Earth Optimism: Success Stories in Plant Conservation[1]

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Abstract. Target 14 of the Global Strategy for Plant Conservation calls for an increase in the communication of the importance of plant diversity and conservation into education and public awareness programs. An unrelenting torrent of bad news about the environment and the loss of plant biodiversity, however, have led to despair among conservation practitioners and the public. Much of the damage to terrestrial habitats and the loss of plant biodiversity stem from problems that both biologists and the public can do something about. Indeed, the past decades have witnessed a growing number of successes in describing new species, saving species, protecting places, and restoring habitats. A number of plant species have come back from the brink of extinction and are being delisted. Priority areas for conservation are being identified and these areas are being established as protected nature reserves. Habitats once degraded by farming have been ecologically restored with native plant species. These and other examples underpin the Earth Optimism initiative that seeks to recognize, learn from, replicate, scale up and celebrate our successes as a means to motivate further action.

Key Words: conservation, Global Strategy for Plant Conservation (GSPC), recovery, restoration, success

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Introduction

The seemingly never ending onslaught of bad news about the environment has led to a profound attitude shift in the public and even among many conservation biologists over the last half century, from unbounded optimism to overwhelming despair (e.g., Beever, 2000; Orr, 2004, 2007; Webb, 2005; Swaisgood & Sheppard 2010). When examining the global state of plant species specifically, bad news is evident. Of the estimated 300,000 to 420,000 described and undescribed plant species (Prance et al.

2000; Govaerts, 2001; Thorne, 2002; Mora et al., 2011), an estimated 94,000 to 193,000 species are threatened with extinction worldwide (Pitman & Jørgensen, 2002). Over 15 million hectares of tropical rain forest is lost each year (Bradshaw et al., 2009), and predictions show that Southeast Asia may lose up to three-quarters of its original forests by 2100 (Sodhi et al., 2004).

These sobering statistics are reflected in curricula and the media, and stand in contrast to other scientific disciplines where new discoveries are often cause for excitement and optimism. In high school and college classes in ecology and conservation biology, students are overwhelmed with stories of gloom, whereas in other science classes, a celebration often occurs with the discovery of new planets and solar systems, new chemical inventions, and new medical treatments (Swaisgood & Sheppard, 2010). The contrast between human medicine and conservation is particularly striking – medical students are taught how to make and keep people healthier while conservation biologists often seem to teach students how to write ever more refined obituaries of nature. News headlines about discoveries in conservation focus on the harmful effects of global warming, the decline of pollinators due to pesticide usage, and the loss of amphibians due to fungal infection.

It is the duty of biologists working in the field of conservation to alert fellow scientists and the public to expanding and impending environmental problems. However, is there such a thing as too much bad news? Conservation professionals have come to the conclusion that messages of doom and gloom do not, on their own, motivate people to behave in a more nature-friendly fashion (Knight, 2013) – recognition of a problem needs to be coupled with ideas or examples of solutions. Nevertheless, it is doom and gloom

that still dominates much of the conservation conversation. This is perhaps unsurprising in the media, where "if it bleeds, it leads" remains the prevailing dictum in the newsroom. Whatever the cause, students and the general public overall are inundated with depressing news about the state of Earth's environment.

The result is that many feel that making a difference does not really make a difference. It is not just one problem, the ozone layer or DDT, but many problems, some of which are daunting in scale. And when we are overwhelmed with many problems, it becomes easier to just tune out the bad news. An Australian survey of pre-teens and teens found that a quarter believe that the world will come to an end before they get older (Tucci et al., 2007). When people sign up to receive e-newsletters from environmental advocacy groups, they hope to stay abreast of the latest environmental news and hope to receive useful information about what they can do as citizens to make the Earth a healthier place to live. But if their daily email is inundated with depressing news about the world in crisis, many individuals will feel helpless and disengage.

What is perhaps more surprising is that professionals in the field of conservation biology are often unaware or at least silent on the subject of the many successes that have occurred. At times it seems as if a reverse form of the shifting baselines syndrome is at work, where we forget how bad things once were. Evidence for this can be seen in the proceedings of scientific meetings. Conservation biology should be about fixing problems, but the abstracts of oral and poster presentations often fail to include positive and hopeful words like *improved*, *success*, and *recovery* (Fig. 1).

To halt the current and continuing loss of plant diversity, the Global Strategy for Plant Conservation (GSPC) (http://www.cbd.int/gspc/) was adopted at the sixth meeting

of the Conference of the Parties to the Convention on Biological Diversity in 2002. The unique attribute of the Strategy was the inclusion of 16 outcome-oriented targets, established and designed to explicitly address the survival and sustainable use of the world's plant biodiversity (GSPC, 2002). The GSPC is essentially an optimistic document, as are many of its targets. When the original 2010 deadline came, considerable progress had been made toward achieving eight of the 16 targets at the global level, but limited progress had been made in achieving the others (https://www.cbd.int/doc/meetings/cop/cop-09/information/cop-09-inf-25-en.pdf). The GSPC was revised in 2010 with modified targets and an extended deadline of 2020 (Convention on Biological Diversity, 2010).

Botanists have the additional burden of overcoming plant blindness in both the public realm and government policy, especially when it comes to biases, such as valuing animals over plants, in conservation action (Balding & Williams, 2016). GSPC Target 14 highlights the importance of plant diversity and the need for its conservation to be incorporated into communication, education and public awareness programs. In this contribution, we argue for the inclusion of messages of hope and optimism in our plant communication efforts, and not only to inspire the general public. At the 2016 IUCN World Conservation Congress in Honolulu, Hawaii, Tom Lovejoy said, "When asked if I'm an optimist or a pessimist, I say there's only one option. Otherwise it's too much to bear."

Reasons for Optimism

Conservation efforts are never-ending and species and ecosystems will never be fully protected in perpetuity without consistent protection and management. This means that success, and for that matter science itself, is always a work in progress. With that in mind, here we present four reasons for optimism—discovering species, saving species, protecting spaces, and restoring habitats—and a number of case studies and stories that showcase hope and optimism. Some examples come from small groups of people with little money succeeding through the power of community, while other examples are top-down efforts that show how governments and large scale initiatives can make a difference. This is not meant to serve as an exhaustive list or overview, but rather to give a sense of some recent accomplishments.

Discovering Species

Target 1 of the GSPC calls for an online flora of all known plants. A working list of all known plant species is available at The Plant List (http://www.theplantlist.org/), and work has begun on the next stage of this target to create an online flora. According to the Royal Botanical Gardens Kew (RBG Kew, 2016), the number of newly described vascular species described each year exceeds 2,000 for the past decade, with 2,034 new species in 2015.

With enough effort, we are less than 50 years away from discovering and describing the last new species of plant on Earth (Kress & Krupnick, 2005; Wheeler et al., 2012). Image-recognition software, electronic field guides, advanced cyberinfrastructure, and fully referenced and digitized herbarium collections will aid in this effort. Further, new methods in molecular biology, such as DNA barcoding, have

proven to be cost-effective tools in identifying new species (Kress & Erickson, 2008; Lahaye et al., 2008; Hollingsworth et al., 2009) and in reconstructing plant-animal networks (García-Robledo et al., 2013), which can assist in the conservation and management of newly discovered interactions.

When new species are discovered, a wave of excitement can spread through social media. New discoveries give a sense of awe and wonder, and can encourage young explorers. Some surprising examples concern new plant species that had been in local use for a long time before scientists described them, such as *Globba sherwoodiana* W.J. Kress & V. Gowda, which was commonly sold in the markets of Myanmar (Gowda et al., 2012), or *Monstera maderaverde* Grayum & Karney, which had been used by local Hondurans in hat weaving (Karney & Grayum, 2012).

In addition to finding new species, the discovery of species and populations either once thought extinct or unseen over decades can add to the feeling of hope and optimism. Many examples exist around the world. For instance, in 2012, a population of 30 individuals of *Lysimachia venosa* (Wawra) H. St. John was rediscovered in Kauai, Hawaii after not being seen for 101 years (Wood, 2013). After further surveys, in 2015, an additional two small populations of this species were found flowering (Plant Extinction Plant Program, 2015).

On occasion, these discoveries can occur within or close to heavily populated urban areas. One example is *Eriogonum truncatum* Torr. & A.Gray, the annual Mount Diablo buckwheat, known only from Mount Diablo in the eastern San Francisco Bay area of northern California. It was thought to have been extinct since its last sighting in 1936

but was rediscovered by a graduate student in 2005 (University of California Berkeley, 2005).

Perhaps the most famous recent botanical rediscovery was the finding of *Wollemia nobilis* W.G.Jones, K.D.Hill & J.M.Allen, the Wollemi pine. Known only through the fossil record that dates back 90 million years ago (Dettmann & Clifford, 2005), a population of the coniferous tree was discovered in 1994 in Wollemi National Park, a protected site approximately 200 kilometers west of Sydney, Australia (Thomas, 2011).

Saving Species

Four GSPC targets are directly focused on saving plant species: Target 7 calls for at least 75% of known threatened plant species to be conserved in situ; Target 8 calls for at least 75% of threatened plant species to be in ex situ collections, preferably in the country of origin, and at least 20% available for recovery and restoration programs; Target 11 calls for no species of wild flora to be endangered by international trade; and Target 12 calls for all wild-harvested plant-based products to be sourced sustainably. Likewise, the Aichi Biodiversity Target 12 calls for the extinction of known threatened species to be prevented and their conservation status, particularly of those most in decline, to be improved and sustained.

In the United States, 902 plant species are currently listed under the Endangered Species Act. Of those plant species, three are currently proposed for delisting due to recovery: *Oenothera avita* ssp. *eurekensis* (Munz & J.C. Roos) W.M. Klein, *Solidago albopilosa* E.L. Braun, and *Swallenia alexandrae* (Swallen) Soderstr. & H.P. Decker.

Five other plant species previously listed have already been delisted due to recovery: *Echinacea tennesseensis* (Beadle) Small, *Erigeron maguirei* Cronquist, *Frankenia johnstonii* Correll, *Helianthus eggertii* Small, and *Potentilla robbinsiana* (Lehm.) Oakes ex Rydb.

Delisting is often the result of diverse, coordinated efforts. *Echinacea tennesseensis*, the Tennessee purple coneflower, is a species with a limited distribution, found only on limestone cedar habitats in three counties in middle Tennessee. It was listed in 1979 due to its extremely limited range and threats from urbanization, fire suppression, grazing, and mowing. The species recovered, aided by purchase of habitat by the Nature Conservancy and the State of Tennessee, active management in invasive species control, and prescribed burns. New colonies were established from propagated plants, all of which are now self-sustaining and adequately protected (Bowen, 2011). The species was delisted in 2011.

Many localities throughout the world have programs devoted to reestablishing populations of rare and endangered plants. One such program is the Plant Extinction Prevention Program (PEPP), established in 1990 to protect Hawaii's rarest plant species. The program has developed a list of "PEP species," those in which fewer than 50 plants remain in the wild. Their 5-pronged approach to prevent plant extinction is to (1) manage threats to protect the remaining wild plants (i.e., "founders"), (2) monitor the founders, (3) collect propagules, (4) establish new populations (reintroductions) or bolster existing populations (augmentation), and (5) survey for new founders. In 2015, 238 plant species were listed on the PEP list, and recovery actions were implemented for 148 of these (Plant Extinction Plant Program 2015). That same year, PEPP reintroduced 1,480

individual plants, representing 35 PEP species and 13 other rare Hawaiian species. It is hoped that these recent out-plantings will lead to self-sustaining wild populations.

One example of a successful reintroduction is *Argyroxiphium sandwicense* subsp. *sandwicense* DC., the Big Island silversword. Once an abundant and iconic species, the silversword populations had dwindled drastically due to the grazing of feral ungulates. When the species was added to the PEP list, there were only 15 individuals remaining in the wild. Through the efforts of both government and non-government partnering groups, there are now 13,600 individuals on Mauna Kea, a remarkable recovery.

Even with just one plant left in the wild, PEPP has not given up hope. When *Cyanea pinnatifida* (Cham.) E. Wimm. was federally listed as an endangered species in 1991, only one individual remained in the southern Waianae mountains of Oahu, and that individual died in 2001 (USFWS, 2007). However, hundreds of seedlings of this species propagated at the University of Hawaii's Lyon Arboretum have now been planted within its historical range (Fig. 2).

Examples outside of Hawaii are also plentiful. In New Zealand, a white variant of an endemic plant, *Clianthus puniceus* (G. Don) Lindl., was pushed to the brink of extinction in the wild due to competition with invasive plant species and herbivory by introduced mammals and mollusks (Shaw & Burns, 1997). Through ex situ seed conservation measures, 100 plants were recently grown from seed and planted within its native range (Office of the Minister of Conservation, 2015).

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is the leading coordinating agency for the implementation, monitoring, and review of Target 11. There are approximately 300 plant species listed in CITES

Appendix I and over 28,000 species (including all members of the orchid and cactus families) listed in Appendix II. These plant species are monitored through the issue and control of export and import permits. New technologies, such as DNA barcoding, are being developed to assist in identifying highly-traded species listed under CITES (Kress & Erickson, 2008; Lahaye et al., 2008; Hollingsworth et al., 2009). With advanced technology, custom officers may one day be able to positively identify plant species and plant fragments (lumber, handcrafted wood), and distinguish those that are listed in Appendix I from Appendix II and those not listed by CITES (Lahaye et al., 2008).

Unsustainable harvesting practices of wild plants such as non-timber forest products (NTFP) are widespread, and are major problems particularly in Africa (Ndangalasi et al., 2007), India (Veach et al., 2003), Southeast Asia (Soehartono & Newton, 2001, Van Sam et al., 2008), and South America (Peres et al., 2003). Not all harvesting practices are unsustainable, and the current challenge among practitioners is finding the balance between maintaining population viability of the harvested species while supplying adequate household incomes to those who harvest the plants (Shaanker et al., 2004). Endress et al. (2006) examined the effects of several leaf harvest treatments on the Mexican palm *Chamaedorea radicalis* Mart. over a 6-year period, and was able to provide recommendations for sustainable harvest of this species with only a few modifications of current harvest practices.

Protecting Spaces

The foremost causes of local plant extinctions and species endangerment globally are habitat destruction and deforestation (Dirzo & Raven, 2003; Rodrigues et al., 2006;

Wright, 2010). Three targets of the GSPC directly address protecting and managing habitats to prevent destruction and alteration: Target 4 calls for at least 15% of each ecological region or vegetation type to be secured through effective management and/or restoration. Target 5 calls for at least 75% of the most important areas for plant diversity of each ecological region to be protected with effective management in place for conserving plants and their genetic diversity. Target 10 calls for effective management plans to be in place to prevent new biological invasions and to manage important areas for plant diversity that are invaded. In addition, the Aichi Biodiversity Target 11 calls for at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, to be conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures that are integrated into the wider landscapes and seascapes.

According to a recent report by UNEP-WCMC & IUCN (2016), a total of 202,467 protected areas currently exist, accounting for 14.7% of Earth's land. Countries with the largest proportion of their land protected are in the Latin American and Caribbean regions, with Brazil having the world's largest protected land area of 2.47 million km^2 (approximately 30% of Brazil's land area).

Envisioning even larger targets than set forth by GSPC is the Half-Earth campaign and project of the E.O. Wilson Foundation. While some have argued that we should adjust our expectations of land protection downward (Webb, 2005), Wilson states that the only way to save the environment and maintain sustainability is to take a giant leap, by raising the area reserved for natural species and ecosystems from the present

15% of the land and 3% of the sea, to 50% of both the land and the sea (Wilson, 2016). To achieve these ambitious goals, cooperation and joint efforts between governments, non-government organizations and private landowners will need to increase dramatically, but there are some promising steps being taken in this regard.

On May 9, 2016, Cambodia issued a sub-decree declaring the creation of the new Southern Cardamom National Park (Erickson-Davis, 2016). The new park is the final and critical piece that connects six major national parks and wildlife sanctuaries. It now forms a massive contiguous mega-protected area spanning a total of more than 2,000,000 hectares. Two non-government organizations (NGOs), Wildlife Alliance and Rainforest Trust, spearheaded the campaign for the creation of the park.

In April 2016, the NGO Nature and Culture International (NCI) announced the creation of a 27,095 hectare protected area in northern Peru, the Chicuate Chinguelas Private Conservation Area (Gaworecki, 2016). The new conservation area in the Huancabamba Province will protect 30% of the region's montane forests. These forests are home to the endangered palm, *Ceroxylon parvifrons* (Engel) H. Wendl., and the podocarp tree *Podocarpus oleifolius* D. Don, which is protected under Peruvian law but still targeted by illegal loggers. NCI worked closely with the community of Segunda y Cajas, the Provincial Municipality of Huancabamba, and the Regional Government of Piura to ensure that the area became protected.

Over the course of 25 years, the Conservation Land Trust, through large-scale private land acquisition, has protected nearly 900,000 hectares of land in South America. After purchasing land, the foundation worked with philanthropists and the Chilean and

Argentinian governments to create and expand ten national parks in Chile and Argentina, guaranteeing long-term conservation.

In 2016, the United States designated about 35,400 hectares in the state of Maine as the Katahdin Woods and Waters National Monument. The land was a private donation to the federal government, and is now the largest region of federal parkland in that state.

And there are more positive steps in the works. For example, during the 2016 IUCN World Conservation Congress in Honolulu, Hawaii, Alejandro Del Mazo, the National Commissioner for Natural Protected Areas of Mexico, was quoted as saying, "By the end of this year, all the islands of Mexico will be protected areas."

Even though a space may be protected, that habitat may still encounter loss or widespread biodiversity decline of species and populations due to the effects of climate change and invasive species (Krupnick, 2013). Laurance et al. (2012) found that over the past 20 to 30 years, about four-fifths of the 60 tropical protected areas examined are declining in health, and for 50% of these reserves the decline was relatively serious. However, those results were primarily based upon expert opinion rather than empirical studies. In a contrasting sign of hope and optimism, Beaudrot et al. (2016) found, using camera trap analyses of bird and mammal species in tropical forested protected areas, that the number and distribution of species did not decline during a 3-8 year examination period.

One way to increase the effective management of protected areas is to monitor illegal logging and encroachment in real time, and there are positive developments in this area as well. Global Forest Watch (http://www.globalforestwatch.org/) is an interactive, open source, online forest monitoring and alert system that uses satellite technology, data

sharing, crowdsourcing, and human networks around the world to monitor and address illegal logging, burning, and deforestation. The new technology offers near-real-time alerts that show locations of recent tree cover loss.

Restoring Habitats

The same targets mentioned in "Protecting Spaces" above (Targets 4, 5, and 10) are also related to restoring habitats, since habitat restoration involves effective management and control of biological invasive species. The Bonn Challenge, an initiative launched in 2011 by Germany and the IUCN, is a global effort to restore 150 million hectares of degraded and deforested land by 2020, and 350 million hectares by 2030. As of September 2016, 36 governments, organizations, and companies have pledged to restore 113 million hectares, bringing the 150 million target within reach (http://www.iucnworldconservationcongress.org/news/20160904/article/bonn-challenge-approaches-target-restore-150-million-hectares-degraded-land).

On a broad scale, forest recovery has recently been seen in the Caribbean (Cuba, Puerto Rico, and Haiti), Mexico, and Central America (Honduras, Costa Rica, and El Salvador), primarily in tropical moist forests at high elevation (Aide et al., 2013). The study was based on satellite imagery, and thus the authors could not separate natural regeneration or direct human intervention as explanations for woody vegetation gain.

New approaches to the large-scale restoration of tropical habitats is reviewed in Krupnick (2013). One method currently receiving attention is the development and use of unmanned aerial vehicles (drones). Aerial reseeding using planes and helicopters is being utilized to revegetate temperate areas of China (Wenhua, 2004). Opportunities for aerial

reseeding using drones, which are cheaper than helicopters and less dangerous in mountainous areas, are being considered in areas such as Thailand (Sutherland et al., 2013). Drones also have the potential for remote sensing of forest cover, species distributions, and illegal harvesting of timber (Koh & Wich, 2012).

Flagship studies in northwestern Costa Rica (Janzen, 2002) and southeastern Brazil (Rodrigues et al. 2010) serve as excellent examples of large-scale restoration efforts in the tropics. These sophisticated efforts have set an inspirational standard for future projects in restoration biology that can be replicated in other areas around the world.

On a smaller scale are examples of community-based conservation and restoration efforts, such as the recent efforts in 11 locations in Madagascar led by the Missouri Botanical Garden. In Vohibe, Madagascar, for instance, 50,000 seedlings were produced and planted in 14 hectares of anthropogenically cleared land over a six-year period (Birkinshaw et al., 2013). The authors of the study state that additional educational outreach and visibility are required to emphasize the importance of restoration in communities reluctant to adopt such approaches.

Efforts by individuals can also make important contributions. Eastern Oregon University agronomist Andy Huber, who began acquiring land in the Grande Ronde Valley of Oregon, created a non-profit native plant reserve that he named “Grande Ronde Overlook Wildflower Institute Serving Ecological Restoration” (GROWISER). In addition to restoring 220 acres of forest and grassland, the preserve protects over 200 species of native plants and serves as a site for propagating native seeds and restoring plant populations. The preserve is the only site in the United States where *Cypripedium*

montanum Douglas ex Lindl., mountain lady's slipper orchids, are grown from seed (Huber, 2002).

To change attitudes and practices, conservation practitioners are increasingly engaging private landowners in restoration projects (Wiederholt et al., 2015). The use of native plant species in the active management of suburban yards, public school grounds, urban community gardens, and agricultural lands is being targeted. The Million Pollinator Garden Challenge (http://millionpollinatorgardens.org/) in the United States is a campaign to register a million public and private gardens and landscapes that use host forage plants to support pollinators. As of October 2016, the site had registered just over 200,000 gardens and was making a push to register a million by the end of 2017. The Challenge has not only attracted the attention of U.S. households and school groups, but citizens have registered their gardens in Canada and Mexico, and in sites in South America, Europe, Asia, and Australia.

Moving Forward

It has been argued that conservation biologists can increase their effectiveness by balancing environmental warnings with optimism (Beever 2000), while being cognizant of not pushing forward hope that is based on blissful ignorance of the problems of the world (Noss, 1995). Suggested solutions for overcoming despair include organizing special symposia and workshops that inspire hope at international conferences and encouraging authors of papers in conservation-oriented journals to explain clearly how their research or ideas may help solve conservation problems (Webb, 2005; Swaisgood & Sheppard, 2010). In this way, authors and speakers can show how plant conservation can

be and is being achieved and they can suggest ways that future work could build on success stories. Earth optimism should aim to be a momentum-building enterprise - as more success is realized in plant conservation, more work in plant conservation should be done.

Social media is another useful tool where the message of hope travels faster than those of doom. Since emotions are often contagious, social media serves as an ideal platform for conservation biologists where the optimism message can spread successfully (Kelsey, 2016).

With this in mind, in 2014, a small group of marine biologists, conservationists and media professionals coined the Twitter hashtag #OceanOptimism and asked their friends and colleagues to use it starting on World Oceans Day. It has since grown enormously, with over 55,000 tweets, over 22,000 contributors (including major organizations like Huffington Post and the World Bank), and over 70 million accounts reached. Use of the hashtag makes it easier to find stories, find research, find successes, and communicate quickly.

This effort is now expanding from the marine realm to the planetary realm, with the Earth Optimism initiative. As with Ocean Optimism, the goal is not to brush aside the bad news, but rather inspire the replication and scaling up of successful conservation actions. A Global Earth Optimism Summit (http://earthoptimism.si.edu), hosted by the Smithsonian Institution, is scheduled to occur over Earth Day weekend, 21-23 April 2017, in Washington, DC. Satellite events (e.g. https://www.conservationoptimism.org/, http://earthdaytx.org/) will be organized by others and hosted at universities, zoos, and botanical gardens around the world. The goal of the summit is to publicize and promote

conservation best practices with academic colleagues, thought leaders, practitioners, international media, policy makers, philanthropists, and planet savvy citizens, and to bring together not only natural scientists but also social scientists, artists, and humanists. Summit events will be live-streamed, and a record will be preserved for distribution in a variety of formats, including a curated web-based story bank that will continue to collect many of the successes that have been achieved so that they can be shared, discussed and propagated. We expect the success of the meeting will lead to a series of Earth Optimism Summits in subsequent years.

Literature Cited

Aide, T. M., M. L. Clark, H. R. Grau, D. López-Carr, M. A. Levy, D. Redo, M. Bonilla-Moheno, G. Riner, M. J. Andrade-Núñez & M. Muñiz. 2013. Deforestation and reforestation of Latin America and the Caribbean (2001–2010). Biotropica 45: 262–271.

Balding, M. & J. H. Williams, K. 2016. Plant blindness and the implications for plant conservation. Conserv. Biol. DOI: 10.1111/cobi.12738

Beever, E. 2000. The roles of optimism in conservation biology. Conserv. Biol. 14(3): 907–909.

Beaudrot, L., J. A. Ahumada, T. O'Brien, P. Alvarez-Loayza, K. Boekee, A. Campos-Arceiz, D. Eichberg, S. Espinosa, E. Fegraus, C. Fletcher, K. Gajapersad, C. Hallam, J. Hurtado, P. A. Jansen, A. Kumar, E. Larney, M. G. M. Lima, C. Mahony, E. H. Martin, A. McWilliam, B. Mugerwa, M. Ndoundou-Hockemba, J. C. Razafimahaimodison, H. Romero-Saltos, F. Rovero, J. Salvador, F. Santos, D. Sheil,

W. R. Spironello, M. R. Willig, N. L. Winarni, A. Zvoleff & S. J. Andelman. 2016. Standardized assessment of biodiversity trends in tropical forest protected areas: The end is not in sight. PLoS. Biol. 14: e1002357.

Birkinshaw, C., Lowry, P.P., Raharimampionona, J., and Aronson, J. 2013. Supporting Target 4 of the Global Strategy for Plant Conservation by integrating ecological restoration into the Missouri Botanical Garden's conservation program in Madagascar. *Ann. Mo. Bot. Garden* 99(2): 139–146.

Bowen, B. 2011. Natural areas protection at its best; protecting the Tennessee purple coneflower (*Echinacea tennesseensis*). *Nat. Areas J.* 31(4): 326–330. http://dx.doi.org/10.3375/043.031.0402

Bradshaw, C. J. A., N. S. Sodhi & B. W. Brook. 2009. Tropical turmoil: a biodiversity tragedy in progress. Front. Ecol. Environ. 7(2): 79–87.

Convention on Biological Diversity. 2010. Global Strategy for Plant Conservation: Technical Rationale, Justification for Updating and Suggested Milestones and Indicators. UNEP/CBD/COP, October 2010.

Dettmann, M.E. & H.T. Clifford. 2005. Biogeography of Araucariaceae. Pp. 1-9 *in* J. Dargavel (editor). Australian and New Zealand Forest Histories. Araucarian Forests. Australian Forest History Society, Kingston, Australia.

Dirzo, R. & P. H. Raven. 2003. Global state of biodiversity and loss. Ann. Rev. Environ. Resour. 28: 137–167.

Endress, B. A., D. L. Gorchov & E. J. Berry. 2006. Sustainability of a non-timber forest product: effects of alternative leaf harvest practices over 6 years on yield and demography of the palm *Chamaedorea radicalis*. For. Ecol. Manag. 234: 181–191.

Erickson-Davis, M. 2016. Cambodia declares new national park, plans to reintroduce tigers. Mongabay, 1 June 2016. <https://news.mongabay.com/2016/06/cambodia-declares-new-national-park-plans-to-reintroduce-tigers/>, accessed 1 October 2016.

García-Robledo, C., D. L. Erickson, C. L. Staines, T. L. Erwin & W. J. Kress. 2013. Tropical plant-herbivore networks: reconstructing species interactions using DNA barcodes. PLoS ONE 8: e52967.

Gaworecki, M. 2016. Private conservation area in northern Peru will protect 30 percent of region's montane forests. Mongabay, 14 June 2016. <https://news.mongabay.com/2016/06/private-conservation-area-in-northern-peru-will-protect-30-percent-of-regions-montane-forests/>, accessed 1 October 2016.

Govaerts, R. 2001. How many species of seed plants are there? Taxon 50(4): 1085–1090.

Gowda, V., W. J. Kress & T. Htun. 2012. Two new species of gingers (Zingiberaceae) from Myanmar. PhytoKeys 13: 5–14.

GSPC. 2002. Global Strategy for Plant Conservation. The Secretariat of the Convention on Biological Diversity, Montreal, Canada.

Hollingsworth, P. M., L. L. Forrest, J. L. Spouge, M. Hajibabaei, S. Ratnasingham, M. Van Der Bank, M. W. Chase, R. S. Cowan, D. L. Erickson, A. J. Fazekas, S. W. Graham, K. E. James, K.-J. Kim, W. J. Kress, H. Schneider, J. Van Alphenstahl, S. C. H. Barrett, C. Van Den Berg, D. Bogarin, K. S. Burgess, K. M. Cameron, M. Carine, J. Chacon, A. Clark, J. J. Clarkson, F. Conrad, D. S. Devey, C. S. Ford, T. A. J. Hedderson, M. L. Hollingsworth, B. C. Husband, L. J. Kelly, P. R. Kesanakurti, J. S. Kim, Y.-D. Kim, R. Lahaye, H.-L. Lee, D. G. Long, S. Madrinan, O. Maurin, I. Meusnier, S. G. Newmaster, C.-W. Park, D. M. Percy, G. Petersen, J. E. Richardson,

G. A. Salazar, V. Savolainen, O. Seberg, M. J. Wilkinson, D.-K. Yi & D. P. Little. 2009. A DNA barcode for land plants. Proc. Natl. Acad. Sci. USA 106: 12794–12797.

Huber, A.G. 2002. Mountain lady's slipper (*Cypripedium montanum*) establishment from seeds in forest openings. *Native Plants J.* 3(2): 151–154.

Janzen, D.H. 2002. Tropical dry forest restoration: Area de Conservación Guanacaste, northwestern Costa Rica. Pp. 559-584 *in* M. R. Perrow & A. J. Davy (editors), Handbook of Ecological Restoration, Vol. 2. Restoration in Practice. Cambridge University Press, Cambridge.

Karney, A. P. & M. H. Grayum. 2012. A new *Monstera* species (Araceae) of economic importance from Honduras. Econ. Bot. 66: 207–213.

Kelsey, E. 2016. The rise of ocean optimism. Hakai Magazine. 8 June 2016. <http://bit.ly/1sZLBH8>, accessed 1 October 2016.

Knight, A. T. 2013. Reframing the theory of hope in conservation science. Conserv. Lett. 6(6): 389-390.

Koh, L. P. & S. A. Wich. 2012. Dawn of drone ecology: low-cost autonomous aerial vehicles for conservation. Trop. Conserv. Sci. 5: 121–132.

Kress, W. J. & D. L. Erickson. 2008. DNA barcoding - a windfall for tropical biology? Biotropica 40: 405–408.

Kress, W. J. & G. A. Krupnick. 2005. Documenting and conserving plant diversity in the future. Pp. 313-318 i*n* G. A. Krupnick & W. J. Kress (editors), Plant Conservation: A Natural History Approach,. University of Chicago Press, Chicago and London.

Krupnick, G.A. 2013. Conservation of tropical plant biodiversity: what have we done, where are we going? Biotropica 45(6): 693–708.

Lahaye, R., M. Van Der Bank, D. Bogarin, J. Warner, F. Pupulin, G. Gigot, O. Maurin, S. Duthoit, T. G. Barraclough & V. Savolainen. 2008. DNA barcoding the floras of biodiversity hotspots. Proc. Natl. Acad. Sci. USA 105: 2923–2928.

Laurance, W. F., D. C. Useche, J. Rendeiro, M. Kalka, C. J. A. Bradshaw, S. P. Sloan, S. G. Laurance, M. Campbell, K. Abernethy, P. Alvarez, V. Arroyo-Rodriguez, P. Ashton, J. Benítez-Malvido, A. Blom, K. S. Bobo, C. H. Cannon, M. Cao, R. Carroll, C. Chapman, R. Coates, M. Cords, F. Danielsen, B. De Dijn, E. Dinerstein, M. A. Donnelly, D. Edwards, F. Edwards, N. Farwig, P. Fashing, P. M. Forget, M. Foster, G. Gale, D. Harris, R. Harrison, J. Hart, S. Karpanty, W. J. Kress, J. Krishnaswamy, W. Logsdon, J. Lovett, W. Magnusson, F. Maisels, A. R. Marshall, D. Mcclearn, D. Mudappa, M. R. Nielsen, R. Pearson, N. Pitman, J. Van Der Ploeg, A. Plumptre, J. Poulsen, M. Quesada, H. Rainey, D. Robinson, C. Roetgers, F. Rovero, F. Scatena, C. Schulze, D. Sheil, T. Struhsaker, J. Terborgh, D. Thomas, R. Timm, J. N. Urbina-Cardona, K. Vasudevan, S. J. Wright, J. C. Arias-G, L. Arroyo, M. Ashton, P. Auzel, D. Babaasa, F. Babweteera, P. Baker, O. Banki, M. Bass, I. Bila-Isia, S. Blake, W. Brockelman, N. Brokaw, C. A. Brühl, S. Bunyavejchewin, J. T. Chao, J. Chave, R. Chellam, C. J. Clark, J. Clavijo, R. Congdon, R. Corlett, H. S. Dattaraja, C. Dave, G. Davies, B. D. Beisiegel, R. D. Da Silva, A. Di Fiore, A. Diesmos, R. Dirzo, D. Doran-Sheehy, M. Eaton, L. Emmons, A. Estrada, C. Ewango, L. Fedigan, F. Feer, B. Fruth, J. Giacalone Willis, U. Goodale, S. Goodman, J. C. Guix, P. Guthiga, W. Haber, K. Hamer, I. Herbinger, J. Hill, Z. L. Huang, I. F. Sun, K. Ickes, A. Itoh, N.

Ivanauskas, B. Jackes, J. Janovec, D. Janzen, M. Jiangming, C. Jin, T. Jones, H. Justiniano, E. Kalko, A. Kasangaki, T. Killeen, H. B. King, E. Klop, C. Knott, I. Koné, E. Kudavidanage, J. Lahoz Da Silva Ribeiro, J. Lattke, R. Laval, R. Lawton, M. Leal, M. Leighton, M. Lentino, C. Leonel, J. Lindsell, L. Ling-Ling, K. E. Linsenmair, E. Losos, A. Lugo, J. Lwanga, A. L. Mack, M. Martins, W. S. Mcgraw, R. Mcnab, L. Montag, J. Myers Thompson, J. Nabe-Nielsen, M. Nakagawa, S. Nepal, M. Norconk, V. Novotny, S. O'donnell, M. Opiang, P. Ouboter, K. Parker, N. Parthasarathy, K. Pisciotta, D. Prawiradilaga, C. Pringle, S. Rajathurai, U. Reichard, G. Reinartz, K. Renton, G. Reynolds, V. Reynolds, E. Riley, M. O. Rödel, J. Rothman, P. Round, S. Sakai, T. Sanaiotti, T. Savini, G. Schaab, J. Seidensticker, A. Siaka, M. R. Silman, T. B. Smith, S. Soares De Almeida, N. Sodhi, C. Stanford, K. Stewart, E. Stokes, K. E. Stoner, R. Sukumar, M. Surbeck, M. Tobler, T. Tscharntke, A. Turkalo, G. Umapathy, M. Van Weerd, J. Vega Rivera, M. Venkataraman, L. Venn, C. Verea, C. Volkmer De Castilho, M. Waltert, B. Wang, D. Watts, W. Weber, P. West, D. Whitacre, K. Whitney, D. Wilkie, S. Williams, D. D. Wright, P. Wright, L. Xiankai, P. Yonzon & F. Zamzani. 2012. Averting biodiversity collapse in tropical forest protected areas. Nature 489: 290–294.

Mora, C., D. P. Tittensor, S. Adl, A. G. B. Simpson & B. Worm. 2011. How many species are there on Earth and in the ocean? PLoS. Biol. 9: e1001127.

Ndangalasi, H. J., R. Bitariho & D. B. K. Dovie. 2007. Harvesting of non-timber forest products and implications for conservation in two montane forests of East Africa. Biol. Conserv. 134: 242–250.

Noss. R. F. 1995. The perils of Pollyannas. Conserv. Biol. 9: 701–703

Office of the Minister of Conservation. 2015. White kakabeak returns from brink of extinction. Department of Conservation, 23 October 2015. <http://www.doc.govt.nz/news/media-releases/2015/white-kakabeak-returns-from-brink-of-extinction/>, accessed 1 October 2016.

Orr, D. W. 2004. Hope in hard times. Conserv. Biol. 18(2): 295–298.

Orr, D. W. 2007. Optimism and hope in a hotter time. Conserv. Biol. 21(6): 1392–1395.

Peres, C. A., C. Baider, P. A. Zuidema, L. H. O. Wadt, K. A. Kainer, D. A. P. Gomes-Silva, R. P. Salomão, L. L. Simões, E. R. N. Franciosi, F. Cornejo Valverde, R. Gribel, G. H. Shepard, M. Kanashiro, P. Coventry, D. W. Yu, A. R. Watkinson & R. P. Freckleton. 2003. Demographic threats to the sustainability of Brazil nut exploitation. Science 302: 2112–2114.

Pitman, N. C. A. & P. M. Jørgensen. 2002. Estimating the size of the world's threatened flora. Science 298(5595): 989.

Plant Extinction Plant Program. 2015. Plant Extinction Plant Program FY 2015 Annual Report (July 1, 2014 – June 30, 2015), Cooperative Agreement: F14AC00174. University of Hawaii at Manoa.

Prance, G. T., H. Beentje, J. Dransfield. & R. Johns. 2000. The tropical flora remains undercollected. Ann. Mo. Bot. Garden 87(1): 67–71.

RBG Kew. 2016. The State of the World’s Plants Report – 2016. Royal Botanic Gardens, Kew.

Rodrigues, A. S. L., J. D. Pilgrim, J. F. Lamoreux, M. Hoffmann & T. M. Brooks. 2006. The value of the IUCN Red List for conservation. Trend. Ecol. Evol. 21: 71–76.

Rodrigues, R. R., S. Gandolfi, A. G. Nave, J. Aronson, T. E. Barreto, C. Y. Vidal & P. H. S. Brancalion. 2010. Large-scale ecological restoration of high diversity tropical forests in southeast Brazil. Forest Ecol. Management 261: 1605–1613.

Shaanker, R. U., K. N. Ganeshaiah, S. Krishnan, R. Ramya, C. Meera, N. A. Aravind, A. Kumar, D. Rao, G. Vanaraj, J. Ramachandra, R. Gauthier, J. Ghazoul, N. Poole & B. V. C. Reddy. 2004. Livelihood gains and ecological costs of non-timber forest product dependence: assessing the roles of dependence, ecological knowledge and market structure in three contrasting human and ecological settings in south India. Environ. Conserv. 31: 242–253.

Shaw, W. B. & B. R. Burns. 1997. The ecology and conservation of the endangered endemic shrub, Kōwhai Ngutukākā *Clianthus puniceus* in New Zealand. Biol. Conserv. 81(3): 233–245.

Sodhi, N. S., L. P. Koh, B. W. Brook & P. K. L. Ng. 2004. Southeast Asian biodiversity: an impending disaster. Trends Ecol. Evol. 19(12): 654–660.

Soehartono, T. & A. C. Newton. 2001. Conservation and sustainable use of tropical trees in the genus *Aquilaria* II. The impact of gaharu harvesting in Indonesia. Biol. Conserv. 97: 29–41.

Sutherland, W. J., S. Bardsley, M. Clout, M. H. Depledge, L. V. Dicks, L. Fellman, E. Fleishman, D. W. Gibbons, B. Keim, F. Lickorish, C. Margerison, K. A. Monk, K. Norris, L. S. Peck, S. V. Prior, J. P. W. Scharlemann, M. D. Spalding & A. R. Watkinson. 2013. A horizon scan of global conservation issues for 2013. Trend. Ecol. Evol. 28: 16–22.

Swaisgood, R. R. & J. K. Sheppard. 2010. The culture of conservation biologists: show me the hope! BioScience 60(8): 626–630.

Thomas, P. 2011. *Wollemia nobilis*. The IUCN Red List of Threatened Species 2011: e.T34926A9898196. http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T34926A9898196.en. Downloaded on 27 September 2016.

Thorne, R. F. 2002. How many species of seed plants are there? Taxon 51: 511–512.

Tucci, J., J. Mitchell, and C. Goddard. 2007. Children's fears, hopes and heroes: Modern childhood in Australia. Australia Childhood Foundation. http://apo.org.au/node/8255

University of California Berkeley. 2005. Press release: Dainty pink Mt. Diablo buckwheat rediscovered. 24 May 2005. <http://www.berkeley.edu/news/media/releases/2005/05/24_buckwheat.shtml>, accessed 1 October 2016.

U.S. Fish and Wildlife Service (USFWS). 2007. *Cyanea pinnatifida* (Haha) 5-Year Review: Summary and Evaluation. Honolulu, Hawaii.

Van Sam, H., P. Baas, Ke & P. J. A. Ler. 2008. Traditional medicinal plants in Ben En National Park, Vietnam. Blumea 53: 569–601.

Veach, R., D. Lee & T. Philippi. 2003. Human disturbance and forest diversity in the Tansa Valley, India. Biodivers. Conserv. 12: 1051–1072.

Visconti, P., E. Game, R. Mathevet & M. Wilkerson. 2015. Proceedings of the 27th International Congress for Conservation Biology and 4th European Congress for Conservation Biology. Montpellier 2-6 August 2015. Society for the Conservation of Biology. http://dx.doi.org/10.13140/RG.2.1.4233.4489/1

Webb, C. O. 2005. Engineering hope. Conserv. Biol. 19(1): 275–277.

Wenhua, L. 2004. Degradation and restoration of forest ecosystems in China. For. Ecol. Manage. 201: 33–41.

Wiederholt, R., A. M. Trainor, N. Michel, P. D. Shirey, R. R. Swaisgood, D. Tallamy & S. C. Cook-Patton. 2015. The face of conservation responding to a dynamically changing world. Integr. Zool. 10(5): 436–452.

Wilson, E.O. 2016. Half-Earth: Our planet's fight for life. Liveright Publishing Corporation, New York.

Wheeler, Q. D., S. Knapp, D. W. Stevenson, J. Stevenson, S. D. Blum, B. M. Boom, G. G. Borisy, J. L. Buizer, M. R. De Carvalho, A. Cibrian, M. J. Donoghue, V. Doyle, E. M. Gerson, C. H. Graham, P. Graves, S. J. Graves, R. P. Guralnick, A. L. Hamilton, J. Hanken, W. Law, D. L. Lipscomb, T. E. Lovejoy, H. Miller, J. S. Miller, S. Naeem, M. J. Novacek, L. M. Page, N. I. Platnick, H. Porter-Morgan, P. H. Raven, M. A. Solis, A. G. Valdecasas, S. Van Der Leeuw, A. Vasco, N. Vermeulen, J. Vogel, R. L. Walls, E. O. Wilson & J. B. Woolley. 2012. Mapping the biosphere: exploring species to understand the origin, organization and sustainability of biodiversity. Syst. Biodivers. 10(1): 1–20.

Wright, S. J. 2010. The future of tropical forests. Ann. NY Acad. Sci. 1195: 1–27.

UNEP-WCMC & IUCN. 2016. Protected Planet Report 2016. UNEP-WCMC and IUCN, Cambridge UK and Gland, Switzerland.

Figure Legends

Figure 1. A word cloud of the top 150 most commonly used words in the titles and abstracts of the 943 oral presentations and 782 poster presentations from the 2015 International Congress for Conservation Biology conference held in Montpellier, France on 2-6 August 2015 (Visconti et al 2015). Each word in the cloud appeared 141 times or more, with *species* appearing 2,359 times, *conservation* appearing 1,905 times, and *biodiversity* appearing 961 times. Optimistic words like *protected* (383 times), *benefits* (169 times), and *effective* (164 times) appear in the cloud, but other optimistic words like *restoration* (125 times), *success* (122 times), *improved* (57 times), and *recovery* (57 times), did not meet the threshold.

Figure 2. *Cyanea pinnatifida*, federally listed as Endangered and once extinct in the wild, currently has hundreds of seedlings propagated and planted within its historical range on the island of Oahu, Hawaii. Photo by W. L. Wagner.