Anthropogenic Development Drives Species to be Endangered: Capitalism and the Decline of Species

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ABSTRACT

Green criminologists have extensively studied crimes against non-human species. Importantly, a great deal of this research has focused on case studies of poaching and the illegal trade in wildlife. What is missing from that literature is a systematic analysis of structural factors that threaten non-human species. As a result, we use the capitalist treadmill of production literature to provide a systematic analysis of crimes/harms committed against non-human species. We do this through a discussion of capitalism during the current period of Anthropocene extinction. In the case of the United States we illustrate the general state of species endangerment with reviews of the International Union of Conservation of Nature's "Red List" of threatened species and additional data on species endangerment from the US Wildlife and Fish Service. The data illustrate the extent of the harm that structural factors may cause to non-human animals. We conclude with suggestions for future work on species decline that focuses on structural factors.

Keywords: Capitalism; Species decline; Ecological disorganization; Political economy

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The study of crimes against non-human species is central to the development of green criminology. The present discussion contributes to this particular area of green criminology by examining limits to the viability of non-human animal populations as a function of systemic ecological harms.[1] By systemic we mean those ecological harms that are endemic to capitalism as a system of production, and which in the current context of global capitalism are also global in their appearance, and therefore are structural in origin. The specific viability issue we address is the endangerment and extinction of species, and the relationship of species viability to the forms of ecological disorganization produced by capitalism in its ordinary course of development. We examine these issues in relationship to the tendency for capitalism to produce ecological disorganization.

One reason that criminologists should study ecological disorganization is that it draws attention to violations of human rules of law and / or natures' rules of law related to physics, chemistry, and planetary boundaries (Long, Stretesky and Lynch 2014; see generally Carson, 2002; Colborn, Dumanoski, and Myers 1996; Ehrlich and Ehrlich 1996; Foster, Clark and York 2011; Steingraber 1997; Rockstrom et al. 2009; Wargo 1998). As a result, green criminologists may illustrate how social and ecological harms can expand criminology, as a science, by rejecting the state definition of crime as the only valid method for examining crime (Long, Stretesky and Lynch 2014). Thus, criminologists can examine crime as a function of ecological organization and the normal functioning of ecosystems (Stretesky, Long, and Lynch 2013; Lynch et al. 2013). As part of those efforts to analyze and understand green crimes, green criminological studies have drawn significant attention to crimes against non-human species (Aatola 2012; Beirne 1999, 2008; Bjørkdahl 2012; Clarke and Rolf 2013; Eliason 2012; Hagstedt and Korsell 2012; Ngoc and Wyatt 2013; Nurse 2013; Pires and Clarke 2012; Sollund 2008, 2011; 2012; 2013a; Svärd 2012; Weem 2012; Wyatt 2009, 2011). In particular, some green criminological studies illustrate the impact of these green crimes by focusing specific attention on activities that have negative non-human species impacts through illegal activities such as poaching, hunting and the illegal trade in wildlife (e.g., Clarke and Rolf 2013; Hagstedt and Korsell 2012; Pires and Clarke 2012; Pires and Moreto 2011; Sollund 2011; Wyatt 2013). Studies of non-human animal harms have significantly expanded the concept of (green) victimization beyond the traditional criminological limits which draws attention only to human victims.

There is much to be learned from case studies of poaching, the illegal trade in wildlife, and the impacts of these activities, and the in-depth studies green criminologists have produced on these issues has certainly expanded knowledge of the details of how many crimes against non-human animals unfold, their scope and the specific kinds of victimization they involve. At the same time, the existing green criminological literature on non-human species victimization has yet to develop a thorough analysis of broader problems non-human species face such as species decline in relation to the structural causes of those outcomes. The structural factors related to species decline are broad and include processes such as deforestation, habitat loss and climate change which impact non-human animal and plant species (see Sollund 2013b), as well as lesser studied non-human entities such as insects, fungi, mollusks, algae and other species that play important roles in maintaining ecosystem functionality and balance. In our view, one of the structural explanations that deserves greater attention is the way in which the capitalist treadmill of production generates widespread non-human species victimization (Stretesky, Long and Lynch 2013; Lynch et al. 2013). Treadmill of production is a framework proposed by Alan Schnaiberg (1980; see also Gould, Pellow and Schnaiberg 2009; Schnaiberg and Gould, 1994).

The framework helps to explain how the capitalist system accelerates ecological disorganization by requiring more production in an effort to continuously grow and accumulate profit. From the view of treadmill theorists, environmental problems – including the extinction and decline of nonhumans – will grow as long as current political economic conditions continue to exist (see also Foster, Clark & York 2010). While there are exceptions (e.g., Pellow 2004; Stretesky, Long and Lynch 2013; Vail 2009), green criminologists have not yet seriously entertained structural analysis that is specifically embedded in a treadmill of production framework as a mechanism for explaining crimes/harms against non-human species. We draw attention to this issue in this work.

To illustrate the effects of human economic development on the more general decline of wildlife species[2] we first review how the contemporary expansion of capitalism drives continuous economic development in ways that promote the destruction of nature and facilitates the general decline of species health, vitality and existence. In addition, to support this argument we make reference to scientific literature on the current period of Anthropocene extinction and elevated rates of extinction in the contemporary world to demonstrate the broad scope of extinction in the contemporary era that would be consistent with taking a structural view of these kinds of negative outcomes for non-human species. We then illustrate the more general state of species endangerment through reviews of the International Union for the Conservation of Nature's (IUCN) Red List of threatened species, and data on species endangerment from the US Wildlife and Fish Service (USWFS). We follow the description of those data with a summary of results examining the causes of species decline in the US, and suggestions concerning the implications of this work for further studies of species decline in green criminology.

BACKGROUND: GREEN CRIMINOLOGY, CAPITALISM & SPECIES DECLINE

Green criminology has focused much of its analysis of threatened and endangered species on case studies of specific animals (e.g., Hagstedt and Korsell 2012; Wyatt 2009, 2011) rather than empirical approaches (Clarke and Rolf 2013) to address species decline and endangerment issues. To date, both case studies and empirical studies have been compiled on a case-by-case or species-by-species basis. Extant research of this nature has provided important insights into certain aspects of anthropocentric harms that impact single species. These studies tend to focus almost entirely on the negative effects of poaching and hunting (for an exception see Clarke and Rolf 2013), and tend to be species specific, impeding a broader analysis of the commonalities among crimes/harms against non-human species.

The vast majority of species that are threatened or endangered, however, find themselves in such a state of endangerment due to the more general effect of human development on ecosystems (Czech 2000; Czech, Krausman and Devers 2000; Naidoo and Adamowicz 2001), rather than as a result of more localized human behaviors such as poaching and hunting. The widespread nature of non-human species endangerment indicates that broader structural processes have more salient and persistent effects across species and nations. The vast majority of species that are recognized as threatened or endangered legally are those that are impacted by various forms of human development rather than through poaching, hunting or animal trade. Human development has widespread impacts on species by destroying ecosystems in ways that sometimes eliminates ecosystems and non-human species locally, and on a larger scale impeding ecosystem functionality and habitat structures through processes such as ecosystem segmentation that have negative impacts on non-human species viability. In a structural view the impacts of various forms of development are generally much more significant for species than activities such as poaching, hunting and animal trade. For example, Woodroffe (2000:168) demonstrates a strong correlation between economic development and carnivore extinction, noting that 'for most of the species, local extinctions are associated with growing human populations.' In a significant assessment of state of global extinction research and rates, Stark (2010) does not mention poaching once. Nevertheless, poaching, illegal hunting and illegal trade in animals, however, have tended to attract the attention of criminologists because these activities are clearly defined as illegal and thus identified as crimes in some form of national or international law (for alternatives see Sollund 2011; 2013). In taking that approach and focusing on behaviors defined as illegal in law, green criminologists have been able to illustrate that the harms they are exploring fit within the scope of more traditional forms of criminological analysis since they involve violations of law (e.g., Clifford 1998; Franz 2011; Greife and Stretesky 2013; Pires and Clark 2013). At the same time, this focus on violations of specific laws that define non-human species harms as crimes *tends to overlook* important structural forces that impact non-human species viability.

For specific species, the effect of poaching can be dramatic especially when coupled with the long term impacts of development, and we are not suggesting that green criminologists abandon their analyses of crimes such as poaching (i.e. abduction and killing; see Sollund 2011). However, greater attention must be paid to the ways in which illegal behaviors such as poaching intersects with structural dynamics to produce large scale non-human species harms. One example of the combination of these processes (e.g., poaching and structural dynamics) can be seen in studies of the tiger population, which is significantly impacted by poaching and more general structural conditions. The World Wildlife Fund estimates that the world's tiger population now occurs only in 7% of its historic range, and is comprised of approximately 3,200 individuals, significantly lower than the estimate of 100,000 for tigers around 1900 (see also, Chundawat et al. 2013; Dinerstein et al. 2007). It is estimated that in recent years the number of tigers poached from the wild is somewhere between 200-250 individuals per year. For a population of 3,200 individuals, poaching certainly produces a significant impact on species viability, and if these estimates are correct, leads to a loss of 6% or more of the tiger population annually. Current estimates suggest that if tiger poaching patterns remains unchanged, the tiger is likely to "disappear from many more places, or dwindle to the point of ecological extinction" (Dinerstein et al. 2007: 513). We must recognize that factors other than poaching also contribute to declining tiger populations and may significantly influence tiger survival and the probability of extinction. These factors include human development effects associated with the destruction and fragmentation of tiger habitat through deforestation, the effect of habitat destruction on tiger reproduction rates, the loss of tigers through human-tiger conflict, and loss of tiger prey species due to habitat destruction (Smith, Ahern and McDougal 1998; Karanth and Stith 1999; Kenney et al. 1995; Linkie et al. 2006).

For the vast majority of endangered non-human species, it is human development and encroachment on natural ecosystem space rather than poaching, hunting or animal trade that leads to their listing as a threatened or endangered species. For example, when deforestation occurs, the impact is felt across a wide range of species that make their homes in forest habitats. While we may single out particular species for attention (e.g., tigers, elephants, pandas, whales, etc.), there are large numbers of species to which we pay little attention (e.g., fungi, insects, velvet worms) that are also impacted by forms of human development that imperial wild areas. In particular, in our view the driving force behind wide-spread non-human species habitat destruction is the nature of the global capitalist world system and the normal operation of the capitalist treadmill of production (see Schnaiberg 1980; Gould, Pellow and Schnaiberg 2008) which significantly influences ecosystem destruction across nations of the world in ways that are consistent with the structural organization of global capitalism (see also Stretesky, Long and Lynch 2013).

In the contemporary era, non-human species are becoming extinct at extraordinary rates. In the next section, we briefly make the case that non-human species harm is widespread and often overlooked.

ANTHROPOCENE EXTINCTION AND CAPITALISM

We live in a rapidly changing world, one where human development continuously creates and spreads ecological destruction. One indicator of the extent and widespread nature of such harm is the human ecological footprint, which is now approximately 1.5, meaning that humans are consuming nature 1.5 times faster than nature can reproduce itself (Wakernagel 1996). That rate of consumption also means that humans are rapidly eroding the ability of the ecosystem to not only support humans, but non-human species as well, placing them in conditions that promote accelerated rates of extinction.

One of the responses to species endangerment is the creation of laws that identify threatened and endangered species and single them out for protection. Such statutes began to emerge broadly in the 1970s. Species are officially recognized as endangered to facilitate implementation of additional protective policies designed to prevent extinction. Nevertheless, contemporary extinction rates for animal and plants species are quite high and exceed background rates of extinction – that is, the natural rate of extinction under conditions when humans did not exist and could not impact ecosystems and species viability (Lomolio et al. 2001). Of particular concern is the fact that extinction rates since the industrial era are so high that researchers have identified this period as the sixth wave of extinction, and named it the

Anthropocene to identify the fact that extinction in this era is driven by human influences (Barnosky et al. 2011; Steffen, Crutzen and McNeil 2007; Steffan et al. 2011; Zalasiewcz et al. 2010). Evidence supporting the Anthropocene extinction has identified specific influential factors associated with human development and ecological impacts on species as responsible for extinction rates in the Anthropocene. These factors include deforestation, climate change (Parmesan and Yohe 2003; Thomas et al. 2003; Thuiller et al. 2005), the expansion of the ecological footprint and accelerating consumption (Vackar 2012).

From the preceding, it can be argued that the widespread effect of human development on species often occurs through routes that do not necessarily involve illegal activities such as poaching or illegal animal trade. Rather, species endangerment and extinction are largely the result of routine human activities related to economic development and expansion that we suggest is part of the expansionary tendencies of capitalism. Theoretically, human development and the consumption of nature through ecological withdrawals, ecological additions and ecosystem space conversion create the structural conditions through which ecosystems and consequently species are destroyed. In this sense, then, we can say that the majority of species that become extinct or which are listed as threatened and endangered is a consequence of "normal" patterns of human economic development. In the modern era, those "normal" patterns of development are associated with the constant expansion of the economy, and thus can be interpreted as a consequence of the expansion of capitalism and the capitalist treadmill of production (Stretesky, Long and Lynch 2013).

Dating back hundreds of years, capitalism emerged as the dominant economic form in the world market, exerting extensive negative ecological pressure and destruction, and limiting ecosystem functionality (Burns et al. 1994; Hornborg 1998; Jorgenson 2004). Thus, to understand ecological consequences such as the widespread decline of various species identified as threatened, endangered or extinct in the Anthropocene, it is necessary to refer to the ways in which capitalism produces ecological pressures that facilitate the decline of species. Here, we begin with the widely recognized observation that capitalism's primary goal is the production of continually expanding profit. To meet this goal, the capitalist system of production must constantly increase production, and hence must also constantly increase its extraction and consumption of raw materials. The result of constantly expanding production and consumption is the acceleration and expansion of ecological destruction and disorganization (Stretesky, Long and Lynch 2013). These negative ecological impacts of capitalism are widely detailed and explained in the ecological literature (Burkett and Foster 2006; Clark and York 2005; Clausen and Clark 2005; Foster 1992, 1994, 1997, 1999, 2000; Foster and Clark 2004; Jorgenson 2004; Foster, Clark and York 2010; Jorgenson and Clark 2011; Schnaiberg 1980). Moreover, these assertions about capitalism and ecological destruction have extensive empirical support. Empirical examinations of the capitalism-species endangerment connection support a link between capitalism and species destruction across nations (Brewer et al. 2012; Clausen and York 2008; Hoffman 2004; McKinney, Kick and Fulkerson 2010; Shandra et al. 2008) and to processes related to species endangerment such as deforestation (Jorgenson 2006).

Here we hypothesize but do not test the assertion that the widespread nature of species decline over time and across nations *must* be the result of influences or factors that occur persistently across nations and over time. They must also be factors that apply across a diverse range of non-human animal and plant species to effectively explain the widespread nature of species decline across societies, time and species. These influences are beyond the scope of activities such as poaching, hunting and animal trade. For example, a number of insects worldwide are listed as endangered. An example of several US insect species listed as endangered or critically endangered by the IUCN or the USWFS is as follows: American Burying Beetle; Avalon Hairstreak; Blind Cave Beetle; Carson's Wandering Skipper; Columbia Clubtail; Delhi Sands Flower-Loving Fly; Desert Everglade Sprite; Dorymyrmex Insanus; Everglades Sprite; Franklin's Bumble Bee; Helotes Mold Beetle; Keys Scaly Cricket; Manica Parasitica. Beside the fact that these creatures may be collected for scientific purposes by those with appropriate licenses or by a curious youngster, these creatures have no commercial value and are not trafficked, poached or hunted. Yet, they are still threatened with extinction. These geographically diverse species are endangered by forms of human development that encroach upon and destroy natural spaces. That pattern of human encroachment is, we suggest, related to the continuous expansion of the capitalist treadmill of production. That is, while non-humans have certainly gone extinct prior to capitalism, they do so at a greater rate after the development of capitalism – and clearly do so independently of population growth. This occurs in two ways. First, researchers who study species extinction demonstrate that the expansion of logging contributes greatly to these non-human rates of extinction and decline. For example, in the journal *Nature*, Pimm and Raven (2000) point out that damage to timber hotspots is the single greatest threat to non-human loss and they emphasize that it is a relatively recent phenomena. That is, as timber was needed as an energy source for the development of capitalism a "relaxation" period occurred. Relaxation needs to be taken seriously as a source of non-human extinction and should not be discounted as similar to the causes of extinction that occurred prior to the development of capitalism. Relaxation suggests that the "the original number of species in the fragmented area eventually relaxes to a new, lower number" (Brooks, Pimm, and Oyugi 1999:1140). While there is debate about the time frame associated with the emergence of a relaxation period, the dates of timber withdrawals suggests that the significant expansion of timber-related energy that were needed to drive capitalist production are the cause. This is especially documented during the period of 'advanced industrialization' that occurred worldwide between 1920 and 1960 (Tillman 2012). More importantly, current background levels as a result of this capitalist expansion are driving extinction rates to the tune of at "least 1000 times higher than the background rate" without this form of human economic activity (Brooks, Pimm, and Oyugi, 1999:1150).

Second, it is also increasingly important to note that as populations expand they have destroyed species to provide for continual economic growth. We need to be clear that it is not population growth directly that is the cause of this destruction. That is, population expansion and growth in the current period are organized to be compatible with the expansion of the treadmill of production. Thus, we take a similar position as Tabb and Sawyers (1984:4) who point out living spaces are "merely a reflection of the larger economic and social fabric, termed the mode of production." As a result, the organization of various living spaces that may encroach on natural habitats is likely to be environmentally destructive in the current period of capitalism in different ways than those developments that occurred prior to the emergence of capitalism where the human ecological footprint was at an all time low. This issue is made clear by biologists who study the history of extinction rates. It is not population that matters, but the ecological impact of that population under the current form of production. Thus, currently we see extremely high ecological footprints in those nations that are most central to the production process (see Jorgenson 2003). For example, Barnowski et al., (2011:57) point out this problem is directly linked to what some biologists have called the sixth mass extinction:

> [T]here are clear indications that losing species now in the 'critically endangered' category would propel the world to a state of mass extinction that has previously been seen only five times in about 540 million years. Additional losses of species in the 'endangered' and 'vulnerable' categories could accomplish the sixth mass extinction in just a few centuries. It may be of particular concern that this extinction trajectory would play out under conditions that resemble the 'perfect storm' that coincided with past mass extinctions: multiple, atypical high-intensity ecological stressors, including rapid, unusual climate change and highly elevated atmospheric CO_2.

In short, as Barnowski et al. point out, it is the organization of society that is the threat. To further illustrate the widespread nature of the species endangerment problem, below we review data on the count of endangered species globally and within the US. While we do not test our proposition that these widespread patterns of endangerment are a product of capitalism with these data, future research should be explored that addresses this issue. For examples, statistical models of population extinction could be used to test the difference in extinction coefficients that are associated with variations in modes of production. The ubiquitous nature of capitalism, however, makes such hypotheses tests difficult. Thus, further refinement of an applicable hypothesis concerning variations in core aspects of capitalism are needed before such a hypothesis could be tested with these data.

GLOBAL COUNT OF ENDANGERED SPECIES: IUCN RED LIST

Threatened and endangered species are found in all nations of the world. Efforts to count and regulate endangered species at the international and national levels exist and provide us with some evidence of the widespread nature of this problem.

In 2012, the International Union for the Conservation of Nature (IUCN) updated its Red List, which is an assessment of the health of species derived from its global survey of species. Part of the Red List data keeps track of species extinction and the status of endangered species. IUCN estimates that there are currently 1,729,693 species in various categories that exist throughout the world.[3] Of those species, the status of only 71,576 (4.1%) species has been adequately assessed by the IUCN. Of the assessed species, 21,286 (29.7%) were identified as threatened in 2013. Of threatened species, 6,451(30.3% of threatened species, and 9.1% of all assessed species) are listed as endangered, while 4,286 species (20.1% of threatened species, and 6% of all assessed species) as listed as critically endangered.[4] In addition, 61 species are listed as extinct in the wild while an additional 799 species listed as extinct. Thus, of the 71,576 species surveyed in the Red List, about 15.1 % are identified as endangered/critically endangered while 1.2% of all identified and studied species are listed as extinct.

Table 1 summarizes global IUCN data reports (IUCN 2013). The table shows a collapsed distribution of species for four categories: vertebrates; invertebrates; plants and fungi/protists. Of the species in each category, the status of 57.3% of vertebrates; 1.2% are invertebrates; 6.0% of plants and 0.04% of fungi/protists has been assessed (for discussion see endnote 2). For vertebrates, 19.8% of species are classified as threatened; for invertebrates, 24.0% are classified as threatened; for plants, 55.0% are classified as threatened; and for fungi/protists, 50% are classified as threatened.

Insert Table 1 About Here

Research on the status of various species indicates that many are in a state of decline. Stuart et al., (2004) note that scientists have been examining declines in amphibian populations since the 1970s. Employing IUCN data, the authors examined the status of the then identified 5,743 (2004) amphibians (or 81.5% of the number of amphibians IUCN currently identifies). One of the limitations of this study was that insufficient data was available for 22.5% of amphibians. They found that amphibians were more widely threatened than mammals or birds. Since 1980, there is sufficient data to indicate that nine amphibians have become extinct, while other data indicated that up to 113 additional amphibians can no longer be located in the wild (Stuart et al. 2004). One of the major causes of amphibian decline was reduced habitat. But, many of the declines were classified as “enigmatic,” meaning that they had no clear cause. Of the 435 species identified as facing high threats for extinction in 2004 compared to 1980, 50 (11.5%) faced population declines due to “over-exploitation” or extraction from natural environments; 183 (42.1%) faced population declines due to habitat destruction; and 207 (47.6%) faced population declined due to enigmatic forces, which have largely been associated with diseases and climate change. As these data indicate, the amphibian trade, poaching and illegal trafficking (over-exploitation) plays a relatively minor role in the decline of amphibians world-wide. Similar conclusions have been reached with respect to global bird populations (Sekercioglu et al. 2008) and reptiles (Gibbon et al. 2000). This is an important point to consider, since much of the green criminological research on species declines have focused on population declines related to over-exploitation as opposed to those associated with habitat destruction or enigmatic forces such as climate change (for alternative discussion see Sollund 2012b). That focus has important implications for the kinds of policy responses green criminologists suggest for controlling biodiversity loss and species declines. While species decline and biodiversity loss due to over-exploitation are important and should not be over-looked, the major forces behind species decline and biodiversity loss are habitat loss and climate change, and require different types of control policies than those often suggested by green criminologists.

In the section that follows, we examine the distribution of endangered species across US states. The data examined is extracted from the US Fish and Wildlife Service (USFWS). Data on extinct species once located in the US are also examined. These data were collected from USFWS information and trace extinct species since 1860 and include some species identified as endangered or critically endangered by IUCN.[5]

THE DISTRIBUTION OF ENDANGERED SPECIES ACROSS US STATES

Above we have reviewed IUCN data on endangered species which focuses on the global nature of that problem. We also wish to draw attention to the problem of endangered species on more local levels. For this purpose, we examined data on threatened species in the US across states.

As noted, US data on threaten species is available from the US Wildlife and Fish Service (USWFS). The USWFS publishes a list of threaten species in the US following the specifications of threatened species as identified in applicable US laws (50 CFR 17.11(h) and/or 50 CFR 17.12(h)). Based on those laws, there are currently 645 animal species listed as threatened or endangered and 872 plants species listed as threatened or endangered in the US (USFWS 2013). The number of threatened and endangered species of animals and plants by state is shown in Table 2.

To succinctly summarize the USFWS data, we collapsed the data into two general categories: animals and plants. The data in Table 2 displays two categories of endangered species for animals and plants. The "animal1/plant1" columns show the number of threatened species officially recognized in each state. The "animal2/plant2" columns shows the number of species that, while not officially recognized in each state, also appear in those states. In our calculations, the sum of animal1, animal2, plant1 and plant2 was used to identify the total number of animal and plant species at risk in each state and across states.

Following US law, the USFWS recognizes the existence of 1,517 endangered plant and animal species. The total number of endangered species listed in Table 2 (the sum of the "Total column") exceeds that figure because a species can be listed in more than one state and species listed in multiple states are thus counted more than once. Across states, the total number of endangered plant and animal species is 2,374 (1,352 animals and 1,022 plants) rather than 1,517.

The data in Table 2 can be used to describe some characteristics of the distribution of endangered species across US states. The range for endangered animal species, for instances, is between 2 (Vermont) and 126 (California), with a mean of 27.04 endangered species per state. For plants species the range is between 1 (Alaska) and 368 (Hawaii), with a mean number of endangered species of 20.44 for plants. The mean number of endangered animal and plants species per state is 47.48. That per state average is significantly impacted by California and Hawaii. For animal species, 19.5% of 645 endangered animal species occur in California; 42% of the 872 endangered plants species occur in Hawaii. Thus, when omitting California for animal species, the mean number of endangered species per state declines to 25, or by about 7.2%. Omitting plant species in Hawaii has a much greater effect, and the mean number of endangered plant species across states declines from 20.44 to 13.3 with the omission of Hawaii.

For both plants and animal species, omitting both California and Hawaii decreases the mean number of endangered species per state from 47.48 to 33.9, or by 28.6%.

The distribution of endangered species is highly skewed and uneven across states. The majority of states (N =29 or 58%) have a distribution of endangered species between 4 and 27. Within that small range of endangered species and states, the distribution approximates a normal curve. For the remaining 21 states, however, the distribution of endangered species ranges from 28 to 435, and with the exception of small spikes around 38-47 (N = 7), 58-62 (N= 3) and above 100 (N = 3), the number of endangered species is widely distributed.

In the final column in Table 2, we present what we call the Endangered Species Enrichment Factor (ESEF). This is the percentage of all recognized endangered species (N = 1,517) found within each state. At the low end, only 0.26% of endangered species are located in Vermont. At the upper end, 28.68% (plant) and 20.5% (animal) of endangered species are located in Hawaii and California respectively. The ESEF, therefore, indicates that both Hawaii and California appear to be locations of significant species diversity and endangerment. With respect to policy and efficiency, one could make the argument that efforts to control human ecological destruction in Hawaii and California has more “bang for the buck” with respect to the probability of aiding in protecting endangered species. Such an approach, however, would overlook the fact that in other kinds of ecosystems, important ecosystem species are in danger of becoming extinct and threatening the functioning of the ecosystems in those locations as well.

These data have their limitations. As Wilcove and Master (2005) note, the vast majority of species in the US have not been “well studied,” meaning that there is insufficient data to efficiently judge the extent to which species are threatened and endangered in the US. Reviewing the available data, Wilcove and Master estimate that the number of species listed in the Endangered Species Act (ESA) is well below the level needed to protect species biodiversity in the US. Wilcove and Masters suggest that the ESA list of species needs to increase by a factor of at least ten to efficiently protect species and to adequately represent the extent of species endangerment in the US.

Having reviewed the extensive variation in species endangerment for species at the global level and across US states, in the section that follows, we address the relevance of this exploratory study for future green criminological research.

Insert Table 2 About Here

DISCUSSION & CONCLUSION

Based upon the theoretical discussion and the data presented above, we suggest that green criminologists devote additional attention to the use of empirical data that addresses the relationship between anthropogenic sources of ecological disorganization and species endangerment and pay additional attention to structural processes that influence harms against non-human species across and within nations. To date, the majority of green criminological studies on biodiversity loss have used case studies and qualitative approaches which, while informative for any particular individual species, does not provide an adequate understanding of broader structural factors influencing species and biodiversity loss across the globe. Like several other green criminologists, we argue that these structural factors are largely responsible for environmental harm (Ruggiero 2013; Ruggiero and South 2010, Walters 2010). In our view, those structural factors are specifically related to the organization of capitalism, its inherent drive to constantly expand production, and as a result, its continual need to escalate the extraction of natural resources for the creation of commodities.

The data examined above on the variability in the distribution of endangered species across US states indicates the need for further research focused on identifying the factors that may be associated with the distribution of endangered species across US states. Persistent and widespread effects on non-human loss are produced by habitat loss and climate change. The effects of poaching are much more limited. Even for African Elephants, a species that suffers from extensive poaching, poaching leads to an estimated loss of 7.4% of elephants (Lawson and Vines, 2014). Clearly, one of the important factors in species loss is the natural distribution of species, and species are unlikely to be lost at high rates under certain distribution parameters. The natural distribution of species, however, does not tell us why a species becomes endangered within any specific location. Species endangerment is a consequence of the intersection of species distribution with factors that promote endangerment. The factors that promote endangerment of non-human species include those identified above: enigmatic effects such as climate change which may be difficult to isolate at the state level; over-exploitation of species and variability in over-exploitation across US sates; habitat destruction; and the general effects of the expansion of the capitalist treadmill of production and its impacts on ecological disorganization through ecological withdrawals and additions (see below). We limit our discussion to examples of empirical research conducted in the US to focus attention on the USFW service data reviewed above.

Prior research on the distribution of endangered species across the US has found that there are "hotspots" of biodiversity loss and that these hotspots ought to be addressed when devising policies to control biodiversity loss (Dobson et al. 1997; see also Czech and Krausman 1997; for additional hotspot analysis on biodiversity see, Orme et al. 2005). Non-human species loss hotspots are those associated with human development and encroachment on natural environments, which we see as the result of the constantly expanding nature of the capitalism treadmill of production.

Theoretically, loss hotspots are important with respect to policy issues. Loss hotspots are useful to the extent that they can be targeted to improve the efficiency of species protection efforts. At the same time, we must keep in mind that a focus on loss hotspots to the exclusion of larger species protection policies may be insufficient to broadly protect species from economically generated harms that cause biodiversity and species loss that stem from economic development promoted by the treadmill of production. Related studies should also be considered, especially from a localized hotspot perspective. Ando et al. (1998), for example, found that land value plays a significant role in being able to institute efficient conservation policies that protect endangered species, perhaps indicating that endangered species are better protected in states where a significant volume of low economic value land is present and available for use in conservation efforts and where, therefore, large tracts of land can be purchased that will protect numerous species simultaneously.[6] In those locations, the differential development of the treadmill of production is likely to impact land values. As Marxist ecologists such as Foster, Clark and York (2010) note, the long history of metabolic rift between urban and rural areas establishes an unequal exchange of metabolic materials from rural to urban areas, resulting in forms of ecological destruction in rural areas (e.g. dams, mountaintop removal in the case of coal extraction). That form of ecological destruction can lower land values, as rural land adversely impacted by treadmill of production practices loses its natural productivity. Illustrating the utility of this approach are studies that examine species loss from the opposing direction as well – that is, studies that draw attention to the relationship between habitat loss and species loss. Wilcove et al. (1998) examined the effects of several variables relevant to modification of ecosystems that included habitat destruction but also measures of over-exploitation of natural resource systems, the occurrence of alien species, and disease as threats to endangered species survival. Consistent with the above observations, they found that habitat loss had the strongest effect on species endangerment. Such results indicate the need for green criminologists to pay additional attention to concerns such as habitat loss as a major driver of species endangerment and extinction.

Others studies point toward the effect of economic development on species diversity. In our view, such studies are important because the capitalist treadmill of production drives economic development to continually expand in the pursuit of profit regardless of the ecosystem consequences. Importantly, as Czech (2000) noted, ecologists have paid insufficient attention to the effect of economic development and growth on species and wildlife conservation, and some, influenced by inaccurate depictions of the effect of indigenous peoples on species loss, follow reasoning which suggests that it is the poor people of the world and population growth in those regions that drive species extinction. In contrast, a structural economic view calls attention to the fact that the traditional behaviors of indigenous peoples only become ecologically destructive once capitalism expands into developed regions, and claims significant portion of the ecosystem for production, especially through the extraction of raw materials and imposed mono-agricultural methods of production consistent with the efficiency requirements of capitalism. Following up on that the economic development hypothesis, Czech, Krausman and Devers (2000) found that economic growth had an important impact on species endangerment, which in our view indicates the potential importance of considering the impact of the treadmill of production on species endangerment. Following Czech's (2000) critique, one can suggest that like some ecologists, green criminologists have not paid significant attention to the effect of economic development on species endangerment and extinction. The more general ecological literature, however, indicates that the larger concerns with respect to species health and vitality are related to economic development and habitat loss, issues recently raised, for example, in discussions of the treadmill of crime (Stretesky, Long and Lynch 2013).

Studies also indicate the importance of considering other indicators of development on species endangerment. Though not restricted to studies performed in the US, Luck (2007) undertook a meta-analysis of studies examining the relationship between human population density and species diversity, and found that the evidence for a link between human population density and biodiversity loss was weak. In a cross-state model, Brown and Laband (2006) assessed the relationship between human activities that impact ecosystems (specifically mean household population density, an indicator of roadways, and intensity of nighttime lighting) and species endangerment. Controlling for population density, they found that every 1% increase in human activities leads to an increase in species endangerment of 0.25% across states. In their study of variations across states for federally listed endangered mammals, Kirkland and Ostfield (1999) found significant effects for habitat diversity, wetland loss, percent forest cover and area reserved for state parks.

At the cross-national level, Naidoo and Adamowicz (2002) tested the effects of per-capita gross national product on the number of threatened species across nations. Their study was devised as a test of the Environmental Kuznets Curve argument (EKC) that over time or across nations, economic development has an inverted “U” shape relationship to ecological destruction – that is, that after per capita income reaches a saturation point, additional economic development causes a reduction in ecological destruction. That argument suggests that initially, economic development has a negative impact on ecological destruction, so that as economic development expands, ecological destruction increases which, in Naidoo and Adamowicz view, would increase species endangerment. However, the EKC argument also suggests that once a certain point in economic development is reached, the association between economic development and ecological destruction reverses, and further economic development becomes a protective factor that diminishes ecological destruction and, therefore reduces species endangerment. Naidoo and Adamowicz raise the question as to whether the traditional EKC argument applies to endangered species. Their findings suggest that for the majority of taxonomic species (excluding birds) the observed relationships rejected EKC assumptions, and that economic development increases species endangerment instead of protecting species.

In closing, we return attention to the issue of structural explanations of non-human species harm and decline. As we have illustrated, endangered species are widely distributed, and include a wide range of non-human species. Across these species, we argue that the main cause of endangerment to non-human species is capitalism. Thus, explaining and understanding the broad scale of species endangerment requires adopting structural views of non-human species endangerment and extinction. Specifically, we take an alternative perspective on species extinction and argue that extinction patterns are not caused by population expansion, poaching and/or wildlife trade. For example, as noted above, even for species in which poaching plays an important role in the final stages of decline for a species (e.g., elephants), poaching accounts for a small percentage of wildlife loss (i.e., in the study cited above, 7.4% of elephants are lost to poaching). Given available data such as the data on the percentage of elephant losses due to poaching, the assumption that poaching drives species extinction places undo emphasis on poaching as a cause of extinction, and, we would also suggest, draws attention to the behavior of indigenous peoples as the cause of such problem, while simultaneously diverting attention from the structural economic origins of species extinction.

In lieu of arguments that "blame the poor" and developing nations for ecological problems such as species extinction, we opt instead for a structural explanation. Structural explanations have an advantage with respect to species endangerment and extinction related to explaining the pattern of species extinction. For example, the data from the US on species endangerment by state are useful to illustrate our point. Within the US, there is no division between states that is similar to the division between nations (developed vs. developing). That is, no US state is so economically disadvantaged that its level of income shrinks to levels found in developing nations. For example, Santos-Paulino (2012) has pointed out that 80% of the population in the UN sample of developing nations exists on an income of less than $ 2 (US) per day. Returning to the US, there is no indication that under development impacts endangerment or extinction. We also suggest that such a hypothesis would not be applicable within the context of any developed nations. Thus, framing species extinction simply as a problem caused by people in underdeveloped nations misses the larger point concerning the distribution of species endangerment and extinction across areas of the world.

As we have argued, it is our contention that levels of endangerment and extinction are connected to the expansion of capitalism in its current form. For example, the Amazon Basin has a high rate of threatened and endangered species (van Solinge, 2008). Most of the countries in that region are classified as developing and some as underdeveloped economically. However, the simple fact that the high level of species endangerment and extinction co-occur in nations that are economically underdeveloped does not, in turn, mean that species extinction and endangerment is driven by economic underdevelopment or the specific behaviors of people living in those nations. The correlation is spurious – as many residents of that Basin would suggest. On this point, our structural economic argument draws attention to the fact that economic underdevelopment in the Amazon is linked to its exploitation and the development of the global treadmill of production. It is widely recognized that capital penetration into the Amazon region play a very significant role in ecological destruction in that region, and includes treadmill of production process related to the extraction of timber and its effects on deforestation, as well as treadmill of production agricultural practices that convert forest lands to agricultural use including cattle farming to produce food products for those in developed nations (van Solinge, 2008; 2010).

We recognize that there are many processes contribute to species extinction and threats. Those factors that contribute to extinction and threats that we have not explored are wars, pesticide use and abductions and killings by humans. Moreover, we hold that it is entirely possible to enumerate each of these contributing factors. That is, relative weights can be assigned to species endangerment. The point we are making – while somewhat controversial - is that the majority of the factors that contribute to endangerment and extinction is so mathematically small that they cannot be compared to the impact of the treadmill of production and capitalist economic development. Part of the point in drawing attention to this connection is to suggest that criminologists pay closer attention to how economic structures such as the treadmill of production is a chief driver of the process of species decline in the contemporary era. As we have noted, the scientific literature supports our theoretical assertions. That is, scientists are now beginning to talk about a new era of species extinction, which ranks among the most significant in biosphere history. The difference is this time the loss in biodiversity is a result of the way in which human economics interact with the ecology. This relationship has produced the term

'Anthropocene' to indicate that species extinction is driven by human behavior. Above all, we argue that the scientific literature recognizes that the single most important human effect on rates of extinction and endangerment is economic development. We argue that if the discipline of green criminology does not take science seriously that a criminological literature will emerge that is inconsistent with empirical scientific evidence on this point. That is, an emphasis within criminology will develop that focuses on the least important variables as drivers of destruction.

We have argued that one theoretical perspective that can be employed to highlight the connection between ecological concerns such as species extinction/threats and economic development is to pay greater attention to the past thirty-four years of research on the intersection of economic development and ecological destruction found in the ecological economics literature. From among the options in that literature, we focused attention on the specific connection between economic development and ecological destruction presented in the treadmill of production literature and the ecological Marxist literature. As noted above, both literatures contain substantial empirical support for the proposition that economic development and ecological destruction are linked. In the present analysis, we extended those economic arguments to threats to non-human species as one form of ecological destruction, and illustrated points on which the scientific literature would also support such a contention.

Part of this analysis is, therefore, to draw attention to the fact that outside of criminology, there are numerous empirical studies that are directly relevant to the interaction between economic development and species threats/extinction. Those studies call attention to the persistence of these threats to species globally. We see these studies as indicating a need for a structural analysis of the threat to species that is situated in ecological Marxism (e.g., Burkett and Foster, 2006; Foster 2000) and the treadmill of production as developed by Alan Schnaiberg

(1980). Absent efforts to understand the structural nature of non-human species declinen, green criminologists will be confined to case study approach, whether empirical or qualitative, and will fail to come to grips with the broader economic forces that drive species harm.

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Table 1. IUCN Species Data Summary

	Estimated	Assessed	Threatened 1996	Threatened 2013
Vertebrates	65,146	37,356	3,314	7, 390
Invertebrates	1,305,250	15,911	1,891	3,822
Plants	306,674	18,291	5,328	10,065
Fungi/Protists	51,623	18	--	9
TOTAL	1,729,693	71,576	10,533	21,286

Notes: Vertebrates include: mammals, birds, reptiles, amphibians, fish. Invertebrates include: insects, mollusks, crustaceans, corals, arachnids, velvet worms, horseshoe crabs, others. Plants include: mosses, ferns and allies, gymnosperms, flowering plants, green algae, red algae. Fungi/protists include: lichens, mushrooms, brown algae.

Table 2. Endangered and Threatened Species Count by State, US Fish and Wildlife Service

	Animal 1	Animal 2	Plant 1	Plant 2	Total	ESRF*
Alabama	103	3	18	1	125	8.24
Alaska	16	1	1	0	18	1.19
Arizona	37	1	20	1	59	3.89
Arkansas	24	5	5	0	34	2.24
California	124	2	180	5	311	20.50
Colorado	16	0	16	0	32	2.11
Connecticut	14	0	2	0	16	1.06
Delaware	10	0	5	0	15	0.99
Florida	64	3	57	0	114	7.52
Georgia	38	2	22	2	64	4.22
Hawaii	65	2	362	6	435	28.68
Idaho	9	0	3	0	12	0.79
Illinois	19	0	9	0	28	1.85
Indiana	17	0	4	0	21	1.38
Iowa	9	0	5	0	14	0.92
Kansas	11	2	2	0	15	0.99
Kentucky	35	1	8	0	44	2.90
Louisiana	18	4	3	0	25	1.65
Maine	9	2	3	0	14	0.92
Maryland	16	0	6	0	22	1.45
Massachusetts	17	1	3	0	21	1.38
Michigan	13	0	4	0	21	1.38
Minnesota	10	0	4	0	14	0.92
Mississippi	33	8	4	0	45	2.97
Missouri	25	2	10	0	37	2.44
Montana	9	0	3	0	12	0.79
Nebraska	8	3	4	0	15	0.99
Nevada	27	3	9	0	39	2.57
N. Carolina	29	6	27	0	62	4.09
N. Dakota	6	0	1	0	7	0.46
N. Hampshire	5	3	3	0	11	0.73
New Jersey	13	1	6	0	20	1.32
New Mexico	31	3	13	0	47	3.10
New York	17	1	7	1	26	1.71
Ohio	17	0	5	1	23	1.52
Oklahoma	18	1	1	1	21	1.38
Oregon	36	7	16	2	61	4.02
Pennsylvania	11	0	2	0	13	0.86
Rhode Island	10	1	2	0	13	0.86
S. Carolina	15	5	19	2	41	2.70
S. Dakota	9	1	1	0	11	0.73
Tennessee	71	1	18	1	91	6.00

Texas	60	3	30	1	94	6.20
Utah	16	1	25	0	42	2.77
Vermont	2	0	2	0	4	0.26
Virginia	51	5	15	3	74	4.88
Washington	30	3	9	0	42	2.77
West Virginia	14	2	6	0	22	1.45
Wisconsin	9	1	7	0	17	1.12
Wyoming	6	0	4	0	10	0.66
TOTAL	1262	90	995	27	2374	156.52
Mean	25.24	1.8	19.9	0.54	47.48	3.13
Range (low)	2	0	1	0	4	0.26
Range (high)	124	8	362	6	435	28.68

Source: USFWS (2013).
Notes: Animals include mammals, fish, amphibians, reptiles, birds and insects.
Animal 1 = Endangered and threatened animals specifically listed for state.
Animal 2= Endangered and threatened animals that occur in state but are not listed as state species.
Plant 1 = Endangered and threatened plats specifically listed for state.
Plant 2 = Endangered and threatened species that occur in state but are not listed as state species.
ESRF = Endangered species richness factor. This measure was created by dividing the total number of threatened and endangered species in a state by the total number of endangered and threatened species in the US (N = 1,517)

ENDNOTES

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[1] Where we use the term non-human we are generally referring to non-human animal species. Non-human-non-animal species are also the victims of systemic ecological harm, but are excluded from the current discussion due to the length such a discussion would add to the current project.

[2] The combination of the IUCN Red List species and the US Fish and Wildlife Services lists includes the following wildlife as animals and plants: (animals) mammals, birds, reptiles, amphibians, insects, mollusks, crustaceans, corals, arachnids, horseshoe crabs; (plants) mosses, conifers, sponges, ferns and allies, gymnosperms, flowering plants, trees, green algae, red algae, lichens, mushrooms, and brown algae.

[3] Estimates of the number of known species are controversial. Consider, for instance, the estimate of the number of fungi species. The Red List places the estimate of fungi species at 51,623 as of 2013. The literature on fungi species, however, accepts an upper end estimate of approximately 1.5 million species (Hawksworth 2001) – or 29 times the number of fungi species IUCN recognizes. In contrast, Frohlich and Hyde (1999) suggest that the number of fungi species may be as high as 9.9 million. In addition, the literature suggests that the minimum number of fungi species is at least 74,000 (Hawksworth 2001), a figure that is still 43% higher than the Red List estimate. Thus, the Red List appears to underestimate the number of fungi species. With respect to lichens, for example, Feuerer and Hawksworth (2007) employ a checklist measure which suggests that there are 18,882 lichens compared to the Red List estimate of 17,000.

[4] For specific details on definition of terms used for Red List classifications see (ICUN 2013). Definitions of endangered and critically endangered involve complex measures. Here, we include a summary for critically endangered and endangered species. This summary, however, does not provide a sufficient indicator of the complexity of the measurements involved. Nevertheless, the summary of these measures are as follows:

	Critically Endangered	Endangered
Population Size measure		
Population Reduction observed estimate or suspected	> 90%	> 70%
Geographic Range		
(A) Extent	< 100 km^2	< 5,000 km^2
(B) Area of occupancy	= 1	< 5
Number of mature individuals	< 250	< 2,500
(C) Projected continuing decline	25% in 3 years	20% in 5 years
(D) Number mature individuals In subpopulations, or	< 50	< 250
(E) % mature individuals in one Subpopulation	90%-100%	95%-100%
Very Small/Restricted Population	< 50	< 250
Probability of Extinction in Wild	> 50% in 10 years	> 20% in 20 years

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[5] The extinct and possibly extinct species for the US (n =142) and year of extinction since 1860S are as follows as extracted from the IUCN Red List, USFWS data and Fuller's *Extinct Birds* (2000; NY: Oxford University Press): (1) Acorn Pearly Mussel, Unknown; (2) Acorn Ramshell, Unknown; (3) Agate Rocksnail, Unknown; (4) Alabama Clubhsell, Unknown; (5) Alabama Pigtoe, Unknown; (6) Alvord Cutthroat Trout, 1920s; (7) 'Āmaui, 1860s; (8) American Chestnut Moth, Unknown; (9) Amistad Gambusia, 1987; (10) Angled Riffleshell, 1967; (11) Antioch Dunes Shieldback Katydid, unknown; (12) Arc-form Pearly Mussel, 1940; (13) Arcuate Pearly Mussel, Unknown; (14) Ash Meadows Killifish, 1948; (15) Bachman's Warbler, 1988; (16) Bigmouth Rocksnail, Unknown; (17) Bishop's 'Ō'ō, 1980s; (18) Black Mamo, 1907; (19) Blackfin Cisco, 1969; (20) Blue Walleye, 1983; (21) Boulder Snail, Unknown; (22) Brown Pigtoe, Unknown; (23) Cahaba Pebblesnail, 1965; (24) California Golden Bear, 1922; (25) Carolina Elktoe, Unknown; (26) Carolina Parakeet, 1918; (27) Catahoula Salamander, 1964; (28) Cascade Mountain Wolf, 1940; (29) Central Valley Grasshopper, Unknown; (30) Channeled Pebblesnail, Unknown; (31) Chestnut Casebearer Moth, 1900; (32) Chestnut Ermine Moth, Unknown; (33) Clear Lake Splittail, 1970s; (34) Closed Elimia, 1967; (35) Cobble Elimia, Unknown; (36) Constricted Elimia, Unknown; (37) Coosa Elktoe, Unknown; (38) Coosa Pigtoe, Unknown; (39) Coosa Rocksnail, Unknown; (40) Corded Purg, Unknown; (41) Deepwater Cisco, 1952; (42) Dusky Seaside Sparrow, 1987; (43) Eastern Cougar, 2011; (44) Eastern Elk, 1887; (45) Eskimo Curlew, 1981; (46) Eelgrass Limpet, 1920s; (47) Elimia Gibbera, Unknown; (48) Elimia lachrymal, Unknown; (49) Elimia macglameriana, Unknown; (50) Excised Slitshell, Unknown; (51) Fine-rayed Pearly Mussel, Unknown; (52) Fish Lake Physa, Unknown; (53) Franklin Tree, Unknown; (54) Fusiform Elimia, Unknown; (55) Grass Valley Speckled Dace, 1938; (56) Greater 'Akialoa, 1969; (57) Greater 'Amakihi, 1904;

(58) Great Auk, 1852; (59) Greater Koa Finch, 1896; (60) Goff's Pocket Gopher, 1955; (61) Gull Island Vole, 1897; (62) Hairlip Sucker, 1893; (63) Hawai'i 'Akialoa, 1940; (64) Hawai'i Mamo, 1898; (65) Hawai'i 'Ō'ō, 1930s; (66) Hawaiian Rail, 1890; (67) Hearty Elimia, Unknown; (68) Heath Hen, 1932; (69) Hemigrapsus estellinensis, 1963; (70) High-spired Elimia, Unknown; (71) Independence Valley Tui Chub, 1970s; (72) Ivory-Billed Woodpecker, 1987; (73) Kakawahie, 1963; (74) Kāma'o, 1990s; (75) Kioea, 1860s; (76) Kona Grosbeak, 1894; (77) Labrador Duck, 1880; (78) Lāna'i Hookbill, 1918; (79) Las Vegas Dace, 1986; (80) Laysan 'Apapane, 1923; (81) Laysan Rail, 1944; (82) Lewis Pearly Mussel, Unknown; (83) Lesser Koa Finch, 1891; (84) Lined Pocketbook, Unknown; (85) Longjaw Cisco, 1975; (86) Maryland Darter, 1988; (87) Merriam's Elk, 1906; (88) Moho braccatus, 1987; (89) Navassa Curly-tailed Lizard, 1970; (90) Navassa Island Dwarf Boa, late 1800s; (91) Navassa Island Iguana, late 1800s; (92) Nearby Pearly Mussel, 1901; (93) New Mexico Sharp-tailed Grouse, 1952; (94) Nukupu'u, 2000; (95) O'ahu 'Alauahio, 1990s; (96) O'ahu 'Ō'ō, 1860s; (97) Ochlockonee Arcmussel, Unknown; (98) Oloma'o, 1980s; (99) Pagoda Slitshell, Unknown; (100) Pahranagat Spinedace, unknown;(101) Pallid Beach Mouse, 1959; (102) Pasadena Freshwater Shrimp, 1933; (103) Passenger Pigeon, 1914; (104) Pecatonica River Mayfly, Unknown; (105) Phantom Shiner, 1975; (106) Po'o-uli, 2004; (107) Pupa Elimia, Unknown; (108) Pygmy Elimia, Unknown; (109) Pyramid Slitshell, Unknown; (110) Raycraft Ranch Killifish, Unknown;(111) Ribbed Elimia, Unknown; (112) Ribbed Slitshell, Unknown; (113) Robert's Stonefly, Unknown; (114) Rocky Mountain locust, 1902; (115) Rubious Cave Amphipod, unknown; (116) Rough-lined Elimia, Unknown; (117) Round Slitshell, Unknown; (118) Sampson's Pearly Mussel, Unknown; (119) Sandhills Crayfish, Unknown; (120) Sea Mink, 1860; (121) San Marcos Gambusia, 1983; (122) Shortnose Cisco, 1985; (123) Shoal

Sprite, Unknown; (124) Short-spired Elimia, Unknown; (125) Silvernose Trout, 1930; (126) Sloane's Urania Butterfly, 1894; (127) Smith Island Cottontail, 1987; (128) Snake River Sucker, Unknown; (129) Sooty Crayfish, late 1800s; (130) Southern Rocky Mountain Wolf, 1935; (131) Steward's Pearly Mussel, Unknown; (132) Striate Slitshell, Unknown; (133) Tacoma Pocket Gopher, 1970; (134) Tecopa Pupfish, 1979; (135) Thicktail Chub, 1950s; (136) Thismia Americana, 1916; (137) Turgid-blossom Pearly Mussel, Unknown; (138) 'Ula-'ai-hawane, 1937; (139) Umbilicate Pebblesnail, Unknown; (140) Utah Lake Sculpin, 1928; (141) Yellowfin Cutthroat Trout, 1903; (142) Xerces Blue Butterfly, 1943.

[6] Unfortunately this does not mean that all species can live on these lands. This is important because even if conservation policies are effective, they may have little or no impact on endangered species since the habitats on those lands may be irrelevant to the survival of a species. We thank Ragnhild Sollund for bringing this issue to our attention.