

# Challenge Essay on Endangered Species Myths Versus Realities Concerning Threatened and Endangered Species in the Rockies

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The Rockies is a place where the Endangered Species Act (ESA) has huge effects. Wolf reintroduction is proceeding, the grizzly range is expanding, and the Preble's meadow jumping mouse is listed and then delisted. Utah prairie dogs have more rights than landowners. Desert tortoises make some people rich and others poor, depending on whether the tortoise has taken up residence on their land. Endangered fish change dam management and recreation policies.

Most of us believe that saving endangered species is a good thing. But good analysis requires us to ask some questions such as what is a species, should subspecies and populations have the same standing as a species, are some species more equal than others, what is natural, and how should scarce species protection dollars be spent? I address these and other questions by considering what modern science tells us about the assumptions underlying the ESA.

## Humans and Nature

There are four core assumptions underlying the ESA and other federal environmental statutes:<sup>1</sup> First, that there is a "balance of nature" where ecosystems achieve a constancy or equilibrium that persists through time. Second, that North America was a "wilderness" unharmed by human activity, prior to the arrival of Europeans. Third, that this "wilderness" teemed with wildlife, especially large herds of bison, elk, moose, antelope, and deer.<sup>2</sup> Fourth, that Native Americans were either so few in number and so primitive that they had no impact on the "pristine" landscape or native peoples were children of nature and original conservationists who were too wise to overuse their environment.<sup>3</sup>

These assumptions lead many to conclude that pre-Columbian America and especially the Rockies were a Garden of Eden filled with uncountable numbers of ungulates (hoofed mammals such as deer, elk, antelope, and bison), wolves, and other wildlife. According to this view, Europeans destroyed this idyllic state of nature.<sup>4</sup> Restoring American ecosystems to their original conditions and saving endangered species require eliminating European influences. The preferred policy, then, is to "let nature take its course" and is often called hands-off or natural regulation management.

If these underlying assumptions about nature are false, then policies and management based on them are unlikely to create conditions that protect species and may even create harmful conditions. If the "balance of nature" is not supported by modern ecology, then endangered species management must be hands-on instead of hands-off. If the American continent was not heavily populated by large ungulates, then policies that attempt to create conditions that never existed will not provide the conditions that allowed North American species to emerge and survive. If, instead of having little

effect on landscapes, Native Americans were both the ultimate keystone predator and the ultimate keystone species that created North America's landscapes and habitats, then policies ought to be structured that mimic some of what actually happened before European contact.

## The "Balance of Nature"

In his book about reinventing nature, Cronin<sup>5</sup> claims that, "Many popular ideas about the environment are premised on the conviction that nature is a stable, holistic, homeostatic community capable of preserving its natural balance more or less indefinitely if only humans can avoid 'disturbing it.'" This assumption, which he calls "problematic," descends from the work of botanist Frederic Edward Clements, for whom the "landscape is a balance of nature, a steady-state condition maintained so long as every species remains in place."<sup>6</sup>

Central to this belief is the presumption that nature is highly structured, ordered, and regulated, and that disturbed ecosystems will return to their original states once the disturbance is removed. This view of nature is an integral part of successional theory, which assumes that species replace one another in ordered procession, culminating in climax communities.

Rachel Carson, in her book "Silent Spring" (1962), perhaps best popularized the idea of a balance of nature. Although she noted that, "The balance of nature is not a *status quo*; it is fluid, ever shifting, in a constant state of adjustment,"<sup>7</sup> she also claimed that it is no more possible to ignore the balance of nature than a "man perched on the edge of a cliff" can defy the "law of gravity."<sup>8</sup> "Silent Spring" promoted the notion that there is a delicate balance of nature that stands in danger of being upset by humans. Carson wrote that it took "eons of time" for life to reach "a state of adjustment and balance with its surroundings."<sup>9</sup>

The belief in a balance of nature continues to animate many modern activists. In 1999, the Nobel Prize Peace laureates attempted to start a worldwide movement under the banner of "Manifesto 2000." The goal was to present 100 million signatures to the United Nations General Assembly meeting at the turn of the millennium in September 2000. The signers of Manifesto 2000 pledged to "promote consumer behavior that is responsible, and development practices that respect all forms of life and *preserve the balance of nature on the planet*" (italics added).<sup>10</sup>

Many environmental laws are based on a supposed balance of nature. As ecologist Norman Christensen, dean of Duke University's



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Nicholas School of the Environment and chair of the Ecological Society of America's panel that reviewed the 1998 Yellowstone National Park fires, explains,

Everything from the Endangered Species Act to the Clean Water Act has implicit in it the notion of an equilibrium ecology, the idea that systems tend toward these stable end points and that they are regulated by complex feedbacks—a sort of balance of nature that is almost Aristotelian.<sup>11</sup>

A belief in a balance of nature gives strong moral content to environmental protection. From Rachel Carson to Barry Commoner (“everything is connected to everything else”),<sup>12</sup> Paul Ehrlich,<sup>13</sup> E.F. Shumacher (“small is beautiful”),<sup>14</sup> the Club of Rome,<sup>15</sup> Al Gore (“various parts of nature interact in patterns that tend toward balance and persist over time”),<sup>16</sup> and the deep ecologists,<sup>17</sup> there is an acceptance of not only the existence of a balance of nature but of a belief that upsetting it is morally wrong.<sup>18</sup>

Although the balance of nature is the basis of environmental law, environmental activists' belief systems, and is promoted by Nobel Peace Prize laureates, it is widely rejected by ecologists,<sup>19</sup> and by many in the environmental community.<sup>20,21</sup> Rather than constancy and stability, disturbance and change have characterized the earth's evolutionary history. Glaciers that covered large portions of North America advanced and retreated only to continually repeat the cycle over the last three million years. The climate has fluctuated so widely that what we live in the United States view as “normal,” that which we have experienced during our lives or since the birth of our nation, is, when viewed from a perspective of the last several hundred thousand years, an abnormally warm, dry period. The “normal” climate for most of Canada, for instance, is several thousand feet of ice, not what we see today.<sup>22</sup> As one might expect, the distributions of plants and animals have also contracted and expanded over time. Local extinctions are a fact of life, as is the extinction of entire species.<sup>23</sup> Disturbance and change are the only ecosystem constants.

Christensen suggests that this modern understanding of nature raises difficult problems for the ESA, which “assumes that we can know what a minimum viable population of a plant or animal is in a very predictable way.” He says,

The nonequilibrium approach to ecology suggests that species populations fluctuate constantly. Species may go locally extinct in a given area. They may appear and reappear. That's very frustrating for managers of endangered species and for a public that expects much more deterministic answers from science.<sup>24</sup>

## Wilderness, Wildlife, and Native Americans

If there is no “balance of nature,” there is no ecological stasis, there is only change. Insofar as the ESA tries to maintain stability, it is out of step with the processes of nature and it is doomed to fail. Daniel Botkin in his 1991 book, “Discordant Harmonies,” reviewed the research that contradicts “nature knows best.” Botkin explained that the views underlying the 1970s laws and resulting policies “represented a resurgence of prescientific myths about nature blended with early 20<sup>th</sup> century studies that provided short-term and static images of nature undisturbed.”

“Nature undisturbed” assumes the Americas were a wilderness teeming with untold numbers of bison, passenger pigeons, and other wildlife until despoiled by Europeans. “Nature undisturbed”

also assumes that Native Americans were primitive savages who were the original conservationists—“ecologically noble savages.”

My colleague Charles Kay, a wildlife ecologist, quantified all the wildlife observations and encounters with native people recorded in the Lewis and Clark journals. He found more than 40,000 journal entries and plotted the abundance of wildlife and native people day by day for the entire 863 day journey. The only places Lewis and Clark observed significant numbers of wildlife were in buffer zones between competing tribes. If it had not been for buffer zones, Lewis and Clark would have found little wildlife anywhere in the West. Kay's research, along with new research in ecology, archeology, and anthropology, clearly contradicts the “nature undisturbed” vision and demonstrates that humans were the apex predator in the pre-Columbian Americas.

If humans were the top predator that structured western ecosystems, then the current efforts to restore wolves in the northern Rockies are based on myth. Because humans out-compete wolves for prey, at Columbian contact there were few wolves in the West—there was not a prey base sufficient to support them. Restoring wolves will not return ecological processes to a mythical or mystical or even pre-Columbian balance of nature.

Consider the efforts to reintroduce wolves to Yellowstone National Park. The plan was predicated, in part, on the premise that large numbers of wolves inhabited that ecosystem before the Park Service eliminated them from the park.<sup>25</sup> According to some, “[wolves] were a relatively common sight in Yellowstone when it was declared the nation's first national park in 1872.”<sup>26</sup> Defenders of Wildlife's Dick Randall claimed that “when trappers and explorers reported on the Yellowstone region in the mid-1800s, they sang [of] a land teeming with bison, elk, mule deer, bighorn sheep, and antelope. The great carnivores—grey wolf, grizzly bear, and mountain lion—flourished.”<sup>27</sup>

As part of Kay's research in the Yellowstone ecosystem, he conducted a continuous-time analysis of journals left by early explorers. He systematically recorded all observations of ungulates and other large mammals, including wolves. Between 1835 and 1876, 20 different expeditions spent a total of 765 days traveling through the Yellowstone ecosystem on foot or horseback, yet,





no one reported seeing or killing even a single wolf. Wolf sign, primarily howling, was reported on only three occasions. Since these early observers lacked scientific training, they could have easily mistaken coyote howls or other animals' calls for wolves. Besides, when these journals were written, even trained scientists called coyotes wolves or prairie wolves. There certainly is no evidence in historical journals that suggests that large numbers of wolves were common in Yellowstone during the 1835-1876 period.<sup>28</sup>

Other records indicate that wolves were also not particularly common even after Yellowstone Park was established. During the late 1800s and early 1900s, few observations were recorded of wolves in the park. "Wolves inhabited the area in unknown but seemingly low densities."<sup>29</sup> From 1914 to 1926 when the Park Service was actively working to eradicate wolves from Yellowstone, they killed 136 wolves. This may seem like a lot, but it included only 56 adults over a 13-year interval. Park Service records also suggest that during this time there were, at most, only four wolf packs in the park and possibly only two.<sup>30</sup> So, available information does not support the belief that large numbers of wolves inhabited Yellowstone at any point in recorded history. There is no historical support for the belief that restoring wolves would re-establish natural conditions. In fact, the data suggest that wolves were always rare in Yellowstone. As explained above, native hunting was so intense that historical and pre-Columbian ungulate populations were very low, which, in turn, accounts for the relative scarcity of carnivorous species, like wolves.<sup>31</sup>

Clearly, Yellowstone and the rest of the Rockies were not a wilderness waiting to be discovered but instead were home to thousands of aboriginal peoples before the arrival of Europeans and their diseases. Wilderness was not even a concept understood or used by native peoples as no native language even contains a word for "wilderness."<sup>32</sup>

These arguments are central to thinking about endangered species policies because they provide clues about the condition of America prior to European contact. The now-extinct passenger pigeon, for example, is often cited to support claims that pre-Columbian America teemed with wildlife before Europeans drove that and other species to extinction. But if we could visit the eastern United States in 1400 A.D., we would find relatively few passenger pigeons and certainly no flocks that darkened the skies. As archaeologist Thomas Neumann<sup>33</sup> chronicled, pre-Columbian native populations were so large that they consumed most of the nuts, fruits, and berries, collectively called mast, which passenger pigeons needed for food. That is to say, human competition for the annual mast crop was so intense that there was little food left for passenger pigeons and other wildlife. It was only after European diseases decimated

Native American populations, and thereby freed the mast crop for wildlife, that passenger pigeons increased to unprecedented numbers. So, the large flocks of passenger pigeons reported during the 1700s and 1800s were an artifact of decimated Native American populations, not an example of how America teemed with wildlife before Europeans arrived.

A similar situation exists with grizzly bears in the West, an animal that has been on the Endangered Species list in the lower 48 states since 1973. Those who maintain that there were tens of thousands of grizzly bears in the West before that species was driven to near extinction, often cite the abundance of grizzlies on Alaskan salmon spawning streams, where the bears are not hunted, as an example of what the West was like before it was despoiled by Europeans. It turns out, though, that Alaska's concentrations of grizzlies are not natural, but an artifact of European conquest.

Ted Birkedal of the National Park Service points out vast archaeological complexes where many of Alaska's bears now fish for salmon. Research at those sites shows that there were few bears in pre-Columbian times for the natives simply killed and ate them. Before European diseases arrived and decimated native populations, grizzlies were rather scarce in Alaska, and probably throughout western North America, as well. Speaking of the present concentrations of grizzlies along the Naknek River in Alaska's Katmai National Park, Birkedal noted that, "This 'bear heaven' is not a creation of Mother Nature, [but instead] it is a cultural artifact of national park management," which has excluded Native Americans to create an Alaskan "wilderness."<sup>34</sup>

But what is natural? If Native Americans determined the structure of entire plant and animal communities by burning the vegetation and limiting wildlife numbers, then they created completely different situations than what we have today.<sup>35</sup> A hands-off, let-nature-take-its-course approach by modern land managers will not duplicate the ecological conditions under which those communities developed.<sup>36</sup> Since aboriginal predation and burning created those communities, we believe they will be best maintained by replicating aboriginal influences and processes.<sup>37</sup>

As paradoxical as it may sound, nature has to be managed. Setting aside an area as "wilderness" today, as has been suggested to protect various endangered species, will not preserve some remnant of the past but will instead create conditions that have not existed for the last 10,000 years.<sup>38</sup> North Americans, for instance, view the Amazon as a wilderness to be saved and protected, but to indigenous peoples it is a home—a home they modified to suit human needs.<sup>39</sup>

A new ESA would recognize that a balance of nature or nature undisturbed is an impossible goal. It would also shift the finger of blame from what we have done or have not done since 1491 to more serious questions about managing for change, risk, and complexity.

## Species Act or Subpopulation Act?

Today, wolves as a species are not threatened with extinction. There are thousands of grey wolves in Canada and Alaska. Yet, of the list of 1,264 endangered or threatened U.S. species, the gray wolf ranks 24<sup>th</sup> in terms of expenditures. We spend millions of dollars to protect a non-threatened species and justify it by arbitrarily

creating distinct population segments. What that means is that if a grey wolf wanders south to where Interstate 70 bisects Utah and manages to cross the road, he immediately changes legal status. He has moved into the Southwest distinct population segment and must receive extra protection. Biologically he is the same animal. Legally he is not.

The same is true of 70 percent of the ESA's listing of mammals in the United States—a distinct subpopulation of subspecies is endangered but not the species itself. Examples of non-endangered species whose populations are listed under the ESA include grizzly bear, wolf, and lynx in the lower 48 states; salmon and steelhead stocks on the Pacific Coast, the Eastern stock of Stellar's sea lions; and Southwest Alaska's stock of sea otters. Non-endangered species whose subspecies are listed include northern spotted owls, coastal California gnatcatcher, Mexican wolf, woodland caribou in Idaho and Washington, and the Sonoran pronghorn antelope.

This all suggests that distinct population segments (DPS) and subspecies have little scientific meaning. The grizzly, wolf, and lynx are listed under the ESA as DPS in the Western states but not in Canada or Alaska. As noted above, these species are not endangered, although there are some small local populations.

Another myth that should be abandoned is the belief that all species are equally important. This is often phrased as "saving all the pieces." According to current interpretations of the Endangered Species Act, we must save not only all endangered species, but all endangered subspecies, and even unique or endangered subpopulations as well. But biologically, not all species, subspecies, and populations, were created, nor did they evolve, equal. There are, however, what are called keystone species whose loss will completely alter or change an ecosystem<sup>40</sup>—there will still be an ecosystem but it will be a different ecosystem. Beaver is an excellent example of a keystone species.<sup>41</sup>

Beaver not only create and maintain riparian areas that are critical to hundreds of other species, but they also alter the hydrology, energy flow, and nutrient cycling of aquatic systems. Beaver dams impound water and trap sediments that raise the water table, increase the wetted perimeter, and allow the extension of riparian communities into former upland sites. In addition, beaver dams regulate stream flow by storing water, reducing peak or flood flow, and augmenting low flows during summer. During dry periods, 30 to 60 percent of the water in a stream system can be held in beaver ponds. By trapping silt behind their dams over thousands of years, beaver actually created many of the West's fertile valleys.<sup>42</sup> Therefore, protecting beaver makes a lot more biological sense than protecting species like the grizzly bear or kangaroo rat, which are not critical to ecosystem control or function.

Moreover, some species, subspecies, and populations are naturally rare, especially those on the edge of their ranges, the geographical

areas throughout which they exist. Lynx and wolverine are examples, and a campaign has been mounted to have both listed as endangered species in the northern Rockies.<sup>43</sup> These species are clearly very rare today, but they have been rare in the lower 48 states for the past several thousand years. Lynx and wolverines normally inhabit boreal forests, a habitat type that barely extends into the lower states.<sup>44</sup> Even if all people of European ancestry were removed and the West returned to its pre-Columbian state, lynx and wolverines would still be rare.

These species are also predators and predators are always less abundant than their herbivorous prey which, in turn, are less abundant than the plants they consume. When species at one level of a food chain consume species at a lower level, there is generally a 90 percent loss in energy. Thus, 100 units of plants can support only 10 units of herbivores, which, in turn, can support only one unit of carnivores; a trophic pyramid, with a large plant base and a small apex of carnivores. This explains why top predators, species that are not normally prey for other species and, thus, are on top of the food chain, will always be rare, especially at the edge of their ranges. In addition, as the weather varies and the climate changes, the ranges of these species will contract and expand. Again, there is no constancy in nature.

Trying to save top predators on the edges of their ranges, like lynx or wolverines, will always be a losing battle. Saving endemic species—species that for one reason or another have a very restricted natural distribution—should have a much lower priority than saving keystone species. These species are usually rare in a particular area because long-term climatic changes now favor other species. Biologically, saving these remnant populations makes little sense because large numbers of the same species are usually found in other areas where the habitat and climate are more favorable. While lynx and wolverine are rare in the northern Rockies, those species are common in Canada and Alaska.

## Old-Growth Myths

In their campaigns to save this or that endangered species, environmental activists are usually quick to invoke visions of pristine America cloaked in climax, old-growth forest from sea to shining sea. Not only is this too a myth, but it ignores the actions of indigenous peoples. It is often claimed, for instance, that the eastern United States was blanketed in climax deciduous forests before Europeans landed. Early accounts depict a forest of widely spaced trees with little understory, a park-like forest through which one could easily ride a horse or drive a wagon. What they described as natural had really been crafted by Native Americans.<sup>45</sup> Aboriginal burning created the open, park-like forest that the first Europeans mistook for natural. The tangled undergrowth common in our eastern deciduous forests today is certainly not representative of pre-Columbian conditions.<sup>46</sup>

Native Americans determined density and composition of forests by repeatedly burning the vegetation. Repeating historical photographs by finding the original camera position and making a new photograph of the original scene as well





as analyzing the age of forests in the West show that there was little old-growth forest prior to the elimination of native burning and active fire suppression. Moreover, the little old-growth forest that existed ca. 1850 was entirely different structurally and ecologically from what we have today. In the past, a few large, widely-spaced trees were surrounded by a lush understory of grasses and flowering plants called forbs. Arizona's ponderosa pine forests, for instance, had just 20 to 60 trees per acre prior to European settlement while today 300 to 900 trees per acre are common.<sup>47</sup> A team and wagon could drive through the areas of Yellowstone where lodgepole pine stands are so thick today that a human can barely walk through.

Historically, most Western forests would not support high-intensity, stand-replacing crown-fires because frequent ground-fires, set by native peoples, kept the forests open and park-like. Now that our forests have both grown-up and thickened-up, large-scale crown-fires are becoming the rule, something that never happened before. Fire certainly structured most North American forests, but they were not lightning-caused infernos that totally consumed forests. Moreover, by changing fire regimes, our forest ecosystems today are nothing like they were in the past, and ecological integrity has been compromised.<sup>48</sup>

This is true even in the coastal forests of the Pacific Northwest. In fact, plans to save the endangered northern spotted owl are all, to one degree or another, based on the assumption that the entire region was blanketed with old-growth forests, defined as trees more than 200 years old, before Europeans arrived.<sup>49</sup> But historical photographs and old stand maps show that in 1840, when large numbers of Europeans first began to physically occupy the Pacific Northwest, only 20 percent to 40 percent of the area supported old-growth forests. Although, it may be hard to believe, there is more old-growth forest today, despite a century of logging, than there was in 1800.<sup>50</sup> The reason is that for thousands of years, native peoples structured all the Northwest's plant communities by repeatedly burning the vegetation.<sup>51</sup> The burning was so persistent that it created grasslands and open valleys in what would otherwise have been forested environments.<sup>52</sup>

The West's forests are not self-perpetuating, climax forests, but instead most are born of fire. Even many of the forests in the Pacific Northwest need fire to regenerate.<sup>53</sup> Douglas fir, which presently dominates huge tracts of old-growth forests, will not regenerate in its own shade. That is to say, new Douglas fir trees are physically incapable of growing under an overstory of mature Douglas fir. The only way to maintain coastal Douglas fir forests is to burn them so Douglas fir can then seed-in on the burned sites. In these forests, stand-replacing crown fires occurred at infrequent intervals.<sup>54</sup>

During the 1980s and 1990s, large-scale, stand-consuming fires raged throughout the West. On Idaho's Boise National Forest,

for instance, high-intensity crown fires blackened nearly 800,000 acres during 1993 and 1994. Never in the history of this area have crown fires burned so large an area in such a short time. Clearly, conditions today are outside the range of historical variability. One reason is that activists have worked to protect old-growth forests and old-growth dependent species, while in reality both were always rare. Another reason is that the U.S. Forest Service's fire suppression program has caused a huge build-up of fuels that would not exist under a regime of aboriginal burning.<sup>55</sup>

## Conclusions

The conclusions I draw from the data reported here can be disconcerting: stopping logging in the Pacific Northwest's forests will not restore the forests to their pre-Columbian state, saving an endemic species makes less biological sense than saving truly endangered species, nature must be managed, ecosystems (however defined) are not delicately balanced, today's ecosystems did not result from nature "taking its course;" and modern environmental policies are based on a series of myths and wrong assumptions about so called "natural" processes.

Given the generally accepted goals of protecting and saving species, what ought to be done? I suggest the following: First, forget the 1970s mythology and romanticism of the "balance of nature" and concentrate on real problems. Global extinctions are what really matter for a species. It makes little sense to spend scarce money to protect a marginal distinct subpopulation of a species already thriving elsewhere if it means you cannot protect another actual species from extinction. Thus, the ESA should be amended to be an endangered species, not subspecies, or distinct subpopulation segment act. Then, the national government can allow states to decide whether or how to protect subspecies.

American federalism is supposed to encourage experimentation, trial and error, and sequential learning. Relying on national rules to manage local species violates that system. National rules forbid experimentation. National rules turn trial and error systems from learning about how to manage species into systems that learn how to follow the national law. Managers can use time- and place-specific information to craft a management plan only if that information fits into the national rules. Thus, the question under today's management system is not "is the status of the species improving?" It is, "does the management plan follow federal rules?"

Some will object to environmental federalism, claiming states will engage in a race to the bottom in an attempt to promote development. In fact, the opposite tends to be true. State forests are better managed, both environmentally and economically, than federal forests. Some states have stricter laws than those imposed by the federal government. States have time and place-specific information that allows them to react more quickly and more creatively than federal agencies.

## Endnotes

<sup>1</sup>These assumptions underlie nearly three decades of environmental legislation and some scientists continue to use them. For a thoughtful discussion of this issue, see Rubin 1994. For an example of scientists relying on these assumptions for their scientific work, see "The Science of Overabundance" edited by McShea, Underwood, and Rappole (Smithsonian Institution Press 1997), especially Chapter 2 by McCabe and McCabe. It unconsciously summarizes and relies on these four assumptions.

<sup>2</sup>McName, T. (1986). Putting nature first: A proposal for whole ecosystem management. *Orion Nature Quarterly*, 5(4), 3-15. McName, T. (1987). "Nature first: Keeping our wild places and wild creatures wild." Boulder, Colorado: Roberts Rinehart. Rolston, H. (1990).

Biology and philosophy in Yellowstone. "Biology and Philosophy," 5, 241-258.

<sup>3</sup>Budiansky, S. (1995). "Nature's keepers: The new science of nature management." New York: The Free Press. Flores, D. (1997). "The West that was, and the West that can be." *High Country News*, 29(15), 1 & 6-7.

<sup>4</sup>Noss, R. F. (1991). "Wilderness recovery: Thinking big in restoration ecology." *Environmental Professional*, 13, 225-234. Noss, R. F. (1992, Special Issue). "The wildlands project: Land conservation strategy." *Wild Earth*, 10-25. Noss, R. F. (1994). "Building a wilderness recovery network." *The George Wright Forum*, 11(4), 17-40. Noss, R. F. & Cooperider, A. Y. (1994). *Saving nature's legacy: Protecting and restoring biodiversity*. Washington, D.C.: Island Press.

<sup>5</sup>Cronin, W. (Ed.) (1995). *Uncommon ground: Toward reinventing nature*. New York: W. W. Norton and Company, 24.

<sup>6</sup>Barbour, M. G. (1995). "Ecological fragmentation in the fifties." In W. Cronin (Ed.), *Uncommon ground: Toward reinventing nature* (pp. 233-255). New York: W. W. Norton & Company, 235.

<sup>7</sup>Carson, R. (1962). *Silent Spring*. Boston: Houghton Mifflin, 246.

<sup>8</sup>*Ibid.*, 5.

<sup>9</sup>*Ibid.*, 5.

<sup>10</sup>Manifesto 2000 can be found on the World Wide Web at [http://www2.unesco.org/manifesto2000/uk/uk\\_manif2000\\_t.htm](http://www2.unesco.org/manifesto2000/uk/uk_manif2000_t.htm).

<sup>11</sup>Basgall, M. (1996). "Defining a new ecology." *Duke Magazine*, May-June, 39-41.

<sup>12</sup>Commoner, B. (1974). *The closing circle: Nature, man, and technology*. New York: Bantam Books.

<sup>13</sup>Ehrlich, P. R. (1968). *The population bomb*. New York: Ballantine Books.

Ehrlich, P. R. & Wilson, E. O. (1991, August 16). "Biodiversity Studies: Science and Policy." *Science*, 253, 761.

<sup>14</sup>Schumacher, E.F. (1973) *Small is Beautiful: Economics as if People Mattered*. New York: Harper Row.

<sup>15</sup>Club of Rome, *Limits to Growth*, London: Earth Island Limited, 1972.

<sup>16</sup>Al Gore, A. (1992). *Earth in the Balance: Ecology and the Human Spirit*. New York: Houghton Mifflin.

<sup>17</sup>Lovelock, J. (2000). *The Ages of Gaia: A Biography of our Living Earth*. New York: Oxford University Press.

<sup>18</sup>Rubin C. T. (1994). *The Green Crusade*. New York: The Free Press.

Mills, S. (1995). *In Service of the Wild*. Boston: Beacon Press.

<sup>19</sup>Botkin, D. B. (1990). *Discordant harmonies: A new ecology for the twenty-first century*. New York: Oxford University Press. Botkin, D. B. (1991). "A new balance of nature."

*Wilson Quarterly*, 15(2), 61-72. Botkin, D. B. (1992). "A natural myth." *Nature Conservancy Magazine*, 42(3), 38. Pielou, E. C. (1991). *After the Ice Age: The return of life to glaciated North America*. Chicago, IL: University of Chicago Press. DeGraaf, R. M. & Healy, W. H. (1993). "The myth of nature's constancy--preservation, protection, and ecosystem management." *Trans. North American Wildlife & Natural Resource Conf.*, 58, 17-28.

<sup>20</sup>A 1998 ballot measure in Oregon (Measure No. 64) attempted to codify the balance of nature. If passed it would have outlawed harvesting trees in excess of 30 inches diameter at breast height and would have required leaving at least 70 well-distributed trees per acre harvested. Although some environmentalists were opposed to such attempts to maintain stasis in forests, the Oregon chapter of the Sierra Club, the Native Forest Council, Forest Guardians, and other local preservationist groups supported this proposal.

<sup>21</sup>Worster, D. (1995). "Nature and the disorder of history." In M. E. Soule and G. Lease, (Eds.), *Reinventing Nature*. Washington, D.C.: Island Press. Foreman, D. (1995/96, Winter). "Wilderness: From scenery to nature." *Wild Earth*, 11.

<sup>22</sup>Pielou, E. C. (1991). *After the Ice Age: The return of life to glaciated North America*. Chicago, IL: University of Chicago Press.

<sup>23</sup>Although extinctions are a fact of life, that should not be interpreted as an argument that all extinctions are acceptable or that public policies should not be enacted to reduce rates of extinction.

<sup>24</sup>Basgall, M. (1996). "Defining a new ecology." *Duke Magazine*, May-June, 39-41.

<sup>25</sup>Askins, R. (1992). "View of the Wolf Fund." *Wyoming Wildlife*, 56(1), 14-17. Fischer, H. (1995). *Wolf Wars*. Helena, MT: Falcon Press Publishing. Wright, R. G. (1992). *Wildlife research and management in the national parks*. Urbana, IL: University of Illinois Press.

<sup>26</sup>Anonymous (1987, February 11). "Grey wolves may again howl in Yellowstone." *Logan Herald Journal*, Logan, UT.

<sup>27</sup>Randall, D. (1980). "Wolves for Yellowstone: Experts say 'yes,' though cautiously, to re-introduction." *Defenders*, 55(3), 188-190.

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<sup>54</sup>In most western forests, frequent low-intensity ground fires were once the norm while stand-replacing crown fires generally occurred only at higher elevations and in wetter environments, such as the Pacific Northwest (Bonnicksen 1993). With fire suppression and fire exclusion, however, forest fuels have both grown up and accumulated to unprecedented levels. Thus, crown fires are now common where they never occurred in the past, while in other areas, the size and intensity of the crown fires have increased since earlier times. Even in wet coastal environments, though, aboriginal burning was once widespread.

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