Bayed A. (ed.). Sandy beaches and coastal zone management – Proceedings of the Fifth International Symposium on Sandy Beaches, 19th-23rd October 2009, Rabat, Morocco
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An illustration of the importance of sandy beaches to coastal ecosystem services at the regional scale

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Sandy beaches are the dominant feature of most of the world's ice-free coastlines, they are increasingly threatened by coastal squeeze and they are relatively poorly understood. Management intervention is often required for the persistence of functional beaches, especially in tourist centres. Here, engineering solutions are used either to maintain artificial beaches or to replace them with seawalls of various types. Both engineering interventions disrupt coastal processes. The pertinent questions for beach ecologists revolve around the degree of disruption to beach ecology and the resulting consequences. Where charismatic species, like turtles, seabirds and rare or commercially-important fish species use beaches for spawning or nesting, the degree of impact will depend on whether managed beaches can mimic natural conditions sufficiently well in terms of the physical parameters that determine the nesting or spawning success of the individual species. It is not clear that the resident biotic communities on beaches contribute much in this respect. However, providing breeding grounds for a limited number of conspicuous species is not the only ecosystem service that beaches provide. Here, we use a case study conducted in KwaZulu-Natal, South Africa, to investigate a broad-scale index of ecosystem functioning for beaches that contextualises their importance to ecological processes in the coastal zone at regional scales.

First, we argue that the trend towards quantifying ecosystem services is anthropocentric because the focus is on benefiting humanity. Where human benefits are concerned, short-term economic prerogatives are often prioritised under the guise of "sustainable development", where sustainability is defined in financial terms rather than those of persistent ecosystem functioning. We prefer the idea that certain ecosystem processes can be used as a common currency to evaluate the relative importance of the contribution of different systems to overall ecological integrity (and therefore sustainability) at regional scales. Specifically, we advocate measures of carbon turnover in this regard, because they are ecocentric, univariate, process-oriented, comparable across systems, and relevant to ecosystem services (although not exclusively from a human perspective).

The geographical context of our study is the KwaZulu-Natal (KZN) shore. Stretching approximately 560 km southwards from South Africa's northern border with Mozambique, this coastline is bathed in warm, oligotrophic subtropical waters. There is little macrophyte wrack, although organic inputs from wastewater outfalls and estuaries can be significant. Roughly two-thirds of this coastline is sandy, and one-third rocky and it is punctuated by more than 70 estuaries, some of which contain mangrove systems.

We compiled estimates of biomass, primary productivity, community respiration rates and trophodynamic relationships based on the known structure of macro-, meio- and micro-biotic communities in KZN, supplemented with published values from comparable systems where data were scarce or absent. These formed the basis of a simple mass-balance model that we used to assess the total rate of carbon turnover through four coastal habitats: sandy beaches; rocky shores; estuaries; and mangroves.

Preliminary results indicate that on a per-unit-area basis, sandy beaches turn carbon over an order of magnitude more slowly than do the other systems, especially when primary production (PP) is included in the estimates (PP on beaches is negligible, so when it is excluded beaches cycle carbon as fast per unit area as mangroves). However, when expressed on a per habitat rather than per unit area basis, beaches cycle an order of magnitude more carbon per unit time than rocky shores (irrespective of whether PP is considered or not) and mangroves (if PP is ignored). While estuaries cycle two orders of magnitude more carbon than beaches, much of this could be attributed to internal recycling because the majority of KZN estuaries are cut off from the sea by sand bars for much of the year; during this time, estuaries likely contribute less to overall coastal processes than their rates of carbon cycling would suggest. Moreover, because there is negligible PP on

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beaches, much of the carbon cycled by beaches is of allochthonous origin on the first trophic level (as detritus). This suggests that beaches provide significant services to the other coastal ecosystems in terms of processing their exported carbon (most probably in the form of particulate and dissolved organic carbon) and making this available to the macroscopic coastal food web in the form of trophically available biomass. In other words, beaches in KZN seem to be fulfilling their intuitively attributed function of acting as large biological filters for coastal systems.

In many senses, this ecocentric ecosystem service provided by sandy beaches at regional scales is similar to that which might otherwise be provided in the pelagic ecosystem by the “slimes and jellies” that are thought to be replacing the conventional phytoplankton-zooplankton-fish assemblages in degraded marine ecosystems. While the importance of beaches at regional scales emerges here only because of the prevalence of beaches along the KZN coast, this proportion of beach to rock holds globally, so similar results are likely to emerge elsewhere, emphasising the importance of beaches at the global scale. These results suggest that coherent and integrated conservation strategies are needed for entire coastlines and that beaches should be treated as important ecological components within conservation plans.