

**PERSPECTIVE**

# The Natural Capital approach: A framework for the successful recovery of nature in estuaries

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**Abstract**

1. Estuaries are unique and complex systems that are important for ecological, cultural and economic reasons. They provide valuable habitat for biodiversity and provide a wide range of regulating, cultural and provisioning ecosystem services.
2. Estuaries have a disproportionate importance to people in comparison to other habitats, which has resulted in high levels of utilization and environmental impact. Poor management, ineffective conservation approaches and global economic changes have resulted in many temperate estuaries becoming both economically and environmentally degraded.
3. We present an argument for the use of the Natural Capital approach as part of the wider green economic agenda in temperate estuaries to support both the environmental and economic recovery of these areas.
4. We make the case that in a habitat always likely to be subject to intense human pressure it provides a holistic decision-making approach which considers ecological aspects alongside the ecosystem's anthropogenic importance and pressures. This allows for damage to be identified quickly and accelerates the process of designing and implementing solutions. It provides a framework for multiple partners with a material interest in maintaining a healthy estuarine environment providing multiple benefits to drive investment in natural capital and delivery of nature recovery.
5. We highlight some of the obstacles in implementing the Natural Capital approach in estuaries at scale, including collaboration and communication between stakeholders in various sectors, the existence of quality natural capital and environmental baselines and the need for partnership to create investment opportunities. We explore how these are being addressed and identify progress in the Natural Capital approach and how this can inform and advance the widespread implementation of the approach.

**KEYWORDS**

conservation, estuarine ecosystems, natural capital

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## 1 | INTRODUCTION

Estuaries are transitional zones between rivers and seas (McLusky & Elliott, 2004), and the combined influence of terrestrial and marine processes leads to an ecosystem with complex ecological and physical dynamics (Boesch, 1974; Maccreeady, 1999). Estuarine systems typically have high rates of primary production due to high population densities of resident species (Cloern et al., 2014; Odum, 1956). Some of these species, such as wading birds, are rare and/or threatened resulting in them, and the associated estuarine habitats being afforded protected status (Day et al., 2012) under national (e.g. in UK Sites of Special Scientific Interest) and international (e.g. Ramsar sites) legislation.

In addition to their importance for nature and ecosystem function, there is also evidence that estuaries have a disproportionate importance to people in comparison to other habitats (Agardy et al., 2001) with almost half of the population of the European economic area living on the coast with that figure rising to 77% in the United Kingdom (Statistical Office of the European Communities & European Commission, 2011). This is in part likely to be due to the important ecosystem services they provide, including aesthetic beauty and maintenance of economically important fisheries. Other services include flood regulation, carbon sequestration and storage (Krauss et al., 2018) and habitats for protected species (Sheaves et al., 2015). However, the previously mentioned high percentages of people living in proximity to estuarine habitats, and the economic exploitation of estuary locations for industrial purposes has led to prolonged human impacts (Lotze et al., 2006) and consequently, degradation. Shifts in the industry and tourism in temperate regions have meant that many coastal communities have faced economic decline and are socio-economically disadvantaged, leaving these areas both economical and environmentally degraded (Fleming et al., 2019; House of Lords Select Committee on Regenerating Seaside Towns & Communities, 2019). The threats to coastal systems and their ecosystem functions and the need for their conservation for both their intrinsic value as well as their economic benefits and value for human health and well-being have been well documented (Agardy et al., 2001; Russi et al., 2013).

Despite the well-known importance and value of estuaries and their protected status, their continued degradation calls into question the efficacy of traditional conservation approaches in estuary protection. The existing model of conservation has failed to effectively conserve estuary environments for several reasons, including management issues arising from lack of funding leading to significant staff turnover (Morris et al., 2014) and inadequate consideration of the balance between conservation of the environment and the needs of people and communities (Pittock, 2015). A recent drive to promote the green economy (European Commission, 2019; United Kingdom HM Government, 2020) has led to the consideration of intervention to improve both ecological and economic health in these areas. Here, we explore the application of the Natural Capital approach in estuaries as a potential route to achieve more successful management and conservation outcomes through a wider appreciation and understanding

of value of natural assets and the benefits they provide. In this paper, we focus on temperate estuaries in North-West Europe, particularly the United Kingdom, as this is where the majority of Natural Capital approaches in temperate estuaries have taken place given the U.K. governments focus on a Natural Capital approach; however, this discussion is relevant to any temperate estuary with a significant population. We explore the progress made in the implementation of a Natural Capital approach, the current barriers to wider use and how these can be overcome.

## 2 | ESTUARINE CONDITION IN NORTH-WESTERN EUROPE

Temperate estuaries are rarely in optimal condition, with European coastal habitats classified as being in 'good' condition less than 15% of the time (Airoldi & Beck, 2007). Historical damage due to the effects of industrialization can still be found in most estuaries, with sediments containing a legacy of heavy metals and chemical pollutants (McLusky, 1999; Rodgers et al., 2020) and wetland areas significantly diminished due to extensive past reclamation activity and erosion. More recent problems in European estuaries and elsewhere arise from increases in nitrogen inflows from various sources, particularly agriculture (Billen et al., 2011; Howarth et al., 2011), hydrocarbons from roads (Beyer et al., 1998), habitat destruction through urban expansion and the negative consequences of increasing shipping (and associated dredging) along estuaries (Andersen et al., 2020; Teuchies et al., 2020). There are also indirect sources of damage affecting estuaries such as climate change-induced sea level rise leading to coastal squeeze and loss of intertidal area (Jackson & McIlvenny, 2011; Pontee, 2013). Coastal wetlands also directly impact climate change by either providing a sink or source of blue carbon, depending on the status and health of the marsh system (Beaumont et al., 2014).

One of the most notable environmental policies to have used traditional conservation approaches for wetlands is the Ramsar convention. This international treaty led to a conservation framework that resulted in many estuaries being designated protected status, with strict regulation for resource exploitation and activity that might damage the important habitats and species. However, this restricted human use of these areas, which led in many cases, to low compliance with the regulations or negative impacts on those who relied on the estuary (Pittock, 2015). In these cases, estuarine areas continued to experience ecological degradation. In addition to this, protected areas alone, without management, typically fail to reach conservation goals (Wauchope et al., 2022).

Within England in particular, there is evidence that protected area approaches based upon access and activity restrictions do not work well in estuarine environments due to inconsistent funding and a lack of feedback between monitoring and actions (Morris et al., 2014). These flaws in conserving estuaries can be addressed through a more dynamic, collaborative landscape-based approach which would mitigate conflict and increase successful outcomes. In addition, many

coastal communities in the United Kingdom in particular have faced recent economic decline and are socio-economically disadvantaged (Fleming et al., 2019; House of Lords Select Committee on Regenerating Seaside Towns & Communities, 2019), highlighting the need for a management solution that both conserves environmental assets and serves the needs of people.

### 3 | THE NATURAL CAPITAL APPROACH

An increasingly discussed approach which does consider the balance of people's needs and the conservation of nature in estuarine environments is the Natural Capital approach. The Natural Capital approach is relatively recent to ecology but the underlying concepts of people relying on nature has been persistent throughout history (Mooney et al., 1997). The Natural Capital approach as it is known today is a holistic decision-making tool, brought to mainstream attention originally by (Costanza & Daly, 1992), and further developed by Harte (1995), Daily et al. (2009), Özdemiroğlu (2019) and Hancock (2010). The approach feeds into the green economy concept, providing a framework for investment into natural assets to improve their ecological condition alongside improving the socio-economic status of the area (Boehner et al., 2016; Loiseau et al., 2016; ten Brink, 2014). This approach also supports the integration of ecological function to benefit society and economy. It considers ecological aspects of a natural system such as functional diversity and biodiversity alongside the ecosystem's anthropogenic importance and pressures (Turner & Daily, 2008; Voora & Venema, 2008). Consideration of the systems anthropogenic importance involves including local landowners and stakeholders to establish local and cultural values which are important in the area. This can lead to improved outcomes for all parties, through increased acceptance and understanding of conservation approaches (Myatt et al., 2003), increases in traditional or cultural ecosystem services (Arkema et al., 2015) and local management and ownership of conservation approaches (Kenter, 2020). This not only involves local landowners and gives back some sense of control but may also increase the longevity of the actions with increased participation and acceptance. Additionally, the Natural Capital approach can also improve financial flows to local landowners and stakeholders in the area by inclusion of local values in assessments as well as through underpinning of ecosystem services needed for traditional economies or schemes such as Local Climate Bonds in which investment towards nature recovery feeds into income generation for the local area (<https://www.greenfinanceinstitute.co.uk/programmes/ceeb/lcbs/>). This also allows for ecosystem damage to be identified quickly and accelerates the process of designing and implementing policy through faster predictions of the system response to certain actions. Through engaging a range of stakeholders including the public, private and third sector with a vested interest in highly functioning habitats and the benefits they provide, many organizations involved have the capacity to implement and fund nature recovery. This is useful for estuaries as they have disproportionate importance to

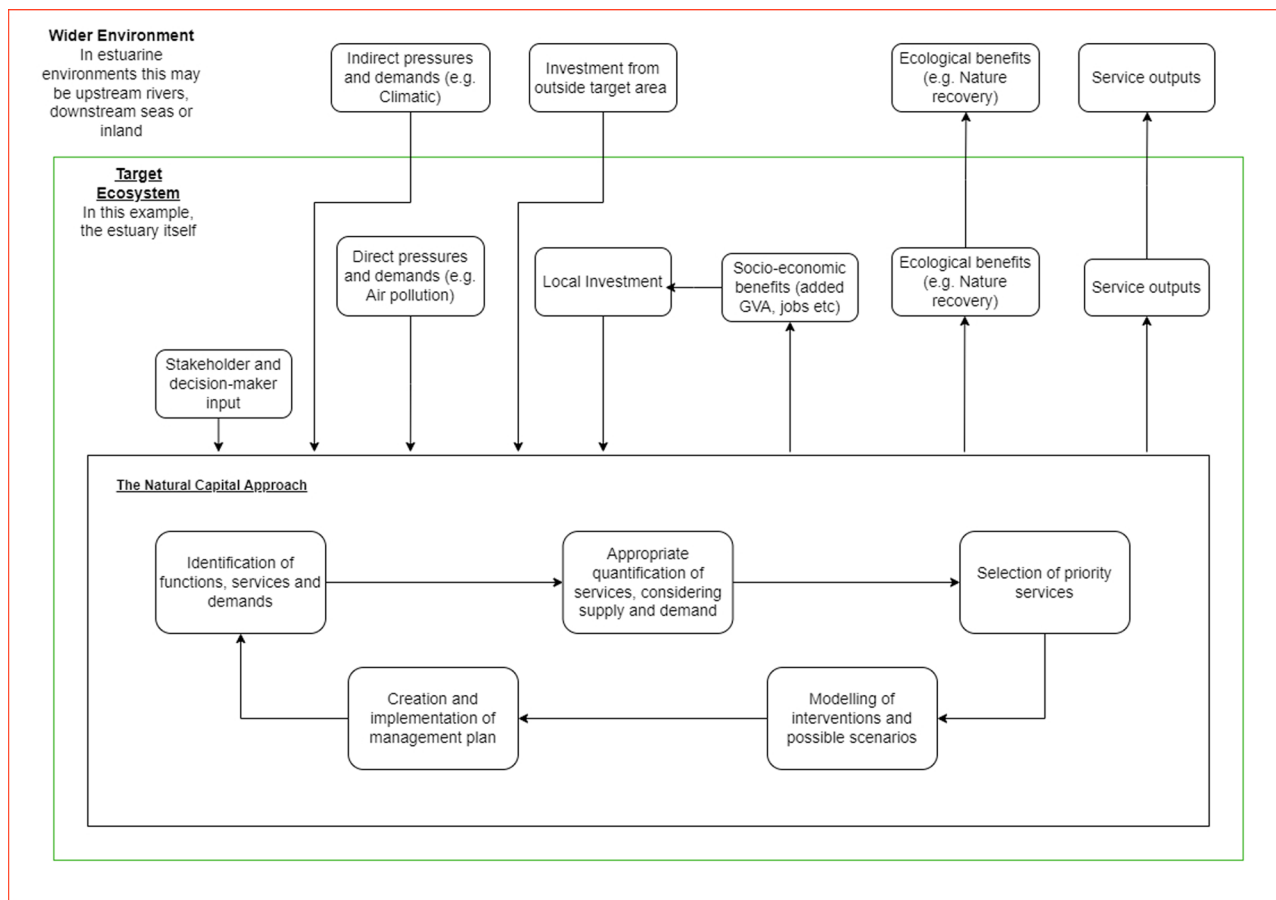
both nature and people, particularly in highly populated areas typical of European estuaries (Collet, 2010).

A key example of this comes from Dicks et al. (2020) who estimated economic and social benefits from salt-marsh improvement. They showed that restoration of salt marshes provides environmental benefits such as carbon sequestration and flood risk mitigation which provide economic benefits directly to the private sector or wider society, further supported in a similar study by Viera da Silva et al. (2014). This investment in nature recovery generates economic growth and creation of green jobs (Alvis & Avison, 2021). Estuaries also have great cultural importance and so enhancement of these environments can lead to improvement of areas for recreational sense of place and social value, driving place making and economic uplift (Pascual et al., 2017).

The Natural Capital approach provides a framework (see Figure 1), and so considers a diverse range of values and benefits to both better understand the ecosystem and implement in policy for long-term conservation. Mapping processes within an integrated framework enables the identification of functions, services and demands, whilst recognizing interaction with stakeholders is necessary to ensure important services are not missed. This, along with appropriate quantification of benefits (through use of valuation or other metrics), makes up the Natural Capital baseline. Establishing this baseline is crucial since it provides the basis against which the impact of interventions can be modelled. This informs decision-making with interventions, ensures an optimum supply of priority services as well as demonstrates opportunities for investment into interventions. Examples of interventions include managed realignment, habitat restoration or planned developments. Identification of the baseline can also help support with identifying the scale and nature of investment required to improve natural habitats and maintain or improve the level of ecosystem services provision as well as possible benefits. These benefits can extend beyond environmental with creation of green jobs, attracting public and private sector investors and thus, improvements in the socio-economic status of the area.

### 4 | OBSTACLES TO IMPLEMENTATION OF NATURAL CAPITAL APPROACH

The Natural Capital approach has some obstacles which have been highlighted and must be overcome to be effective. One of these is the knowledge gap regarding the Natural Capital approach and ecosystem service assessments between scientists, decision-makers, conservation practitioners and those in the finance sector. This gap has been highlighted by Cosgrove (2020) during a trial of a Natural Capital approach in a coastal system. This gap requires effective and clear communication to be bridged along with collaborative efforts. This communication can be through direct means, such as knowledge transfer, training and focus groups (Kenter, 2020), or through less direct means such as making the state of the art easier to understand and more accessible, particularly to policymakers. This itself presents an



**FIGURE 1** An overview of the Natural Capital approach in estuaries

obstacle as interaction with multiple stakeholders can be challenging and time consuming. It also requires participants to be multidisciplinary and upskill in effective communication for a wider audience.

The United Kingdom's Green Finance Institute provides an example of this in which financial experts are working alongside policymakers and conservation practitioners to drive investment into natural assets. The UK National Parks Partnership working alongside a financial organization (Palladium) provides another. Despite this difficulty, previous studies have noted that this is necessary for long-term effective conservation in dynamic and complex systems such as estuaries (Cosgrove, 2020; Jacobs et al., 2013; Rounsevell et al., 2018) and the Natural Capital approach does provide a framework to facilitate participation from stakeholders and local landowners (Hinson et al., 2022; Kenter, 2019).

Another obstacle is the availability of accurate ecological baselines in coastal and estuarine areas. There are significant data gaps in European assessments of habitat condition of intertidal environments and salt marshes (Maes et al., 2021). Additionally, data that are available for European estuaries have some geographical and habitat biases, notably a geographical bias towards Mediterranean coastal areas, with less data available in temperate estuaries (Delbosch et al., 2021). Furthermore, national assessments of ecosystems that have been undertaken

in Europe, while a step in the right direction, require more synthesis between each other for Europe-wide comparison and to be more informative to policy (Schröter et al., 2016). The work towards a salt-marsh carbon code will make a significant contribution to standardizing methods; however, there are still few metrics which have been agreed as a recognized 'standard' for other ecosystem services.

A further obstacle is driving investment into nature recovery and the conservation of estuarine environments, particularly as there is increasing concern that limited public funding will not be enough for environmental goals to be achieved (Credite Suisse et al., 2014; RSPB, 2018). Though this is typically a general concern of conservation approaches, Natural Capital could provide a solution to this through promotion of investment into natural assets, a key element of green finance (Lindenberg, 2014), and easier identification of investment opportunities for the private sector. This is being trialled in projects such as the Humber estuary initiative (Humber Estuary Plan Final Draft, 2021) and through schemes such as Nature North ([www.naturenorth.org.uk](http://www.naturenorth.org.uk)), through landscape scale collaboration, allowing for larger, more attractive investable propositions to invite private funding alongside public funding. For more examples of this, see European Investment Bank and Özdemiroğlu (2019).

## 5 | NATURAL CAPITAL APPROACHES IN NORTH-WEST EUROPEAN ESTUARIES

Within the United Kingdom, several local-scale assessments have used a Natural Capital approach to inform and manage coastal environments. For example, the Medway Estuary and Swale Shoreline Management Plan (2018) was developed using Natural Capital assessments alongside typical ecosystem and economic assessments to inform management. This included creating service models with assessments of pollination and carbon sequestration to establish which services were in demand and select between coastal realignment and hard sea defence management options. The Suffolk Marine Pioneer (Cosgrove, 2020) also undertook a Natural Capital approach to the management of a coastal salt marsh. The aims of this included testing methods, pioneering funding mechanisms and identifying best practice for an integrated Natural Capital approach. This resulted in the identification of management options for the salt marsh. In addition to general Natural Capital assessments and approaches being taken in U.K. estuaries, there has been a study evaluating the monetary and non-monetary benefit of coastal pathways in England (ICF et al., 2020), concluding that these areas had multiple benefits and that a monetary assessment alone ignored important recreational, well-being and exercise benefits. This is in addition to frameworks linking ecosystem services to cultural benefits (Rendón et al., 2019).

Frameworks such as SEEA (The Committee of Experts on Environmental-Economic Accounting, 2021) are also being increasingly used to support Natural Capital approaches in policy within estuarine systems to help achieve environmental goals. One example of this is within the Scottish Natural Capital Assets Index (NatureScot, 2020) which includes monitoring of quantity and quality of coastal habitats in Scotland and feeds into the National Performance Framework (The Scottish Government, 2018) which decision makers at all levels are encouraged to work to. These metrics show moderate increases in coastal assets from 2000 due to conservation work, with the metric continuing to monitor these habitats using a Natural Capital approach to measure success. A more recent example of Natural Capital for supporting coastal environments through private investments is the introduction of 'Green Bonds' from the Swedish National Debt Office (Swedish National Debt Office, 2020). The first sale of these in 2020 raised 20 billion SEK, equivalent to 1.94 billion euros as of 17 January 2021, the proceeds of which are linked to government spending on environmental policies. A total of 296 million SEK, equivalent to 28.7 million euros as of 17 January 2021, was allocated to improving marine and aquatic environments including estuaries after the initial sale with 10,600 ha of wetlands being restored (Swedish National Debt Office, 2021). While these examples have few results, they are relatively new and make steps towards demonstrating that Natural Capital approaches can be used to raise significant funding for coastal and estuarine systems and provide a framework for monitoring the success of conservation projects within these habitats.

## 6 | CONCLUSION

Estuaries have been important to people and nature for centuries and will continue to be important for the foreseeable future. This importance and human use of estuaries has led to damage to the natural environments and traditional efforts to restore them have not been adequate to mitigate damage or consider the needs of people. The Natural Capital approach could be the key to long-term effective conservation in these environments.

Estuaries are ideal for the implementation of the Natural Capital approach. The services and functions they provide are essential to those who rely on them and the pressure on them is unlikely to decline. Communities in these areas also suffer from economic challenges and the Natural Capital approach provides a potential path to green economic growth and improved well-being. The importance of nature in temperate estuaries is clear, but their value has been overlooked and often undermined. A balance is necessary that seeks to accommodate utilization of resources, whilst minimizing impact and enhancing ecosystem service benefits. A Natural Capital approach has the potential to satisfy this goal, so the conservation of these complex and important ecosystems is sustainable for the long-term future.

The beginnings of a Natural Capital approach have started to take place in estuaries. Though there are obstacles to overcome to facilitate wider implementation, exemplars of these activities are underway. This review advocates for the Natural Capital approach to be the primary tool when aiming for holistic, effective and sustainable estuarine conservation. We argue for increased collaboration between academia, policymakers, the conservation and the financial sector, alongside other stakeholders with a material interest in a healthy ecosystem for the benefit of society and nature to enable the wider implementation of the Natural Capital approach.

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### CONFLICT OF INTEREST

The authors declare no conflict of interest.

### AUTHOR CONTRIBUTIONS

Lucy Dowdall conceived the idea and wrote the original manuscript. Colm Bowe and Jason Kirby provided review of the original manuscript and edited the original manuscript.

### DATA AVAILABILITY STATEMENT

No data was used in the creations of this manuscript.

## PEER REVIEW

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