

Paulina Przybylski

Professor Lori Bedell

CAS 138T

15 April 2022

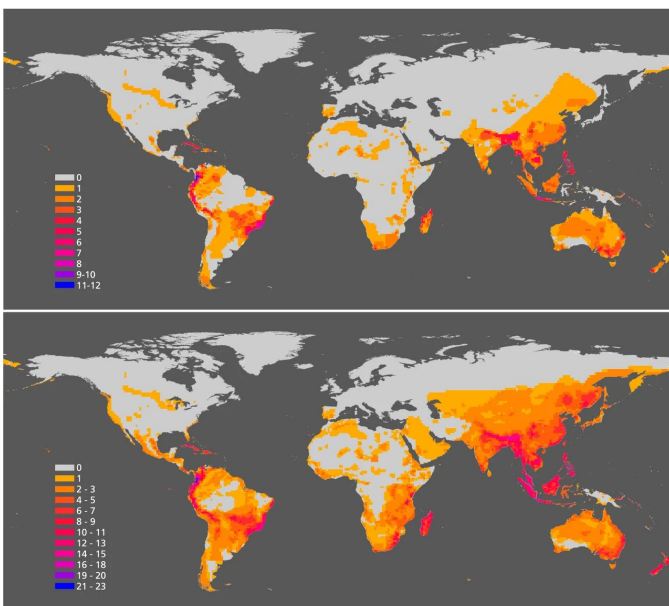
### The Effects of the Holocene Mass Extinction on the Planet and Human Population

In the past 500 years, vertebrate species have been going extinct between 24 and 85 times faster than during the Cretaceous Mass Extinction Event, known for wiping out the dinosaurs.<sup>1</sup> While this mass extinction event was caused by an asteroid impact, the current rate of species extinction can be attributed to the activities of one species: us, the *Homo sapiens*.

The idea that species are going extinct is not concerning by itself, since extinctions on Earth are relatively common. A background extinction rate is always present, with recent estimates placing it at 0.1 E/MSY (extinctions per million species per year, estimated from the fossil record), as reported by Mossy Earth, an organization that works to restore nature and fight climate change.<sup>2</sup> Such extinctions are typically balanced out by the introduction of new species through evolution known as speciation. In order for an extinction event to be classified as a mass extinction event, the rate of extinction must be significantly higher than the background, with the Earth losing around three-quarters of its species in a geologically short time interval.<sup>3</sup> There have been five such mass extinction events in the past 540 million years near the end of the Ordovician, Devonian, Permian, Triassic, and Cretaceous Periods, each caused by a catastrophic change in Earth's environment. While these events are often thought of as much removed from ourselves, the current extinction rate of 100 E/MSY is over 1,000 times higher than the background rate, leading scientists to say we are in the midst of a sixth mass extinction deemed the Holocene Mass Extinction Event.<sup>4</sup>

## The Holocene Mass Extinction Event: Evidence and Causes

According to a 2020 scientific report titled “Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction” by Gerardo Ceballos et al., the living mass of humans and their domesticated animals is thirty times greater than that of all of Earth’s wild mammals, which are in competition with them for the space and resources necessary for survival. It follows that so many species are approaching extinction due to anthropogenic causes, as is reflected in data showing that species on the brink of extinction are concentrated in areas with high human impact.<sup>5</sup> The International Union for Conservation of Nature (IUCN) considers a species to be critically endangered when it consists of 1,000 or fewer individuals, making it on the brink of extinction.<sup>6</sup> The aforementioned scientific report found that “84% of the under 5,000s species are found in the same regions as the species on the brink,” seemingly indicating an “incipient regional biodiversity collapse in those areas.”<sup>7</sup> It is apparent that “extinction breeds extinctions” as species that closely interact with those on the brink are moved to extinction when the latter eventually disappear.<sup>8</sup> As a result, the current extinction rate will continually increase as more species are lost, which in combination with the current number of species on the brink has led to the suggestion that the predicted future rates are most likely underestimated.<sup>9</sup>



“Current distribution of 515 terrestrial vertebrate species on the brink (i.e., with under 1,000 individuals; Top) and 903 species with under 5,000 individuals (Bottom). Of the 388 species under 5,000 that have populations larger than 1,000 individuals, 84% have overlapping distributions with the species at the brink (i.e., with under 1,000 individuals), indicating high distribution congruence.”<sup>10</sup>

Given the evidence that there is, in fact, an ongoing mass extinction event and that it is human-caused, it is now important to recognize the specific drivers of the increased extinction rate resulting from human activity. Scientists have determined these drivers to be “habitat loss, increased pollution, over-exploitation of resources and species, the proliferation of invasive species and the rapid rate of climate change,” which are all “ultimately caused by the increasing size of the human population, the increasing size of human economies and the ever-increasing rate of human overconsumption of resources.”<sup>11</sup> This ongoing mass extinction is historically unique in that while humans are the sole cause, they will also be victims.

### **The Insect Apocalypse: Evidence and Causes**

Prominent biologist, entomologist, and writer E.O. Wilson stated, “If all mankind were to disappear, the world would regenerate back to the rich state of equilibrium that existed ten thousand years ago. If insects were to vanish, the environment would collapse into chaos.”<sup>12</sup> This quote puts into perspective the corresponding influences of humans and insects on the world, while what has been dubbed the insect apocalypse is underway as part of the ongoing mass extinction. Insect populations are declining at an astonishing rate due to habitat loss, lack of food, and harmful chemicals, all as consequences of human action.<sup>13</sup> In terms of recent trends of insect populations, data from a German study describes “a 76% decline in biomass over 26 years,” and a Puerto Rican study estimates “a decline of between 75% and 98% over 35 years.”<sup>14</sup> This evidence was corroborated with data from elsewhere in the world such as the United States and other European countries, demonstrating that the declines are a widespread concern, rather than an isolated issue.<sup>15</sup>

Although it is crucial to pay careful attention to all of the populations being affected by this anthropogenic decline in biodiversity whether they directly benefit humans or not, people tend to focus their attention on the big and ideally cuddly endangered mammals, out of a sense of emotional connection to them. But in doing so, ecologist and entomologist Dave Goulson asserts that we have been missing the most profound change that has been going on in our environment for a long time: “the quiet disappearance of insects.”<sup>16</sup> Even though they play a vital role in maintaining life on this planet, insects are traditionally overlooked when it comes to worries of extinction because they are “about as far as you can get from charismatic megafauna,” as described by Brooke Jarvis in “The Insect Apocalypse is Here.”<sup>17</sup> However, E.O. Wilson says that they are “the little things that run the natural world,” and in imagining what our world would look like without them, we discover what Jarvis calls “the invisible importance of the common.”<sup>18</sup> Insects are so crucial to the health of Earth’s ecosystems that scientists respond to the idea of a total disappearance of these organisms with words like “chaos, collapse, [and] Armageddon.”<sup>19</sup>

### **The Holocene Mass Extinction Event and The Insect Apocalypse: Impacts and Implications**

Although it is important to care about the wellbeing of other life, simply as the species with the greatest impact and power to protect our planet, mass extinction also has disastrous implications for society. Humans often fail to acknowledge their dependence on the ecosystem services provided by life on Earth, which can be as simple as fresh water, clean air, and fertile soil, and which are currently facing degradation at the hands of extinction.<sup>20</sup> Ecosystem services are positive benefits that people receive from wildlife or ecosystems, and they are broken down by the UN sponsored Millennium Ecosystem Assessment into the following four categories:

provisioning, regulating, cultural, and supporting.<sup>21</sup> Provisioning services are benefits that people can extract from nature like food, water, fuel, and plants for clothing or medicine. Regulating services are benefits provided by ecosystem processes that control natural systems and make life possible, such as pollination, decomposition, carbon sequestration, and climate regulation. Cultural services are intangible benefits to the cultural, intellectual, and social development of humans, including the cultural significance of nature, creativity inspired from nature, and recreation. Finally, supporting services are the fundamental and underlying processes that allow Earth to sustain life, namely photosynthesis, nutrient and water cycling, and soil formation.<sup>22</sup>

The collapse of ecosystems through species extinction will cause, and already is starting to cause, the loss of these crucial ecosystem services in all categories, making the future of humankind a bleak one. Scientists agree that the sixth mass extinction and the degradation of ecosystem services will result in the loss of food security due to a dependence on pollinators, the deterioration of soil fertility and increased erosion as microorganisms disappear, clean water shortages from the loss of wetlands, increased natural disasters in number and severity, a loss of resilience in ecosystems paired with more pandemics, and a loss of heritage, culture, and non-physical benefits from nature.<sup>23</sup>

In *Insect Biodiversity*, Geoffrey G. E. Scudder writes that, “In terms of biomass and their interactions with other terrestrial organisms, insects are the most important group of terrestrial animals - so important that if all were to disappear, humanity probably could not last more than a few months.”<sup>24</sup> After all, insects are the biological foundation of all terrestrial ecosystems due to their primary role in cycling nutrients, pollinating plants, dispersing seeds, maintaining soil structure and fertility, controlling other organisms’ populations, and acting as a food source for other creatures.<sup>25</sup> To put a number to the benefits we receive from insects, the service of insects

pollinating about 75% of our food crops is worth around \$500 billion every year, without even taking into account the 80% of wild flowering plants they pollinate which serve as the foundation for so much of the life on Earth.<sup>26</sup> With the disappearance of insects including our primary pollinators, the insect apocalypse means that these regulating services will be lost, leaving a higher financial and manpower burden to humans themselves, and resulting in a loss of many sources of food paired with an ever-growing starvation crisis.

Environmental issues in general disproportionately affect racial and ethnic minorities and low-income communities, since they are typically least able to prepare for and recover from environmental crises. The current mass extinction event and resulting ecosystem degradation is no exception to this generalization. Within the United States, an EPA analysis from 2021 showed that underserved communities and socially vulnerable populations are disproportionately impacted by climate change, with the most severe damages and negative health impacts falling first and foremost on them.<sup>27</sup> The report describes that, “Black and African American individuals are 40% more likely than non-Black and non-African American individuals to currently live in areas with the highest projected increases in mortality rates due to climate-driven changes in extreme temperatures.”<sup>28</sup> Additionally, “American Indian and Alaska Native individuals are 48% more likely than non-American Indian and non-Alaska Native individuals to currently live in areas where the highest percentage of land is projected to be inundated due to sea level rise.”<sup>29</sup> Coverage of a 2019 UN general assembly meeting outlines that climate change will have unprecedented impacts and place disproportionate burdens on developing countries.<sup>30</sup> For example, the delegate from Botswana mentioned his nation’s struggle to achieve the UN’s Sustainable Development Goals as Botswana is already suffering from the effects of climate change-induced drought.<sup>31</sup> Although the majority of privileged people living in developed

nations may not see the urgency in resolving environmental crises such as climate change or the highly related mass extinction event, these crises are very much so already a reality for many. Following the presentation of the impact and implications of the ongoing mass extinction event both on the planet and human population, it then seems intuitive that we as humans must work together as a global collective to halt the mass extinction and save species while we still can, as we are the only species with the power and responsibility to do so.

### **Resolving the Crisis: Public Awareness and a Global Initiative to Halt the Extinction**

In *The Song of the Dodo*, David Quammen asserts that, “While the scientists have murmured, the general public has heard almost nothing ... even well-informed people with some fondness for the natural world have remained unaware that any such dark new idea [of species loss and ecosystem decay] is forcing itself on the world.”<sup>32</sup> To begin seriously working toward solutions for the sixth mass extinction event, the first step that must be taken is informing the public. Discussions of mass extinction must be brought beyond the scientific realm and into people’s day to day lives in a similar fashion to the discussion about global climate change. As described by Jason Lambacher in “The Politics of the Extinction Predicament – Democracy, Futurity, and Responsibility,” people’s perspective of a normal and healthy level of biodiversity is always shifting so that less is acceptable.<sup>33</sup> As a result, people are unaware of how many species are being annihilated due to human activity, and they are blind to the severity of the crisis, failing to even see it as such. When more people have the knowledge that gives them the ability to be concerned about the present and future states of the world, governments and institutions will feel more public pressure to take widespread action. This pressure is necessary to ensure actual change is on its way.

The spread of this knowledge and the inspiration of an appropriate sense of urgency should begin with the International Union for Conservation of Nature (IUCN) classifying all species with under 5,000 individuals as critically endangered. This step was suggested by Gerardo Ceballos et al. as part of their report on vertebrates on the brink of extinction.<sup>34</sup> Following this change that will mean many more species are defined as critically endangered, they then propose that governments and institutions should elevate the conservation of endangered species to a national and global emergency, to result in levels of discourse and plans for action equivalent to that of the climate crisis.<sup>35</sup>

In approaching this issue on a global scale, the United Nations should create a comprehensive binding agreement to address the ongoing extinction event in a conservation agenda.<sup>36</sup> In the upcoming second part of the UN Biodiversity Conference (COP15 summit) to lay out a post-2020 biodiversity framework and set targets for protecting Earth's ecosystems by 2030, one target of 21 up for debate is the "30 by 30" plan, which would give 30% of lands and oceans a protected status.<sup>37</sup> As this measure is already supported by a wide range of nations with the goal to achieve the 2050 vision of a world "living in harmony with nature," it is crucial that it is passed in order to begin halting extinction and saving the planet.<sup>38</sup> If this plan is not passed by the UN, the United States Department of the Interior should work separately to conserve and restore 30% of this nation's land and waters by 2030, thereby progressing the America the Beautiful Initiative.<sup>39</sup>

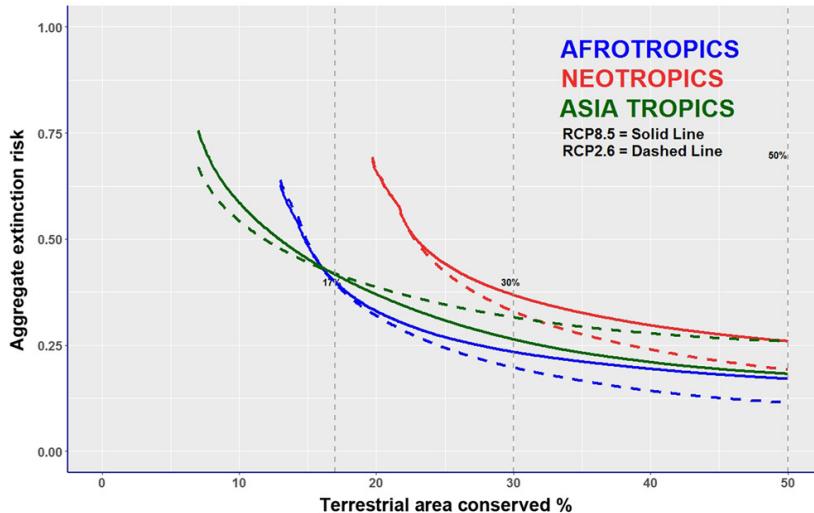
It is also imperative that nations continue to act in accordance with the UNFCCC's Paris Climate Agreement, with the focus of international policy being on limiting climate change to below 2°C, as this is also essential to preventing extinctions.<sup>40</sup> This limit, in combination with the conservation and restoration of certain crucial areas from the "30 by 30" plan, has the potential



to significantly combat the increasing extinction rate.<sup>41</sup> This idea presents the difficulty of choosing the appropriate areas to place under protection, especially in considering the movement of species when shifting their distribution in response to new environmental conditions brought about through climate change.

A 2020 publication by Lee Hannah et al. describes research conducted to address this exact predicament, so it no longer stands in the way of taking action. Their work uses data on 289,219 species to model the future in the context of two greenhouse gas concentration pathways (RCP2.6 to approximate a climate consistent with meeting the target of the Paris Agreement and RCP8.5 to approximate a climate without taking action to combat climate change) with varying amounts of protected and conserved areas. It provides people the new ability to assess which natural areas must be conserved to minimize extinction risk, as well as to approximate how much extinction risk may be avoided through this conservation.<sup>42</sup> It is important to note that land conservation in the most effective and necessary areas would require restoration of nature through rewilding and reforestation, which is the focus of organizations like Mossy Earth.<sup>43</sup> The research group's results indicate that "30% land conservation combined with climate change action could reduce extinction risk by half or more across multiple conservation/climate combinations in all three tropical regions [the Afrotropics, Neotropics, and Southeast Asian tropics]."<sup>44</sup> Furthermore, their analysis suggests that "50% land conservation could lead to an even larger decrease in extinction risk, resulting in over 80% reduction in all regions when coupled with lower climate change (RCP2.6)."<sup>45</sup> It therefore becomes evident that the aforementioned actions toward conservation planning and implementation are necessary to follow, since even if they are not perfect just yet, they are good enough to present us with a promising future, and they can be continually assessed for improvement as the planet continues

to change with us.<sup>46</sup> Jumping to take the chance at a promising future is much better than accepting a bleak one.



“Modeled extinction risk reduction with increasing land conservation. Ensemble mean Aggregate extinction risk (AER) versus % terrestrial area conserved under RCP 2.6 (dashed lines) and RCP 8.5 (solid lines) for the Afrotropics (blue), Neotropics (red) and Asia Tropics (green). Vertical lines show the aggregate extinction risk curve intersection with 17%, 30% and 50% terrestrial area conserved. AER is the mean of individual species extinction risk at each increment of conserved natural land and is scaled from 0 to 1 (zero probability of extinction to likely extinct).”<sup>47</sup>

## Conclusion and Call to Action

To conclude, below is a final outlook provided by experts on the world we face if the sixth mass extinction and insect apocalypse continue in their tracks, given that the calls to action are ignored and the proposed solutions outlined above are not followed:

*[David] Wagner, the University of Connecticut entomologist, describes a flowerless world with silent forests, a world of dung and old leaves and rotting carcasses accumulating in cities and roadsides, a world of “collapse or decay and erosion and loss that would spread through ecosystems” — spiraling from predators to plants. E.O. Wilson has written of an insect-free world, a place where most plants and land animals become extinct; where fungi explodes, for a while, thriving on death and rot; and where “the human species survives, able to fall back on wind-pollinated grains and marine fishing” despite mass starvation and resource wars.*

*“Clinging to survival in a devastated world, and trapped in an ecological dark age,” he adds, “the survivors would offer prayers for the return of weeds and bugs.”<sup>48</sup>*

The sixth mass extinction has gone underestimated and underemphasized for far too long. Its subdivision of the insect apocalypse has also received much too little attention for the severity of the outlook promised by the loss of these small yet vitally important creatures. The current environmental crisis means that “3 out of 4 species that we are familiar with could be gone within a few decades,” as “in the past 40 years, we have annihilated about half of the wildlife living on the planet.”<sup>49</sup> We as humans should be driven to save all of the species facing extinction simply to protect life, maintain the health of our planet, and rectify our ecologically destructive actions of the past and present. Beyond these moral obligations, the beneficial services provided by ecosystems and the catastrophic consequences that will come with their loss should serve as more than enough motivation to take urgent global action.

*“We must save what we can, or lose the opportunity to do so forever.”<sup>50</sup>*

*“What is at stake is the fate of humanity and most living species. Future generations deserve better from us.”<sup>51</sup>*

---

**Endnotes**

<sup>1</sup> Katerina Chernyuk. “What Is the Sixth Mass Extinction and What Can I Do about It?” Mossy Earth, available at <https://mossy.earth/rewilding-knowledge/sixth-mass-extinction> (last accessed April 14, 2022).

<sup>2</sup> Chernyuk. “What Is the Sixth Mass Extinction and What Can I Do about It?”; Anthony D. Barnosky et al. “Has the Earth's Sixth Mass Extinction Already Arrived?” *Nature* 471, no. 7336 (March 3, 2011): 51-7. doi:<http://dx.doi.org/10.1038/nature09678>, available at <https://ezaccess.libraries.psu.edu/login?url=https://www.proquest.com/scholarly-journals/has-earths-sixth-mass-extinction-already-arrived/docview/856589325/se-2?accountid=13158>.

<sup>3</sup> Ibid.

<sup>4</sup> Gerardo Ceballos et al. “Vertebrates on the Brink as Indicators of Biological Annihilation and the Sixth Mass Extinction.” *Proceedings of the National Academy of Sciences of the United States of America* 117, no. 24 (June 1, 2020): 13596–602, available at <https://doi.org/10.1073/pnas.1922686117>; Chernyuk. “What Is the Sixth Mass Extinction and What Can I Do about It?”

<sup>5</sup> Ceballos et al. “Vertebrates on the Brink as Indicators of Biological Annihilation and the Sixth Mass Extinction.”

<sup>6</sup> Ibid.

<sup>7</sup> Ibid.

<sup>8</sup> Ibid.

<sup>9</sup> Ibid.

<sup>10</sup> Ibid.

<sup>11</sup> Chernyuk. “What Is the Sixth Mass Extinction and What Can I Do about It?”

<sup>12</sup> Joel Johnson. “The Insect Apocalypse Is Here.” Half-Earth Project, November 28, 2018, available at <https://www.half-earthproject.org/the-insect-apocalypse-is-here/> (last accessed April 14, 2022).

<sup>13</sup> Dave Goulson. “Why We All Need to Learn to Love Insects.” *TED*. Speech presented at TEDxBratislava (July 2019), available at [https://www.ted.com/talks/dave\\_goulson\\_why\\_we\\_all\\_need\\_to\\_learn\\_to\\_love\\_insects?utm\\_campaign=tedspeak&utm\\_medium=referral&utm\\_source=tedcomshare](https://www.ted.com/talks/dave_goulson_why_we_all_need_to_learn_to_love_insects?utm_campaign=tedspeak&utm_medium=referral&utm_source=tedcomshare).

<sup>14</sup> Dave Goulson. “The Insect Apocalypse, and Why It Matters.” *Current Biology* 29, no. 19 (October 2019): R967–R971, available at <https://doi.org/10.1016/j.cub.2019.06.069>.

<sup>15</sup> Ibid.

<sup>16</sup> Goulson. “Why We All Need to Learn to Love Insects.”

<sup>17</sup> Brooke Jarvis. “The Insect Apocalypse Is Here.” *The New York Times Magazine*, November 27, 2018, available at [http://nategabriel.com/egblog/wp-content/uploads/2020/03/5-1\\_The-Insect-Apocalypse-Is-Here-The-New-York-Times.pdf](http://nategabriel.com/egblog/wp-content/uploads/2020/03/5-1_The-Insect-Apocalypse-Is-Here-The-New-York-Times.pdf).

<sup>18</sup> Ibid.

<sup>19</sup> Ibid.

<sup>20</sup> Ceballos et al. “Vertebrates on the Brink as Indicators of Biological Annihilation and the Sixth Mass Extinction.”; Chernyuk. “What Is the Sixth Mass Extinction and What Can I Do about It?”

---

<sup>21</sup> The National Wildlife Federation. “Ecosystem Services.” available at <https://www.nwf.org/Educational-Resources/Wildlife-Guide/Understanding-Conservation/Ecosystem-Services#:~:text=An%20ecosystem%20service%20is%20any,or%20indirect%E2%80%94small%20or%20large> (last accessed April 14, 2022).

<sup>22</sup> Ibid.

<sup>23</sup> Alistair Walsh. “What to Expect from the World's Sixth Mass Extinction.” Deutsche Welle, January 11, 2022, available at <https://www.dw.com/en/what-to-expect-from-the-worlds-sixth-mass-extinction/a-60360245> (last accessed April 14, 2022).

<sup>24</sup> Robert G. Foottit and Peter H. Adler. *Insect Biodiversity: Science and Society*. Google Books 1. 2nd ed. Vol. 1. Chichester, UK: Wiley Blackwell, 2017, available at [https://www.google.com/books/edition/\\_/hYMtDwAAQBAJ?hl=en&gbpv=1&pg=PA9&dq=importance+of+insects](https://www.google.com/books/edition/_/hYMtDwAAQBAJ?hl=en&gbpv=1&pg=PA9&dq=importance+of+insects).

<sup>25</sup> Ibid.

<sup>26</sup> Jarvis. “The Insect Apocalypse Is Here.”

<sup>27</sup> Environmental Protection Agency. “EPA Report Shows Disproportionate Impacts of Climate Change on Socially Vulnerable Populations in the United States.” EPA, September 2, 2021, available at

<https://www.epa.gov/newsreleases/epa-report-shows-disproportionate-impacts-climate-change-socially-vulnerable> (last accessed April 14, 2022).

<sup>28</sup> Environmental Protection Agency, Office of Atmospheric Programs. “Climate change and social vulnerability in the United States: A focus on six impacts.” (September 2021), available at [https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability\\_september-2021\\_508.pdf](https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability_september-2021_508.pdf).

<sup>29</sup> Ibid.

<sup>30</sup> United Nations. “Unprecedented Impacts of Climate Change Disproportionately Burdening Developing Countries, Delegate Stresses, as Second Committee Concludes General Debate.” Meetings Coverage and Press Releases. United Nations, October 8, 2019, available at <https://www.un.org/press/en/2019/gaef3516.doc.htm> (last accessed April 14, 2022).

<sup>31</sup> Ibid.

<sup>32</sup> Jason Lambacher. “The Politics of the Extinction Predicament - Democracy, Futurity, and Responsibility.” (2013): 13, available at [https://digital.lib.washington.edu/researchworks/bitstream/handle/1773/23458/Lambacher\\_washington\\_0250E\\_12041.pdf?sequence=1&isAllowed=y](https://digital.lib.washington.edu/researchworks/bitstream/handle/1773/23458/Lambacher_washington_0250E_12041.pdf?sequence=1&isAllowed=y).

<sup>33</sup> Lambacher. “The Politics of the Extinction Predicament - Democracy, Futurity, and Responsibility,” p. 10.

<sup>34</sup> Ceballos et al. “Vertebrates on the Brink as Indicators of Biological Annihilation and the Sixth Mass Extinction.”

<sup>35</sup> Ibid.

<sup>36</sup> Ibid.

---

<sup>37</sup> Walsh. “What to Expect from the World's Sixth Mass Extinction.”; United Nations Environment Programme. “UN Biodiversity Conference (COP 15).” UNEP, August 18, 2021, available at <https://www.unep.org/events/conference/un-biodiversity-conference-cop-15> (last accessed April 14, 2022); “COP15: Countries Debate New Biodiversity Plan.” Deutsche Welle, October 11, 2021, available at <https://www.dw.com/en/cop15-countries-debate-new-biodiversity-plan/a-59468114> (last accessed April 14, 2022).

<sup>38</sup> Lee Hannah et al. “30% Land Conservation and Climate Action Reduces Tropical Extinction Risk by More than 50%.” *Ecography* 43, no. 7 (February 25, 2020): 943–53, available at <https://doi.org/10.1111/ecog.05166>; United Nations Environment Programme. “UN Biodiversity Conference (COP 15).”

<sup>39</sup> U.S. Department of the Interior. “America the Beautiful.” DOI, available at <https://www.doi.gov/priorities/america-the-beautiful> (last accessed April 14, 2022); World Wildlife Fund. “What Is the Sixth Mass Extinction and What Can We Do about It?” WWF, March 15, 2022, available at <https://www.worldwildlife.org/stories/what-is-the-sixth-mass-extinction-and-what-can-we-do-about-it> (last accessed April 14, 2022).

<sup>40</sup> Hannah et al. “30% Land Conservation and Climate Action Reduces Tropical Extinction Risk by More than 50%.”

<sup>41</sup> Ibid.

<sup>42</sup> Ibid.

<sup>43</sup> Hannah et al. “30% Land Conservation and Climate Action Reduces Tropical Extinction Risk by More than 50%.”; Chernyuk. “What Is the Sixth Mass Extinction and What Can I Do about It?”

<sup>44</sup> Hannah et al. “30% Land Conservation and Climate Action Reduces Tropical Extinction Risk by More than 50%.”

<sup>45</sup> Ibid.

<sup>46</sup> Ibid.

<sup>47</sup> Ibid.

<sup>48</sup> Jarvis. “The Insect Apocalypse Is Here.”

<sup>49</sup> Chernyuk. “What Is the Sixth Mass Extinction and What Can I Do about It?”

<sup>50</sup> Ceballos et al. “Vertebrates on the Brink as Indicators of Biological Annihilation and the Sixth Mass Extinction.”

<sup>51</sup> Ibid.