Marine Pollution Bulletin xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

# An alert system for triggering different levels of coastal management urgency: Tunisia case study using rapid environmental assessment data

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ARTICLE INFO

*Keywords:*
Ecosystem health
Environmental assessment
Mediterranean
Thresholds
Coastal management

ABSTRACT

Rapid environmental assessment (REA) involves scoring abundances of ecosystems/species groups and magnitude of pressures, concurrently, using the same logarithmic (0–6) assessment scale. We demonstrate the utility of REA data for an alert system identifying different levels of coastal management concern. Thresholds set for abundances/magnitudes, when crossed, trigger proposed responses. Kerkennah, Tunisia, our case study, has significant natural assets (e.g. exceptional seagrass and invertebrate abundances), subjected to varying levels of disturbance and management concern. Using REA thresholds set, fishing, green algae/eutrophication and oil occurred at 'low' levels (scores 0–1): management not (currently) necessary. Construction and wood litter prevailed at 'moderate' levels (scores 2–4): management alerted for (further) monitoring. Solid waste densities were 'high' (scores 5–6): management alerted for action; quantities of rubbish were substantial (20–200 items $m^{-1}$ beach) but not unprecedented. REA is considered a robust methodology and complementary to other rapid assessment techniques, environmental frameworks and indicators of ecosystem condition.



## 1. Introduction

Comprehensive environmental information, usually from detailed surveys, is normally considered essential for effective coastal management (Pernetta and Elder, 1993; Khan et al., 2002). However, information generated is not always at a resolution, or in a format, that best suits management needs (Price, 1990). This can create difficulties in translating survey and monitoring outputs into optimal management responses. In the case of marine protected area (MPA) conservation, potentially significant sites seldom become part of an MPA network without detailed field survey. Yet by the time (exhaustive) field surveys are undertaken, prolonged environmental damage may already have occurred and become irreversible, undermining any future conservation. In areas where coastal demands are high, there can be wisdom in 'declare the MPA now, survey later'. This approach has been adopted in parts of the Red Sea (Pearson and Shehata, 1998). Without this strategy, some areas within current Egyptian protectorates would probably now be more heavily developed for tourism or other coastal infrastructures.

Rapid environmental assessment (REA) is a simple yet robust, 'intermediate-level' methodology utilizing low-resolution, semi-quantitative data on abundance of ecosystems/species groups and magnitude of coastal uses/pressures (reviews: Price, 2004; Price et al., 2014). It utilizes a broad spectrum of environmental indicators and bridges the gap between detailed/quantitative and qualitative assessments of coastal systems and management requirements. The methodology was initially developed for the Red Sea and later used elsewhere, though not in the Mediterranean. Applications have encompassed ecology as well as management, including: integrated assessment of coastal health; identification of resource-use conflicts; characterization of biogeographic patterns, benthic (seagrass) assemblage composition and environmental associations; a conservation tool for identifying candidate sites for protected area systems; and a means of monitoring environmental change following a massive oil spill or other impacts (reviews: Price, 2004; Price and Harris, 2009; Price et al., 2014).

Hence, REA can facilitate coastal management in various ways. However, the potential for survey data to trigger different levels of management action or concern, in ways that are clear and unequivocal to managers, has not been fully explored.

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http://dx.doi.org/10.1016/j.marpolbul.2014.01.037
0025-326X/

Using REA, we characterize the coastal environment of Kerkennah Islands (Fig. 1). This is a region of Tunisia identified for economic regeneration and potential tourism development (Agriconsulting/Azimut/Shoreline, 2008). Specific objectives include: (1) provide 'baseline' information on Kerkennah's coastal environment, and comparison with REA survey data from other parts of the world; (2) establish possible thresholds for REA abundance/magnitude scores, from single and repeat surveys, for determining when environmental conditions warrant management action/concern; and (3) apply the alert system, at different spatial scales, to determine management actions required in response to coastal threats of varying intensities.

The study provides the basis for an automated information system for directly linking assessment outputs (e.g. using REA) to coastal management urgency and response. We see this as a broad input to the more complex task of determining Good Environmental Status (GEnS) and when it has been met (Borja et al., 2013). Preliminary aspects of the work are reported in unpublished form (Agriconsulting/Azimut/Shoreline, 2008).

## 2. Materials and methods

### 2.1. Study area: Kerkennah islands

Located in the northern Gulf of Gabès 20 km offshore from the city of Sfax, the Kerkennah archipelago is *c.* 35 km long and ⩽11 km wide. It consists of 14 islands and islets, the largest being Mellita and Chergui. The archipelago covers 1500 hectares of flat terrain: 90% of land is <5 m high and >30% comprises *sabkha*. Kerkennah's 162 km of coastline consists of 94.5 km of border *sabkha*, 42.8 km of rocky cliffs and 24.3 km of cliffs and sandy clay micro-cliffs, all showing signs of erosion and retreat. The archipelago contains significant flora and fauna, which are subject to anthropogenic pressures. Kerkennah is a Zone of Importance for the Conservation of Birds (ZICO), a wintering area for the Cormorant, *Phalacrocorax carbo* (1000–10,000 individuals present during winter), and an important potential natural preserve in the Gulf of Gabès.

Coastal areas contain highly developed seagrass beds, dominated by *Posidonia oceanica* (up to ~1 m high) and biologically rich assemblages, including important fishery species (e.g. mullet, sole, wrasse). Bivalves (e.g. pen shells & pearl oysters), Leatherback, Green and Hawksbill turtles are among the species of conservational significance. Although less highly developed than many Mediterranean coastal areas, Kerkennah has much (but un-quantified) shore rubbish and debris, as well as major construction in some areas. Besides these and other direct human disturbances (e.g. heavy fishing), the island is influenced by erosion and sea level rise. Studies have been made of the island's physical environment (e.g. Nedia et al., 2011; Etienne et al., 2013) and ecosystems (e.g. Tlig-Zouari and Zaouali, 1994; Machreki-Ajmi and Hamza-Chaffai, 2006; Aloui-Bejaoui and Afli, 2012). However, few integrated assessments have been attempted prior to a Global Environment Facility (GEF) project examining tourism potential, environmental condition and future socio-economic prospects (Agriconsulting/Azimut/Shoreline, 2008). A focused evaluation of physical constraints to tourism prospects has also been undertaken recently (Hellal, 2012).

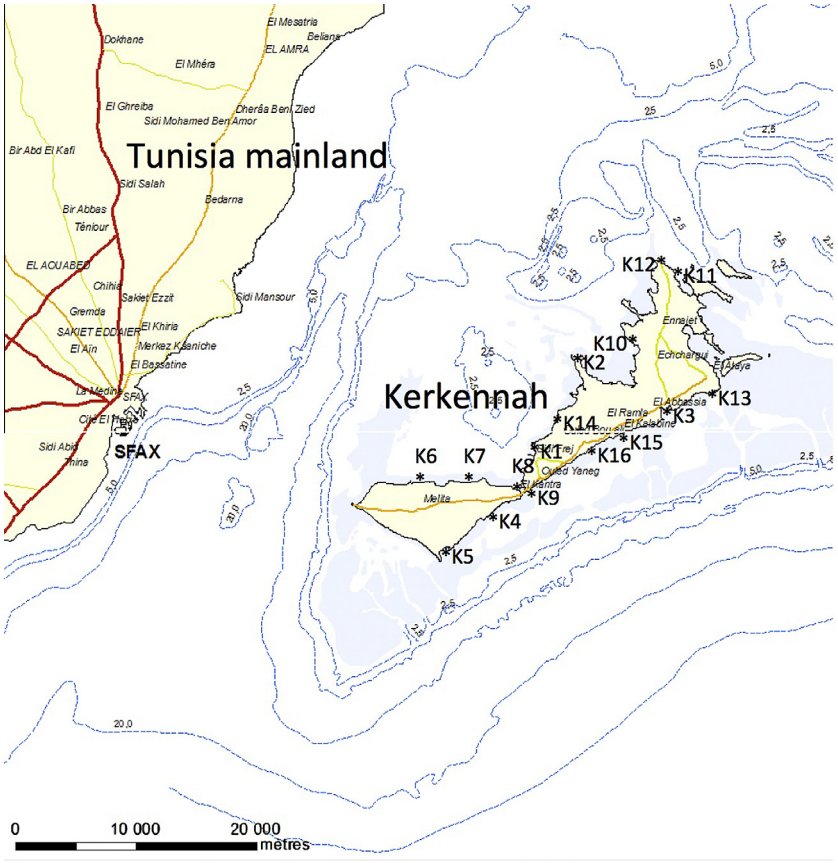


**Fig. 1.** Map of Kerkennah Islands in relation to coastline of mainland Tunisia, showing locations, latitudes (N) and longitudes (E) of 16 sites (K1–K16) examined using rapid environmental assessment (REA) during May 2008: K1 Cercina hotel, 34 41.38, 11 08.05; K2 Sidi Founkhal, 34 45.62, 11 10.51; K3 Abbassia, 34 43.20, 11 15.05; K4 Ouled Ezzeddine, 34 38.86, 11 05.66; K5 Ras Esmoum, 34 37.39, 11 03.13; K6, Marsa Macheni, 34 40.22, 11 01.10; K7 El Jorf, 34 40.24, 11 04.40; K8 El Kantara, 34 39.85, 11 07.53; K9 SE Kantara (Ouled Yaneg), 34 39.84, 11 07.68; K10 Bounouma, 34 46.13, 11 13.69; K11 Sidi Khalfoun, 34 49.11, 11 15.95; K12 Kraten (port), 34 49.70, 11 15.27; K13 Port El Attaya (1 km ouest), 34 43.98, 11 17.49; K14 Borj El Hassar, 34 43.15, 11 09.47; K15 Ouled Bou Ali, 34 41.91, 11 11.62; K16 Ouled Kasem, 34 41.16, 11 10.20.

Please cite this article in press as: Price, A.R.G., et al. An alert system for triggering different levels of coastal management urgency: Tunisia case study using rapid environmental assessment data. Mar. Pollut. Bull. (2014), http://dx.doi.org/10.1016/j.marpolbul.2014.01.037