Planetary well-being

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PLANETARY WELL-BEING

ABSTRACT

Tensions between the well-being of present humans, future humans, and nonhuman nature manifest in social protests and political and academic debates over the future of Earth. The increasing consumption of natural resources no longer increases, let alone equalizes, human well-being, but has led to the current ecological crisis. While the crisis has been acknowledged, it is often approached in human-centred terms, with framings that limit the moral worth of nonhuman nature to its contribution to human well-being. We derive and propose the concept of *planetary well-being* to recognize the moral considerability of both human and nonhuman well-being, and to promote transdisciplinary, cross-cultural discourse for addressing ecological and social crises and for promoting societal and cultural transformation. Conceptually, we shift focus in well-being from individuals to Earth system and ecosystem processes that underlie all well-being. Planetary well-being is a state where the integrity of Earth system and ecosystem processes remains unimpaired to a degree that species and populations can persist to the future and organisms have the opportunity to achieve well-being. After grounding and introducing planetary well-being, we shortly discuss how it can be measured and reflect upon its potential as a bridging concept between different worldviews.

INTRODUCTION

Human activities dominate Earth: less than one quarter of the land area remains free from significant direct human impact, and by 2050 this area is projected to shrink to less than 10 % (IPBES 2018; Watson et al. 2016). Nearly three-quarters of freshwater areas and over half of marine areas are exploited for food

production (IPBES 2019; Díaz et al. 2019). During the last five decades, the population sizes of vertebrate animals have declined on average by 68 % (WWF 2020), wild mammal biomass by 82 % (IPBES 2019), and it is projected that by 2050 humans will have eliminated 38–46 % of all biodiversity (measured as mean species abundance) from the planet (van der Esch et al. 2017; IPBES 2018).

Human actions threaten to cause irreversible changes in the Earth system, with critical safety limits (planetary boundaries) exceeded for biosphere integrity, biochemical flows, climate change, and land system change (Rockström et al. 2009; Steffen, Richardson, et al. 2015; O'Neill et al. 2018; IPCC 2019). Crossing such boundaries may lead to irreversible changes in the Earth system (Steffen et al. 2015b; O'Neill et al. 2018). The scale of these pressures has evoked a proposal for labelling the current geological epoch the Anthropocene, an era where humans shape the geo- and biosphere evolution (e.g. Crutzen and Stoermer 2000; Dryzek and Pickering 2018). The negative anthropogenic impact on the Earth system has thus reached a point where the future of human societies and the flourishing of life in general are threatened.

On the other hand, attributing the aforementioned negative impacts to the whole of humanity, 'Anthropos', is overgeneralizing: it dismisses that only a fraction of the humanity is historically responsible for most of the environmental harm and that the extent of harmful impacts varies significantly depending on particular processes of production and consumption (Malm and Hornborg 2014). According to the historical graphs, these developments have "been almost entirely driven by a small fraction of the human population, those in developed countries" (Steffen et al. 2015a).

Global inequalities among humanity are stark regarding who receive the benefits of environmentally damaging actions and who have to bear their detrimental impacts. Around the world, nations' top 10 % earners capture 37-61 % of national income; globally, the share of the top 10 % of global income is between 53-60 % depending on the method of measurement (Alvaredo et al. 2018). The costs of ecosystem

71 degradation and climate change, on the other hand, hurt the well-being of at least 3.2 billion less affluent
72 people (IPBES 2018; UN Environment 2019). Retaining the present standard of living in the wealthiest
73 countries necessitates structures that maintain globally unequal, exploitative labour division and ecological
74 exchange (Hornborg 1998; Newsome et al. 2015). Transformative changes to social, economic, and
75 technological systems are increasingly called for to change the course towards more sustainable future in
76 both environmental and social terms (e.g. Díaz et al. 2019; Kohler et al. 2019; Willemen et al. 2020).

77 The environmental and social problems described above have generated a broad spectrum of discourses
78 and action, from the sustainable development framework and goals (UN General WCED 1987; Assembly
79 2015) to the foundations of social justice (Nussbaum and Sen 1993) (for key frameworks, see the
80 Supplementary Box). From the ecological viewpoint especially, a serious challenge is that a majority of the
81 frameworks focus on human perspective and consider nonhuman well-being important only to the extent it
82 contributes to human well-being (e.g. Dryzek 2005, p. 157). Solely human-concerned ethos of many
83 conceptualisations of sustainability is typical of Western science, contrary to some other knowledge
84 systems (e.g. some forms of indigenous and local knowledge) that emphasize balance and collaboration
85 with nature (Díaz et al. 2015).

86 Another challenge with the existing frameworks is that they seldom focus on the systems and processes
87 that support life, well-being, and biodiversity at different spatial scales. Although sustainability studies have
88 recognized the interconnectedness of the social, economic, and ecological aspects of life, and the
89 importance of studying processes as taking place in complex socio-ecological systems (Ostrom 2009), the
90 mainstreaming of such thinking to well-being studies has been slower. Lack of a systems-oriented and
91 multi-scalar outlook can result in a fragmentary view to the problems and their solutions. Many frameworks
92 presented in Box 1 aim to overcome either anthropocentrism, or the lack of systemic and multi-scalar
93 outlook, but few attempt both.

94 The need to conceptualise well-being in a way that is non-anthropocentric and encourages systems-
95 oriented, multi-scalar outlook, raises a fundamental question: what is well-being? In human psychology, the
96 focus is traditionally on subjective, experienced well-being: persons with subjectively high well-being are
97 satisfied with life, experience positive feelings, are able to fulfil personal aspirations, have favourable
98 relations, and are in good mental health (Keyes 2005; Kokko et al. 2013). Ecopsychology argues that human
99 beings are simply a part of nature (Winter and Koger 2004). From this perspective, nature and humanity are
100 ineradicably linked and high levels of well-being can only be achieved through the experiential realization of
101 nature connectedness and exposure to nonhuman nature (Roszak et al. 1995; Mayer and Frantz 2004;
102 Brymer et al. 2010). On the other hand, the focus on subjective well-being is problematic from the
103 viewpoint of social justice and equality. Underprivileged people can adapt to their circumstances
104 (demonstrating ‘malleable preferences’) and may be unable to articulate their experiences of lower well-
105 being and satisfaction of life, whereas minor losses of the privileged groups can get overemphasized
106 (Nussbaum and Sen 1993; Nussbaum 2011). The subjective accounts of well-being have also been criticized
107 from the environmental sustainability viewpoint: if experienced well-being depends on the fulfilment of
108 seemingly limitless human desires and wants (instead of limited needs), this poses unsustainably high
109 material criteria for well-being (Gough 2015).

110 In social sciences, consequently, well-being is often understood to depend on the satisfaction of basic
111 human needs, such as the need for material subsistence, protection, affection, understanding, and
112 autonomy, which contribute to physical and mental health, and to the abilities for social participation (e.g.
113 Doyal and Gough 1984; Rice 2013; Gough 2017; see also Nussbaum and Sen 1993). The argument is that
114 these universal human needs persist through cultures and time, even while the strategies and means to
115 satisfying the needs, and thresholds for adequate needs satisfaction, can change.

116 The needs-based, objective accounts of well-being are also used in the context of nonhumans, since
117 studying their experienced well-being is challenging (Wemelsfelder 1997). Most of the literature on

118 nonhuman well-being focuses on nonhuman animals and maintains that they have species-typical physical
 119 and behavioural needs, the satisfaction of which is crucial for their well-being (e.g. Broom 1991; Bartussek
 120 1999; Singer 2002; Nussbaum 2006). The concept of well-being (also referred to as thriving or flourishing)
 121 has been applied to other organisms, populations, species or lineages, and ecosystems, too. Ecosystem
 122 well-being, for example, has been defined as the functional integrity of an ecosystem and its capacity to
 123 retain its typical functionings and characteristics (Schlosberg 2007; Kortetmäki 2017; see also Prescott-Allen
 124 2001), including succession and adaptation. The well-being of species or lineages is addressed via needs: to
 125 be well, species must be able to maintain self-sustaining capacities and to adapt to environmental changes
 126 (Kortetmäki 2018).

127 We propose a new concept, *planetary well-being*, to address the above discussed need for a non-
 128 anthropocentric, systemic conceptualization of well-being that takes into account the multiple scales of
 129 interaction. Planetary well-being acknowledges the value of both human and nonhuman well-being for their
 130 own sake: the moral right for both humans and nonhumans to exist, to have their needs satisfied, and to
 131 realize their typical characteristics and capacities. The needs of organisms – both human and nonhuman –
 132 are interconnected so that the satisfaction of the needs of various entities creates both synergies and
 133 conflicts. Hence, the concept transcends the level of individual organisms and focuses on the integrity of
 134 Earth system and ecosystem processes underlying the well-being of all forms of life. It also serves as a
 135 framework that ties together ecological and social equality crises. As a concept, planetary well-being
 136 facilitates scientific and political discussions by using the same vocabulary to address the impacts of human
 137 activities on the well-being of human and nonhuman nature.

138 To derive and propose a non-anthropocentric concept means that we openly commit to certain normative
 139 views on moral considerability. Morally considerable beings and collectives have moral value for their own
 140 sake (inherent value), regardless of whether they have instrumental value for humans. Consequently, the
 141 well-being of morally considerable entities matters for their own sake. We adopt a pluralist or multi-criterial

approach to moral valuation; it grounds the moral considerability of entities on several criteria (Warren 1997). The pluralist valuing grants moral considerability to human and nonhuman individuals but extends the sphere of moral considerability beyond them: species or lineages and ecosystems that can be well or flourish and have self-regulative capacities (e.g. Rolston 1985, 2002; Schlosberg 2007) are also morally considerable (hereafter, the term ‘living entities’ denotes this diverse ensemble of morally considerable entities). While our normative viewpoint may not be shared by all, we believe that responding to ecological crisis adequately requires adopting a non-anthropocentric approach where nonhuman nature is valued also for its own sake, not only due to its importance for human prosperity.

CONCEPTUALIZATION OF PLANETARY WELL-BEING

We ground the concept of planetary well-being on accounts that link well-being with the satisfaction of basic needs as they are perceived from a neutral, non-subjective viewpoint. As described above, the needs-based accounts of well-being have been previously applied to human well-being (Doyal and Gough 1984; Max-Neef 1991; Gough 2017, 2015; Rice 2013), animal well-being (e.g. Broom 1991; Bartussek 1999; Singer 2002; Nussbaum 2006) and well-being of populations and ecosystems (e.g. Schlosberg 2007; Kortetmäki 2017). Yet, the overall diversity and number of different needs of various life forms prevents their integration into a singular calculus of well-being – or at least renders the possible results hardly applicable in practice. Therefore, instead of focusing on the needs themselves, we propose a focus on the systems and processes that are necessary for the satisfaction of the needs of diverse life forms on Earth. The focus on life-supporting systems and processes enables the integration of human and nonhuman well-being into a single framework.

A systems-oriented approach (Bunge 2003, 2004) allows conceptualizing well-being at a general level (see Table 1). We utilize this approach to define planetary well-being in a way that links well-being across levels

164 of biological hierarchies, from organisms (including humans) and populations and lineages to ecosystems –
 165 that can all be considered as *systems* - and to Earth system and ecosystem processes. In general, life on
 166 Earth can be understood as a set of interlinked, interdependent systems, and well-being at any level (be it
 167 an individual organism, population, or ecosystem) as the integrity of that particular system. Crucially, the
 168 functional integrity of any system (i.e., its well-being) is dependent on the satisfaction of its needs. Need
 169 satisfiers are usually products of, or comprise interactions between, other systems. In other words, the
 170 well-being of any particular system depends on inputs provided by other systems.

171 Table 1. The generic systems-oriented conceptual framework for well-being

System	System is an entity that is comprised of its components, that can be impacted by the environment, has characteristic relations and interactions between its components, and has system-specific characteristics and capacities that stem from the system processes.
Critical system processes	System processes are recurring interactions between system components. Interactions require inputs to function. Critical system processes are those without which the system cannot continue its existence and realize its system-specific characteristics and capacities.
Needs and need satisfiers	Needs are conditions of dependence on inputs (need satisfiers). Needs must be satisfied for the critical system processes to function.
Well-being	The functional integrity of the system, or in other words the integrity of the critical system processes, that allows the system to continue its existence and realize its system-specific characteristics and capacities.

173 The conceptualization of well-being as the functional integrity of a system could, in principle, be applied
 174 also to human artefacts (like motors), or to socially constructed systems (like economic systems). However,
 175 as we do not consider such entities or systems to have moral considerability (value of their own that does
 176 not depend on their value for humans), the well-being of artefacts and socially constructed systems falls
 177 outside the scope of this manuscript.

178 The consideration of life on Earth as interlinked and interacting systems directs attention to how the needs
 179 and well-being of different species and ecosystems are connected. For example, the needs of organisms
 180 have evolved over their evolutionary history in the context of ecosystems they inhabit. All organisms
 181 participate in many interactions, some of which are critical for their well-being (like feeding), while others
 182 may be detrimental and even lethal for them (like being fed upon), yet critical for some other organism(s).
 183 These interactions take place in ecosystems that in turn are dependent on the functioning of other, larger
 184 scale processes (e.g. climatic processes that affect temperatures and rainfall). Ecosystems further interact
 185 with other ecosystems; the examples of teleconnections between ecosystems include precipitation in
 186 terrestrial areas that depends in large part on evapotranspiration in distant forested areas ([Van der Ent et](#)
 187 [al. 2010](#)) and transport of energy and nutrients from marine to terrestrial ecosystems by migratory fish
 188 ([Cederholm et al. 1999](#)).

189 We define planetary well-being *as a state in which the integrity of Earth system and ecosystem processes*
 190 *remains unimpaired to a degree that lineages can persist to the future as parts of ecosystems, and*
 191 *organisms (including humans) can realize their typical characteristics and capacities* (see Table 2). Planetary
 192 well-being puts the emphasis on the integrity of Earth system and ecosystem level processes instead of
 193 organismal well-being, because at the organismal level life is rife with conflicts (such as predator-prey
 194 relations), and consequently not all organisms can ‘be well’ all the time. Death and senescence are normal
 195 parts of life’s processes. However, the integrity of Earth system and ecosystem processes is fundamental for
 196 the survival and evolutionary potential of species and lineages – and for the existence and well-being of

197 organisms and ecosystems they inhabit. We intend planetary well-being as a concept to promote respectful
 198 ways of co-inhabiting Earth with nonhuman life so that both humans and nonhumans can achieve well-
 199 being in all parts of the world.

200 Table 2. Key concepts of planetary well-being.

Organismal (human and nonhuman) well-being	Organismal well-being is a state where an organism can realize its typical characteristics and capacities.
Organismal needs and need satisfiers	Organismal needs are conditions of dependence on inputs (need satisfiers). Needs must be satisfied for an organism to realize its typical characteristics and capacities. Needs depend on the evolutionary history of the lineage in which the organism belongs to.
Lineages, species, populations	A group of organisms with shared genetic ancestry that is distinct from other such groups constitutes a lineage. For sexually reproducing organisms, species and populations constitute lineages at global and local scales, respectively.
Ecosystems	Ecosystems are communities of organisms that interact with each other and the abiotic environment.
Earth system and ecosystem processes	Processes relating to flows of energy and matter on Earth and to biotic interactions in ecosystems.
Planetary well-being	Planetary well-being is a state in which the integrity of Earth system and ecosystem processes remains unimpaired to a degree that lineages can persist to the future as parts of ecosystems, and organisms (human and nonhuman) can realize their typical characteristics and capacities.

201

202 By the integrity of Earth system and ecosystem processes, we refer to the integrity of those flows of energy
203 and matter on Earth and biotic interactions in ecosystems that are critical for the satisfaction of the needs
204 of various organisms, populations and communities. These processes are manifold, and while there is
205 reasonable understanding of several important processes, such as nutrient cycles or pollination, it would be
206 foolhardy to assume that all important processes are known inside out. For example, the depletion of ozone
207 layer following the emission of chlorofluorocarbons came as a surprise to the scientific community
208 (Rowland 2006). Thus, all actions that significantly impact the flows of energy and matter are serious
209 concerns for planetary well-being, be it by resource use such as the human appropriation of 38 % per cent
210 of net primary production on Earth (Running 2012), or by release of nutrients, greenhouse gases, or other
211 chemicals with possibly unknown effects. Similarly, excessive interference with natural ecosystems (as by
212 e.g. the destruction of natural habitats) or overharvesting of natural populations is likely to harm planetary
213 well-being.

214 While we have incomplete understanding of specific processes, we also have limited knowledge about
215 interactions between and among Earth systems, ecosystems, and human-created systems (e.g. Reid et al.
216 2010; Liu et al. 2015; Liu et al. 2018). Many of these interactions are likely to magnify each other: risks of
217 causing irreversible changes to Earth system are higher in studies that consider interactions between
218 systems or processes (e.g. Lade et al. 2019). Given that there are profound uncertainties regarding the
219 consequences of human interference with Earth system and ecosystem processes, abstinence from
220 potential harm even in the absence of the *proof of harm* (the precautionary principle (e.g. Cameron and
221 Abouchar 1991) — is often a safer strategy to avoid worsening global environmental problems.

222 When defining planetary well-being, we underscore the persistence of lineages (e.g. species and
223 populations) as parts of ecosystems for both practical and moral reasons. As discussed above, the processes
224 contributing to the satisfaction of the needs of various living systems are not fully understood. However, it

is possible to monitor the status of populations and species, and this gives a good indication of whether the needs of lineages and organisms within them can be adequately satisfied. For example, if population sizes show unusual persistent declines, this usually indicates a failure of some critical process(es) relating to need satisfaction. Viability of species and populations thus indicates the integrity of the critical, but sometimes intractable, processes that underpin well-being at all levels.

As a non-anthropocentric and holistic concept, planetary well-being aligns with views that consider the survival of lineages to be an end in itself (Rolston 1985). Currently the human exploitation of and interference with ecosystems harms vast numbers of other species and populations, with the estimated number of species considered to be under risk of extinction being up to 1 million (IPBES 2019). However, humans also have needs that have to be satisfied for human well-being. The satisfaction of some of these needs – like the need for adequate nutrition – is practically impossible without some interference with ecosystems. From the planetary well-being point of view, the level of the human interference with ecosystems must not compromise the ability of other species and lineages to persist in these ecosystems to the future (i.e., it must not increase their risk of extinction). Achieving planetary well-being necessitates that human basic needs are satisfied in a way that does not compromise the capacity for nonhuman nature (its entities) to achieve well-being. An important step in this direction is to prioritize the satisfaction of basic human needs over the satisfaction of desires and wants that have a negative impact on nonhuman nature.

PUTTING THE CONCEPT TO USE

As a concept, planetary well-being has potential to contribute positively to the transformational changes towards sustainability (sustainability transition) by helping to navigate trade-offs between human and nonhuman needs, providing measures and targets for decision making, and bridging divergent worldviews.

RECONCILING HUMAN NEEDS WITH PLANETARY WELL-BEING

247 The idea of needs and need satisfiers is integral to the concept of planetary well-being. While the
 248 satisfaction of needs is necessary for the well-being of any system, the relationship between the needs and
 249 need satisfiers is contingent: needs can often be satisfied in various ways. Importantly however, when it
 250 comes to securing the satisfaction of the needs of nonhuman nature, the human action mainly concerns
 251 safeguarding or not harming the Earth system and ecosystem processes as far as possible. Active measures
 252 are often unnecessary; the well-being of ‘wild’ nonhuman nature is often best served by “deconstructing
 253 the impediments to nature’s own capabilities [or capacities] to fully and continually function” (Schlosberg
 254 2007, p. 150). Domesticated animals and ecosystems (e.g. gardens) on the other hand depend on human
 255 provision for their continued existence. While we do not discuss the status of domesticated nature (that
 256 raises distinct normative questions) here, we note that many domesticated animals are not able to realize
 257 their characteristics and capacities, and ecosystem modification (e.g. building a garden) may interfere with
 258 ecosystem processes that are critical for the needs satisfaction of wild nonhuman nature.

259 When it comes to the satisfaction of human needs, it is necessary to reflect upon what the quality of life –
 260 as associated with well-being – entails, especially when it comes to consumption of material goods (IPBES
 261 2019). Humans are complex social beings and different scientific fields provide different accounts of human
 262 well-being with different points of emphasis. However, when the question is how societies can organize and
 263 operate in ways that best support human well-being, it is necessary to approach well-being in a way that is
 264 institutionally applicable and meaningful for governance and policymaking. This directs attention to the
 265 needs-based, non-subjective conceptions of human well-being. They are grounded on the assumption that
 266 all humans, like all organisms, have certain universal basic needs that have to be satisfied in order to have a
 267 good life, to avoid serious harm, and to be able to act fully in life: the satisfaction of needs is a necessary
 268 (though not always sufficient) condition for well-being. Although the articulation of the needs varies
 269 between different authors (e.g. Doyal and Gough 1984; Max-Neef 1991; Rice 2013; Gough 2017) and some
 270 accounts emphasize the capabilities to achieve various functionings that contribute to needs satisfaction

(Nussbaum and Sen 1993; Nussbaum 2011), they all share the key elements of the need for physical and mental health, for relationships, and for autonomy in action and thought. Satisfaction of these key elements requires (that aforementioned authors suggest to include, for example, adequate nutrition, safety, and at least some kind of health care and education. When approached from a human perspective, planetary well-being is a state in which the organization of human systems simultaneously allows human needs to be met, and the impact on Earth and ecosystem processes is limited so that lineages can persist to the future as parts of ecosystems and organisms can realize their typical characteristics and capacities.

The social scientific, needs-based approach to human well-being has several features that are relevant for discussions about sustainability (Gough 2017). First, many human needs are objective: regardless of subjective experiences, it is empirically verifiable that for example malnourishment or lack of caring relationships causes serious harm to individuals (this is not to deny that needs will always be subjectively interpreted at the individual level). Second, human needs are plural: they include material, social and psychological aspects. Third, human needs are non-substitutable, e.g. it is not possible to satisfy a need for healthy nutrition with more education. Fourth, human needs are, in principle, satiable: it is possible to identify a level of needs satisfaction that would suffice for adequate well-being. However, in consumerist societies, being able to 'live without shame' requires a level of consumption that matches - or exceeds - the consumption of others, and thus drives ever-increasing consumption. Yet at the societal level this does not lead to increasing social well-being but to fragmentation and anomie (Jackson 2017 p. 124). Fifth, the needs are substantially universal, applying to people in different places and at different times, though the ways of satisfying them vary in different times and cultures: even the objective and universal needs are not 'absolute' but involve relative, context-specific aspects. The precise level where a need is satisfied may vary across individuals and contexts (consider the differentiated needs for nutrition or, for example, belongingness); and some space of choice for needs satisfaction and actual doings in one's individual life are required for freedom (Nussbaum and Sen 1993). The conception of universal needs and average

295 requirements for their satisfaction at individual level, nevertheless, provide a very useful tool for guiding
296 and evaluating societal activities in directions that support human well-being. This gives a foundation for
297 considering the well-being of both present and future generations.

298 The idea of satiable human needs means that good, fulfilling and dignified life can be achieved with limited
299 consumption sufficient to meet the material needs, together with satisfaction of non-material needs like
300 significant primary relationships, leisure, and social participation (Max-Neef 1991; Gough 2017).

301 Acknowledged, the levels of subjectively experienced well-being in such scenarios of reduced material
302 consumption are not well known, though similar changes have historically occurred in societies especially
303 during the post-war periods. Suggestions for achieving well-being with significantly lower material
304 consumption, however, are difficult. They are in stark contrast with consumerist and materialistic societies,
305 where ever-increasing production and consumption fuel the dynamics of the economy, where well-being is
306 understood as the realization of insatiable human preferences, and where good life is understood as rising
307 material standard of living. In contrast, achieving planetary well-being requires reducing consumption of
308 material goods that are not relevant for human needs (or that directly harm well-being). Global and
309 regional equality considerations also necessitate a focus on the well-being and satisfaction of both material
310 and non-material needs of all, instead of increased well-being for the already privileged.

311 It is also important to note that human material needs can be satisfied in many ways (*i.e.* by different need
312 satisfiers), with different impacts on planetary well-being. This directs attention to the sustainability of
313 production. One relevant example that has received much research attention is the human need for
314 protein, which can be satisfied in various ways that differ in their impacts on planetary well-being. When
315 there are multiple alternatives for fulfilling human needs, those with the least harmful impacts on planetary
316 well-being and the most beneficial impacts on needs satisfaction globally, between and within human
317 communities, should be prioritized in order to maximize planetary well-being. Simultaneously, it should be

kept in mind that the best need satisfiers may be different in different locations and societies and should hence remain open to community-level reflections and individual freedom of choice (cf. Nussbaum and Sen 1993). Also, understanding and propping up the factors that promote pro-environmental behaviour (including lower material consumption) at individual levels is crucial. Related behaviour patterns are known to be influenced by, for example, institutional, economic, social, emotional, motivational, value, attitude and awareness factors (Kollmus & Agyeman, 2002).

MEASURES AND TARGETS FOR DECISION MAKING

The rapid declines in animal population sizes and increases in extinction rates manifest the lack of well-being of nonhuman life on Earth today. Improving planetary well-being necessitates halting or transforming the harmful human activities and fostering actions to restore the integrity of Earth system and ecosystem processes that have been impaired by past actions. Ecological remediation, rehabilitation and restoration represent tools for advancing this aim at local levels (Gann et al. 2019). Data about the national/regional drivers of extinction threats can be a valuable source of information to identify those human practices (such as livestock farming and ranching, logging and wood harvesting, and the release of effluents) that are most damaging to planetary well-being at regional and national scales, and to justify urgent changes in these actions. This information (direct drivers of extinction threat) is available in national/regional IUCN Red Lists (<https://www.iucnredlist.org/>) though the coverage is not yet global. Information from the IUCN Red Lists also helps to identify those ecosystems and processes that require most urgent protection and restoration actions to improve the viability of threatened species and populations.

From Red Lists, it is also possible to construct indices that can be used as surrogate measures for regional and global states and trends in planetary well-being, at least as far as wild organisms are concerned. The Red List index (RLI) calculates the average threat status of the set of species included in the index. RLI takes values between 0 (all species extinct) and 1 (all species in the 'Least Concern' category). As we define

341 planetary well-being also in terms of persistence of lineages to the future (see Table 2), RLIs for well-chosen
 342 sets of organisms at regional and global scales could be used to measure the status of planetary well-being
 343 at different scales (however, extinction threats due to non-human causes, e.g. volcanic eruptions and
 344 natural diseases, should not count negatively to the score). Regional and global Red List Index values
 345 approaching 1 could also serve as intuitive, specific and measurable targets for efforts to stop and reverse
 346 current declines in biodiversity, similarly to the IPCC target of limiting global warming to 1.5 °C.

347 Whether planetary well-being will be achieved or not ultimately depends on how human societies organize
 348 their systems for human needs satisfaction. This is the crucial question and task at hand. It requires better
 349 tools for evaluating the impacts of different policies and practices for achieving more equal human well-
 350 being alongside improved planetary well-being: in the long run, there can be no human well-being without
 351 planetary well-being.

352 BRIDGING DIVERGENT WORLDVIEWS

353 We believe that planetary well-being could enrich the conceptual toolbox to foster transformation to a
 354 world that promotes well-being more equally by unifying systems-thinking and both human and nonhuman
 355 well-being to a single, intuitively appealing concept. Unlike many related concepts, planetary well-being
 356 avoids anthropocentrism, yet allows for discussions about human and nonhuman well-being in a common
 357 framework. The emphasis on well-being as the satisfaction of basic needs helps draw attention to the plight
 358 of underprivileged human communities and socio-economic groups and to the literally existential plight of
 359 nonhuman nature.

360 The concept speaks to different scientific disciplines, which we have tested during the process of writing
 361 this work, and is approachable to different domains in the public sector, at different levels, as well as to civil
 362 society and private sector actors whose cooperation is required for solving the ecological crisis. It aims not
 363 to replace previous conceptual frameworks but, rather, to supplement them by providing a multi-scalar and

non-anthropocentric approach to discussing the pressing questions of environmental and social challenges. Planetary well-being – the opportunity for both humans and nonhumans to have their needs satisfied now and in the future – can, and should, become the ultimate goal of human activities and cooperation.

SUPPLEMENTARY ITEMS

1. Neighbouring concepts

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REFERENCES

Alvaredo, Facundo, Lucas Chancel, Thomas Piketty, Emmanuel Saez, and Gabriel Zucman. 2018. *World inequality report 2018* (Belknap Press).

- 382 Assembly, UN General. 2015. 'Transforming our world: the 2030 Agenda for Sustainable Development',
 383 *Division for Sustainable Development Goals: New York, NY, USA*.
- 384 Bartussek, H. 1999. 'A review of the animal needs index (ANI) for the assessment of animals' well-being in
 385 the housing systems for Austrian proprietary products and legislation', *Livestock Production Science*,
 386 61: 179-92.
- 387 Broom, Donald M. 1991. 'Animal welfare: concepts and measurement', *Journal of animal science*, 69: 4167-
 388 75.
- 389 Bunge, Mario. 2003. *Emergence and convergence: Qualitative novelty and the unity of knowledge*
 390 (University of Toronto Press).
- 391 ———. 2004. 'How does it work? The search for explanatory mechanisms', *Philosophy of the social sciences*,
 392 34: 182-210.
- 393 Cameron, James, and Juli Abouchar. 1991. 'The precautionary principle: a fundamental principle of law and
 394 policy for the protection of the global environment', *BC Int'l & Comp. L. Rev.*, 14: 1.
- 395 Cederholm, C. Jeff, Matt D. Kunze, Takeshi Murota, and Atuhiko Sibatani. 1999. 'Pacific Salmon Carcasses:
 396 Essential Contributions of Nutrients and Energy for Aquatic and Terrestrial Ecosystems', *Fisheries*,
 397 24: 6-15.
- 398 Crutzen, Paul J, and Eugene F Stoermer. 2000. 'The "Anthropocene"', *IGBP Global Change Newsletter*: 17-
 399 18.
- 400 Díaz, Sandra, Sebsebe Demissew, Julia Carabias, Carlos Joly, Mark Lonsdale, Neville Ash, Anne Larigauderie,
 401 Jay Ram Adhikari, Salvatore Arico, Andrés Báldi, Ann Bartuska, Ivar Andreas Baste, Adem Bilgin,
 402 Eduardo Brondizio, Kai M. A. Chan, Viviana Elsa Figueroa, Anantha Duraiappah, Markus Fischer,
 403 Rosemary Hill, Thomas Koetz, Paul Leadley, Philip Lyver, Georgina M. Mace, Berta Martin-Lopez,
 404 Michiko Okumura, Diego Pacheco, Unai Pascual, Edgar Selvin Pérez, Belinda Reyers, Eva Roth,
 405 Osamu Saito, Robert John Scholes, Nalini Sharma, Heather Tallis, Randolph Thaman, Robert

406 Watson, Tetsukazu Yahara, Zakri Abdul Hamid, Callistus Akosim, Yousef Al-Hafedh, Rashad
 407 Allahverdiyev, Edward Amankwah, Stanley T. Asah, Zemedede Asfaw, Gabor Bartus, L. Anatheia
 408 Brooks, Jorge Caillaux, Gemedo Dalle, Dedy Darnaedi, Amanda Driver, Gunay Erpul, Pablo Escobar-
 409 Eyzaguirre, Pierre Failler, Ali Moustafa Mokhtar Fouda, Bojie Fu, Haripriya Gundimeda, Shizuka
 410 Hashimoto, Floyd Homer, Sandra Lavorel, Gabriela Lichtenstein, William Armand Mala, Wadzanayi
 411 Mandivenyi, Piotr Matczak, Carmel Mbizvo, Mehrasa Mehrdadi, Jean Paul Metzger, Jean Bruno
 412 Mikissa, Henrik Moller, Harold A. Mooney, Peter Mumby, Harini Nagendra, Carsten Nesshover,
 413 Alfred Apau Oteng-Yeboah, György Pataki, Marie Roué, Jennifer Rubis, Maria Schultz, Peggy Smith,
 414 Rashid Sumaila, Kazuhiko Takeuchi, Spencer Thomas, Madhu Verma, Youn Yeo-Chang, and Diana
 415 Zlatanova. 2015. 'The IPBES Conceptual Framework — connecting nature and people', *Current*
 416 *Opinion in Environmental Sustainability*, 14: 1-16.

417 Díaz, Sandra, Josef Settele, Eduardo S. Brondízio, Hien T. Ngo, John Agard, Almut Arneth, Patricia Balvanera,
 418 Kate A. Brauman, Stuart H. M. Butchart, Kai M. A. Chan, Lucas A. Garibaldi, Kazuhito Ichii, Jianguo
 419 Liu, Suneetha M. Subramanian, Guy F. Midgley, Patricia Miloslavich, Zsolt Molnár, David Obura,
 420 Alexander Pfaff, Stephen Polasky, Andy Purvis, Jona Razzaque, Belinda Reyers, Rinku Roy
 421 Chowdhury, Yunne-Jai Shin, Ingrid Visseren-Hamakers, Katherine J. Willis, and Cynthia N. Zayas.
 422 2019. 'Pervasive human-driven decline of life on Earth points to the need for transformative
 423 change', *Science*, 366: eaax3100.

424 Doyal, Len, and Ian Gough. 1984. 'A theory of human needs', *Critical Social Policy*, 4: 6-38.

425 Dryzek, John S. 2005. *The Politics of the Earth: Environmental Discourses* (Oxford University Press: Oxford).

426 Dryzek, John S, and Jonathan Pickering. 2018. *The politics of the Anthropocene* (Oxford University Press).

427 Environment, UN. 2019. "Global Environment Outlook – GEO-6: Healthy Planet, Healthy People." In.
 428 Nairobi.

- 429 Gann, George D., Tein McDonald, Bethanie Walder, James Aronson, Cara R. Nelson, Justin Jonson, James G.
 430 Hallett, Cristina Eisenberg, Manuel R. Guariguata, Junguo Liu, Fangyuan Hua, Cristian Echeverría,
 431 Emily Gonzales, Nancy Shaw, Kris Decler, and Kingsley W. Dixon. 2019. 'International principles
 432 and standards for the practice of ecological restoration. Second edition', *Restoration Ecology*, 27:
 433 S1-S46.
- 434 Gough, Ian. 2015. 'Climate change and sustainable welfare: the centrality of human needs', *Cambridge*
 435 *Journal of Economics*, 39: 1191-214.
- 436 ———. 2017. 'Recomposing consumption: defining necessities for sustainable and equitable well-being',
 437 *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*,
 438 375: 20160379.
- 439 Hornborg, Alf. 1998. 'Towards an ecological theory of unequal exchange: articulating world system theory
 440 and ecological economics', *Ecological Economics*, 25: 127-36.
- 441 IPBES. 2018. "Summary for policymakers of the assessment report on land degradation and restoration of
 442 the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services." In, edited
 443 by Luca Montanarella, Robert Scholes and Anastasia Brainich, 744 pages. Bonn, Germany:
 444 Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem
 445 Services.
- 446 ———. 2019. "Summary for policymakers of the global assessment report on biodiversity and ecosystem
 447 services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services."
 448 In *IPBES Secretariat: Bonn, Germany*, edited by S Díaz, J Settele, ES Brondízio, HT Ngo, M Guèze, J
 449 Agard, A Arneth, P Balvanera, KA Brauman and SHM Butchart, 56.
- 450 IPCC. 2019. "Climate Change and Land: an IPCC special report on climate change, desertification, land
 451 degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial

- 452 ecosystems." In, edited by PR Shukla, J Skea, E Calvo Buendia, V Masson-Delmotte, HO Pörtner, DC
 453 Roberts, P Zhai, Raphael Slade, Sarah Connors and Renée Van Diemen.
- 454 Jackson, Tim. 2017. *Prosperity without growth: foundations for the economy of tomorrow* (Routledge).
- 455 Keyes, Corey LM. 2005. 'Mental illness and/or mental health? Investigating axioms of the complete state
 456 model of health', *Journal of consulting and clinical psychology*, 73: 539.
- 457 Kohler, Florent, Timothy G Holland, Janne S Kotiaho, Maylis Desrousseaux, and Matthew D Potts. 2019.
 458 'Embracing diverse worldviews to share planet Earth', *Conservation Biology*, 33: 1014-22.
- 459 Kokko, Katja, Anni Korkalainen, Anna-Liisa Lyyra, and Taru Feldt. 2013. 'Structure and continuity of well-
 460 being in mid-adulthood: A longitudinal study', *Journal of Happiness Studies*, 14: 99-114.
- 461 Kollmuss, Anja, and Julian Agyeman. "Mind the gap: why do people act environmentally and what are the
 462 barriers to pro-environmental behavior?." *Environmental education research* 8.3 (2002): 239-260.
- 463 Kortetmäki, Teea. 2017. 'Applying the capabilities approach to ecosystems: Resilience as ecosystem
 464 capability', *Environmental Ethics*, 39: 39-56.
- 465 ———. 2018. 'Can Species Have Capabilities, and What if They Can?', *Journal of Agricultural and*
 466 *Environmental Ethics*, 31: 307-23.
- 467 Liu, Jianguo, Vanessa Hull, H Charles J Godfray, David Tilman, Peter Gleick, Holger Hoff, Claudia Pahl-Wostl,
 468 Zhenci Xu, Min Gon Chung, and Jing Sun. 2018. 'Nexus approaches to global sustainable
 469 development', *Nature Sustainability*, 1: 466-76.
- 470 Liu, Jianguo, Harold Mooney, Vanessa Hull, Steven J Davis, Joanne Gaskell, Thomas Hertel, Jane Lubchenco,
 471 Karen C Seto, Peter Gleick, and Claire Kremen. 2015. 'Systems integration for global sustainability',
 472 *Science*, 347.
- 473 Malm, Andreas, and Alf Hornborg. 2014. 'The geology of mankind? A critique of the Anthropocene
 474 narrative', *The Anthropocene Review*, 1: 62-69.

- 475 Max-Neef, Manfred A. 1991. *Human scale development : conception, application and further reflections*
 476 (The Apex Press: New York).
- 477 Newsome, Kirsty, Philip Taylor, Jennifer Bair, and Al Rainnie. 2015. *Putting labour in its place: labour process*
 478 *analysis and global value chains* (Palgrave).
- 479 Nussbaum, Martha C. 2006. *Frontiers of justice: Disability, nationality, species membership* (Harvard
 480 University Press).
- 481 Nussbaum, Martha C. 2011. *Creating Capabilities : The Human Development Approach* (Harvard University
 482 Press: Cumberland, UNITED STATES).
- 483 Nussbaum, Martha, and Amartya Sen (ed.)^(eds.). 1993. *The quality of life* (Clarendon Press).
- 484 O'Neill, Daniel W, Andrew L Fanning, William F Lamb, and Julia K Steinberger. 2018. 'A good life for all
 485 within planetary boundaries', *Nature Sustainability*, 1: 88-95.
- 486 Ostrom, Elinor. 2009. 'A general framework for analyzing sustainability of social-ecological systems',
 487 *Science*, 325: 419-22.
- 488 Prescott-Allen, Robert. 2001. *The wellbeing of nations* (Island Press).
- 489 Reid, W. V., D. Chen, L. Goldfarb, H. Hackmann, Y. T. Lee, K. Mokhele, E. Ostrom, K. Raivio, J. Rockström, H.
 490 J. Schellnhuber, and A. Whyte. 2010. 'Earth System Science for Global Sustainability: Grand
 491 Challenges', *Science*, 330: 916-17.
- 492 Rice, Christopher M. 2013. 'Defending the Objective List Theory of Well-Being', *Ratio*, 26: 196-211.
- 493 Rockström, Johan, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin Iii, Eric F. Lambin, Timothy M.
 494 Lenton, Marten Scheffer, Carl Folke, Hans Joachim Schellnhuber, Björn Nykvist, Cynthia A. de Wit,
 495 Terry Hughes, Sander van der Leeuw, Henning Rodhe, Sverker Sörlin, Peter K. Snyder, Robert
 496 Costanza, Uno Svedin, Malin Falkenmark, Louise Karlberg, Robert W. Corell, Victoria J. Fabry, James
 497 Hansen, Brian Walker, Diana Liverman, Katherine Richardson, Paul Crutzen, and Jonathan A. Foley.
 498 2009. 'A safe operating space for humanity', *Nature*, 461: 472.

- 499 Rolston, Holmes. 1985. 'Duties to endangered species', *Bioscience*, 35: 718-26.
- 500 ———. 2002. "What do we mean by the intrinsic value and integrity of plants and animals?" In.: Colorado
501 State University. Libraries.
- 502 Rowland, F. Sherwood. 2006. 'Stratospheric ozone depletion', *Philosophical Transactions of the Royal
503 Society B: Biological Sciences*, 361: 769-90.
- 504 Running, Steven W. 2012. 'A measurable planetary boundary for the biosphere', *Science*, 337: 1458-59.
- 505 Schlosberg, David. 2007. *Defining environmental justice: theories, movements, and nature* (Oxford
506 University Press: Oxford).
- 507 Singer, P. 2002. *Animal liberation*.
- 508 Steffen, Will, Wendy Broadgate, Lisa Deutsch, Owen Gaffney, and Cornelia Ludwig. 2015. 'The trajectory of
509 the Anthropocene: the great acceleration', *The Anthropocene Review*, 2: 81-98.
- 510 Steffen, Will, Katherine Richardson, Johan Rockström, Sarah E Cornell, Ingo Fetzer, Elena M Bennett,
511 Reinette Biggs, Stephen R Carpenter, Wim De Vries, and Cynthia A De Wit. 2015. 'Planetary
512 boundaries: Guiding human development on a changing planet', *Science*, 347.
- 513 Van der Ent, Rudi J, Hubert HG Savenije, Bettina Schaefli, and Susan C Steele-Dunne. 2010. 'Origin and fate
514 of atmospheric moisture over continents', *Water Resources Research*, 46.
- 515 van der Esch, Stefan, Ben ten Brink, Elke Stehfest, Michel Bakkenes, Annelies Sewell, Arno Bouwman, Johan
516 Meijer, Henk Westhoek, Maurits van den Berg, and Gert Jan van den Born. 2017. 'Exploring future
517 changes in land use and land condition and the impacts on food, water, climate change and
518 biodiversity: scenarios for the UNCCD Global Land Outlook'.
- 519 Warren, Mary Anne. 1997. *Moral status: Obligations to persons and other living things* (Clarendon Press).
- 520 Watson, James E M., Danielle F Shanahan, Moreno Di Marco, James Allan, William F Laurance, Eric W
521 Sanderson, Brendan Mackey, and Oscar Venter. 2016. 'Catastrophic Declines in Wilderness Areas
522 Undermine Global Environment Targets', *Current Biology*, 26: 2929-34.

- 523 WCED. 1987. *Our common future* (Oxford University Press: Oxford).
- 524 Wemelsfelder, Françoise. 1997. 'The scientific validity of subjective concepts in models of animal welfare',
525 *Applied Animal Behaviour Science*, 53: 75-88.
- 526 Willemen, Louise, Nichole N Barger, Ben Ten Brink, Matthew Cantele, Barend FN Erasmus, Judith L Fisher,
527 Toby Gardner, Timothy G Holland, Florent Kohler, and Janne S Kotiaho. 2020. 'How to halt the
528 global decline of lands', *Nature Sustainability*, 3: 164-66.
- 529 Winter, Deborah Du Nann, and Susan M Koger. 2004. *The psychology of environmental problems*
530 (Psychology Press).
- 531 WWF. 2020. "Living Planet Report 2020 - Bending the curve of biodiversity loss." In, edited by R.E.A.
532 Almond, M. Grooten and T. Petersen. Gland, Switzerland.
- 533
- 534