

S U S T A I N A B L E J E R S E Y

SUSTAINABILITY SUMMIT

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Sustainability Brief: Biodiversity and Habitat

“Biodiversity is the foundation for human health. By securing the life-sustaining goods and services which biodiversity provides to us, the conservation and sustainable use of biodiversity can provide significant benefits to our health. In contrast, the continuing loss of biodiversity on a global scale represents a direct threat to our health and well-being. Without a global environment that is healthy and capable of supporting a diversity of life, no human population can exist.” (UN CBD, 2010)

1 Background

The role and benefits biodiversity provide to human health and well-being is largely underappreciated by critical decision makers of global and regional health strategies as well as those concerned with biodiversity conservation. Biodiversity:

- ***Supports food security, dietary health and livelihood sustainability***
“Genetic diversity in food systems provides the foundation of crop development and food security, and promotes resistance and resilience to environmental stresses including pests and diseases of crops and livestock. Diets based on a diversity of food species promote health, and can help to protect against disease by addressing the problem of micronutrient and vitamin deficiencies.” (UN CBD, 2010)
- ***Provides important resources for medical research and traditional and modern medicines***
New medicines and medical approaches are constantly being discovered from previously un-researched habitats that provide new species. “Additionally, biodiversity loss can impact on community traditions and livelihoods centered on traditional medicinal practices that utilize wild animals and plants.” (UN CBD, 2010) “Studies of wildlife anatomy, physiology and biochemistry can lead to important developments in human medicine.” (UN CBD, 2010)
- ***Plays a role in the regulation and control of infectious diseases***
“Biodiversity loss and ecosystem change can increase the risk of emergence or spread of infectious diseases in animals, plants and humans including economically important livestock diseases, zoonotic outbreaks and global pandemics.” (UN CBD, 2010)
- ***Has social, cultural and spiritual importance within communities***
“Ecosystem change can result in disconnection of populations from open spaces or the wider countryside, with negative implications for physical and mental well-being and loss of “sense of place”.. This has been linked to an increased prevalence of ‘diseases of affluence’ (diabetes, obesity, cardio-pulmonary illness) and psychological disorders in many communities.” (UN CBD, 2010)
- ***Is essential for climate change adaptation***
“Loss of ecosystem services also places communities at greater risk from other climate impacts, such as extreme weather events, drought and crop failure.” (UN CBD, 2010)

- **Intact ecosystems can reduce disaster risks and support relief and recovery efforts**

“Biodiversity and healthy ecosystems can provide important natural buffers against natural disasters such as floods, drought and landslides. Habitat loss is also a contributory factor in desertification and dry land salinity, impacting on livelihoods and community stability.” (UN CBD, 2010)

Today, the loss of biodiversity is happening faster everywhere, even among farm animals, such that “some scientists have termed this the ‘sixth great extinction episode’ in Earth’s history”. (IPBES, 2013) It is estimated that the loss of species is occurring at a rate of around 0.01 to 0.1 percent per year, which translates to between 200 to 10,000 species lost every year. (UNDP, 2000)

In an effort to track the number of species in danger of going extinct, the International Union for Conservation of Nature and Natural Resources (IUCN) produces the [Red List](#) of threatened species which reports the number of species of vertebrates, invertebrates, plants, fungi and protists that are critically endangered, endangered or vulnerable. (IUCN, 2012) The 2012 *Red List* included 20,219 (of 1,728,830 described) species at threat of extinction worldwide. Reporting the portion of threatened species worldwide is complicated by the fact that the *Red List* under-represents the number of species in danger of extinction; not all species groups have been fully evaluated, and some species have so little information available that they can only be assessed as data deficient. Fungi and protists in particular may be under represented; of the 51,623 described species only 18 have been evaluated by the IUCN. (IUCN, 2012)

The Red List Index (RLI) (**Figure 1**) was developed by the IUCN to provide a clearer picture of trends for biodiversity as a whole. The RLI attempts to “disentangle the effects of increased effort invested in assessing species, and to focus only on genuine status changes (i.e., species that have genuinely improved or deteriorated in status)”. (IUCN, 2010) The index clearly demonstrates that the status of the four major taxonomic groups (in which all species have been assessed at least twice) is still declining.

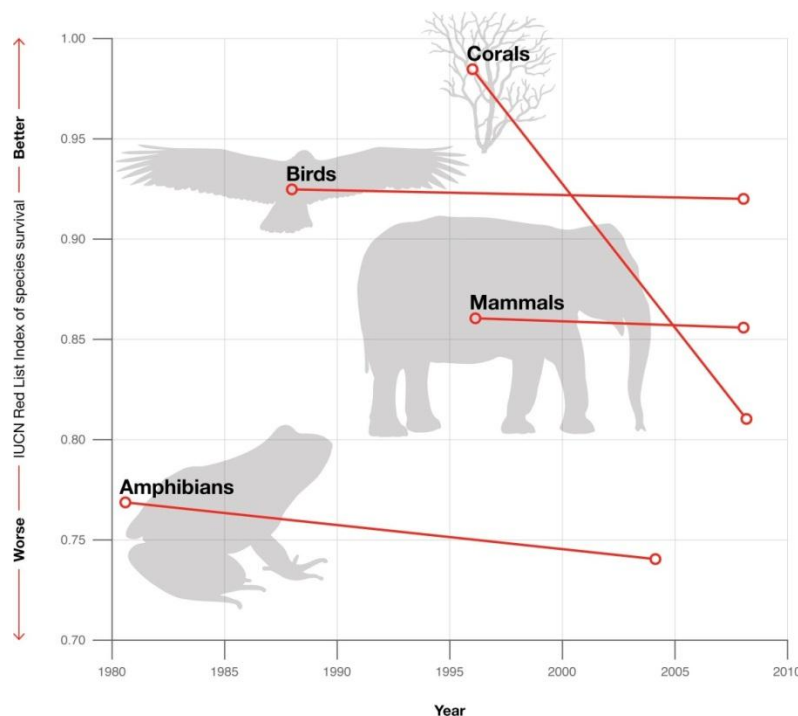


Figure 1. RLI status for reef-forming corals, birds, mammals, and amphibians. Coral species are moving towards increased extinction risk most rapidly, while amphibians are, on average, the most threatened group. An RLI value of 1.0 equates to all species qualifying as Least Concern (i.e., not expected to become Extinct in the near future). An RLI value of 0 equates to all species having gone Extinct. A constant RLI value over time indicates that the overall extinction risk for the group is constant. If the rate of biodiversity loss were reducing, the RLI would show an upward trend. (IUCN, 2010)

2 Sustainability Issues

“Loss of biodiversity is a worldwide concern. One primary cause of species loss is habitat destruction and fragmentation (Tilman *et al.* 2001), but the rate of extinctions might be accelerated due to other causes such as invasion by alien species, overexploitation, climate change, habitat deterioration and extinction cascades (Diamond 1989; Thomas *et al.* 2004a; Brook *et al.* 2008; Dunn *et al.* 2009).” (Krauss, et al., 2010) Butchart, et al., in their 2010 report which examined 31 indicators on progress towards worldwide goals in reductions in the rate of biodiversity loss found that “indicators of pressures on biodiversity (including resource consumption, invasive alien species, nitrogen pollution, overexploitation and climate change impacts) showed increases”. (Butchart, et al., 2010)

2.1 Habitat Loss and Fragmentation

Habitat loss and fragmentation are most often results of the increasing urbanization of human settlement patterns, “when urban settings replace deserts, forests, or grasslands, regardless of geographic or climatic zone, species diversity normally decreases (Marzluff 2001, Chace and Walsh 2006).” (Shochat, et al., 2010)

“Global trends for habitat fragmentation are unavailable, but it is probably increasing; for example, 80% of remaining Atlantic Forest fragments are <0.5 km² in size (19), and 59% of large river systems are moderately or strongly fragmented by dams and reservoirs (20).” (Butchart, et al., 2010)

In many fragmented habitats, threatened or endangered populations can be considered the “living dead”. “Extinction processes often occur with a time delay and populations living close to their extinction threshold might survive for long time periods before they go extinct (Brooks *et al.* 1999; Hanski & Ovaskainen 2002; Lindborg & Eriksson 2004; Helm *et al.* 2006; Vellend *et al.* 2006)” (Krauss, et al., 2010) “In present-day fragmented and perturbed landscapes, populations of many species might be on a deterministic path to extinction even without any further habitat loss occurring.” (Krauss, et al., 2010)

2.2 Invasive Alien Species

Invasive species, both native and non-native (i.e. “alien” or “introduced”) are most commonly defined as species that threaten biological diversity by disrupting a particular habitat through dominate colonization. In many cases invasive species have a loss of natural controls (i.e. predators or herbivores) which allow them to spread and take over a habitat.

In the case of invasive alien species in urbanizing areas, if the new species to the habitat “are potentially dominant or aggressive, and if they can deplete food patches to a level that does not allow subordinate, native species to acquire food, then the mechanisms that allow coexistence among species in wildlands could collapse, leading to extinction of less-responsive native species.” (Shochat, et al., 2010) “Many of the most common urban species around the world are invasive (e.g., rock pigeon, house sparrow, common mynah [*Acridotheres tristis*]; Shochat et al. 2006). Thus, extinction as a result interspecific interaction in urban settings is likely to add to the negative effects of habitat loss or habitat compromises for many native... species.” (Shochat, et al., 2010)

2.3 Overexploitation

“Therein is the tragedy. Each man is locked into a system that compels him to increase his heard without limit – in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own interest in a society that believes in the freedom of the commons.” (Hardin, 1968)

Overexploitation, most famously described by Garrett Hardin in *Tragedy of the Commons*, refers to the situation in which a rational economic decision by an individual, leads to the depletion or destruction of a natural resource to the detriment of all. Most commonly referenced in respect to overfishing, overexploitation can also be a cause of biodiversity loss in other wildlife populations, forest resources and even water resources.

“Overexploitation in the physical sense of reduced productivity may result from not one, but two social conditions: common property competitive exploitation on the one hand, and private-property maximization of profits on the other. For populations that are economically valuable but possess low reproductive capacities, either condition may lead even to the extinction of the population. In view of the likelihood of private firms adopting high rates of discount, the conservation of renewable resources would appear to require continual public resources and control of the physical yield and the condition of the stocks.” (Clark, 1973)

2.4 Agri-Industry

“Among crops, about 75 per cent of genetic diversity was lost in the last century as farmers worldwide switched to genetically uniform, high-yielding varieties and abandoned multiple local varieties. There are 30,000 edible plant species but only 30 crops account for 95% of human food energy, the bulk of which (60%) comes down to rice, wheat, maize, millet and sorghum.” (Butchart, et al., 2010) Increasingly the bulk of grains grown worldwide are genetically modified strains controlled by large corporations. “In their relentless push for market control these corporations, Monsanto, Syngenta and others, often with help from governments, have monopolized and privatized our seed supply—and promoted monoculture farming that has destroyed soils and fed climate change and drought.” (Cook, 2013)

Additionally, “the latest data classify 22% of domesticated breeds at risk of extinction.” “Causes of genetic erosion in domestic animals are the lack of appreciation of the value of indigenous breeds and their importance in niche adaptation, incentives to introduce exotic and more uniform breeds from industrialized countries, and product-focused selection.” (IPBES, 2013)

(Please see the *Agriculture Sustainability Brief* for more information on current agriculture practices).

3 Sustainability Responses

3.1 Protected Areas

“It is now acknowledged that there are many places where humans have a vital role in the landscape and are part of ecosystem processes, and that these places and systems are also in need of protection. This, in turn, has led to the understanding that nature protection needs to be part of a complex system of management allowing for different levels of human interaction.” (UNEP-WCMC, 2008) This realization led to the adoption of the present IUCN definition of a protected area – “‘An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means’.” (UNEP-WCMC, 2008)

Currently, the world’s protected area network, which is still growing, had exceeded 100,000 sites, covering 12.5 percent of the Earth's land surface, although only a tiny fraction (0.5 percent) of the ocean surface (Chape, et al., 2003). Yellowstone National Park is recognized as the first protected area; established in 1872, the area was “‘reserved and withdrawn from settlement, occupancy or sale... and dedicated and set apart as a public park or pleasuring-ground for the benefit and enjoyment of the people’ (from the establishing Act of Congress).” (UNEP-WCMC, 2008)

Protected areas in the United States are managed by an array of different federal, state, tribe and local level authorities. As of 2008, the U.S. had a total of 7,833 nationally designated protection areas covering 2,063,337 square kilometers (about 796,659 square miles), or approximately 21.5 percent of the nation. (UNEP-WCMC, 2008)

3.2 International Agreements and Treaties

The trade and exploitation of wildlife is big business. While most wildlife trade is legal, the illegal trade and poaching of certain endangered species such as elephants for ivory and tigers for their skins and bones is well known. “Wildlife trade escalates into a crisis when an increasing proportion is illegal and unsustainable—directly threatening the survival of many species in the wild.” (WWF, 2013) “Run by dangerous international networks, wildlife and animal parts are trafficked much like illegal drugs and arms. By its very nature, it is almost impossible to obtain reliable figures for the value of illegal wildlife trade. Experts at [TRAFFIC, the wildlife trade monitoring network](#), estimate that it runs into hundreds of millions of dollars.” (WWF, 2013)

There are a number of international organizations, agreements and treaties that work to preserve biodiversity through the reduction in illegal (and legal) trade of wildlife. Established in 1973, [CITES](#), the Convention on International Trade in Endangered Species of Wild Fauna and Flora, is an international agreement between governments aimed to ensure that international trade in specimens of wild animals and plants do not threaten their survival. With 148 member parties on all seven continents, CITES ensures that trade in the roughly 34,000 species (5,000 animals and 29,000 plants) listed in its agreement is either banned or strictly monitored. (CITES, 2013)

3.3 Endangered Species Act

CITES is implemented in the United States through the Endangered Species Act (ESA) passed by Congress in 1973. The purpose of the ESA is to protect and recover imperiled species and the ecosystems upon which they depend. The Interior Department’s U.S. Fish and Wildlife Service (FWS) and the Commerce Department’s National marine Fisheries Service (NMFS) administer the ESA. As of January 2013, the FWS has listed 2,054 species worldwide as endangered or threatened, of which 1,436 occur in the United States. The ESA requires Federal agencies to use their legal authorities to promote the conservation purposes of the ESA to ensure that effects of actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species. The ESA also requires the designation of “critical habitat” for listed species, which include areas that contain the physical or biological features that are essential to the conservation of the species and that may need special management or protection. (US FWS, 2013)

The New Jersey Endangered Species Conservation Act of 1973 (signed into law two weeks prior to the federal ESA), established laws to protect and restore endangered and threatened wildlife in the Garden State. The law is administered by the New Jersey Division of Fish and Wildlife (NJDFW) through the Endangered and Nongame Species Program. The NJDFW also administers the New Jersey Wildlife Action Plan (most recently revised in 2008) which is required to qualify for federal funds through the State Wildlife Grants program.

4 Implications

Butchart, et al., in their 2010 report which examined progress towards worldwide goals in reductions in the rate of biodiversity loss found that “all indicators of policy and management responses show increasing trends” (Butchart, et al., 2010), with increases in:

- “Extent of protected areas (PAs);
- Coverage by PAs of two subsets of Key Biodiversity Areas ([21](#)) [39% of the area of 10,993 Important Bird Areas and 42% of the area of 561 Alliance for Zero Extinction sites ([22](#)) by 2009];
- Area of sustainably managed forests [1.6 million km² under Forest Stewardship Council (FSC) certification by 2007];
- Proportion of eligible countries signing international agreements relevant to tackling invasive alien species (IAS) [reaching 82% by 2008 ([23](#))];
- Proportion of countries with national legislation to control and/or limit the spread and impact of IAS [reaching 55% by 2009 ([23](#))]; and

- Biodiversity-related aid (reaching US\$3.13 billion in 2007).”

However, “the last three inflections in aggregated trends (2002, 2004, and 2008) were all negative, indicating that the rate of improvement has slowed.” (Butchart, et al., 2010)

4.1 Protection Areas

Setting aside protection areas has been the leading strategy over the past few decades to reverse ongoing biodiversity loss through the protection of habitat. However, “the effectiveness of existing, and the current pace of the establishment of new, protected areas will not be able to overcome current trends of loss of marine and terrestrial biodiversity.” (Mora & Sale, 2011) There is a growing realization that “setting aside conservation areas is just the beginning - effective management action and provision of financial and technical resources are essential if conservation objectives are to be achieved.” In North America the rapid growth of protection areas has “generally been matched by decreasing resources available to manage these areas. Finding innovative financing mechanisms is critical to all future work on protected areas. Harnessing public support, lobbying, and education will help convince government decision makers of the need for more financing.” (UNEP-WCMC, 2008) Moreover, “we also need to ensure that the location and extent of protected areas effectively conserves the Earth's remaining biodiversity. The existing protected area system still falls short of this objective; a recent study (Rodrigues, et al., 2003) identified more than 700 threatened species believed not to occur in any protected area.” (UNEP-WCMC, 2008)

4.2 International Agreements and Treaties

There are criticisms that international agreements and treaties, such as CITES, have “failed to curtail, let alone prevent, illegal trade—especially in species for which demand and market price are extremely high, and they climb ever higher, the closer to extinction a species becomes.” “Demand is growing fast in some of the world’s most dynamic economies, notably China, where parts of many endangered species are used in traditional medicine.” “Elephants and rhinos, which bounced back from the brink of extinction in the 1970s, are again under threat. The illegal ivory trade is reported to have more than doubled since 2007, and increased threefold since 1998. An estimated 25,000 to 30,000 elephants are killed every year in Africa, from a population of 400,000.” (The Economist, 2013)

4.3 Endangered Species Act

There has been some success at the national and state level in the United States in bringing back endangered species from the brink of extinction. In 1982, New Jersey’s only remaining bald eagle nest failed for at least the sixth consecutive year; biologists intervened and removed the egg to artificially incubate allowing the eagle egg to successfully hatch. Between 1983 and 1990 the State also brought in and released 60 young fledgling bald eagles from Canada. In 2012, after nearly 40 years of state and federal endangered species legislation the New Jersey Endangered and Nongame Species Program monitored 135 eagle pairs during the nesting season with 165 young successfully fledged.

5 Defining & Tracking Sustainability

Based on the issues and responses presented above, the following statement is offered to define sustainability for this area:

- **The vision of sustainable biodiversity** is “a world living in harmony with nature and where, by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people” (CBD 2010c Decision X/2). (UNEP, 2011)

The Strategic Plan for Biodiversity 2011–2020, including the Aichi Biodiversity Targets, adopted by the Parties to the Convention on Biological Diversity (CBD) in October 2010, contains five strategic goals and establishes

targets for achieving sustainable biodiversity. These strategic goals are also offered as a further refinement of the conditions necessary for sustainable biodiversity. They are:

- Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society
- Reduce the direct pressures on biodiversity and promote sustainable use
- Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity
- Enhance the benefits to all from biodiversity and ecosystem services
- Enhance implementation through participatory planning, knowledge management and capacity building

See Matrix below for various preliminary metrics and associated targets.

6 Conclusion

Despite a few recent encouraging achievements, such as an agreement after 40 years of fruitless discussion on how to regulate commercially fished oceanic species and the addition of three shark and two manta-ray species to CITIES list, “efforts to address the loss of biodiversity need to be substantially strengthened by reversing detrimental policies, fully integrating biodiversity into broad-scale land-use planning, incorporating its economic value adequately into decision making, and sufficiently targeting, funding and implementing policies that tackle biodiversity loss, among other measures.” (Butchart, et al., 2010)

Strategic Plan for Biodiversity 2011-2020 & Aichi Biodiversity Targets

(Adopted by Convention on Biological Diversity (CBD) 2010)

Goal	Target (By 2020)	Proposed Indicator*	Scale of Analysis
Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society	<ul style="list-style-type: none"> • People are aware of the values of biodiversity and the steps they can take to conserve and use is sustainably • Biodiversity values have been integrated into national and local planning and accounting processes • Incentives harmful to biodiversity are eliminated and incentives for conservation are applied • Governments, businesses and stakeholders at all levels have taken steps to achieve/implement plans for sustainable production/consumption 	<ul style="list-style-type: none"> • Biodiversity Barometer • Ecological Footprint • Status of species in trade • Wild Commodities Index <p>* The Biodiversity Indicators Partnership (BIP) provides information and links to data sources on all proposed indicators.</p>	<ul style="list-style-type: none"> • International • National • State/regional • Local
Reduce the direct pressures on biodiversity and promote sustainable use	<ul style="list-style-type: none"> • Rate of loss of all natural habitats is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced • All fish, invertebrate and aquatic plant stocks are managed and harvested sustainably. Fisheries have no significant adverse impact on threatened species • Areas under agriculture, aquaculture and forestry are managed sustainably • Pollution, including from excess nutrients, has been brought down to levels that are not detrimental to ecosystem functions and biodiversity • Invasive alien species are identified and controlled or eradicated • Multiple anthropogenic pressures on coral reefs and other vulnerable ecosystems impacted by climate change/ocean acidification are minimized 	<ul style="list-style-type: none"> • Red List Index • Extent of forests & forest types • Extent of marine habitats • Living Plant Index • Wild Bird Index • Area of forest under sustainable management • Forest Fragmentation • River fragmentation & flow regulation • Wild Commodities Index • Marine Trophic Index • Proportion of fish stocks in safe biological limits • Number of MSC certified fisheries • Water Quality Index for Biodiversity • Nitrogen deposition 	<ul style="list-style-type: none"> • International • National • State/regional

Goal	Target (By 2020)	Proposed Indicator*	Scale of Analysis
Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity	<ul style="list-style-type: none"> • At least 17% of terrestrial and inland water areas and 10% of coastal marine areas are conserved • Extinction of known threatened species has been prevented and their conservation status has been improved and sustained • Genetic diversity of cultivated plants and farmed and domesticated animals (and wild relatives) is maintained 	<ul style="list-style-type: none"> • Coverage & management effectiveness of protected areas • Protected areas overlays with biodiversity • Red List Index, Living Planet Index, Wild Bird Index • Ex-situ crop collections • Genetic diversity of terrestrial domesticated animals 	<ul style="list-style-type: none"> • International • National • State/regional
Enhance the benefits to all from biodiversity and ecosystem services	<ul style="list-style-type: none"> • Ecosystems that provide essential services (including water) and contribute to health, livelihoods and well-being are restored and safeguarded – taking into account needs of women, indigenous and local communities and the poor and vulnerable • Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational 	<ul style="list-style-type: none"> • Red List Index • Biodiversity for food & medicine • Health & wellbeing of communities directly dependent on ecosystems goods & services • Nutrition indicators for biodiversity • Ratification status of Nagoya Protocol • Increased knowledge among the general population of the value of biodiversity and ecosystems resulting in support for preservations 	<ul style="list-style-type: none"> • International • National • State/regional • Local
Enhance implementation through participatory planning, knowledge management and capacity building	<ul style="list-style-type: none"> • Each Party has developed, adopted and commenced implementing and effective, participatory and updated national biodiversity strategy and action plan (NBSAP) • Traditional knowledge, innovations and practices of indigenous/local communities are respected and integrated at all relevant levels • Knowledge, science based and technologies relating to biodiversity are improved, widely shared and applied • Mobilization of financial resources for effectively implementing the Strategic Plan should increase substantially from current levels – contingent on assessments of needs 	<ul style="list-style-type: none"> • Status of NBSAPs • Number of maintained species inventories being used to implement the CBD • Official development assistance in support of the Convention 	<ul style="list-style-type: none"> • International • National • State/regional • Local

7 Works Cited

- Butchart, S. H., Walpole, M., Bollen, B., van Strien, A., Scharlemann, J. P., Almond, R. E., et al. (2010, May 28). Global Biodiversity: Indicators of Recent Declines. *Science*, 328(5982), 1164-1168.
- CITES. (2013). Retrieved June 2013, from Convention on International Trade in Endangered Species of Wild Fauna and Flora: <http://www.cites.org/>
- Clark, C. W. (1973). The Economics of Overexploitation. *Science*, 181(4100), 630-634.
- Cook, C. (2013, May 28). *Diet for a Dead Planet: Big Business and the Coming Food Crisis*. Retrieved from <http://www.commondreams.org/healine/2013/05/28-6>
- Franklin, A. B., Noon, B. R., & George, T. L. (2002). What is Habitat Fragmentation? *Studies in Avian Biology*, 25, 20-29.
- Hardin, G. (1968). The Tragedy of the Commons. *Science*, 162(3859), 1243-1248.
- IPBES. (2013, May 27). *Even Farmed Plan, Animal Diversity in Decline as Accelerating Wild Species Loss Threatens Humanity: Founding Chair of new world biodiversity body offers first public remarks*. Retrieved from Intergovernmental Platform on Biodiversity and Ecosystems Services: <http://www.ipbes.net/>
- IUCN. (2010). *Summary Statistics: Trends in Biodiversity Status*. Retrieved June 2013, from The IUCN Red List of Threatened Species: <http://www.iucnredlist.org/about/summary-statistics#TrendsInBiodiversityStatus>
- IUCN. (2012). *Numbers of treated species by major groups of organisms (1996-2012)*. Retrieved June 2013, from IUCN Red List: http://www.iucnredlist.org/documents/summarystatistics/2012_2_RL_Stats_Table_1.pdf
- Krauss, J., Bommarco, R., Guardiola, M., Heikkinen, R. K., Helm, A., Kuussaari, M., et al. (2010, May). Habitat fragmentation causes immediate and time-delayed biodiversity loss at different trophic levels. *Ecology Letters*, 13(5), 597-605.
- Mora, C., & Sale, P. F. (2011, July 28). Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea. *Marine Ecology Progress Series*, 434, 251-266.
- Popowski, R., & Clark, K. (2013). *From One to 135: New Jersey's bald eagle success story*. Retrieved from U.S. Fish & Wildlife Service: http://www.fws.gov/endangered/map/ESA_success_stories/NJ/NJ_story2/index.html
- Shochat, E., Lerman, S. B., Anderies, J. M., Warren, P. S., Faeth, S. H., & Nilon, C. H. (2010). Invasion, Competition, and Biodiversity Loss in Urban Ecosystems. *American Institute of Biological Sciences*.

- The Economist. (2013, March 16). *The endangered-species trade: On the way out*. Retrieved June 2013, from The Economist: <http://www.economist.com/blogs/banyan/2013/03/endangered-species-trade>
- UN CBD. (2010, October). *The importance of biodiversity to human health*. Retrieved from Cohabinitiative: Cooperation on Health and Biodiversity: <http://www.cbd.int/doc/health/cohab-policy-brief1-en.pdf>
- UNDP. (2000). *Biodiversity Facts*. Retrieved from Equator Initiative: A Partnership for Resilient Communities: http://www.equatorinitiative.org/index.php?option=com_content&view=article&id=565&Itemid=685
- UNEP. (2011). *Biodiversity*. Retrieved June 2013, from United Nations Environmental Programme: http://www.unep.org/geo/pdfs/geo5/GEO5_report_C5.pdf
- UNEP-WCMC. (2008). *The World's Protected Areas. Status, Values and Prospects in the 21st Century*. Retrieved from United Nations Environmental Programme: World Conservation Monitoring Centre: <http://archive.org/details/worldsprotecteda08chap>
- US FWS. (2013). *ESA Basics*. Retrieved from U.S. Fish & Wildlife Service: http://www.fws.gov/endangered/esa-library/pdf/ESA_basics.pdf
- WWF. (2013). *Illegal Wildlife Trade*. Retrieved June 2013, from World Wildlife Federation: <http://worldwildlife.org/threats/illegal-wildlife-trade>

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