Assessing the natural capital value of water quality using a EUNIS habitat classification approach

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1 Introduction

Integrating the value of natural capital within economic and environmental management systems is gaining increasing attention and interest from the government, regulators, and companies. However, future coastal management interventions to improve water quality are often confounded by an inability to understand natural capital in terms of the function of critical habitats. Using the Solent region of the UK as a case study, we adopted a three-step approach to assess the contribution of marine habitats to remediating nitrogen and phosphorus impacts. This critical evidence base will enable coastal managers and regulators to ensure natural resources are given an appropriate level of protection, whilst supporting sustainable economic growth, which together deliver Net Environmental gain.

2. Methods

1) Information on EUNIS habitat extent for six main biotopes (littoral sediments, sublittoral sediments, saltmarsh, seagrass beds, water-fringing reedbeds (*Phragmites australis*) and native oyster beds (*Ostrea edulis*) were collated into maps using GIS for the Solent (Figure 1)

2) We then combined measureable biophysical rates for nitrogen (N), and phosphorus (P) removal, as a function of denitrification and burial in soils and sediments. Rates were quantified from previous studies and literature reviews (see references) of coastal and estuarine habitats similar to those being restored in the Solent.

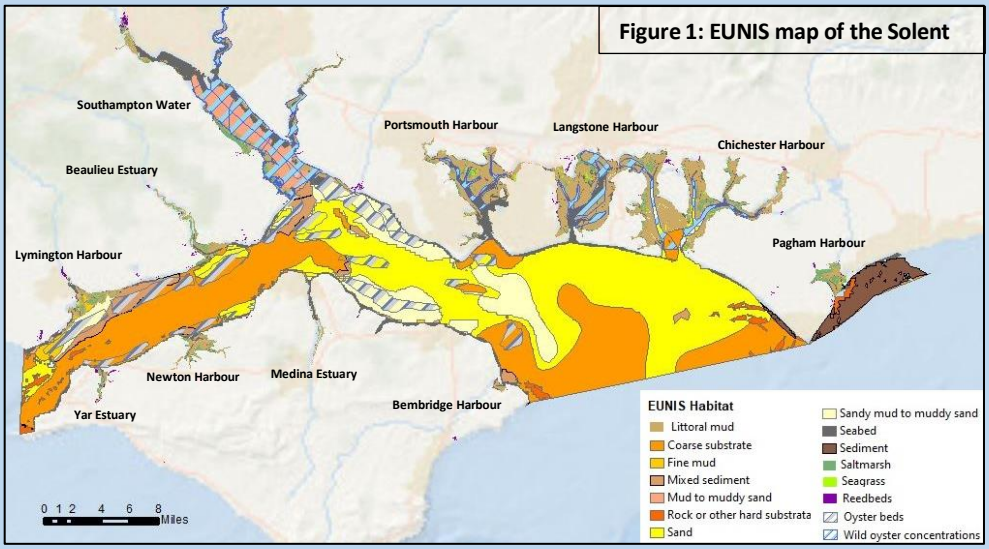

Figure 1: EUNIS map of the Solent

3) To estimate the economic value associated with nitrogen and phosphorous storage we used a replacement cost valuation method using actual costs of nutrient reduction measures undertaken on the UK's southwest coast. Average abatement costs of reducing nitrogen and phosphorus from these sources are estimated here as £295 kg^{-1} for N and £282 kg^{-1} for P.

3. Results

Solent Region	Vegetated coastal habitats		Coastal and marine sediments		Native Oysters (*Ostrea edulis*)		Av Total Value (£)	Av Total Value (£)
Tonnes (yr^{-1})	Nitrogen	Phosphorus	Nitrogen	Phosphorus	Nitrogen	Phosphorus	Nitrogen	Phosphorus
Lymington Estuary	36	7	39	-6	0	0	£22,038,683	£364,335
Beaulieu Estuary	41	9	45	-6	0	0	£25,214,882	£889,390
Southampton Water	90	24	237	-24	172	1.6	£147,329,649	£176,060
Portsmouth Harbour	58	10	178	-59	83	0.8	£94,406,444	-£13,694,987
Langstone Harbour	65	11	266	-78	147	1.3	£140,839,933	-£18,645,053
Chichester Harbour	151	23	388	-53	130	1.2	£197,445,259	-£8,346,847
Pagham Harbour	49	8	44	-6	0	0	£27,367,551	£695,895
Western Yar Estuary	18	6	10	-1	0	0	£8,320,171	£1,167,101
Newtown Harbour	23	3	37	-10	0	0	£17,817,545	-£2,068,536
Medina Estuary	13	2	12	-4	0	0	£7,381,323	-£387,302
Bembridge Harbour	2	0	6	-2	0	0	£2,471,696	-£360,321
Solent (open water)	193	43	544	-32	316	2.8	£310,846,082	£4,718,972
Total	739	145	1807	-282	849	8	£1,001,479,218	-£35,491,294

4. Conclusions

1. The biogeochemical data presented here provides a comprehensive view of N and P burial within both vegetated coastal habitats and marine sediments using a EUNIS habitats approach to assess stocks of natural capital.
2. The bioremediation potential of habitats in the Solent is of high value, providing nutrient reductions of ~3400 tonnes of N per year equivalent to just over £1 billion per year in avoided nitrogen abatement costs.
3. Coastal and offshore sediments are the largest stores for N in the Solent while vegetated coastal habitats are the most efficient per m^2 in removing P.
4. Future accrual of value associated with maintaining usable clean water could rapidly increase when taking into account the additional costs of water treatment infrastructure that is likely as the region's population continues to grow.

5. References

Adams, C.A., Andrews, J.E., Jickells, T., 2012. Nitrous oxide and methane fluxes vs. carbon, nitrogen and phosphorous burial in new intertidal and saltmarsh sediments. Sci. Total Environ. 434, 240–251; Blackwell, M.S.A., Yamulki, S., Bol, R., 2010. Nitrous oxide production and denitrification rates in estuarine intertidal saltmarsh and managed realignment zones. Estuar. Coast. Shelf Sci. 87, 591–600; Brix, H., Sorrell, B.K., Lorenzen, B., 2001. Are Phragmites -dominated wetlands a net source or net sink of greenhouse gases ? 69, 313–324; Holmer, M., Carta, C., Andersen, F., 2006. Biogeochemical implications for phosphorus cycling in sandy and muddy rhizosphere sediments of Zostera marina meadows (Denmark). Mar. Ecol. Prog. Ser. 320, 141–151.; Kellogg, M.L., Cornwell, J.C., Owens, M.S., Paynter, K.T., 2013. Denitrification and nutrient assimilation on a restored oyster reef. Mar. Ecol. Prog. Ser. 480, 1–19.; Newell, R.I.E., Fisher, T.R., Holyoke, R.R., Cornwell, J.C., 2005. Influence of Eastern Oysters on Nitrogen and Phosphorus Regeneration in Chesapeake Bay, USA. Comp. Roles Suspens. Ecosyst. 93–120.; Palomo, L., Clavero, V., Izquierdo, J.J., Avilés, A., Becerra, J., Niell, F.X., 2004. Influence of macrophytes on sediment phosphorus accumulation in a eutrophic estuary (Palmones River, Southern Spain). Aquat. Bot. 80, 103–113.

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