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PERSPECTIVES

The coastal conservation narrative is shifting from crisis to ecosystem services

Thorsten Balke[1] · Alejandra G Vovides[1] · Cai JT Ladd[1] · Mark Huxham[2]

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Abstract
Conservation biology emerged as a crisis discipline in the twentieth century amongst an increasing awareness of pollution and habitat loss. Since the early 2000s, societal and monetary benefits of nature were added to the narrative for biodiversity conservation. Using text mining, we show that authors now favour ecosystem-services over a crisis framing in scientific publications on coastal habitats. This may signal a shift in conservation science from a crisis to a services discipline despite continuing habitat loss. We discuss whether authors should more critically assess what conservation narrative they deploy and what consequences this may have for conservation action.

Keywords Conservation biology · Research narrative · Research context · Crisis discipline · Biodiversity crisis · Coastal habitat · Text mining

Introduction

Science is a collective endeavour that responds to social imperatives. In the 1970s, as the emerging sustainability megatrends of extinction, population pressure and climate change were increasingly discussed, survival sciences emerged (Egan 2017); and conservation biology was coined as a crisis discipline (Soulé 1985). Eliminating anthropogenic pressures and separating human activity from nature to halt the loss of biodiversity were the focal points of conservation science during the advent of the discipline (Mace 2014). This was followed by a realization of failure in the 1980s due to continued evidence for unacceptably high extinction rates (Mace 2014). By the early 2000s, studies quantifying economic and societal benefits of nature came to the fore and were quickly utilized to promote nature conservation (Millennium Ecosystem Assessment 2003; Costanza et al. 1997). Here, we demonstrate that today scientific articles increasingly highlight the benefits of, rather than the threats to, habitats, especially for coastal ecosystems. We further discuss whether this signals a shift in conservation science from a crisis to a services narrative, and how this may affect conservation action.

Emergence of the ecosystem-services concept

Ecosystem services developed into a widely accepted framework for assessing nature's benefits to society in the early 2000s, with the publication of the Millennium Ecosystem Assessment (2003). The notion of nature's services first appeared in the late 1970s (see, e.g. Force 1978), exemplifying that 'inexorable trend of policy makers in the Global North seeking to monetize items and qualities of nature formerly regarded as priceless' (Westman, 1977, p. 197). In a bid to identify and quantify 'natural capital', ecosystem services have emerged as a favoured means to communicate the value of nature amongst the 'new conservationists' (Soulé 2013). The link between conservation and utilitarian economic thinking has strengthened, so that implicit and explicit links between science and policy are now routinely made using the ecosystem services concept (McKinley et al. 2020). This is despite apprehensions that the new 'humanitarian focus' may not always 'trickle down' to benefit biodiversity (Soulé 2013). Cultural ecosystem services that cannot be easily

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✉ Thorsten Balke
thorsten.balke@glasgow.ac.uk

[1] School of Geographical and Earth Sciences, University of Glasgow, University Avenue, Glasgow G128QQ, UK

[2] School of Applied Sciences, Edinburgh Napier University, Edinburgh, UK

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monetized are still underappreciated (Hirons et al. 2016) which fuels an ongoing resistance to the monetizing of all ecosystem services in favour of more values-based assessments (Díaz et al. 2018).

The arguments over whether an ecosystem-services framing helps or hinders the protection of biodiversity are continuing (e.g. Dee et al. 2017, Potschin et al. 2016, Silvertown 2015), as is the debate about the extent to which biodiversity (i.e. species richness) directly correlates with the delivery of ecosystem services (Winfree et al. 2015; Isbell et al. 2015). There is also a risk that management and restoration motivated only by the delivery of a single ecosystem service, such as monospecific tree planting for carbon sequestration, will damage biodiversity.

As authors, we can choose how to frame our studies on conservation biology, biodiversity and ecosystem functions. However, many scientists entering the field post 2000 may already take the ecosystem-services narrative for granted (Kull et al. 2015) instead of reflecting on how the framing of their research may affect conservation objectives.

Text mining for crisis versus ecosystem-services framing

To understand how perceptions in the ecology and conservation-biology research community have changed over the past five decades, we analysed over 90,000 publications using a text-mining approach (detailed methods are available from the supporting information 1). We analysed publications on different habitats for the occurrence of words and word combinations (also referred to as n-grams in text mining) that either relate to threats and stresses (i.e. crisis framing; derived from the IUCN threats classification scheme (IUCN n.d.-a) and the IUCN stresses classification scheme (IUCN n.d.-b)) or to ecosystem services. The latter was derived from the World Resources Institute's categorisation of ecosystem services (Hanson et al. 2012) which builds on the original Millennium Ecosystem Assessment (2003) categories. The list of n-grams is available in the supporting information 2. We calculated the percentage of papers directly related to crisis vs. services (i.e. the research topic defined as the proportion of publications per year with at least one of the respective n-grams in the title or author keyword list). We also considered the research context or framing of publications that are not directly about crisis or services (i.e. calculated as the annual percentage of publications that contain at least one crisis vs. services n-gram in their abstract minus the publications with crisis vs. services n-grams in title or keyword). The proportion of publications with ecosystem services as the main topic has been increasing across all habitat types especially in the past 10 years (Fig. 1 left panel). For publications on seagrass, mangrove and salt marsh, the percentage of published papers adopting an ecosystems service research context now exceeds those with a crisis context (i.e. threats/stresses) (Fig. 1). Publications on rainforest and grassland habitats have seen similar trends; however, the crisis context still exceeds the services-context proportion.

A change in language

Thematic coding of publications in the five decades from 1970–1979 to 2010–2019 on the four coastal habitats (i.e. coral reef, mangrove, seagrass and salt marsh; see supporting information 3) provided further insights into the observed research-framing trends. Selecting the five most-cited papers from each habitat and decade, we coded their habitat introductions for the qualitative themes 'ecological descriptions and biodiversity', 'ecosystem services' and 'threats', to capture the motivating conceptual context used to introduce and justify the work. In the 1970s papers, all habitats were introduced as sites of high diversity or as having interesting ecological dynamics. This was true also for the 1980s, apart from mangroves for which most introductions now included ecosystem services as the study justification (e.g. 'it is almost an article of faith amongst estuarine scientists that coastal wetlands, such as mangrove forests, are important nursery sites for juvenile fish and crustaceans' (Robertson and Duke 1987)). This pattern remained until the 2010s for mangrove habitats. By the 1990s, the ecosystem-services framing was also dominant for seagrasses, and it became the most common introductory justification for salt marshes during the 2010s. Coral reefs were an exception to this trend. By the 1990s, the most influential reef papers had switched from justifications based on pure science and description to warning about threats (e.g. 'Why, then, should the coral reef bleaching and mortality events of the 1980s command great concern? Probably... because the frequency and scale of bleaching disturbances are unprecedented' (Glynn 1993)). This theme remains dominant today (e.g. 'The world's tropical reef ecosystems… are increasingly affected by climate change … rising sea surface temperatures… have triggered unprecedented mass bleaching of corals' (Hughes et al. 2017)).

The contrast in framing between coral reefs and coastal wetland studies is striking. Does it suggest that reefs are more severely threatened than other coastal habitats? Or that they provide less valued ecosystem services? The literature suggests that coral reefs and coastal wetlands are both still in crisis. Souter et al. (2020) report an estimated decline in annual global average hard coral cover of nearly 20% between 1978 and 2019, with a historic global loss of 42%. Global decline in mangrove forests was estimated at 18% between 1985 and 2016 (FAO 1994; Bunting et al. 2018). A global assessment of historic salt marsh extent change is to our knowledge not available. However, for the USA, China, and Europe, marsh extent has declined by approximately 35% between the 1970s and 2010s with losses predominantly occurring in the USA and China (Irving et al. 2011; Gu et al.

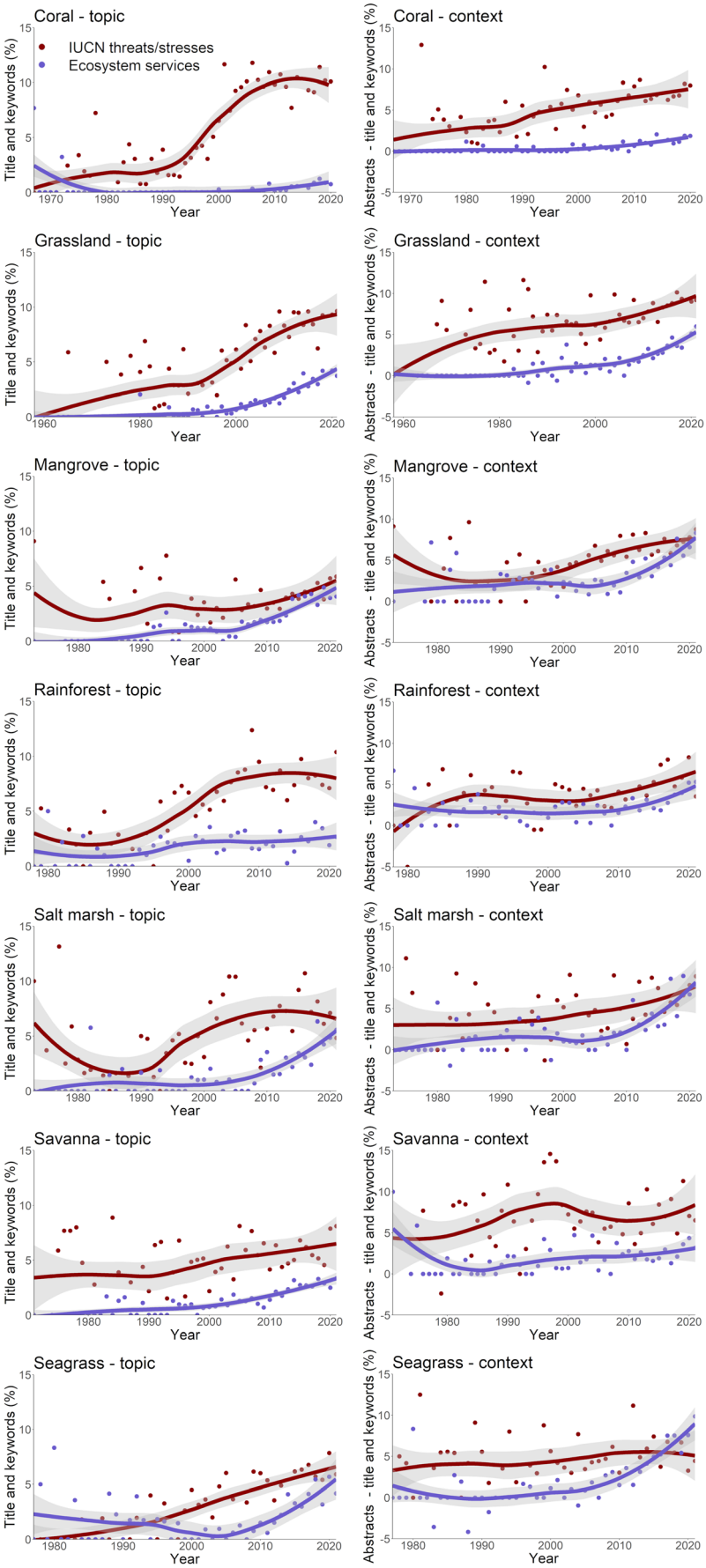

Fig. 1 Left: Annual percentage of publications per year that contain at least one ecosystem service vs. threats/stresses (i.e. crisis) n-gram in title or keyword list (i.e. the research topic of the study). Right: Annual percentage of publications that contain at least one ecosystem services vs. threats/stresses n-gram in their abstract minus the number of publications with n-grams in title or keywords (i.e. the research context or framing). The line represents a LOESS (locally weighted smoothing) smoother and the grey area the confidence interval

2018; Laengner et al. 2019). Waycott et al. (2009) report a seagrass decline globally of nearly 40% from the 1930s to 2006, although a revised study by Dunic et al. (2021) places estimated net global losses nearer to 19% since 1880. All coastal habitats provide ecosystem services such as shoreline protection and fisheries provision (Barbier et al. 2011). The continued crisis framing of coral reef studies, in contrast to the ecosystem-services framing of coastal wetland studies, may reflect the different scientific cultures in coastal wetland vs. coral reef communities (see language change assessment above). It may, however, also reflect the role that various ecosystem services currently receive in policy and practise (e.g. blue carbon and coastal protection for coastal wetlands) and the high confidence in the negative short-term predictions for coral reefs under climate change (IPCC 2018).

Consequences of crisis vs. ecosystem-services framing

Although objectivity is the prime value of science, it is always hard (many would say impossible) to obtain. The most important processes and practices of science—such as peer review and replication—uphold objectivity, and the social status of science largely derives from it. In practice, however, all scientific discourse incorporates, to a greater or lesser extent, subjective and societal values. This is partly because language is ineradicably metaphorical; apparently neutral words such as 'growth' carry different nuance depending on their context (compare economics with epidemiology). Subjectivity also arises because many applied disciplines are openly normative; welfare economics, for example, aims to maximise human welfare whilst conservation biology upholds the value of biodiversity. It follows that the language used in reporting science, particularly how results are framed in introductions and then understood in discussions, deserves careful thought since it will carry explicit or implicit value judgements or political standpoints.

Consider a study that finds mangrove coverage in a country has declined by 20% over the past decade. These findings could be reported as unadorned fact, perhaps in comparison to other similar areas. They could be framed as evidence for decline of threatened species, as an injustice to marginalised communities that depend on the forests, or as a result of unequal power dynamics between men and women (if, for example, women are particularly dependent on fuelwood collection). They could be seen as an assault on indigenous belief systems that hold the forests to be sacred, or they could be set in the context of loss of natural capital implicitly sending a message to economists, and policy makers influenced by them, that here is a problem to be addressed using the tools of cost-benefit analysis and economic trade-off. One could even take a conservation-optimism standpoint when introducing this study by highlighting the potential for recovery rather than emphasizing what has been lost. All these framings may be correct (even simultaneously), and all imply different audiences, sentiments and actions. Perhaps a balanced conservation narrative, acknowledging threats and opportunities, economic and cultural values, may best incentivise the transformative change we urgently need.

Conclusion

Ecosystem-services framing, rather than a crisis framing, is increasing and now predominant for mangroves, seagrasses, and salt marshes whereas this remains marginal for the coral reef literature. The reasons for this may be embedded in the different services and threats that these habitats feature (e.g., blue carbon, bleaching) and the culture and language within the respective research communities. Whereas we did not establish how each narrative may incentivise or hinder the transformative change that is required to halt biodiversity loss, we suggest that it is imperative to actively consider the conservation and ecology research framing we adopt in publications.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval No animal testing was performed during this study.

Sampling and field studies The study does not contain sampling material or data from field studies.

Data availability Text mining output tables available at Zenodo: 10.5281/zenodo.6396072.

Author contribution Balke conceived the idea for the paper, carried out the text mining analyses, and led the writing of the paper. Vovides and Ladd contributed to writing and collated recent habitat change information. Huxham contributed to writing and carried out thematic coding of introduction excerpts.

References

Barbier EB, Hacker SD, Kennedy C, Koch EW, Stier AC, Silliman BR (2011) The value of estuarine and coastal ecosystem services. *Ecol Monogr* 81:169–193. https://doi.org/10.1890/10-1510.1

Bunting P, Rosenqvist A, Lucas R, Rebelo L-M, Hilarides L, Thomas N, Hardy A, Itoh T, Shimada M, Finlayson C (2018) The global mangrove watch—a new 2010 global baseline of mangrove extent. *Remote Sens* 10(10):1669. https://doi.org/10.3390/rs10101669

Costanza R, D'Arge R, De Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neill RV, Paruelo J, Raskin RG, Sutton P, Van Den Belt M (1997) The value of the world's ecosystem services and natural capital. *Nature* 387(6630):253–260

Dee LE, De Lara M, Costello C, Gaines SD (2017) To what extent can ecosystem services motivate protecting biodiversity? *Ecol Lett* 20(8):935–946. https://doi.org/10.1111/ele.12790

Díaz S, Pascual U, Stenseke M, Martín-López B, Watson RT et al (2018) Assessing nature's contribution to people. *Science* 359(6373):270–272. https://doi.org/10.1126/science.aap8826

Dunic JC, Brown CJ, Connolly RM, Turschwell MP, Côté IM (2021) Long-term declines and recovery of meadow area across the world's seagrass bioregions. *Glob Chang Biol* 27(17):4096–4109. https://doi.org/10.1111/gcb.15684

Egan M (2017) Survival science: crisis disciplines and the shock of the environment in the 1970s1. *Centaurus* 59:26–39. https://doi.org/10.1111/1600-0498.12149

FAO (1994) Mangrove forest management guidelines. Technical Report FAO Forestry Paper 117, 169–191

Force J (1978) Research planning in the forest service to assess the impacts of air pollutants on forest resources. Ohio State University

Glynn PW (1993) Coral reef bleaching: ecological perspectives. *Coral Reefs* 12(1):1–17

Gu J, Luo M, Zhang X, Christakos G, Agusti S, Duarte CM, Wu J (2018) Losses of salt marsh in China: trends, threats and management. *Estuar Coast Shelf Sci* 214:98–109

Hanson C, Ranganathan J, Iceland C, Finisdore J. (2012) The corporate ecosystem services review: guidelines for identifying business risks and opportunities arising from ecosystem change. Version 2.0. Washington, DC: World Resources Institute

Hirons M, Comberti C, Dunford R (2016) Valuing cultural ecosystem services. *Annu Rev Environ Resour* 41:545–574. https://doi.org/10.1146/annurev-environ-110615-085831

Hughes T, Kerry J, Álvarez-Noriega M et al (2017) Global warming and recurrent mass bleaching of corals. *Nature* 543:373–377. https://doi.org/10.1038/nature21707

IPCC (2018) Summary for Policymakers. In: (Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty) {[eds.] [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield] }. World Meteorological Organization, Geneva, Switzerland, 32 pp

Irving AD, Connel SD, Russell BD (2011) Restoring coastal plants to improve global carbon storage: reaping what we sow. *PLoS One* 6(3):e18311. https://doi.org/10.1371/journal.pone.0018311

Isbell F, Tilman D, Polasky S, Loreau M, Bardgett R (2015) The biodiversity-dependent ecosystem service debt. Ecol Lett 18(2):119–134. https://doi.org/10.1111/ele.12393

IUCN (n.d.-a) IUCN - CMP Unified Classification of Direct Threats (Version3.2). Available at: [https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_threats_classification_scheme.pdf]. Accessed 23 Mar 2022

IUCN (n.d.-b) IUCN - CMP Unified Classification of Stresses (Version 1.1). Available at: [https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_stresses_classification_scheme.pdf]. Accessed 23 Mar 2022

Kull CA, Arnauld de Sartre X, Castro-Larrañaga M (2015) The political ecology of ecosystem services. *Geoforum* 61:122–134

Laengner ML, Siteur K, van der Wal D (2019) Trends in the seaward extent of saltmarshes across Europe from Long-Term Satellite Data. *Remote Sens* 11:1653. https://doi.org/10.3390/rs11141653

Mace GM (2014) Whose conservation? *Science* 345:1558

McKinley E, Acott T, Yates KL (2020) Marine social sciences: looking towards a sustainable future. *Environ Sci Pol* 108:85–92. https://doi.org/10.1016/j.envsci.2020.03.015

Millennium Ecosystem Assessment (2003) In: Press I (ed) Ecosystems and human well-being: a framework for assessment. Island Press, Washington DC

Potschin MB, Primmer E, Furman E, Haines-Young RH (2016) Have ecosystem services been oversold? A response to Silvertown. *Trends Ecol Evol* 31(5):334–335. https://doi.org/10.1016/j.tree.2016.03.008

Robertson AI, Duke NC (1987) Mangroves as nursery sites: comparisons of the abundance and species composition of fish and crustaceans in mangroves and other nearshore habitats in tropical Australia. *Mar Biol* 96(2):193–205. https://doi.org/10.1007/BF00427019

Silvertown J (2015) Have ecosystem services been oversold? *Trends Ecol Evol* 30(11):641–648. https://doi.org/10.1016/j.tree.2015.08.007

Soulé ME (1985) What Is Conservation Biology? *BioScience* 35(11):727–734

Soulé ME (2013) The "new conservation". *Conserv Biol* 27(5):895–897

Souter D, Planes S, Wicquart J, Logan M, Obura D, Staub F (2020) Global coral reef monitoring network: status of coral reefs of the World: 2020. Chapter 2. Status of Coral Reefs of the World. Aust. Inst. Mar. Sci, Townsville, Queensland. https://gcrmn.net/wp-content/uploads/2021/10/Chapter-2.-Status-of-Coral-Reefs-of-the-World.pdf. Accessed 05/09/2022

Waycott M, Duarte CM, Carruthers TJ, Orth RJ, Dennison WC, Olyarnik S et al (2009) Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *PNAS* 106(30):12377–12381. https://doi.org/10.1073/pnas.0905620106

Westman WE (1977) How Much Are Nature's Services Worth? *Science* 197(4307):960–996

Winfree R, Fox JW, Williams NM, Reilly JR, Cariveau DP, Shea K (2015) Abundance of common species not species richness drives delivery of a real-world ecosystem service. Ecol Lettb18(7):626–635. https://doi.org/10.1111/ele.12424