Enabling conservation Theories of Change

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Abstract

Global Theories of Change (ToCs), such as the post-2020 Global Biodiversity Framework (GBF), provide broad, overarching guidance for achieving conservation goals. However, broad guidance cannot inform how conservation actions will lead to desired outcomes. We provide a framework for translating a global-scale ToC into focussed, ecosystem-specific ToCs that consider feasibility of actions, as determined by national socioeconomic and political context (i.e., enabling conditions). We demonstrate the framework using coastal wetland ecosystems as a case study. We identified six distinct multinational profiles of enabling conditions (‘enabling profiles’) for coastal wetland conservation. For countries belonging to enabling profiles with high internal capacity to enable conservation, we described plausible ToCs that involved strengthening policy and regulation. Alternatively, for enabling profiles with low internal enabling capacity, plausible ToCs typically required formalising community-led conservation. Our ‘enabling profile’ framework could be applied to other ecosystems to help operationalise the post-2020 GBF.

Introduction

Theories of Change (ToCs) describe how conservation interventions can achieve desired outcomes[1]. The Convention on Biological Diversity’s post-2020 Global Biodiversity Framework (GBF) has an overarching ToC for achieving a 2050 vision of ‘humans living in harmony with nature’[2]. Operationalising this global ToC will require conservation actions to be implemented by a diverse set of actors working internationally, regionally and locally, including NGOs, governments, and communities[1,3]. Ultimately, these actors will need well-defined ToCs that state how action can address drivers of ecosystem loss and degradation, dependent on socioeconomic and political factors that influence conservation feasibility (hereafter referred to as ‘enabling conditions’). Enabling conditions are fundamental to the development of a meaningful ToC, as ToCs will not be valid unless social, economic, and political mechanisms are in place to enable conservation action[4]. A first step towards operationalising a global ToC can therefore be to generate multiple, nested ToCs that identify appropriate actions based on enabling conditions and drivers of ecosystem loss and degradation[1].

Vegetated coastal wetland ecosystems - mangroves, seagrass, and saltmarsh - provide important services that support global environmental goals, such as action to regulate climate (Lovelock et al., 2017; Zeng et al., 2021), and preserve biodiversity[7]. However, pressure on coastal ecosystems is increasing in all regions of the world[8], degrading these services and creating an urgent need for their conservation. Coastal wetlands were under-represented in global ecosystem assessments that informed the Convention on Biological Diversity’s previous global ToC, the ‘Strategic Plan for Biodiversity’[9]. Furthermore, while global goals can inspire action to conserve and restore services provided by coastal wetlands, they will need to be translated into tangible actions. Developing nested, ecosystem-specific ToC’s could provide a first step towards establishing the strategic direction needed to unlock funding and support for the conservation of these important ecosystems.

Here, we propose a framework for translating a global ToC into nested, ecosystem-specific ToCs that are informed by enabling conditions. We focused on coastal wetland ecosystems as a case-study for demonstrating the proposed framework. Our approach for developing nested ToCs for coastal wetland ecosystems involved three steps (Fig. 1): 1) **Identify and understand enabling profiles** by compiling a database of national socioeconomic and political indicators relevant to coastal wetland conservation, and then classify countries with similar indicator values into groups that represent distinct enabling condition contexts for conservation, 2) **Identify drivers of ecosystem loss** and degradation within each enabling profile, and 3) **Describe plausible, nested ToCs** for enabling profiles, i.e., conservation implementation pathways. In our case study, we only describe ToCs for seagrass and mangroves because global data on drivers of saltmarsh loss were lacking. Our framework for operationalising a global ToC has the potential to offer multiple benefits including: 1) facilitating coordinated actions across multiple actors involved in implementing a global ToC, 2) encouraging knowledge sharing, and 3) providing a basis for 'experimental adaptation' whereby conservation actions are tested under different enabling profiles. Our case study results are most relevant to actors working internationally, as we consider how national enabling conditions can inform the development of multinational enabling profiles and associated ToCs. However, our framework could be applied sub-nationally to develop ToCs relevant to actors working at a local scale.

Results

Identify and understand enabling profiles

From a database of 19 national socioeconomic and political enabling condition indicators (Supplementary Table S1), we used cluster analysis to identify 6 multinational enabling profiles for coastal wetland ecosystems (Fig. 2A). We then used classification trees to determine the relative importance of national indicators in differentiating enabling profiles (Fig. 2B), and how individual indicators define each profile (Fig. 2C). To aid interpretation, we categorised the 19 national indicators into the following groups: 1) **Policy** – policy commitments and governance frameworks to facilitate conservation work (including international treaties), 2) **Regulation** – active management of pressures and impacts to the environment, 3) **Engagement** – active engagement with conservation, either through financial investment (domestic or foreign) or social interest (Fig. 2B&C).

Key indicators differentiating enabling profiles were the regulation of wastewater pollutants, regulation via environmental tax, the number of biodiversity-related projects funded by international aid, domestic conservation spending, Ramsar management, and commitment to international climate policy (Nationally Determined Contributions - NDCs) (Fig. 2B). Post-hoc hierarchical cluster analysis revealed that enabling conditions in Profiles 1 & 2 were more similar relative to Profiles 3 & 4 and Profiles 5 & 6 (Fig. 2A). The majority, i.e., 91%, of countries in Profiles 1 & 2 were high-income countries, 77% of countries in Profiles 3 & 4 were middle-income countries, and 52% of countries in Profiles 5 & 6 were low or lower middle-income countries (see Supplementary Fig. S1 for country income-status and enabling profile designation).

Profiles 1 & 2 had high capacity to enable conservation through policy, regulation, and domestic conservation investment relative to other enabling profiles, however mangroves, seagrass and saltmarsh were not included in their NDC climate mitigation and adaptation policy strategies (Fig. 2C). Profile 2 also had relatively low protection of vegetated coastal wetlands via the Ramsar convention, although implementation of management plans in Ramsar protected areas was high (Fig. 2C). Profiles 3, 4, 5, & 6 generally had higher capacity for enabling conservation through engagement mechanisms linked to foreign aid and social interest, although Profile 1 had relatively high NGO-support for environmental projects and social interest in biodiversity. Conversely, policy and regulatory capacity in Profiles 3, 4, 5 & 6 was typically lower, with the exception of NDC climate mitigation and adaptation strategies and Ramsar protection.

There were clear differences in the policy and regulatory capacity of Profiles 3, 4, 5, & 6 (Fig. 2C). Specifically, Profile 3 had moderate to high capacity for most policy and regulation indicators, whereas Profile 4 had moderate to low capacity on most of these indicators (Fig. 2C). Profile 5 had relatively low policy capacity and moderate regulatory capacity (Fig. 2C). Profile 6 included countries affected by internal conflict (e.g., Somalia) and international sanctions (e.g., North Korea) (Fig. 2A), and had moderate to low capacity for most policy and regulation indicators, with the exception of including vegetated coastal wetlands in NDC climate change mitigation and adaptation strategies (Fig. 2C).

Identify Drivers Of Ecosystem Loss

We identified drivers of ecosystem loss within enabling profiles for mangroves and seagrass only, as global data on drivers of saltmarsh loss were not available. For mangroves, the main drivers of loss within enabling profiles were non-productive conversion or erosion, although for Profile 3, agri/aquaculture accounted for a substantial proportion of loss (Fig. 3B). Profile 2 countries did not intersect with the global distribution of mangroves and so are absent from Fig. 3.

For seagrass, catchment processes (e.g., coastal development, erosion, flooding) were a driver of loss common to all enabling profiles, while boating-related losses were unique to Profile 1 (Fig. 4). Climate/storms were also a driver of loss for Profiles 1 & 3, aquaculture and fishing drove seagrass loss in Profiles 1, 2, 3, & 4, and disease drove seagrass loss only in Profiles 1 & 4 (Fig. 4). Profile 5 countries did not intersect with the global distribution of seagrass and so are absent from Fig. 4.

Describe Plausible, Nested ToCs

We described a plausible ToC for conserving mangroves or seagrass in each enabling profile. Our ToC descriptions were formalised as causal statements of how action can address drivers of loss, and lead to desired conservation outcomes (*sensu* Qiu et al., 2018[4]; Fig. 5 and see Supplementary Table S2 for a detailed description of all ToCs and case-studies providing qualitative validation). In enabling profiles 1 & 5, non-productive conversion (e.g., vegetation dieback from nearby human development such as mines and roads, harvesting of mangrove trees for timber) was a main driver of mangrove loss, but ToCs differed (Fig. 5; Supplementary Table S2). In Profile 1, improved monitoring of indirect negative effects on mangroves could inform improved policy and regulations to reduce mangrove dieback[12,13] (Fig. 5; Supplementary Table S2). Alternatively, in Profile 5, mangrove clearing for fuel or timber could be reduced if NGOs are engaged to support the development of community-based sustainable management of mangroves, and ensure this is recognised in government policy[14] (Fig. 5). For seagrass, ToCs to address loss driven by aquaculture or fishing differed between Profiles 2 & 4 (Fig. 5). In Profile 2, policy could be established to ensure aquaculture is not placed near seagrass[15]. In Profile 4, external support and funding to establish payments for seagrass ecosystem services could provide an alternative source of income that incentivises the reduction of destructive fishing practices that negatively impact seagrass[16] (Fig. 5).

Discussion

Our framework for operationalising a global Theory of Change (ToC) ensures that enabling conditions underpin pathways for implementing conservation, thereby increasing the likelihood of achieving desired outcomes[4]. Enabling profiles offer a platform for knowledge transfer between profiles and countries that share drivers of ecosystem loss and degradation. In an era of rapid and complex global change, sharing knowledge on how to effectively implement conservation is important. Our framework could also encourage testing of conservation actions under similar or different enabling condition contexts, thereby encouraging experimental adaptation of ToCs[17].

Theories Of Change For Coastal Wetland Ecosystems

We identified six distinct enabling profiles to inform nested ToCs for globally coordinated conservation of coastal wetland ecosystems. Profiles 1 & 2 generally had high capacity to enable conservation via policy, regulation, and domestic funding relative to other profiles. Many countries in Profiles 1 & 2 belong to the European Union (EU) where multilateral environmental agreements (e.g., the Water and Marine Strategy Framework Directives) have improved water quality and led to recovery of lost seagrass[18]. Alternatively, in Profiles 3, 4, 5 & 6, capacity to leverage support for conservation via engagement with external actors was relatively high (see Supplementary Table S2 for a detailed description of enabling conditions in each profile). In the past, external actors such as NGOs have played an important role in prompting governments of countries in these profiles, e.g., Mexico and South Korea, to effectively implement Ramsar protection or wetlands[19].

We used real-world examples of conservation interventions to validate proposed implementation pathways for each nested ToC (see Supplementary Table S2). We recommend that, where possible, pathways for implementation be tested quantitatively by relating enabling conditions to conservation outcomes, thereby ensuring ToC are robust (*sensu* Williamson et al., 2018[20]). However, in data-sparse contexts, real-world examples of conservation interventions provide a qualitative alternative for justifying proposed pathways. Depending on enabling conditions and drivers of loss, it may be possible to define severable plausible implementation pathways that could become testable hypotheses, forming a basis for experimental adaptation of ToCs[17]. Where experimentation cannot be used to choose from competing implementation pathways, the heuristic 'Mitigation and Conservation Hierarchy' could help differentiate priority actions (i.e., refrain, reduce, restore, renew)[3]. The development of robust, nested ToCs may be limited by information available on enabling conditions and drivers of loss for individual ecosystems, and these should be made transparent to stakeholders (see Supplementary Table S3 for a complete description of the limitations of our case study on coastal wetland ecosystems).

There is no 'one-scale-fits-all' ToC. For example, the nested ToCs that we have described may not have sufficient detail or local context for actors working to implement conservation on the ground. To overcome this, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has recognised the need for multi-scale conservation planning[21]. Our framework could be extended to support multi-scale conservation planning by establishing multi-level, hierarchical enabling profiles that represent enabling condition contexts operating at different spatial scales (e.g., sub-national enabling profiles nested hierarchically within multinational enabling profiles). In our case-study, ToCs were informed by enabling conditions operating at the national-scale and are therefore most relevant to actors developing and coordinating conservation actions internationally. To be relevant to local-scale conservation practitioners, ToCs could be further developed using a participatory framework (*sensu* Reed et al., 2022[22]) that engages actors working across sectors and scales, from local practitioners to international policymakers, and ensures ToCs are just and equitable. It is also important to recognise that human behaviour can play an important role in whether ToCs will achieve desired outcomes. Tacit working models of how human behaviour and conservation relate to one another could be used to integrate this understanding into ToC development[23].

Our framework provides a first-step towards translating a global ToC into actionable implementation pathways. As countries implement conservation actions and monitor outcomes, the dissemination of knowledge and learnings could help other countries define ToCs or inform adaptation of those that are already established. ToCs by their very nature will be dynamic, requiring adaptation as enabling conditions and drivers of loss change through time. Therefore, ToCs should not be considered static entities, but instead should be adapted as enabling conditions and drivers of loss change. For example, rapidly developing middle- and low-income countries may acquire greater internal capacity for facilitating conservation and rely less on international aid[24]. Their ToCs could be adapted based on what has or has not worked in other enabling profiles with similarly high internal capacity for conservation.

Conclusion

Global conservation planning and mapping has been criticised for lacking a clear ToC[25]. It is true that a global ToC is at risk of failing to achieve overarching goals if it is not effectively translated into tangible and discrete pathways for implementing action. Our framework for operationalising a global ToC makes national and international capacity for conservation transparent and ensures that this is at the forefront of developing robust implementation pathways.

Methods

Compile a database of national enabling condition indicators

We compiled a database of national values for 19 policy, regulation, and engagement indicators representative of enabling conditions for vegetated coastal wetland conservation in 138 countries, i.e., 70% of all countries with oceanic coastline. To identify countries with these wetlands, we intersected the EEZ boundaries of countries that have oceanic coastline[26] with the global distributions of mangroves[27], seagrass[28], and saltmarsh[29].

We used national indicators to classify countries into global enabling profiles that represent similar policy, regulation, and engagement settings for conservation. We first used a Bayesian latent variable model (LVM) to gap-fill missing indicator values prior to classification[30]. The LVM estimates correlations among all indicators across countries and leverages these correlations to interpolate missing values. The model assumes that values are 'missing at random', which we evaluated for each indicator by determining whether the probability of missing values was likely to be dependent upon both observed and unobserved information. The model was formulated:

$$\log(\mu_{ij}) = \theta_{0j} + z_i^T \boldsymbol{\theta}_j \qquad \text{eqn 1}$$

where μ_{ij} is the mean response at country i for indicator j, θ_{0j} is the indicator-specific intercept, z_i are vectors of latent variables, and $\boldsymbol{\theta}_j$ are their corresponding indicator-specific coefficients[30]. We set the number of latent variables in our model to 9 (approximately half the number of indicators), which provided accurate estimates of indicator responses (see Appendix 1 in the supplementary materials for a detailed description of model settings). Prior to fitting the LVM, continuous indicator response variables were log-transformed and z-score standardised (mean = 0, standard deviation = 1). We then used Eq. 1 to predict indicator values to all countries, including interpolating to those countries with missing values. Where indicators were found to violate the 'missing at random' assumption we fit an additional LVM without these indicators to check our predictions were robust to missing data.

Eleven indicators had missing values that were interpolated (see Supplementary Table S1 for the percentage of missing values for each indicator, ranging from 0–46%; and see Supplementary Fig. S2 for assessment of model fit). The ‘Conservation spending’ indicator violated the ‘missing at random’ interpolation assumption of the LVM because data were only available for countries that were signatories to the Convention on Biological Diversity or the Sustainable Development Goals[31]. However, only one country (the United States) was missing a value for this reason, and all other missing values were due to insufficient data[31]. The ‘Ramsar Management’ indicator also violated this assumption because countries without coastal wetland Ramsar sites were designated as ‘NA’ (Supplementary Table S1). However, predictions from LVMs fit with and without each indicator were positively correlated (Supplementary Fig. S3 & S4), demonstrating that parameter estimates were robust. Supplemental methods for fitting models are also provided in Supplementary Appendix 1.

Classify countries into global enabling profiles

We performed a cluster analysis on the gap-filled, standard-normal indicator values obtained from the LVM to group countries into enabling profiles. Specifically, we used k-medoid clustering with the ‘partitioning-around-medoids’ algorithm on a Euclidean distance matrix of indicator values. Standard-normal indicator values were rescaled to the minimum and maximum values of the indicator with the narrowest range before clustering to reduce leverage of indicators with exceptionally large ranges (i.e., binomial response variables: NDC commitment, NDC adaptation, NDC mitigation, and Ramsar protection). We investigated a range of clustering configurations (n = 5 to 10) to identify the number of clusters that best represented country-level variability in indicator values, while also identifying general patterns useful for informing coastal wetland conservation. We used average silhouette width[32] to measure the quality of each clustering configuration (i.e., cluster cohesion and separation). All configurations were of similar quality, so we chose 6 clusters as the final configuration because it best balanced national indicator variability with generalisable patterns across countries. We assessed the robustness of clusters by re-evaluating the cluster analysis across the full distribution of indicator values predicted by the LVM (see Supplementary Fig. S5 and S6 for an assessment of the robustness of the final clustering configuration). Finally, we used post-hoc hierarchical cluster analysis of cluster medoids to group and order enabling profiles by their similarity, and we used principal components analysis to visualise country-level variability within enabling profiles.

Determine how indicators define global enabling profiles

We used classification trees to determine 1) the relative importance of national indicators in the classification of enabling profiles, and 2) how individual indicators define each profile. Classification trees are non-parametric, supervised machine-learning models that use recursive partitioning to generate decision rules that relate predictor variables (i.e., indicator values) to response variables (i.e., enabling profiles) [33]. Observations are repeatedly split into sub-groups by predictor variables, aiming to minimize heterogeneity of observations in each sub-group of the final tree[33].

To measure the relative importance of indicators, we fit a classification tree using indicator values as predictors of enabling profiles. Indicator importance was measured as the sum of the Gini goodness of split measure where the indicator was a primary splitting variable in the classification tree. Gini goodness of split is measured as the inverse of Gini impurity, an estimate of the probability of misclassification[34]. We also used decision rules generated by individual classification trees, where each indicator was the sole predictor of enabling profiles, to identify indicator thresholds that define each profile. To minimize the influence of outliers on threshold definition, we fit individual classification trees using only indicator values within the interquartile range of each enabling profile. Threshold values were re-scaled from 0 to 1 to provide a relative measure of indicator scores defining each profile, where 0 = low and 1 = high.

Identify drivers of ecosystem loss in each enabling profile

We identified drivers of coastal wetland loss and degradation in each enabling profile using 1) data on drivers of mangrove areal loss derived from satellite data[10], and 2) data on the drivers of seagrass areal loss from a meta-analysis of in-situ and remote sensing data[11]. Global data on drivers of saltmarsh loss was not available[9]. We use the term ‘drivers’ to refer to environmental stressors (both human and natural) that can cause ecosystem loss and degradation. This is unlike the well-known DPSIR (Driver-pressures-state-impact-response) framework, first elaborated in the European Environment Agency (EEA) programme and later on adopted for other environmental issues in Europe[35], which refers to human environmental stressors as ‘pressures’. However, our terminology is consistent with the literature for mangroves[10] and seagrass[11].

Global drivers of mangrove loss from 2010 to 2016 were: erosion, extreme weather events, commodities (i.e., agriculture or aquaculture), non-productive conversion (including clearing and dieback from indirect effects of human development), and human settlement[10]. We calculated the proportion of mangrove loss attributed to each driver in each country, and then averaged these proportions across enabling profiles. This statistic standardizes for differences in overall mangrove area across different countries. Seagrass study locations from Dunic et al., 2021[11] were intersected with country EEZ and enabling profile boundaries, and drivers of trends were identified for each enabling profile and continent to determine opportunities for conservation.

Seagrass data were not globally comprehensive and so the identification of ecosystem loss drivers was limited to countries where peer-reviewed studies identified drivers of trends in seagrass meadow area. Primary drivers were identified from original sources in one of two ways: 1) attribution by visual (aerial imagery or graphical) or inferential (statistical) methods or 2) the driver that was described and discussed most frequently[11]. We opted to exclude the ‘invasive species’ driver from our analysis because invasive fauna, such as tunicates, crabs, and lugworm disturbance, were not reported in the peer-reviewed literature, which may mis-represent the distribution and influence of this driver. Note that absence of these invasive fauna in the peer-reviewed literature may be due to lack of classification/nomenclature. For example, lugworm disturbance has been identified as a driver of seagrass loss, but the lugworm was not classified as an invasive species[11]. A complete description of mangrove and seagrass drivers is provided in Supplementary Table S4.

Describe nested ToCs for each enabling profile

We described nested ToCs for each enabling profile as causal statements that define how actions can lead to desired conservation outcomes for mangroves and seagrass. We used case-study examples to qualitatively validate nested ToCs.

Declarations

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Authors’ contributions

CAB, CJB, RMC, LG, and VT conceived of the project idea; all authors contributed to the methodology; LG, CAB, and BH collected the data; CAB and CJB analysed the data; CAB wrote the first draft, and all authors contributed to revising the manuscript; CJB, BGM, and RMC resourced the project.

Data availability statement

Data and code are available on Github and archived on Zenodo.

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Figures

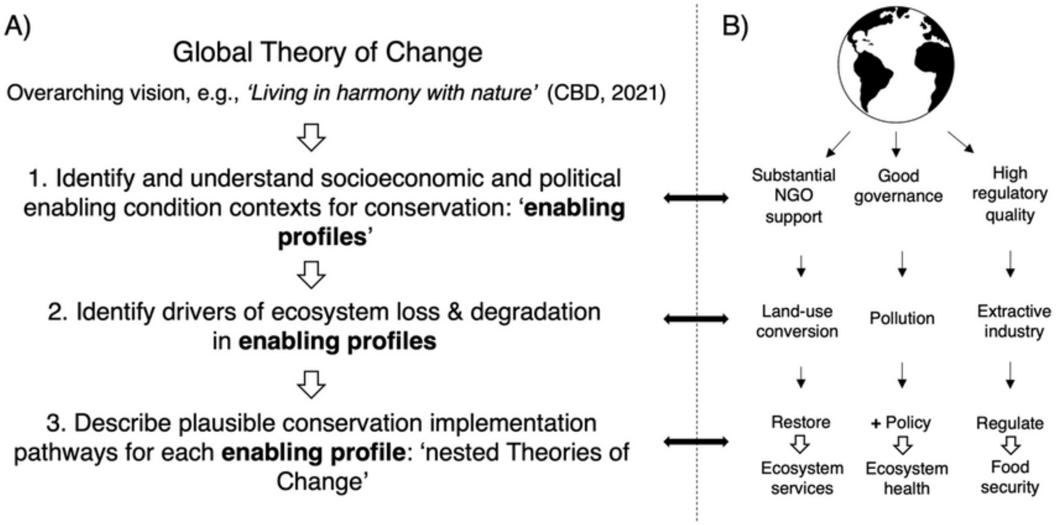

Figure 1

Operationalising a global Theory of Change (ToC). A) Steps to translate a global ToC into nested, ecosystem-specific ToCs informed by enabling conditions, B) Generalised example of three distinct enabling condition contexts (i.e., enabling profiles), their drivers of ecosystem loss, and nested ToCs.

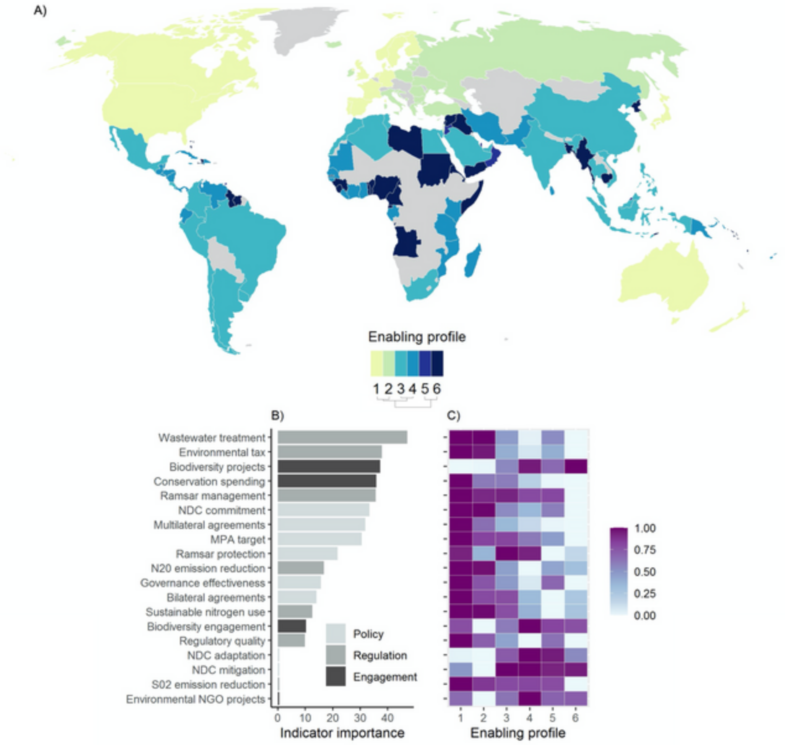

Figure 2

Enabling profiles for conserving coastal wetland ecosystems. A) Enabling profiles for vegetated coastal wetland ecosystems (seagrass, mangroves, and saltmarsh) ordered by their overall similarity (see dendrogram below the profile legend), B) relative importance of national indicators for defining enabling profiles and C) relative ranking of national indicator thresholds across enabling profiles (low = 0 and high = 1). For ease of interpretation, national indicators are grouped as most relevant to policy, regulation or engagement.

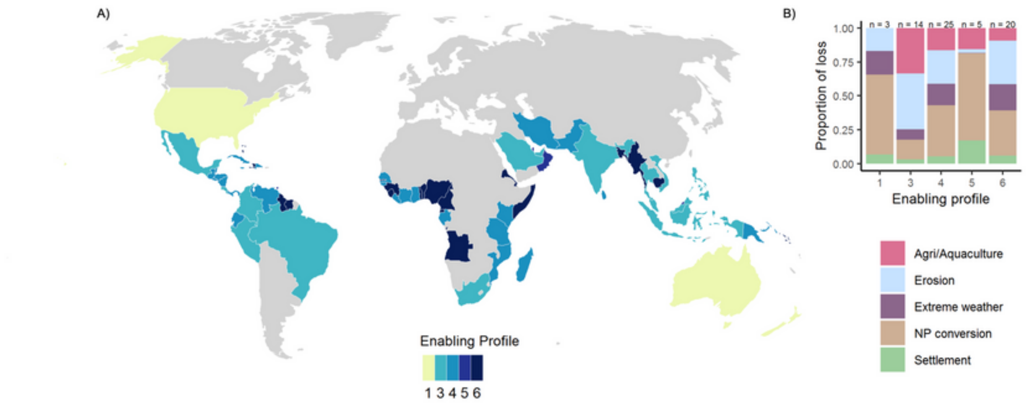

Figure 3

Drivers of mangrove loss in enabling profiles. A) Intersection of enabling profiles with countries where drivers of recent mangrove loss (i.e., agri/aquaculture, erosion, extreme weather events, clearing, and human settlement) have been mapped, and B) the proportion of mangrove loss attributed to each driver within each enabling profile (n = number of countries; NP = non-productive).

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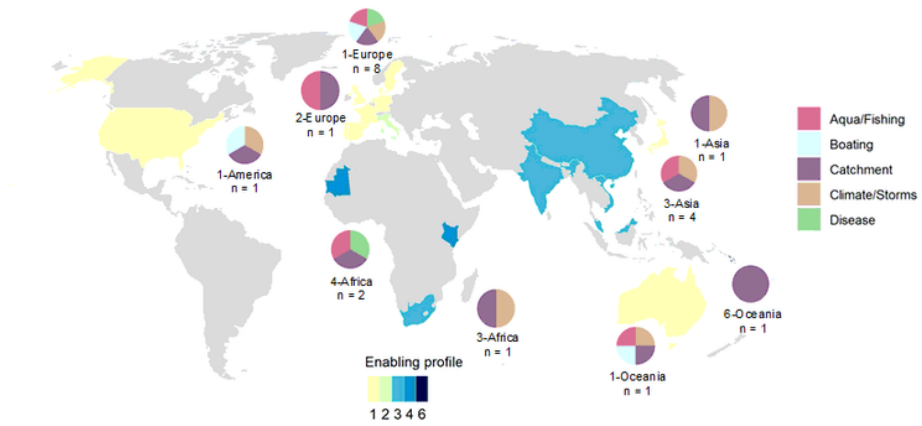
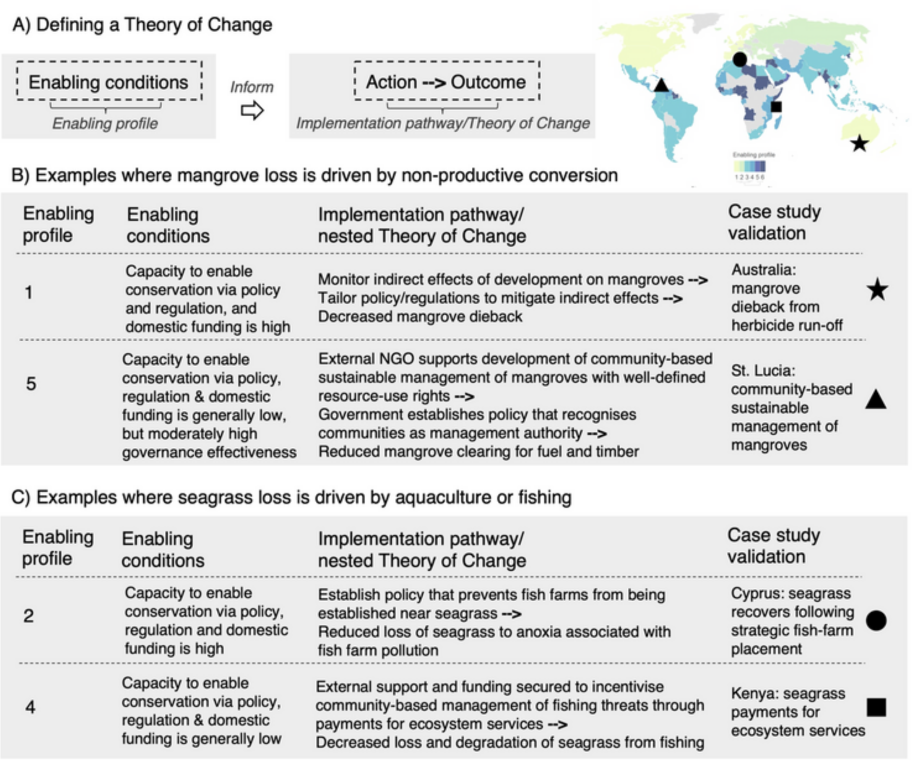


Figure 4

Drivers of seagrass loss in enabling profiles. Countries where seagrass drivers of loss (i.e., aquaculture and fishing, boating, catchment processes, climate and storms, and disease) have been identified, coloured by enabling profile. Pie charts represent the drivers of seagrass trends identified in each continent and enabling profile (n = number of countries). Seagrass driver data represents sites where seagrass drivers have been identified via a synthesis of peer-reviewed literature rather than the entire global distribution of seagrasses.


A) Defining a Theory of Change

B) Examples where mangrove loss is driven by non-productive conversion

Enabling profile	Enabling conditions	Implementation pathway/ nested Theory of Change	Case study validation	
1	Capacity to enable conservation via policy and regulation, and domestic funding is high	Monitor indirect effects of development on mangroves --> Tailor policy/regulations to mitigate indirect effects --> Decreased mangrove dieback	Australia: mangrove dieback from herbicide run-off	★
5	Capacity to enable conservation via policy, regulation & domestic funding is generally low, but moderately high governance effectiveness	External NGO supports development of community-based sustainable management of mangroves with well-defined resource-use rights --> Government establishes policy that recognises communities as management authority --> Reduced mangrove clearing for fuel and timber	St. Lucia: community-based sustainable management of mangroves	▲

C) Examples where seagrass loss is driven by aquaculture or fishing

Enabling profile	Enabling conditions	Implementation pathway/ nested Theory of Change	Case study validation	
2	Capacity to enable conservation via policy, regulation and domestic funding is high	Establish policy that prevents fish farms from being established near seagrass --> Reduced loss of seagrass to anoxia associated with fish farm pollution	Cyprus: seagrass recovers following strategic fish-farm placement	●
4	Capacity to enable conservation via policy, regulation & domestic funding is generally low	External support and funding secured to incentivise community-based management of fishing threats through payments for ecosystem services --> Decreased loss and degradation of seagrass from fishing	Kenya: seagrass payments for ecosystem services	■

Figure 5

Enabling conditions inform nested Theories of Change (ToC). A) How to define a ToC, B) selected mangrove case-study ToCs, and C) selected seagrass case-study ToCs. A comprehensive set of ToCs for each enabling profile and coastal wetland ecosystem is provided in Supplementary Table S2, along with a detailed description of supporting case-study examples. An interactive visualisation of the enabling profiles and all case-studies are available at: https://github.com/cabuelow/enabling-profiles-app.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

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