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Forum

Beyond ecosystem services as justification for biodiversity conservation

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The earth is currently facing its sixth mass extinction event and, unlike previous events, is anthropogenic in origin (Cafaro 2015). Against the backdrop of this extinction crisis, and the apparent lack of concern of our world leaders, many conservationists feel they need to justify conservation efforts by stating that biodiversity, or a particular organism(s), are important for provision of ecosystem services – most commonly defined as "the benefits provided to humans through the transformations of resources (or environmental assets, including land, water, vegetation and atmosphere) into a flow of essential goods and services, for example clean air, water and food" (Costanza *et al.* 1997). For recent examples, 'preserving species diversity is critical to ensure ecosystem functioning' (Coulin *et al.* 2019); 'critical weight range mammals could provide considerable ecosystem services to a range of industries, including farming, which highlights the value of maintaining these species and assisting their recovery within the landscape' (Halstead *et al.* 2020); and 'it is important to have native species around novel, disturbed ecosystems as they provide a range of ecosystem services for native pollinators' (Everingham *et al.* 2019). However, is this the best way to encourage conservation, be it of a single species or a diversity of species? Is it true? And can this approach have unintended consequences? Below, I critique the focus on ecosystem services and highlight how a more nuanced perspective is required.

If the focus is on 'ecosystem services', often defined in what services nature can provide just one species – humans, of course – this can mean compromising species richness. For example, in some agricultural contexts, especially in Australia where many crops are exotic, and many pollinators have evolved to forage only on native plants (Murray *et al.* 2009), the European honeybee, *Apis mellifera*, is the sole, or most effective pollinator (Hermansen *et al.* 2014). Honeybees can also be more effective pollinators of native flora compared with native bees (Schmidt-Adam *et al.* 2009). Many Australian bee species are arguably rather poor pollinators: euryglossines and hylaeines comprise over 50% of native bee species (Batley & Hogendoorn 2009), yet these taxa swallow pollen and lack scopae (Michener 2007), suggesting they are relatively ineffective pollinators (Beardsell *et al.* 1993). Additionally, most are specialists on native flora and hence are underrepresented as crop pollinators (Michener 2007). At the same time, there are numerous where wild native bees have proven to be more effective pollinators than honeybees, both overseas (Garibaldi *et al.* 2013) and in Australia (Hogendoorn *et al.* 2006). This variation makes it evident that ecosystem services cannot always serve as a justification for biodiversity conservation (Kleijn *et al.* 2015; Winfree *et al.* 2015).

While there are numerous examples of positive correlations between ecosystem services and species richness (Weyland *et al.* 2019), this is not ubiquitous (Ridder 2008). Taxonomic diversity can be lost without impacting functional diversity (Doupé *et al.* 2006), and not all components of biodiversity or ecosystem services respond similarly to a given management regime, for example Coulin *et al.* (2019). Moreover, the mechanism underlying the biodiversity–ecosystem service provisioning (BD-ESP) relationship is a topic of ongoing debate but appears to vary depending on the ecosystem service, community, scale and context (Norgaard 2010; Harrison *et al.* 2014). In some cases, the positive BD-ESP is due to a 'sampling effect' (Wardle 1999), in which case most of the species could be lost without consequence to the ecosystem service in question.

Trying to advocate that one particular species is important to conserve for its ecosystem services is even less tenable. This is especially so when that species is rare and at low abundance, yet therefore most in need of conservation efforts (Winfree *et al.* 2015). Ecosystems naturally have redundancy, and losing one species may be inconsequential (the 'portfolio effect'; Ehrlich & Walker 1998; Figge 2004; Hooper *et al.* 2005). Consider the iconic koala: at high densities, it can even cause an ecosystem 'disservice' by defoliating keystone eucalypt trees; however, few people would be comfortable with trading the survival of

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koalas for the survival of trees. Short-range endemics (SREs; Driessen 2019) likewise would often fail to meet the criteria for performing a vital ecosystem service. With the ecosystem service concept often tied to economics (McCauley 2006; Sagoff 2008), it can be more fiscal sense not to conserve species that do not contribute or even can reduce, the ability of ecosystems to deliver services. The 'value' of a species can also vary depending on what service is deemed most 'important'. Wombats, as digging mammals, are important in soil turnover, nutrient cycling and providing habitat to other fauna (Fleming *et al.* 2014); however, their digging activities are considered an ecosystem disservice in some agricultural contexts, which has ushered in unethical practices of culling, with the potential to jeopardise their conservation (Tartowski & Stemann 1998). Indeed, some rare species do play critical roles in ecosystem services (Mouillot *et al.* 2013), but again this shows the context-dependent nature of using ecosystem services as justification for conservation.

Even if a species, or species diversity, does not directly benefit ecosystem services, people can put forward other arguments, for example that they are flagship species, umbrella species or indicator species (Simberloff 1998), or that biodiversity, or a particular species, is vital for ecosystem services under variable conditions (e.g. Holley and Andrew (2019)). But perhaps we should stop straining to justify conservation in terms of ecosystem services. From a philosophical perspective, the concept of ecosystem services is strongly anthropocentric; such an ideology has been highly influential in leading to the current conservation crisis (Shoreman-Ouimet & Kopnina 2015). Rather than perpetuating an idea that nature is here to serve the needs of humans and provide goods and services, it can be argued preservation of functioning, healthy ecosystems and the diversity of biota on this planet are better served under an ideology of biocentrism (Humphreys 2016) and appreciating that each species is a unique outcome of the fascinating process of evolution, a natural work of art, and a source of potential knowledge that would be lost forever from the library of life if it were to become extinct.

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