EFFECTS OF CONSTRUCTION OF COASTAL STRUCTURE ON ECOSYSTEM

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ABSTRACT

Coastal defense structures were built to protect part of shore from beach erosion and flooding by sea water. Unfortunately, these structures produced some impacts on the environment which most of them are negative. Physical changes in beach landscape and habitats disturbance are the example of the effects. Although some of the effects are beneficial in socioeconomic aspect, but environment matters should be given more concerns because it can bring bad consequences to the earth landscape and make the ecosystem be unbalanced.

This study outlines the coastal defense structure effects on ecosystem. Effects of coastal defense structures can be negative or positive, but this study concern on the negative impacts as they are dominant. Coastal structures can extremely impact the shoreline configuration. Artificial structures can influence sediment transport, split the coastal space, etc. This can result in habitats loss and lead to noise and visual disturbance of birds. There are two types of coastal defense structures, hard coastal structure and soft coastal structure. Both coastal structures have their own impacts. The impacts are induced during the construction, maintaining, and operation of the structures.

Keywords: Ecosystem; Environmental Impact; Coastal Defense Structures.

INTRODUCTION

There has ever been a need for coastal protection since the residence of human beings in regions exposed to flooding risk. As the income level and, standards of living have been increased in the coastal zones, and as they have developed more, the structures of coastal defense in terms of the extent and scale have also been increased. Coastal defenses are required because the erosion of

coastal zones has an increasing trend which influences all coasts. According to the European Commission and Directorate General Environment, actions done by human beings have the most influence on recent coastal erosion and sedimentary coastlines and cliffs are increasingly encroached by sea sides built artificially [1]. Deficiency of sediment causes the dynamic ecosystems and immature coastal lands to disappear progressively. In many areas, this happens due to the coastal squeeze. The coastal defense structures' geographic impact is highlighted much in plain coastal states; Very significant coastal defense schemes are also present in the other Contracting Parties' lowland coastal stretches and near river mouths. There are a substantial number of residents also valuable properties and assets protected by them. the structure of coastal defense volumes beside rock and cliff coasts are not identified clearly in terms of number and length thus the defense structures beside mentioned coasts are dispersed; however, each of them is locally important.

Mostly hard structures have been used, such as dikes, groin fields and seawalls. However, the length of soft defenses, such as beach nourishment schemes, increases each year. Beach nourishment is often accompanied by dune regeneration programs. With regard to other soft defense techniques, beach scraping is important, while marsh creation is applied on a considerable scale in the world.

Figure 1 and Figure 2 shows the classifications of structures mentioned in the background of the study.

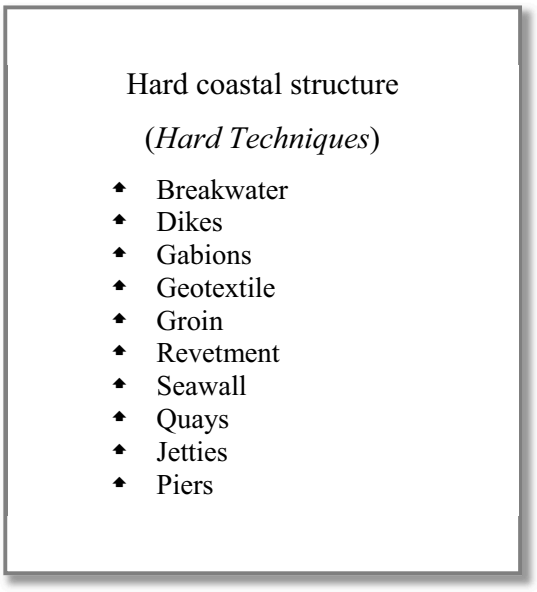

Figure 1: Hard coastal structures

Figure 2: Soft coastal structures

ENVIRONMENTAL IMPACTS OF COASTAL DEFENSE STRUCTURES

The environmental effects of coastal defense are highly linked to the utilized methods. The difference between soft and hard defenses also between long term and short term impacts need to be identified in order to explain the environmental effects.

Hard coastal defense structures

Short term effects

- *Construction phase*

The changes imposed by hard coastal defense structures in terms of type and magnitude can be highly based on the environmental situation that structures are created. On the other hand, hard defense structures' construction constantly causes normal sedimentary habitats to be lost and disturbed, include the related collection of animals and plants, and can also disturb nearby soft substrate benthos environments; Further, urban hard coastal defense structures can introduce new

artificial hard substrata that are extensively and rapidly colonized by algae and marine animals [2], [3], [4], [5].

Some local and sequential interruption may exist for birds and fishes, mostly from noise and vibration related to the hard defense structures' construction; for birds some visual interruptions also can take place.

As a result, the disturbance during the construction phase of hard defense structures is a negative but temporary effect. The failure of soft-bottom collections has a harmful and permanent impact. The substitution of them by hard bottom collections may be either positive or negative.

- *Maintenance phase*

During the maintenance phase, there can be a temporary disturbance of the sessile fauna, algae and mobile fauna that has colonized the artificial hard structures. The ecological impacts throughout the maintenance stage are analogous to the ones in the construction stage. The interruption in the maintenance stage is; therefore, the impact is negative but short-term.

Long-term impacts

Hard defense structures can affect the coastal landscape and the composition and performance of coastal ecosystems. These consequences can occur locally, but also scale up to surrounding areas and ultimately can affect coastal ecosystems on a regional scale. The variability of ecological systems makes it difficult to predict the ecological impacts of hard coastal defense structures in a specific area quantitatively, but there are some qualitative general impacts, as described below.

- *Impacts at local scale*

At a local scale, hard coastal defense structures introduce new artificial hard substrata into areas that are often characterized by scarce natural rocky reefs. They can be extensively and rapidly colonized by algae and epibenthic fauna and can cause an increase in diversity locally. Though, the number of types is less than normal rocky coasts and epibiota are usually conquered by types with a large scattering variety. Moreover, the populations mostly include young stages and individuals typically no older than 2 years. Thus, it shows that the hard coastal defense structures do not offer proper locale for constant communities of adult animals [2], [3], [4], [5], [6], [7], [8], [9], [10].

The existence of hard defense structures is likely to lead to accumulation of sediments, mostly on the part that the existing (and net transport) emerges. This leads to a considerable decrease in the wealth of benthic invertebrates [3].

Hard coastal defense structures can be utilized by birds for feeding, waiting for the wave and as a place to rest [7], [8], [9], [10] (Figure 3).

Figure 3: Hard Coastal Defense Structure (Seawall)

On a local level, artificial hard coastal defense structures build new locales to the rocky coast fauna and flora, and forage, feed and rest locales for birds, But in contrast to normal rocky coast locales, the variety is poor and the biota is conquered by opportunistic types. This ecological effect sometimes can be a slight beneficial impact. The decline in benthic invertebrates on the lee side of the hard coastal defense structure, because of the accumulation of sediments, can have a negative impact.

- *Impacts at regional scale*

On a regional scale, a high number of artificial hard coastal structures in proximity can act as stepping stones, disrupting natural barriers to species distribution and providing new dispersal routes that permit the invasion of non-indigenous species, including pests [4], [11], [12], [13]. This is generally a negative impact.

Soft coastal defense structures

Soft coastal defense structures perform in compassion with the natural procedures of sediment attrition, storage and transport. This happens in a low protection coastal system which can take action to external forcing factors like storms and increase in sea level. There is not any precise information on hand on the ecological effect of the different kinds of soft coastal defense structures. Only the ecological effect of beach nourishment is widely studied and explained.

There are some studies developed to examine ecological impact of beach nourishment [14], [15], [16], [17], [18].

Short-term impacts

- *Construction phase*

Throughout the construction stage of soft coastal defense structures, interruption of feeding birds and nesting, raising shorebirds in terms of both visual and auditory interruption can occur. On the other hand, some types like gulls can become interested in the supplied sediment if it includes food. The use of bulldozers may destroy the primary dune vegetation and increases the degree of compaction of the beach sediment. This can affect vascular plants and their associated terrestrial fauna, predominantly arthropods, living on the dry parts of the beach.

There are effects both at the borrow site (the sediment source) and the target site in the beach nourishment, under water sand nourishment and mudflat recharge. At the borrow site, elimination of sediments leads to spoil and humanity of the benthos [19]. At the target site, interment and stifling occur. This leads to humanity to any benthos which is not able to shift throughout the covering sediments. These impacts will be more prominent as the nourishment region expands more into the sea; the deeper coastal region is a more steady location than the region close to or on the beach, and the benthos is not much adapted to varying environmental situation. Changes in the type after nourishment will affect the pace of revival of the area's normal communities. Making interruption for birds throughout the construction stage of soft defenses has a negative impact, but it is not permanent. The demolition of fauna and flora through the construction stage has a permanent negative impact.

- *Maintenance phase*

Some soft coastal defenses need to be provided. For instance, in beach nourishment, the beach requires to refill once in few years. The ecological impacts through the maintenance stage are analogous to the ones in the construction stage and are normally negative. Further soft coastal defense structures such as mudflat revive or salt bog creation is self-sustaining, thus no protection is required.

Long-term impacts

Long-term effects of soft coastal defenses are type adjustment or the formation of new types, which can offer appropriate sites for a range of related plants and animals, But this mostly leads

to a fractional loss of habitat, which can have higher ecological importance than the newly formed ones.

- *Mudflat recharge and marsh creation*

The formation of mudflats can be an originator to the organization of salt marshes. Given the proper rise, mudflats can be settled by establish saltmarsh plants. Mudflats, which are very low for the growth of saltmarsh, can be settled by intertidal invertebrates through providing extra feeding regions for wading birds. Marshes are also able to be formed by setting pioneer types such as Spartina grass; however, these types are potentially persistent and may extend quickly. It should be considered that artificial mudflats and saltmarshes seldom re-build the exact situations and communities found in normal or semi-normal systems [20].

- *Dune regeneration and stabilization*

Relocating marram grass to the visage of eroded dunes will improve their normal progress above the boundaries of direct wave assail. Sand couch grass and Lyme grass promote the development of new foredunes next to the toe of existing dunes. Dune grass planting will not have any damaging effect on the receiving area's natural environment but may be dangerous for the borrow area. Over harvesting of transplants from any area can give rise to increased local erosion. It should be noticed not to establish non-local shoots that can alter the composition of the dune flora. Fencing to protect specific sites may encourage people to make their own routes through the dunes leading to damage elsewhere in the dune system [21].

- *Beach nourishment*

Utilization of beach nourishment is a quite new phenomenon. Beach nourishment is extensively thought as a better option in contrast to the building of hard structures to protect from detrimental erosion (Figure 4).

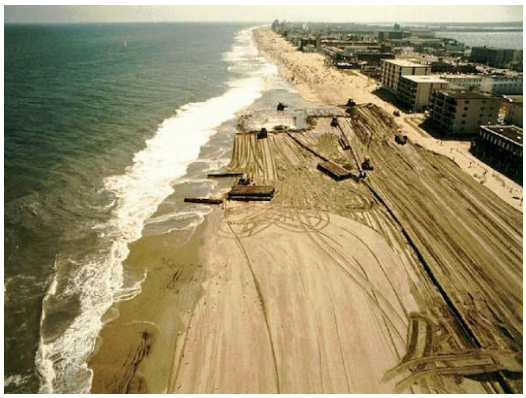

Figure 4: Soft Coastal Defense Structure (Nourishment)

Although beach nourishment is normally considered as an environmentally gentle alternative for coastal protection and beach renovation, considerable effects on several ecosystem mechanisms (microphytobenthos, vascular plants, terrestrial arthropods, marine zoobenthos and avifauna) have been illustrated in the literature [16].

The long term effects of beach nourishment are obvious at the borrow site (the sediment source), the target location and at neighboring sites affected in an indirect way through sediment transfer (longshore and Aeolian transport) [14].

At borrow and target locations there is a lack of the resident fauna and flora throughout the construction stage, which is a negative effect. The extent of re-colonization relies on the types-specific distribution and relocation capacities also on types-specific place demands and leniencies, as well as physical and biological factors [16].

The long run effects of beach nourishment are mainly case-specific and drawing common conclusions are so hard. The ecological impacts of beach nourishment are associated with the character and the extent of the nourishment sediments. For example, if the fill sediment includes a high amount of shell pieces this can deliberate or even stop the revival of some invertebrates or can deliberate the normal progression of plants and are a negative impact. Alternatively, a certain fraction of shells can form constructive nesting situations on the dry beach for some birds, which can be considered as a positive impact.

Expanded nourishment or the fill sediment's erosion can indirectly affect turbidity sensitive animals and plants. These impacts can be either positive or negative. Muddy water can help animals to be protected from visual predators; it can reduce the diffusion of light throughout the water and thus can decrease phytoplankton and benthic algal efficiency; it can prevent polychaetes and bivalves to feed and breathe; it can also deliberate the recovery pace of macrobenthic organisms. Moreover, grain size and the morphology of beaches can affect the composition and performance of the ecosystem. The extent of the ecological impacts is also affected by location, time and size of the nourishment project and the selected nourishment method and strategy [16].

In spite of the interruption of avifauna (birds) throughout the construction stage (as described above), the main effect of beach nourishment on avifauna is the reduction of food accessibility because of the transience of benthic organisms, the rise in turbidity, the deliberate recovery of affected types and probable permanent changes in the ecological community composition. This

can reduce the amount of foraging birds in that region. Birds will re-settle the recently nourished beach after the construction stage, when interruption has stopped and/or supplement food is renovated [14].

Close beaches (in addition to, their coastal dunes, foreshore and groins), also nearby wetlands, can be affected by nourishment throughout the long-shore transfer (by water) and Aeolian transfer of sand [16].

As a result, the anticipated long run effects of soft coastal defenses depends on the case, and may be positive in some cases of beach ecosystem mechanisms or habitats, but may be negative for other cases. Formation of habitat can be considered as a positive impact, for instance. Alternatively, formation of habitat causes a failure of the current habitat which may contain a high ecological value and thus can have a negative impact. Beach nourishment, for instance, can have both negative and positive effects on fauna and flora. The ecological effects are associated with the fill sediment in terms of the quantity and quality, the place, size and time of the nourishment project and the selected nourishment method and strategy.

CONCLUSIONS

Currently, it has been recognized that coastal defense requires to be utilized in a way that takes appropriate consideration for the overall normal procedures running on the coast. These procedures can run on large stretches of coastline. Inappropriate coastal defenses planning on a part of the shore can have tap on impacts elsewhere.

Coastal protection techniques can generally be divided into two main types: hard and soft engineering techniques. Soft coastal defense methods have major effects on local ecosystems. Sessile organisms may be buried in the new sand during nourishment procedure. In both source and target areas are seafloor habitat disturbed, for example when seabed material is deposited on coral reefs or when deposited material hardens. Imported material may contain elements poisonous to local species. Shoreline destabilization may occur by removing material from seashore environment, in part by steepening its submerged slope.

If the relative widths and distributions of key shore areas are quantified, assessments of possible ecological effects of hard coastal structure to open-coast and sheltered soft shore ecosystems may be more effective. Hard coastal structures may also section habitats, decrease connectivity with nearby habitats, and prevent major ecotone processes. Variations or reductions in habitat

availability, quality and bottom-up effects causing from changes in prey collections associated with habitat variation as a consequence of coastal hard coastal defense structures affected animals at higher trophic ranks that use soft shores.

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