Opinion

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What is the future of conservation?

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In recent years, some conservation biologists and conservation organizations have sought to refocus the field of conservation biology by de-emphasizing the goal of protecting nature for its own sake in favor of protecting the environment for its benefits to humans. This 'new conservation science' (NCS) has inspired debate among academics and conservationists and motivated fundamental changes in the world's largest conservation groups. Despite claims that NCS approaches are supported by biological and social science, NCS has limited support from either. Rather, the shift in motivations and goals associated with NCS appear to arise largely from a belief system holding that the needs and wants of humans should be prioritized over any intrinsic or inherent rights and values of nature.

Shaking up the motives and practices of conservation

Throughout its history, and across the globe, environmental conservation has been motivated by a wide range of ethical, utilitarian, aesthetic, and economic concerns. However, a recent and much publicized campaign, originating within the conservation community, marginalizes nature's inherent value in favor of a primarily human-centered conservation ethic. Spearheaded by prominent advocates, this viewpoint has been advanced in both popular and scholarly outlets (see [1–3]) and has received considerable news coverage (e.g., recent articles in *Time*, *Slate*, and *The New York Times*). The message – that the moral imperative of environmental conservation (henceforth, 'conservation') should be to maximize the welfare of humans (see [1,2,4,5]) – is increasingly popular among academics and policy makers and dovetails with tactical shifts in the mission statements of many conservation organizations (Table S1 in the supplementary material online) [6–8]. This movement seeks not a subtle shift in the methods of conservation, but a stark change in its fundamental goals and methods: 'Instead of pursuing the protection of biodiversity for biodiversity's sake, a new conservation should seek to enhance those natural systems that benefit the widest number of people' [1].

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Here we examine the claims and assumptions of those advocating for NCS, a term we use because it has been adopted by some of the leading advocates of this position [2]. This analysis is important because NCS proponents have asserted that most current and past conservation is poorly done, wrongly motivated, and scientifically unsupportable. Given that this position is directly affecting conservation practices, both the claimed failures of past efforts and the promises concerning their alternatives warrant careful scrutiny.

Central premises of the NCS argument

NCS advocates begin by suggesting that there are many flaws in traditional approaches to conservation. (i) Conservation emphasizes protection of biodiversity without regard for human welfare, resulting in regular harm to disadvantaged peoples and impediments to business and development (see [1,2]). (ii) Conservation rests on the myth of a pristine nature and its core purpose is to conserve and restore this state, which in fact never existed: 'We create parks that are no less human constructions than Disneyland' [1]. (iii) Conservationists wrongly assume that nature is inherently fragile and will sustain irreparable damage from human activities: 'Nature is so resilient that it can recover rapidly from even the most powerful human disturbances' [1]. (iv) Conservation has failed to protect biodiversity. Although we have created many protected areas, extinctions and ecosystem degradation continue: 'Protecting biodiversity for its own sake has failed' [1]. (v) Conservation is also failing socially, with dwindling support from a mostly affluent, white minority: 'Conservationists are losing the battle to protect nature because they are failing to connect with the hearts, anxieties, and minds of a large segment of the American public' [9].

Given these perceived ills, NCS advocates call for the following remedies. (i) The primary objective of conservation should be to protect, restore, and enhance the services that nature provides to people: 'The ultimate goal is better management of nature for human benefit' (P. Kareiva, quoted in [10]). (ii) To succeed, conservationists need to ally with corporations and other significant economic actors: '21st century conservation tries to maximize biodiversity without compromising development goals' [11]. (iii) Conservationists should increase their focus on urban areas and on landscapes and species most useful to humans, because human benefits should drive conservation efforts: 'Forward-looking conservation protects natural habitats where people live and extract resources and works with corporations to find mixes of economic and

conservation activities that blend development with a concern for nature' [1].

What's wrong with these claims and remedies?

Although we focus here on the principal shortcomings in NCS's central claims and remedies, we also note that many specific examples and points of evidence offered to bolster NCS positions are poorly supported or misleading (see [12–17], and Tables S2 and S3 in the supplementary material online).

Human well-being is already one of the core features of conservation policy and planning

Conservation's concern for biodiversity has always been accompanied by concern for human well-being and ecosystem services; these human-centered goals form one pillar of a diverse mix of motivations and strategies dating back at least a century to Gifford Pinchot and his predecessors [7,18–20]. Hearkening back to Pinchot (e.g., 'The first principle of conservation is development, the use of the natural resources now existing on this continent for the benefit of the people who live here' [18]), efforts to understand and protect ecosystem services have long been an important plank in the conservationist's platform. More quantitatively, most federal lands in the USA that are in some sense managed for conservation are primarily devoted to the generation of ecosystem services (Figure 1). Emphasis on human use of natural areas is also typical of other countries; in the EU and the Russian Federation, $\leq$2% of all protected forest areas receive the most restrictive status of no active intervention [21]. Consideration of human well-being in conservation decisions does not require a radical departure from current practices. The NCS position, however, restricts the focus of conservation to the advancement of human well-being, which it frequently conflates with narrow definitions of economic development (but see [11]), and thereby marginalizes efforts to preserve diverse and natural ecosystems or to protect nature for esthetic or other non-economic benefits to humans.

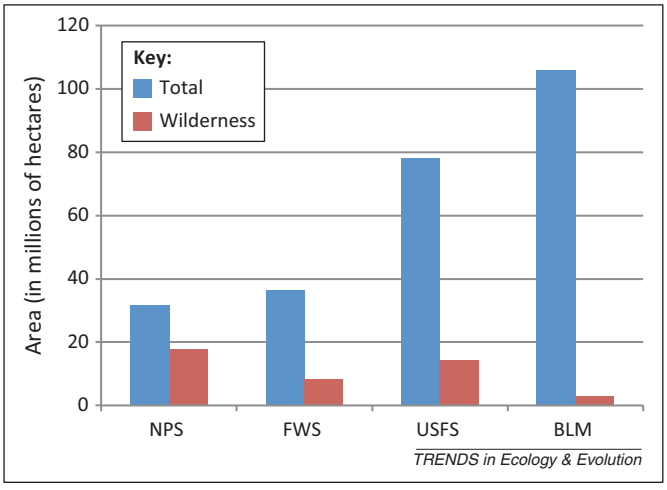

Figure 1. The areas of major US federal land holdings with some mandated conservation role, illustrating that generation of services for humans is already emphasized far more than biodiversity protection. Lands are arranged from those most devoted to biodiversity conservation (as well as tourism), under the jurisdiction of the National Park Service (NPS), to those least devoted to biodiversity and most to resource extraction and other human uses, under the Bureau of Land Management (BLM). In between are lands managed by the Fish and Wildlife Service (FWS) and the US Forest Service (USFS). Red bars show the acreage in designated wilderness areas, which account for 17% of all these lands. Wilderness is primarily managed for the protection of nature for its own sake, but also has considerable tourism value.

Conservation already takes a realistic view of nature's purity and fragility

The NCS argument caricatures the views of conservationists about pristine nature, while making the scientifically unsupportable claim that natural systems are almost infinitely resilient. There are still many relatively undisturbed areas across the globe [17] and although conservationists have long recognized that these areas are not pristine [22], they also recognize that such areas usually harbor far more biodiversity than do urban parks and plantations, a point NCS advocates only sometimes acknowledge [2]. Moreover, conservation scientists have focused at least as much on nature's resilience as its fragility (Table S2 in the supplemental material online). Although many environmental harms can indeed be ameliorated or reversed, others are virtually irreversible (e.g., extinction, climate change, mountaintop removal).

Past conservation has not been a failure

The NCS claim that contemporary conservation has failed is overly simplistic, if not directly misleading. First, it ignores how the creation of parks, innovative resource management regimens, and other conservation work has slowed the pace of biodiversity decline. Although it is difficult to quantify averted declines and extinctions, several recent studies have concluded that, if the conservation community had not been trying for decades to protect land and water resources and biodiversity, losses would have been far greater than they have been to date [23–26]. Second, it ignores the creation of legislation and public support for nature conservation that set the stage for arguments over conservation and development [27,28]; the need to weigh tradeoffs between conservation impacts and economic gains is a central legacy of the conservation movement.

NCS approaches are a dubious fix for conservation's shortcomings

NCS advocates argue that the failure of past conservation efforts to halt biodiversity decline and resource degradation supports a shift toward markedly more human-centered approaches to conservation. However, there is little basis for the assertion that a more narrow, anthropocentric conservation strategy would deliver better results, especially given the track record of poor management of natural resources in the past, including management of the parts of nature we economically value the most [29,30]. In addition, the NCS assertion that focusing on ecosystem services will save biodiversity as well ('the fate of nature and that of humans are deeply intertwined...many of the activities that harm biodiversity also harm human well-being' [5]) has essentially no rigorous scientific support [31,32]. Finally, the claim that NCS will be more effective than contemporary conservation relies on altering the primary goal of conservation from saving species and ecosystems to that of saving only those components of nature that

directly benefit people: 'Some human-caused extinctions are inevitable, and we must be realistic about what we can and cannot accomplish. We must be sure to first conserve ecosystems in places where biodiversity delivers services to people in need' [5].

The priorities of NCS rest on ethical values, not science

Although NCS advocates contend that their approach is science-based and aimed at more efficient conservation outcomes, their remedies appear to be primarily grounded in an assumption that human welfare should be granted a higher moral priority than the protection of species and ecological processes (Table S3 in the supplementary material online). Therefore, they argue that conservation should be done for the sake of human well-being, which NCS often equates with business interests and economic prosperity [10]. Thus, these advocates urge the substitution of a human-centered ethical commitment for the one that has long motivated many conservationists – that other species and nature as a whole have a right to continued existence – and do so under the guise of scientific objectivity.

Most worryingly, NCS's rationale that to be effective and forward thinking, conservation should more directly and narrowly serve human interests is based on dubious evidence. First, NCS advocates argue that conservationists have sacrificed indigenous groups to form parks. Although the establishment of protected areas has sometimes hampered local livelihoods and created conservation refugees [33], widespread efforts have been under way to address this for three decades [6,34]. Indigenous groups and conservationists have also frequently formed alliances to protect lands and counter extractive industries [6]. Further, local and indigenous peoples often receive multiple, tangible benefits from well-designed protected areas (e.g., [35]). Finally, a recent, extensive survey of development and conservation professionals revealed a broad consensus that biodiversity conservation and poverty alleviation are generally positively linked, whereas countervailing minority positions have polarized the debate [36]. Altogether, the evidence shows that biodiversity-motivated conservation can be compatible with rights of indigenous groups and that the motivation of preserving nature for its own sake does not need to be thrown aside to achieve both goals.

Advocates of NCS also argue – both as a matter of efficacy and as a matter of principle – that conservation should partner with, rather than impede, business. Although groups with competing interests can negotiate agreements – and should certainly do so when it is truly beneficial – it is rarely possible to identify solutions that maximize both economic and ecological benefits, as NCS advocates propose [34]. Nor is it clear that giving up on conservation's core goals is the best way to reach compromise with those who may have legitimate, but mostly non-congruent, objectives. We cannot speak effectively on behalf of the natural world if at the outset we prioritize corporate and other human interests. NCS proponents also downplay evidence that corporations have done vast harm to lands and people through resource extraction [37], that recent efforts to 'green' business through environmentally responsible practices have often failed to reduce pollution or biodiversity losses [38,39], and that indigenous rights groups view the 'green economy' as a cultural and ecological threat; for example, the declaration of 500 indigenous groups at the Rio+20 UN Conference on Sustainable Development states: 'The "Green Economy" promises to eradicate poverty but in fact will only favor and respond to multinational enterprises and capitalism.' (See http://www.ienearth.org/docs/DECLARATION-of-KARI-OCA-2-Eng.pdf and Table S2 in the supplementary material online.)

Economic motivations are not always dominant, nor are moral values always weak or immutable

NCS proponents implicitly assume that people's core motivations are deeply self-serving and thus that economic self-interest is the most potent motivator, but a great deal of research shows that social and moral factors strongly shape behavior and support for policies, often outweighing direct economic self-interest (e.g., [40,41]). This conclusion is borne out by even a cursory look at the long history of conservation successes. Most national and international conservation laws have garnered strong support at least in part by appeals to non-economic, ethical principles [e.g., Migratory Bird Act, US Endangered Species Act, Canadian Species at Risk Act, Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), Wilderness Act, Clean Water Act]. Moral arguments are also the way to build alliances across broad coalitions of different constituencies, including those motivated by both social and ecological issues [32]. The stance that conservation progress should be driven by transient economic preferences rather than enduring values also hampers recognition of the possibility or even the need for structural and institutional changes to achieve and sustain conservation objectives. Finally, the assumption, and hence reinforcement, of only economic motivations for conservation ignores and may thus diminish the importance of political, scientific, philosophical, and religious motivations for conservation found across different nations and cultures [42–44].

Recent polling in the USA also shows evidence that the public's concern for nature is not weakening nor is support limited to the wealthy, white population (e.g., Figure 2). Polls find that there is equal or greater support for moral versus human-use arguments for conservation [9,45] and that Hispanics, women, and young voters are currently among those most concerned with various conservation goals, which include protecting America's air and water, wildlife, and other natural resources, as well as confronting climate change (see [46,48]).

NCS proponents also implicitly assume that ethical stances are resistant to change and thus conservation must refashion its message to better appeal to those who are apathetic or opposed to the goals of protecting species and ecosystems. However, innumerable social and environmental justice campaigns have shown that ethical views can be swayed, often very rapidly. Indeed, most successful efforts to win public support for a cause have focused on influencing notions of right and wrong, even if they are combined with multiple other motivations. Slavery was not outlawed in the USA solely because abolition favored the

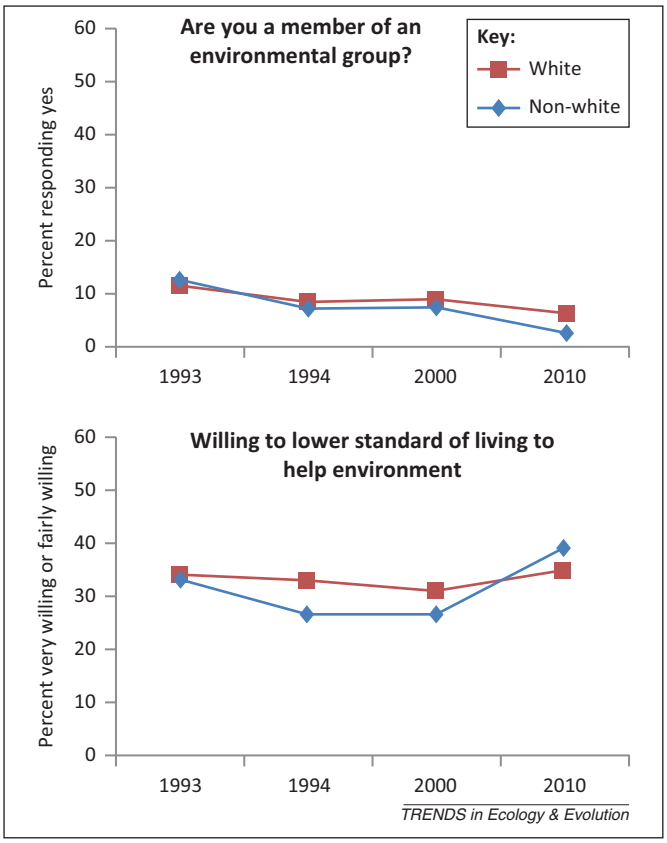

Figure 2. Long-term polling data [51] of adults over 18 living in households in the USA indicate complicated patterns of support for environmental issues across racial and other divides through time, with limited indication of declining support and no indication of a strong racial divide. **(A)** Membership in environmental groups has shown recent declines, but **(B)** stated willingness to sacrifice quality of life for the sake of the environment has not declined and might have risen for non-whites. Note that these polls were administered only in the years shown.

interests of northern manufacturers over southern plantation owners [49]; nor is the lack of complete success in eliminating slavery worldwide – to this day – a reason to conclude that the moral justification against this practice has 'failed' or should be replaced with an economic efficiency argument. Recent campaigns over other human-rights issues (e.g., same-sex marriage), animal welfare, and conservation itself all show that beliefs and priorities are powerful motivators and that they can be altered, often with great speed.

Concluding remarks

Conservation policies and strategies cannot stand still or dwell in the past. The profound and increasing pressures on our natural systems demand that conservationists critically review their goals and approaches and seek ever more effective ways of improving the outlook for all natural ecosystems. Likewise, we have no argument with the goal of meeting human needs, especially those of the poor. In some settings, joint economic development and conservation programs might be an important and cost-effective means to meet the dual goals of human betterment and environmental conservation [8]. However, the congruence of these different goals in some cases does not mean that conservation of biodiversity has to perpetually take a back seat to the betterment of human welfare.

The remedies that follow from NCS's critique of contemporary conservation's track record rest on the assumptions and the values of its authors, not analysis and facts. Conservation has long been concerned both with sustaining human resource needs and with conserving nature's intrinsic value – the right of species and other aspects of nature to exist for their own sake [8]. Rather than adding to the conservation toolbox, NCS seeks to shrink the range of conservation activities, and especially motivations, that are considered legitimate. That advocates of NCS denigrate much past and contemporary conservation work is of real concern, especially given evidence that broad coalitions are most effective at bringing about social change [50]. By the logic of NCS, conservationists should abandon many of the objectives that have motivated generations of activists and scientists. Faithfully following NCS prescriptions would also suggest that conservationists withdraw their support for environmental legislation that seeks to protect rare species, and biodiversity in general, and that they dramatically transform the practices of conservation non-governmental organizations (NGOs).

We do not believe that it is quixotic, misanthropic, or short-sighted to protect nature based on its own value. Moreover, we acknowledge that this position is a statement of values and hope that, as the NCS debate continues, all parties will be clear about where the science of their arguments stops and starts. If the mission of conservation becomes first and foremost the promotion of human welfare, who will work for the protection and restoration of the rest of nature – for desert tortoises, Delta smelts, Hawaiian monk seals, vernal pool invertebrates, and the many other parts of the natural world that do not directly benefit humans and in some cases do demonstrable harm to immediate, economic welfare? Also, we wonder why donors should be generous to such NCS-motivated groups. For those who care about preserving and restoring ecologically rich natural areas, the NCS agenda has little appeal. For donors whose foremost concern is human welfare, groups like Save the Children, Oxfam, and Water for People already, and more explicitly and effectively, embrace the same values of human betterment, including environmental efforts that serve these goals.

NCS advocates argue that traditional conservation is despairing and negative [1,2], but, pared down to its essence, their solution seems far more so: give up your original goals and focus only on a single species – humans. There are now unprecedented demands on natural resources across the globe, and there will never be a shortage of advocates for human use of these resources. The question is whether conservation scientists and practitioners should make promoting economic prosperity their primary mission as well. As conservationists are already acutely aware, the effects of human industry are felt throughout the world, and we must plan conservation strategies that address coupled human and ecological dynamics. However, refashioning conservation into a set of goals that primarily advance human interests means selling nature down the river, serving neither the long-term interests of people nor the rest of the species with which we share this planet.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.tree.2013.10.013.

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SUPPLEMENTARY INFORMATION

Table 1. Changing mission statements of conservation NGOs. Non-profit organizations plan and conduct much of the real work of conservation, both nationally and internationally. The degree to which these groups have altered their activities to align with NCS is thus a measure of the real influence of the NCS point of view. A recent profile of NCS concluded that: "Quietly, these massive funds -- nicknamed the BINGOs, for 'big nongovernmental organizations' -- have utterly revamped their missions, trumpeting conservation for the good it does people, rather than the other way around. 'Biodiversity' is out; 'clean air' is in" [1]. As summed up by Steve McCormick, the Nature Conservancy's former president, "In fact, if anything, this is becoming the new orthodoxy. It's widespread. Conservation International changed its mission, and it's one that Peter Kareiva could have crafted" [1]. Not all NGOs have altered their missions to embrace NCS, but many of the largest have. Two specific examples of these shifts are shown (data drawn from magazines and websites of these organizations).

Conservation International
• Current mission statement: **Building upon a strong foundation of science, partnership and field demonstration, CI empowers societies to responsibly and sustainably care for nature, our global biodiversity, for the well-being of humanity.**
• Mission statement in 2000: **CI believes that the Earth's natural heritage must be maintained if future generations are to thrive spiritually, culturally, and economically. Our mission is to conserve the earth's living heritage, our goal biodiversity, and to demonstrate that human societies are able to live harmoniously with nature.**
• Mission statement in 1988, a year after founding: **To help sustain biological diversity and the ecosystems and ecological processes that support life on earth.**
The Nature Conservancy
• Current mission/objective: **to conserve the lands and waters on which all life depends. Our vision is to leave a sustainable world for future generations.**
• Mission/objective in 1991: **to preserve plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.**

• Mission/objective in 1990: **to find, protect, and maintain the Earth's rare species and natural communities by preserving the lands they need to survive.**
• Mission/objective in 1987: **to find, protect, and maintain the best examples of communities, ecosystems and endangered species in the natural world.**
• Mission/objective in 1984: **to preserving natural diversity by finding and protecting lands and waters supporting the best examples of all elements of the natural world.**
• Mission/objective in 1978**: to preserving natural diversity by protecting lands that contain the best examples of all components of the natural world.**
• Mission/objective in 1977**: to preserve and protect ecologically and environmentally significant land and the diversity of life it supports.**

Table 2: A critique of some of the assertions made to support the New Conservation Science. Advocates of NCS have made sweeping generalizations and also use many specific examples to support their points. Below, we show not only that many of these generalizations are inaccurate, and also that the literature flatly contradicts many of the specific examples. See also [2-5] for other problems with the NCS arguments.

	Assertion	**Evidence from the scientific literature**
	Fragility/resilience of nature	
A1	"Nature can be surprisingly resilient. Nature is often portrayed as fragile, and conservationists routinely talk about damages as catastrophic and irreparable (e.g., a Google Scholar search on 3 April 2012 for *ecosystem* and either *irreparable* or *irreversible* returned more than 40,000 hits)" [6].	Counting Google Scholar hits is a dubious way of tallying areas of emphasis in research since the articles may address ecosystems *not* being irreversibly or irreparably harmed or the two words may not related to each other at all – they just appear together in the article. Using these same methods, we repeated this search on 1 Feb 2013 and got ~51,610 hits in Google Scholar. We then searched for *ecosystem* and either *resilient* or *resilience* and got 130,800 hits. By this evidence conservation scientists are more than twice as likely to focus on ecosystem resilience than on fragility. Repeating this approach using Web of Science, and including *fragile* and *fragility* in our search results in 1,450 references focusing on susceptibility to damage vs. 5,455 focused on resilience.
A2	"The trouble for conservation is that the data simply do not support the idea of a fragile nature at risk of collapse. Ecologists now know that the disappearance of one species does not necessarily lead to the extinction of any others, much less all others in the same ecosystem. In many circumstances, the demise of formerly abundant species can be inconsequential to ecosystem function" [7]	The examples are all for extinctions 75 – 350 years ago, and in all cases we lack quantitative data prior to the extinction event and thus are unable to assess its consequences. In many cases, substantial consequences have been hypothesized by ecologists, as detailed below. We are not aware of any suggestions by conservation scientists that the disappearance of one species would lead to the extinction of "all others in the same ecosystem".
A3	"The American chestnut, once a dominant tree in eastern North America, has been extinguished by a foreign	The American chestnut was largely absent from eastern forests by 1935, and we lack quantitative studies from the era when chestnuts were dominant. Beyond the

	disease, yet the forest ecosystem is surprisingly unaffected." [7]	obvious regional change in forest composition with the loss of a widespread dominant [8-13], numerous scientific papers have hypothesized additional effects on ecosystem dynamics, including the population dynamics of small mammals, songbirds, cavity nesting birds, gypsy moths, and Lyme disease [14-16], impacts on aquatic system function and health including leaf-litter processing rates, quality of litter inputs, growth rates of aquatic invertebrates, input rates of large woody debris into streams, channel structure, and fish and invertebrate habitat quality [16-19], and soil processes including decomposition rates, nutrient cycling, productivity, and carbon sequestration [16, 20].
A4	"The passenger pigeon, once so abundant that its flocks darkened the sky, went extinct, along with countless other species from the Steller's sea cow to the dodo, with no catastrophic or even measurable effects." [7]	The Stellar sea cow went extinct in the mid 1700s and dodo in the mid 1600s. Thus, there are no data to assess potential effects of their loss. However, some scientists have speculated that passenger pigeons may have played a significant role in regulating resource pulses in eastern forests, with potential effects on rodent population sizes and Lyme disease prevalence [21-23].
A5	"These stories of resilience are not isolated examples — a thorough review of the scientific literature identified 240 studies of ecosystems following major disturbances such as deforestation, mining, oil spills, and other types of pollution. The abundance of plant and animal species as well as other measures of ecosystem function recovered, at least partially, in 173 (72 percent) of these studies." [7]	The 240 case studies used by this meta-analysis were found using the following search methods: "To focus on recovery, we searched on the concatenated string of the following words: perturbation type AND resilience AND recovery [24]." Perturbation-type keywords were agriculture, deforestation, eutrophication, hurricane, cyclone, invasive species, logging, oil spill, power plant, and trawling. The authors considered studies published from 1910 through 2008 and "excluded studies that focused on single species recovery. Studies included both experimental and natural perturbations and both passive and active recovery projects." It seems likely that this methodology would result in a biased sample focused on instances of resilience and recovery (using the very reasoning offered in A1 above). Lending support to this conclusion, the authors found only 3 studies looking at the effects of mining over this 99 year time period.

		Note that 28% of studies exhibited “no recovery for any variable whatsoever [24].”, while the statistic that 72% of studies that recovered “at least partially” refers to studies with studies reporting “a mixture of recovered and non-recovered variables [24].” Thus, even this statistic does little to address ecosystem resiliency, since “partial recovery” could mean anything from no effect to dramatic and permanent losses.
A6	“Even Indonesian orangutans, which were widely thought to be able to survive only in pristine forests, have been found in surprising numbers in oil palm plantations and degraded lands.” [7]	While it is good news that orangutans use disturbed forest, the study authors are cautious. “Some populations even use monocultural plantations, although it is doubtful whether their survival there could be long term without access to more natural forest stands [25].” They also note: “It is almost certain that their survival depends not just on plantations but on connectivity to resources available elsewhere in the landscape, including the adjacent national park, and we emphasize that plantations cannot be viewed as stand-alone ‘conservation solutions’ but only as a part of a larger mixed landscape upon which orangutans rely [26].”
A7	“As we destroy habitats, we create new ones: in the southwestern United States a rare and federally listed salamander species seems specialized to live in cattle tanks — to date, it has been found in no other habitat.” [7]	By saying that this “salamander species seems specialized…” this statement seems to imply that the Sonoran tiger salamander (*Ambystoma tigrinum stebbinsi*) has evolved to live in cattle tanks, which seems implausible given the relatively short history of ranching in the San Rafael Valley (SRV) of no more than 300 years, with intense use for substantially less time. The species recovery plan explains why Sonoran tiger salamanders are restricted almost exclusively to both cattle ponds and tanks: “Prior to the 20th century, the SRV contained many more cienegas and vernal pools than it does today. Erosion and arroyo cutting in the late 19th and early 20th centuries caused the SRV water table to drop and natural standing water habitats to disappear (Hendrickson and Minckley 1984, Hadley and Sheridan 1995). However, at the same time natural standing water habitats were disappearing, cattle ponds were built. Many of the remaining springs and cienegas were

		converted into impoundments at this time, so most of the small standing water habitats remaining in the SRV are cattle ponds. Sonora tiger salamanders breed almost exclusively in these cattle ponds [27]."
A8	"Around the Chernobyl nuclear facility, which melted down in 1986, wildlife is thriving, despite the high levels of radiation." [7]	This example actually makes the case for protecting natural areas with minimal human activity, a conservation strategy deemphasized or even maligned by NCS. Both the 1993 study [28] referenced here by [7] and a more recent review in 2000 conclude [29]: "In reality, radioactivity at the level associated with the Chornobyl meltdown does have discernible, negative impacts on plant and animal life [30, 31]. However, the benefit of excluding humans from this highly contaminated ecosystem appears to outweigh significantly any negative cost associated with Chornobyl radiation [32]." [29]
A9	"In the Bikini Atoll, the site of multiple nuclear bomb tests, including the 1954 hydrogen bomb test that boiled the water in the area, the number of coral species has actually increased relative to before the explosions." [7]	Again, this example seems to make the case for protection of natural areas. Recovery of Bikini Atoll was facilitated by the relatively pristine nearby reefs and the complete absence of human disturbance after bombings. The study [33] referenced here by [7] states: "The case of Bikini Atoll demonstrates that coral reef communities can recover from and exhibit resilience to major disturbance events. In this situation, the visible impact and recovery of the reefs from the anthropogenic impact of atomic testing can be compared to those following natural disturbance events such as cyclone/hurricane damage. Bikini Atoll's reefs undoubtedly benefited from the post-testing absence of human disturbance, the presence of uninhabited and non-impacted neighbouring atolls, and a supportive prevailing hydrodynamic regime for larval import [34]. Caution should be taken in generalising our findings to other atolls or coral reef communities that experience a different set of conditions. In most parts of the world, human influences are always present, and chronic

		disturbances (such as long-term overfishing, coral-harvesting, or multiple coral bleaching events) are likely to be more extensive. Additionally it is becoming less likely that relatively unimpacted reefs are available to act as a source of propagules. These considerations illustrate the crucial role of marine reserve networks which may represent the low-impact source reefs of the future."
A10	"Books have been written about the collapse of cod in the Georges Bank, yet recent trawl data show the biomass of cod has recovered to precollapse levels. It's doubtful that books will be written about this cod recovery since it does not play well to an audience somehow addicted to stories of collapse and environmental apocalypse." [7]	Books have not been written about this recovery because it has not happened. Georges Bank cod remain far below historical levels [35, 36], and this year (January 2013) severe restrictions were placed on cod fisherman [37]. The New York Times quoted John Bullard, the regional administrator of the National Oceanic and Atmospheric Administration (NOAA) as saying: "We are headed, slowly, seeming inexorably, to oblivion… It's midnight and getting darker when it comes to how many cod there are. [37]" According to the 2013 assessment by NOAA, "The Georges Bank cod stock is overfished and overfishing is occurring [38]." The report further states that 2011 spawning stock biomass is at 7% of maximum sustained yield (MSY) and fishing mortality is more than twice as high as rates that produce MSY [38]. Even the partial recovery referred to in the reference [39] cited by [7] was a one year increase for predatory fish as a group.
A11	"Even that classic symbol of fragility — the polar bear, seemingly stranded on a melting ice block — may have a good chance of surviving global warming if the changing environment continues to increase the populations and northern ranges of harbor seals and harp seals." [7] And while polar bears certainly are at risk, scientists have found evidence of them exploiting new food sources [40] and of past rapid evolution and hybridization with grizzly bears[41]."[7]	We could find no mention in the literature of scientists suggesting polar bears might be sustained by northward shifts of harbor and harp seals. The challenge of climate change for polar bears is the loss of sea ice as a platform for effective hunting. Again, it easiest to directly quote from the literature. A 2012 review [42] by polar bear biologists of the likely effects of climate change on polar bears stated: "Some have proposed that polar bears may adapt to climate warming by using more terrestrial resources or because of becoming dependent upon them [e.g., 40]. Some bears on land, particularly subadults, have been observed to opportunistically eat a wide variety of foods such as berries, seaweed, mammals,

		sea ducks, and bird eggs [e.g., 43, 44, 45]. However, stable isotope analyses of bear tissues and breath indicate little consumption of nonmarine food sources by polar bears during the ice-free period of late summer and autumn in western Hudson Bay [46, 47]. Use of snow goose (*Chen caerulescens*) and thick-billed murre (*Uria lomvia*) eggs and chicks have been postulated to be associated with climate warming [40, 48]. However, polar bear predation on bird eggs has been known to occur since 1900 [49, 50]. That such foraging behavior is now documented from new areas is interesting, not because it indicates polar bears are adapting to terrestrial ecosystems, but rather because it is indicative of ecosystem change and loss of the primary habitat of polar bears. "In an examination of the energetics of terrestrial foraging, [51] suggested that polar bears could maintain their body mass during the icefree period by feeding on Arctic charr (*Salvelinus alpinus*), seal blubber and, further, that bears ≤280 kg could maintain their mass from blueberries (*Vaccinium uliginosum*). However, they did not explain that the capture of seals by bears in open water during the ice-free in summer is a rare event and occasional scavenging is opportunistic at best. Furthermore, in a rebuttal, [52] showed that while polar bears consume a variety of terrestrial and freshwater food sources opportunistically, these are inadequate to provide the energy these bears require on an annual basis. …The rapid evolution of polar bears from brown bears resulted in adaptations to being active in cold weather, a semi-aquatic lifestyle, and dietary specialization. Changes to cranial morphology resulted in polar bears having a skull that is weaker than that of brown bears and less suited to processing a herbivorous or omnivorous diet [53]. Simply put, polar bears are large highly specialized marine predators and they got that way by eating seals, not vegetation or other terrestrial food sources. Their survival in anything like the large numbers present today is dependent on continued access to large and accessible seal populations and vast areas of ice from which to hunt

		them."
	Sustainable resource use by humans	
A12	"In his 2005 book, *Collapse*, the geographer Jared Diamond famously claimed that Easter Island's inhabitants devolved into cannibalism after they mindlessly cut down the last trees — a parable for humankind's shortsighted overuse of natural resources. But Diamond got the history wrong. It was the combined effect of a nonnative species — the Polynesian rat, which ate tree seeds — and European slavery raids that destroyed Easter Island's people, not their shortsighted management of nature.[7]"	The history of Easter Island is an area of vigorous ongoing debate [54-60], and it is not possible to make such a definitive statement based on the current science. Diamond does not claim indigenous people on Rapa Nui were mindless or short sighted, but instead argues "that they had the misfortune to inhabit one of the Pacific's most fragile environments [57]." It is interesting to note that if introduced rats are a significant cause of decline on Rapa Nui, then this would seem to provide counter-evidence to the NCS claim that ecosystems are resilient to introduced species.
A13	"Finally, we find it remarkable that some of our critics maintain the adolescent view that corporations are evil and not to be trusted, as though they were run by people somehow less ethical and less decent than conservation organizations. Yes, some corporations do harm and behave badly, but so do conservationists on occasion." [7]	Recent evidence of unethical behaviors arising from business practices and causing widespread harm is unequivocal (e.g., the Enron and Worldcom scandals, the financial crisis of 2008). There is a vast literature on organizational structures and missions and their influence on human behavior. A large-scale meta-analysis divides the potential drivers of unethical behavior into intrinsic (bad apples) and extrinsic factors (bad barrels) [61]. There is some evidence the business people are more likely to be bad apples -- the moral reasoning scores of those with MBA degrees is somewhat lower than the adult norm [62-64]. However, conservationists are far more concerned about the considerable evidence that corporate structures represent bad barrels by providing a motive, opportunity, and means for unethical behaviors that maximize short-term profits [65 and references therein, 66]. Specific examples include the vast environmental degradation of the Niger Delta caused by oil companies, which has impoverished the local population [67]
A14	Whenever I talk or write about partnering with	No conservation scientist would dispute the dominant role that corporations play in

	corporations folks tend to interpret my views as a political ideology –as though I am some sort of fawning capitalist. I actually have come to this conclusion from a purely scientific perspective. In ecology one of the most important concepts is that of "keystone species" — these are species whose presence and activities fundamentally shape the dynamics and structure of ecosystems….If one considers the planet earth and asks what are the keystone species for our global ecology, it is hard to conclude anything but major global corporations. …Given this reality, if one is to manage for a sustainable planet, it makes sense to work with and influence the behavior and actions of corporations. One approach could be strict regulation. An alternative approach is to partner with corporations. I favor the latter because I think visionary corporations increasingly see that sustainability is something that will promote their own bottom line and success. It is no accident that 80% of the fortune 500 companies issue sustainability reports and have sustainability officers. Obviously particular corporations and particular industries have done great damage to the earth. But some fraction of all institutions and of people from every sector of society behave badly on occasion. Damning corporations because of some bad actors is not smart. " [68]	the dynamics and structure of ecosystems, and the activities of corporation have long been the focus of conservation efforts. However this does not make a dominant strategy of partnering with corporations in search of win-win solutions a scientific one [69]. Other aspects of this and related claims are also dubious. For example, the studies we could find conclude that corporate social responsibility has been largely ineffective [69-71]. And more worrisomely, many relationships between corporations and indigenous peoples purporting to advance indigenous welfare and conservation have had negative effects on indigenous peoples or their lands [72]
A15	"For instance, in only 10 percent of responses did conservationists most strongly agree with the statement, "conservation priorities should be set by the people most	If we assume those most affected by conservation priorities are those experiencing the most local and most short-term economic impact, this seems to imply that fishing fleets (or the fish processing industry) and loggers (or logging companies)

	affected by them." [7]	should set harvest quotas and miners (or mining companies) should write water quality and reclamation plans. Since short-term economic gains often compel rationale behaviors that have negative consequences, the logic of this NCS suggestion would imply the cessation of much of our current environmental legislation that does not provide economic offsets in whole or in part, such as the Endangered Species Act, and large parts of The National Environmental Protection Act, the Clean Air Act, and the Clean Water Act, all of which have been vigorously opposed by local groups, especially local business interests.
	Views and failings of conservationist	
A16	"And thanks to the Clean Air Act and Clean Water Act, Americans live much healthier lives today than 50 years ago. Unfortunately, conservationists had little to do with the protection of air and water. In fact, modern conservation is notable for its inattention to water pollution and air quality in places like Beijing and Mumbai, which are seen as largely irrelevant to the biodiversity mission." [7]	As the NCS advocates are well aware, there is niche partitioning within the environmental and conservation NGO world, and some groups have focused more on clean water and clean air, while others have focused more on habitat and species protections. However, it is absurd to suggest that environmental/conservation NGOs have had little to do with water pollution and air quality. Groups such as NRDC, Environmental Defense Fund, Environmental Working Group, Earthjustice, American Rivers, Baykeepers, Southern Environmental Law Center, and Clean Water Action make either clean air or clean water a priority.

Table 3. Contradictions and waffling in the writings of 'new conservation science' (NCS) advocates. We have tried to fairly portray the recommendations and views of advocates of a new, human-centered conservation. However, this task was extremely challenging because of the diversity of statements made by these proponents, some of which endorse a broader view of how conservation should be motivated and conducted. We acknowledge and appreciate these more inclusive statements, but have concluded that they largely contradict the central arguments and recommendations in the writings of NCS advocates and the points they appear to emphasize when speaking with the media and public. Here, we cull quotes from several of the clearest statements of NCS ideas and goals to illustrate two points. First, statement from NCS advocates that support the intrinsic value of other species or of natural areas tend to be vague and non-declarative, while statements that conservation should focus on serving the needs of humanity form the coherent core of the NCS argument and are presented as the 'action items' for improving conservation practice. Second, there is cognitive dissonance between these two messages: statements about the intrinsic worth of nature simply don't make sense if one accepts the main changes that NCS seeks to make in conservation.

Issue	**Consistent arguments for the NCS agenda**	**Inconsistent or equivocal statements**
Should protecting natural areas be a key conservation strategy?	conservationists will have to jettison their idealized notions of nature, parks, and wilderness -- ideas that have never been supported by good conservation science -- and forge a more optimistic, human-friendly vision. [7] By removing long-established human communities, erecting hotels in their stead, removing unwanted species while supporting more desirable species, drilling wells to water wildlife, and imposing fire management that mixes control with prescribed burns, we create parks that are no less human constructions than Disneyland. [7] But conservation will be controversial as long as it remains so	Conservation will likely continue to create parks and wilderness areas, but that will be just one part of the field's larger goals. [7] None of this is to argue for eliminating nature reserves or no longer investing in their stewardship. [7] Although protected areas will continue to be an important part of conservation,… [6] That no place is free of human influence does not mean that a large, mature forest has the same conservation value as a plantation or an urban playground. [6]

	narrowly focused on the creation of parks and protected areas, and insists, often unfairly, that local people cannot be trusted to care for their land. [7] Nature could be a garden -- not a carefully manicured and rigid one, but a tangle of species and wildness amidst lands used for food production, mineral extraction, and urban life. [7] Conservation centered on areas free of people is socially unjust and often scientifically misguided. [6] First, conservation must occur within human-altered landscapes. [6] However, there are many places where removing people or banning their activities simply will not work. The good news is that even highly modified ecosystems can offer significant conservation value in terms of both biodiversity and ecosystem services. [6]	Many existing protected areas are working well, and the protected-areas strategy should certainly not be abandoned. [6]
Should preventing extinction and protecting biodiversity be a central goal of conservation?	Ecologists now know that the disappearance of one species does not necessarily lead to the extinction of any others, much less all others in the same ecosystem. In many circumstances, the demise of formerly abundant species can be inconsequential to ecosystem function. [7] Instead of pursuing the protection of biodiversity for	And indeed, there are consequences when humans convert landscapes for mining, logging, intensive agriculture, and urban development and when key species or ecosystems are lost. [7] Soulé's functional postulates are no less true today than they were in 1985, but they are not necessarily what

	biodiversity's sake, a new conservation should seek to enhance those natural systems that benefit the widest number of people, especially the poor. [7] Protecting biodiversity for its own sake has not worked. Protecting nature that is dynamic and resilient, that is in our midst rather than far away, and that sustains human communities -- these are the ways forward now. [7] More and more conservationists accept the fact that human impacts on the environment are unavoidable.[73] In traditional conservation, the objective is to maximize the protection of biodiversity. However, 21st century conservation tries to maximize biodiversity without compromising development goals, such as energy and food production. Once those goals are clearly defined, scientific methods can help establish tradeoffs among them. [73] Soulé's normative postulates [biodiversity is good, extinction is bad] are not necessarily the leading values among contemporary conservationists. Missing is any mention of ecosystem services, which are now emerging as a primary motivation for conservation. [6]	one would consider the essential principles for conservation in today's world [n.b., two of Soule's postulates are, to paraphrase: biodiversity is good, and extinction is bad]. [6] Although we share Soulé's nostalgia and similarly hope that majestic species such as the wolves and grizzly bears of the United States will not be lost to extinction, we are also relatively certain that these species will never be as abundant and widespread as they once were. Some realism is in order. [6]
Should conservation strongly prioritize human welfare over the intrinsic worth of	In summary, we are advocating conservation for people rather than from people. [6] It is time for conservationists to stop viewing humanity's	We argue that in conservation, strategies must be promoted that simultaneously maximize the preservation of biodiversity and the improvement of human well-being. [6]

biodiversity or natural systems?	emphasis on humanity as flawed. [74] I have found that many conservationists view striving for material gains and the prioritization of people above non-human nature as societal pathologies that need to be cured. This is an unproductive and misanthropic attitude. [74] In the developing world, efforts to constrain growth and protect forests from agriculture are unfair, if not unethical…[6] Conservation will measure its achievement in large part by its relevance to people, including city dwellers. [6] This move requires conservation to embrace marginalized and demonized groups and to embrace a priority that has been anathema to us for more than a hundred years: economic development for all, [6] Fourth, only by seeking to jointly maximize conservation and economic objectives is conservation likely to succeed. [6] Forward-looking conservation protects natural habitats where people live and extract resources and works with corporations to find mixes of economic and conservation activities that blend development with a concern for nature. It also seeks value in novel ecosystems and remains open to some of nature's modern experiments. [6]	Unlike conservation biology, conservation science has as a key goal the improvement of human well-being through the management of the environment. If managing the environment to provide human health and safety were the only goal of conservation science, we would probably label it environmental science. The distinguishing feature is that in conservation science, strategies to jointly maximize benefits to people and to biodiversity are pursued. [6] Conservation as Soulé framed it was all about protecting biodiversity because species have inherent value. We do not wish to undermine the ethical motivations for conservation action. We argue that nature also merits conservation for very practical and more self-centered reasons concerning what nature and healthy ecosystems provide to humanity. [6] When conservationists do place a high priority on landscapes perceived to be the least impacted by humans, it is key that they recognize that people have nonetheless probably been a part of the history of these systems and that humans are also likely to inhabit and make a living from some of the world's wildest places. In these places, protection should protect the people as well as the biodiversity. [6]

		Another strategy is to broaden the concerns of conservation beyond biodiversity and also to pay attention to economic development, jobs, poverty, and environmental justice. [6]

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