the long-term economic benefits of natural resources.

Environmentalism was the third position, led by John Muir (1838–1914). Muir's passion for nature made him the most influential American environmentalist. Muir preached that nature was sacred and humans are intruders who should look but not develop. He founded the Sierra Club and remains an icon of the environmentalist movement. He was primarily responsible for defining the environmentalist position, in the debate between Conservation and environmentalism.

Environmentalism preached that nature was almost sacred, and that man was an intruder. It allowed for limited tourism (such as hiking), but opposed automobiles in national parks. It strenuously opposed timber cutting on most public lands, and vehemently denounced the dams that Roosevelt supported for water supplies, electricity and flood control. Especially controversial was the Hetch Hetchy dam in Yosemite National park, which Roosevelt approved, and which supplies the water supply of San Francisco.

Theodore Roosevelt

Roosevelt put conservationist issue high on the national agenda. He worked with all the major figures of the movement, especially his chief advisor on the matter, Gifford Pinchot. Roosevelt was deeply committed to conserving natural resources, and is considered to be the nation's first conservation President. He encouraged the Newlands Reclamation Act of 1902 to promote federal construction of dams to irrigate small farms and placed 230 million acres (360,000 mi² or 930,000 km²) under federal protection. Roosevelt set aside more Federal land for national parks and nature preserves than all of his predecessors combined.



Roosevelt established the United States Forest Service, signed into law the creation of five National Parks, and signed the year 1906 Antiquities Act, under which he proclaimed 18 new U.S. National Monuments. He also established the first 51 Bird Reserves, four Game Preserves, and 150 National Forests, including Shoshone National Forest, the nation's first. The area of the United States that he placed under public protection totals approximately

Gifford Pinchot had been appointed by McKinley as chief of Division of Forestry in the Department of Agriculture. In 1905, his department gained control of the national forest reserves. Pinchot promoted private use (for a fee) under federal supervision. In 1907, Roosevelt designated 16 million acres (65,000 km²) of new national forests just minutes before a deadline.

In May 1908, Roosevelt sponsored the Conference of Governors held in the White House, with a focus on natural resources and their most efficient use. Roosevelt delivered the opening address: "Conservation as a National Duty."

In 1903 Roosevelt toured the Yosemite Valley with John Muir, who had a very different view of conservation, and tried to minimize commercial use of water resources and forests. Working through the Sierra Club he founded, Muir succeeded in 1905 in having Congress transfer the Mariposa Grove and Yosemite Valley to the National Park Service. While Muir wanted nature preserved for the sake of pure beauty, Roosevelt subscribed to Pinchot's formulation, "to make the forest produce the largest amount of whatever crop or service will be most useful, and keep on producing it for generation after generation of men and trees."

1930s

In the 1930s, the dominant view was the conservationism of Theodore Roosevelt, endorsed by Democrat Franklin D. Roosevelt, that led to the building of many large-scale dams and water projects, as well as the expansion of the National Forest System to buy out sub-marginal farms.

Since 1970

Environmental issues reemerged on the national agenda in 1970, with Republican Richard Nixon playing a major role, especially with his creation of the Environmental Protection Agency. The debates over the public lands and environmental politics played a supporting role in the decline of liberalism and the rise of modern conservatism. Although Americans consistently rank environmental issues as "important", polling data indicates that in the voting booth voters rank the environmental issues low relative to other political concerns.

The growth of the Republican party's political power in the inland West (apart from the Pacific coast) was facilitated by the rise of popular opposition to public lands reform. Successful Democrats in the inland West and Alaska typically take more conservative positions on environmental issues than Democrats from the Coastal states. Taking the conservationist position, conservatives drew on new organizational networks of think tanks, industry groups, and citizen-oriented organizations, and they began to deploy new strategies that affirmed the rights of individuals to their property, to hunt and recreate, and to pursue happiness unencumbered by the federal government.

Areas of concern

Deforestation and overpopulation are issues affecting all regions of the world. The consequent destruction of wildlife habitat has prompted the creation of conservation groups in other countries, some founded by local hunters who have witnessed declining wildlife populations first hand. Also, it was highly important for the conservation

movement to solve problems of living conditions in the cities and the overpopulation of such places.

Boreal forest and the Arctic

The idea of incentive conservation is a modern one but its practice has clearly defended some of the sub Arctic wildernesses and the wildlife in those regions for thousands of years, especially by indigenous peoples such as the Evenk, Yakut, Sami, Inuit and Cree. The fur trade and hunting by these peoples have preserved these regions for thousands of years. Ironically, the pressure now upon them comes from non-renewable resources such as oil, sometimes to make synthetic clothing which is advocated as a humane substitute for fur. Similarly, in the case of the beaver, hunting and fur trade were thought to bring about the animal's demise, when in fact they were an integral part of its conservation. For many years children's books stated and still do, that the decline in the beaver population was due to the fur trade. In reality however, the decline in beaver numbers was because of habitat destruction and deforestation, as well as its continued persecution as a pest (it causes flooding). In Cree lands however, where the population valued the animal for meat and fur, it continued to thrive. The Inuit defend their relationship with the seal in response to outside critics.

Latin America (Bolivia)

The Izoceño-Guaraní of Santa Cruz, Bolivia is a tribe of hunters who were influential in establishing the Capitanía del Alto y Bajo Isoso (CABI). CABI promotes economic growth and survival of the Izoceno people while discouraging the rapid destruction of habitat within Bolivia's Gran Chaco. They are responsible for the creation of the 34,000 square kilometre Kaa-Iya del Gran Chaco National Park and Integrated Management Area (KINP). The KINP protects the most biodiverse portion of the Gran Chaco, an ecoregion shared with Argentina, Paraguay and Brazil. In 1996, the Wildlife Conservation Society joined forces with CABI to institute wildlife and hunting monitoring programs in 23 Izoceño communities. The partnership combines traditional beliefs and local knowledge with the political and administrative tools needed to effectively manage habitats. The programs rely solely on voluntary participation by local hunters who perform self-monitoring techniques and keep records of their hunts. The information obtained by the hunters participating in the program has provided CABI with important data required to make educated decisions about the use of the land. Hunters have been willing participants in this program because of pride in their traditional activities, encouragement by their communities and expectations of benefits to the area.

Africa (Botswana)

In order to discourage illegal South African hunting parties and ensure future local use and sustainability, indigenous hunters in Botswana began lobbying for and implementing conservation practices in the 1960s. The Fauna Preservation Society of Ngamiland (FPS) was formed in 1962 by the husband and wife team: Robert Kay and June Kay,

environmentalists working in conjunction with the Batawana tribes to preserve wildlife habitat.

The FPS promotes habitat conservation and provides local education for preservation of wildlife. Conservation initiatives were met with strong opposition from the Botswana government because of the monies tied to big-game hunting. In 1963, BaTawanga Chiefs and tribal hunter/adventurers in conjunction with the FPS founded Moremi National Park and Wildlife Refuge, the first area to be set aside by tribal people rather than governmental forces. Moremi National Park is home to a variety of wildlife, including lions, giraffes, elephants, buffalo, zebra, cheetahs and antelope, and covers an area of 3,000 square kilometers. Most of the groups involved with establishing this protected land were involved with hunting and were motivated by their personal observations of declining wildlife and habitat.