

1 **Biodiversity scientists must fight the creeping rise of extinction denial**

2 Efforts by conservation scientists to draw public and decision-maker attention to the biodiversity
3 crisis are increasingly met with denialist rhetoric that may jeopardize meaningful measures to
4 avert species extinctions. We summarize some of the methods used by denialists to undermine
5 scientific evidence on biodiversity trends, and outline pathways forward for the scientific
6 community to counter misinformation campaigns.

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16 Denial of scientific evidence and rejection of scientific methods are not new phenomena, but
17 represent an increasingly serious problem, especially when driven by politically well-connected
18 and well-funded antagonists seeking to sabotage evidence-based policy for political and/or
19 financial gain. Terms such as ‘science denial’ and ‘science denialism’ are employed as monikers
20 for such anti-scientific enterprises, seeking to discredit for example, the health impacts of
21 smoking, climate science, the teaching of evolution in schools, and vaccination campaigns. There
22 is an emerging body of literature characterising the nature of these activities, and the personal,
23 organizational and economic interlinkages between them¹.

24 The rise of organised denial of the biodiversity crisis was foreseen by conservation biologists² and
25 this wave of denial emerged and broke strongly following the release of the Intergovernmental
26 Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) summary for
27 policymakers which generated substantial media coverage. In its wake a swathe of opinion pieces
28 criticised the report and attacked both the reputations of the report's authors and the process of
29 estimating the total number of species threatened with extinction³.

30 These attempts to downplay the biodiversity crisis follow the “Scientific Certainty Argumentation
31 Methods” playbook, which includes all three categories of denial envisioned by Stanley Cohen in
32 a framework first applied to the study of atrocities and other unwelcome truths⁴. These are: (1)
33 ‘Literal denial’, an assertion that something is untrue, for example the evidence for greatly

34 elevated rates of species threat and extinction; 2) 'Interpretive denial', in which raw facts are not
35 disputed but given a different spin, for example using evidence from temperate ecosystems to
36 make claims about reduced impacts in the tropics; 3) 'Implicatory denial', in which the data itself
37 are not denied, but their implications are, for example arguing that transformative changes to
38 socio-ecological systems are not required to avert species extinctions.

39 We address each of these in detail, before exploring ways to counter erroneous claims and logical
40 fallacies that we understand to be 'extinction denialism' or 'biodiversity loss denialism'.

41 **Literal Denial: "Species extinctions were predominantly a historical problem"**

42 Extinction deniers often downplay the extinction crisis by framing it as a historical problem and a
43 trivial contemporary challenge (SOM Table 1). By focusing attention on the loss of megafauna in
44 prehistory owing to over-hunting and rapid loss of island biodiversity in historic times it is
45 suggested we have passed through these extinction filters and reached the 'other side' of the
46 crisis. This 'literal denial' line of argument misses several key facets of the extinction crisis, notably
47 that species, including island endemics, are still being lost⁵ and that the catastrophic loss,
48 degradation and fragmentation of whole ecosystems, combined with climate change, is triggering
49 a new episode of continental extinctions⁶. This is particularly acute in the highly biodiverse tropics
50 and where extinctions are just the endpoint of a long process of extirpation and defaunation⁷ (Box
51 1, SOM Table 2). Moreover, biologists are typically conservative in declaring possible extinctions,
52 and across the world there are 143 amphibians, 41 reptiles, 29 mammals and 22 bird species
53 classed by the IUCN <https://www.iucnredlist.org> as Critically Endangered (Possibly Extinct). Many
54 of these species are likely already gone, while many more, including the 75 species listed as
55 Extinct in the Wild, are only hanging on due to expensive, last resort, conservation interventions⁸.

56 *Insert Box 1.*

57 **Interpretive denial: Economic growth alone will fix the extinction crisis**

58 Extinction denialists often invoke an Environmental Kuznets Curve (EKC)⁹ response of
59 biodiversity to development (SOM Table 1), arguing that pressures on the environment eventually
60 decrease with rising income levels. Yet the EKC hypothesis is misleading in this context. First,
61 empirical evidence of the relationship between economic development and forest cover only
62 supports the *loss* part of the curve¹⁰. Second, the EKC is typically a *local* rather than a *global*
63 phenomenon, and global environmental indicators of indirect impacts such as CO₂ emissions,
64 waste production and energy consumption are still increasing monotonically. Country-specific
65 assessments of EKC often ignore the outsourcing of environmental degradation to poorer
66 countries. Denialists also highlight the resurgence of certain large charismatic species such as
67 wolves and bears in Europe and North America as evidence that we are through the worst of the
68 extinction crisis. However, this is only a partial success story (Box 1). Similar successes in the
69 tropics are highly unlikely: species richness, species packing and habitat and niche specialisation
70 are all far higher at tropical latitudes, while geographic range sizes are much smaller. These

71 factors mean that tropical biodiversity is far more extinction-prone than temperate biodiversity¹¹.
72 The unfortunate truth is that there are many imminent or actual extinctions in highly deforested
73 tropical regions (SOM Table 2). Finally, the so-called 'Forest Transition' model⁹, which envisages
74 an EKC-style relationship between forest cover and development, fails to differentiate between
75 native forests and monoculture plantations of oil palm, conifers and eucalyptus, despite the
76 expansion of plantations being an important cause of biodiversity loss. Many global forest models
77 are not sensitive to the difference¹² and conflating plantations with natural forests has long been
78 a key artefact in the denialist playbook.

79 **Implicatory denial: Technological fixes and targeted conservation interventions will**
80 **overcome extinction**

81 Extinction denialists are often selective, choosing to highlight only a subset of factors causing
82 contemporary extinctions, such as over-harvesting and predation by non-native species, while
83 choosing not to mention habitat loss that affects the majority of species on the Red List. They
84 then suggest that solutions are simple, requiring no change or business-as-usual actions, even
85 though it is increasing resource demands and current socioecological and economic modes of
86 organisation that imperil biodiversity globally⁷. Invasive species, overharvesting and pathogens
87 are undoubtedly significant conservation issues responsible for global extinctions of many -
88 particularly insular – species, and technological fixes form part of the portfolio of conservation
89 interventions. However, these threats are often exacerbated by habitat loss and climate change,
90 and all must be addressed together. A disproportionate focus on a subset of drivers is a form of
91 'implicatory denial' that is contrary to scientific consensus: recognising the importance of one set
92 of threats does not obviate the need to address others⁸. Another form of 'implicatory denial'
93 involves the misrepresentation of the land sharing/sparing concept (Box 1).

94 **Countering denial**

95 There are multiple ways in which conservation scientists can be proactive in countering denial
96 (Table 1). The first is to conduct rigorous science to refine understanding of the scale, scope and
97 causes of the extinction crisis. However, it is not enough just to get the science right, but also to
98 communicate it to a wide audience, working with journalists, artists and other communicators to
99 disseminate the evidence before denialists are able to contrive a consensus gap¹⁴. In combating
100 the pseudo-science peddled by denialists it has been argued that the scientific consensus on
101 climate change has been impacted by 'seepage', whereby scientists respond to critics by over-
102 emphasising uncertainty, allowing denialist claims to impact how they portray their own
103 research. Where modelled predictions of loss are questioned, it is useful to highlight that
104 empirical observations of extinction risk often outpace predictions¹⁵. Confronting polemicists and
105 rhetoricians well-versed in arguing positions rather than establishing truth can be a major
106 challenge. Whilst retaining a cordial dialogue, there is little point in being respectful of insincere
107 arguments, which should be called out for what they are and dismantled and rebutted
108 systematically with evidence³.

109 *Insert Table 1.*

110 It is important not only to communicate the science of extinction, but also to communicate the
111 implications of biodiversity loss (Table 1). This can be most effective when conservation scientists
112 find ways to demonstrate connections that resonate with a target audience. Examples could
113 include making connections between deforestation, wild animal trade and zoonoses; or between
114 foods people consume daily and their connection to conservation problems – and solutions. Care
115 needs to be taken not to exaggerate the importance of minor threats while overlooking major
116 ones. For example, ‘implicatory denial’ often involves faux-concern about wind farms as a cause
117 of biodiversity loss, despite the evidence that wind energy – while not without negative impacts –
118 is a relatively minor threat compared to habitat loss and climate change, or even the impact of
119 other forms of energy production, such as extraction of shale gas or coal. Here, conservation
120 scientists need to recognise the underlying anti-renewable energy agenda and can respond by
121 putting threats in context, i.e. that wind farms, by being less damaging than other ways of
122 generating energy, are a net benefit - especially when their location and management is informed
123 by ecological science.

124 To generate support for solutions, conservation scientists need to show that similar challenges
125 have been overcome in the past, that the risks are acceptable and that the benefits exceed the
126 costs. It is also necessary to engage people’s emotions, using examples from civil rights to the
127 ozone hole to acid rain to smoking bans. These clearly show that dramatic change is not only
128 possible, but desirable. Denialists find fault with conservationists for failing to report positive news.
129 However, this is a talking point that originates within the conservation community itself, and as a
130 criticism it is now somewhat redundant. Conservationists have called on each other to not only
131 report bad news accurately but also flag up good news stories as best we can¹⁶, e.g. via
132 <https://conservationoptimism.com>, but without sugar-coating the broader truth.

133 Debate is vital as we search for solutions to the biodiversity crisis, but these debates are only
134 useful where there is good will on all sides. For conservation to succeed, it will need to be
135 inclusive, and conservation scientists need to be better at identifying useful discussions and
136 avoiding unnecessary internal conflicts. But in cases when constructive arguments turn into
137 dismissiveness or denial, and when vested interests are prioritized over the search for truth, good
138 will cannot be assumed (Table 1). Unless denialists have a large platform, the best response may
139 be to ignore them to avoid amplifying their efforts at misinformation. For this reason, we have
140 deliberately avoided referencing the names and publications of prominent deniers here in the
141 main text. Where responses are necessary, conservation scientists need to avoid getting dragged
142 down into ugly arguments or personal attacks, be measured and respectful in their responses,
143 and to reinforce their role as trusted experts by countering flawed arguments with evidence. By
144 adopting these approaches, and learning some of the lessons of climate denial, conservation
145 scientists can reclaim the narrative.

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166 **Contributions**

167 A.C.L., S.A., J.B. and B.P. all contributed to the writing of the manuscript.

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170 **Ethics declarations**

171 Competing interests

172 The authors declare no competing interests.

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175 Box 1. Examples of species and systems misrepresented by extinction denialists.

176 **Literal denial:** e.g. underestimating and overlooking recent extinctions.

177 a) The Atlantic Rainforest has been long touted by deniers as an example of a biome
178 that had lost 90% of its habitat without a single documented extinction. Yet this **Alagoas**
179 **Foliage-gleaner** *Philydor novaesi* and the Cryptic Treehunter *Cichlocolaptes*
180 *mazarbarnetti* were confirmed as extinct in 2019 each only ever known from two forest
181 fragments, and seven other species have not been seen for a decade or are down to
182 the last few individuals (SOM Table 2). Extinction deniers downplaying the relatively
183 small number of documented extinctions are wrong for the same reasons as those who
184 sought to downplay the impact of the SARS-CoV-2 pandemic in early 2020. Just as the
185 true number of cases was underestimated because of widespread lack of testing, the
186 true number of extinctions is far higher than those observed, because the majority of the
187 Earth's species have not even been described – especially the rarer and more
188 specialised species, which are most vulnerable. And, as with the initially unthinkable
189 predictions of epidemiologists, conservation scientists are beginning to see their grim
190 predictions of extinction debt borne out. Image credit: Ciro Albano.

191 **Interpretive denial:** e.g. resurgent carnivores are not umbrella species for all taxa.

192 b) The resurgence of **Eurasian Brown Bear** *Ursus arctos arctos*, Grey Wolf *Canis*
193 *lupus*, Eurasian Lynx *Lynx lynx* and their prey base in Europe reflects land
194 abandonment and rural depopulation associated with globalisation and mechanisation
195 of agricultural production systems but should not be interpreted as a recovery of
196 biodiversity more widely. These population recoveries have come alongside losses in
197 farm income and rural employment. Other factors include reduced human-wildlife
198 conflict and better legislative protection. Large mammals are typically habitat generalists
199 and their recolonization of managed habitats like European forests has not been
200 accompanied by a resurgence for habitat specialists. Old growth forest dependent
201 White-backed Woodpeckers *Dendrocopos leucotos*, for example, remain on the cusp of
202 extinction even in heavily-forested Scandinavia. The saproxylic beetles they rely upon
203 are associated with ancient trees and natural large-scale fire regimes with long return
204 times and are consequently extremely rare or extinct in Europe's managed forests.
205 Image credit: Richard Moores.

206 **Implicatory denial:** e.g. misrepresenting land sparing as a silver bullet for conservation.

207 c) Vast **soy bean** *Glycine max* fields at the ecotone of the Amazon and Cerrado biomes
208 in Brazil. Land sparing – minimising the land area of agriculture while protecting and
209 restoring as large an area of native vegetation as possible – may well be a useful
210 strategy to reduce extinctions associated with habitat loss. Various studies have
211 confirmed that protection of large areas of native vegetation will be essential for the

212 conservation of the many specialised and threatened species that inhabit the tropics¹³.
 213 However, agricultural intensification alone is no guarantee that land will be spared for
 214 nature, and if it increases profits, there is a risk that this will encourage further
 215 deforestation. Furthermore, not all methods for increasing yields are equal. There is a
 216 need to minimise negative environmental externalities, make sure that key ecosystem
 217 services are still provided at landscape scales, and ensure that intensification does not
 218 simply result in the increased demand that characterises the great acceleration. Land-
 219 uses that incorporate people, such as indigenous reserves, are among the most
 220 effective at conserving forest cover, and are an essential complement to strictly
 221 protected areas. Image credit: Alexander Lees.

222

223 Table 1. Communicating biodiversity loss with the public in the context of Fischhoff's
 224 Stages of Risk Communication. These are recommendations for communicating with a
 225 wider audience, who might be vulnerable to believing denier messages. In the case of
 226 those who have committed to deny or dismiss the extinction crisis, it is best to ignore or
 227 respectfully (yet firmly) debunk, recognising that your target audience is those observing
 228 the conversation, rather than the deniers themselves.

229

Fischhoff (1995) Stages	Conservation scientist communication recommendations
Get the numbers right and don't over-/under-exaggerate	Business-as-usual rigorous conservation science
Tell them the numbers	Disseminating scientific findings and species loss projections far more publicly, engaging with social, print and televisual media and with politicians, policy makers and other stakeholders (e.g. industry, corporate, financial). Make messaging and communications relevant, accessible and compelling for target audiences.
Explain what we mean by the numbers	E.g., consequences of species declines and loss of ecosystem service provision, zoonoses, ecotourism, connection with nature. Consequences must resonate with audience.
Show they have accepted similar risks in the past	(a) Show they've insisting that biodiversity loss be stopped in the past (e.g. success of the Save the Whales campaign) (b) Show they've accepted similar risks (to those of mitigation and adaptation)

	in the past (e.g. Phasing out of CFCs, tighter pollution legislation)
Show that it is a good deal for them	Remind them of the ancillary benefits of action to combat biodiversity loss, wilder countryside, green jobs, food production sustainability. Play to intrinsic values of nature conservation (e.g. emotional connection to nature) AND utilitarian benefits (e.g. improved mental health, pollination)
Treat them nice	Be respectful when challenging opponents in whatever context. Provide evidence-based alternatives to fallacious arguments.
Make them partners	Try to be inclusive in deliberating solutions, acknowledging trade-offs and seeking and emphasizing co-benefits where they exist.