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A first approach of beach sanding on the Black Sea Romanian's coast

A. Beer [1]

[1] Naval Academy "Mircea cel Batran", 1 Fulgerului Street, RO-900218, Constanta, Romania

E-mail: albertbeer98@yahoo.com

Abstract: The Romanian coastline, which is subject to complex processes of geomorphological evolution due to beach sanding actions, as well as other natural and anthropogenic factors. Beach sanding is an important action in the maintenance and development of coastal areas, it provides protection against erosion, contributes to the formation and maintenance of beaches, as well as to the preservation of coastal ecosystems The main source of sand for Romanian beaches is coastal transport, i.e. the movement of sand along the coast under the action of values, current and wind. Naturally, there is some redistribution of sand along the coast, with an area where it accumulates and an area where it is lost. However, human intervention and other influences can disrupt this natural balance. In order to counteract the negative impact of insufficient sanding, various coastal management measures have been implemented in Romania. These include the artificial replenishment of beaches by bringing in additional sand from the seabed or other sources, as well as the construction of beach protection and stabilization works

Keywords: Black Sea, sanding, impact, sediment

1 Introduction

The Romanian seaside is characterized by a variety of beach types, from wide and sandy beaches to rocky and deltaic beaches. This diversity reflects the influence of different geomorphological processes acting on the coastline. Beach sanding is an essential process for maintaining and developing coastal areas. By providing additional sand, protection against erosion is provided and the dimensions and natural characteristics of beaches are maintained.

One of the key factors influencing beach sanding is coastal transport. It represents the movement of sand along the coast under the action of waves, currents and wind. Naturally, there is a redistribution of sand on the coast, with areas of accumulation and areas of loss. However, human intervention and other influences can disrupt this natural balance and cause significant changes in the geomorphological evolution of the coastline.

On the Romanian seaside, human intervention has played an important role in modifying the geomorphological evolution of beaches. The construction of breakwaters, quays and other protective structures, while it may have short-term benefits, can lead to damming of the coastline and disturbing the natural movement of sand. To counteract the negative impact of insufficient sanding and human intervention, various coastal management measures have been implemented in Romania. These include artificial sanding of beaches by bringing additional sand from external sources, as well as the construction

of beach protection and stabilization works. These measures have been implemented with the aim of maintaining the size and natural characteristics of beaches, as well as protecting coastal ecosystems.
The area that was analyzed and detailed is from the Mamaia beach to the modern beach (Figure 1).

Figure 1 Area of study

2. Material and Methods

Sanding works of beaches and construction of protective structures

The works consisted of taking sedimentary material consisting of clean sand or sand with shell debris, by lifting it in suspension through a piping system connected to a centrifugal pump. Dredging was carried out with a suction-discharge type dredge (TSHD – Trailer Suction Hopper Dredger) (Figure 2). The operation was done at a low speed of 1.5 to 2.5 knots (2.7 to 4.6 km/h), depending on the characteristics of the dredged material. After loading, the ship has left the operating perimeter and is moving to the beach rehabilitation area, where it will be unloaded.

Figure 2. A trailing suction hopper dredge (TSHD) and its primary components for operation.
Source: (anpm.ro)

Direct discharge

This operation was carried out by opening the hatches on the bottom of the ship, and the filling material was unloaded on the seabed, under the bunker self-discharge dredge, which had to be positioned according to the indications for sanding. The direct discharge method could be used by the TSHD dredge to a depth of 1 meter below the ship's draught. If the depth of water in or en route to the sanding area was insufficient, another method of unloading was used.

Remote Pumping (Rainbow)

The TSHD dredge was able to unload the filler material by pumping it through a nozzle located at the bow of the ship. Thus, the sand left the ship in the form of an arc (hence the name of the method - rainbow). In order to place the material in the correct location, the TSHD dredge had to be positioned close to the sanding area, at the distance covered by this arch. If the TSHD dredge could not reach the sanding area due to limited depth or other restrictions, the discharge was carried out by pumping to shore using pipes .

Data on shoreline dynamics supplied with sediments (Figure 3, 4 and 5):

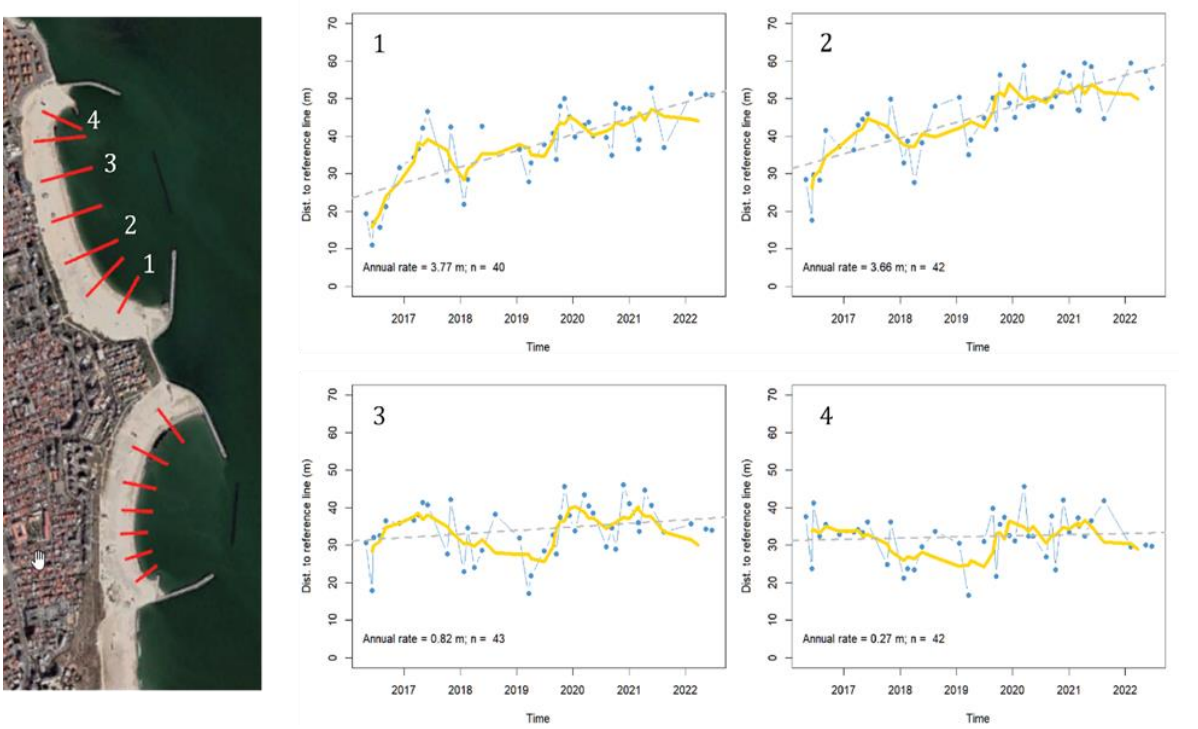

Figure 3 Constanța – Reyna sector after sediment supply

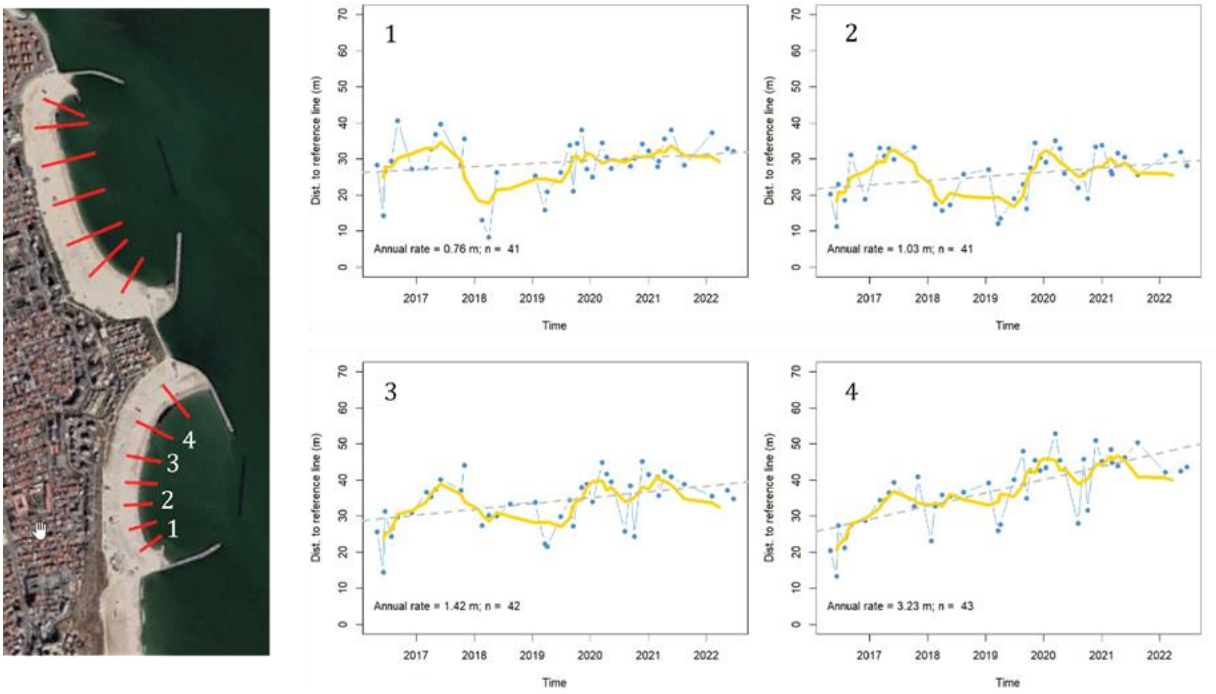

Figure 4 Slippers sector – Constanța after the sediment supply

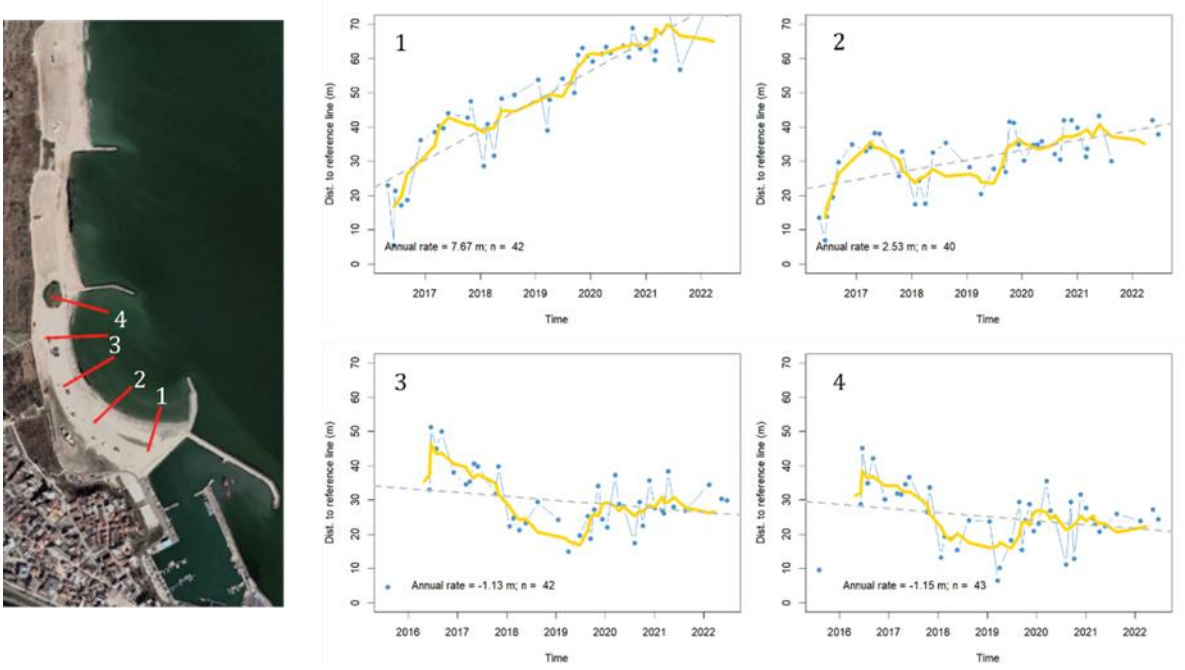

Figure 5 Constanța – Modern sector after sediment supply

The construction of the dams was started and in order not to affect in any way the summer season, they were completed by the beginning of summer 2021(Figure 6).

– seven with a total length of almost 3 km, 6 of them are perpendicular to the shore and one is parallel to the shore in the southern area and has a protective role and creates an area of almost 2.9 ha for the implantation of seagrass

– for the construction of dikes in the Eforie area, which were located on a length of over 5,000 linear meters, 635,000 tons of stone were used, requiring 26,000 transports.

Figure 6 Construction of dikes.
Source: rowater.ro)

Effects on Coastal Morphology: the implementation of beach sanding has influenced the coastal morphology of the Romanian coast. The replenished beaches have experienced increased sediment accumulation, leading to the widening and lengthening of the shoreline. As a result, the eroded areas have been restored, providing protection against wave action and erosion processes. The beach sanding actions have also contributed to the formation of new coastal landforms (Figures 7, 8, 9, 10, 11 a, b, c, 12 a, b) and the modification of existing ones.

Figure7 Before sanding the beache-Reyna sector

Figure 8 Before sanding the beach 3 Slippers sector

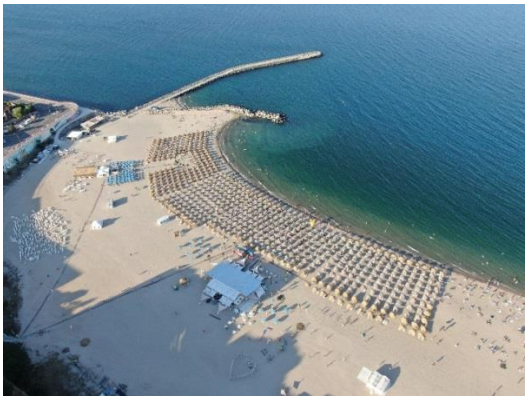

Figure 9 After sanding the beache-Reyna sector

Figure 10 After sanding the beach 3 Slippers sector

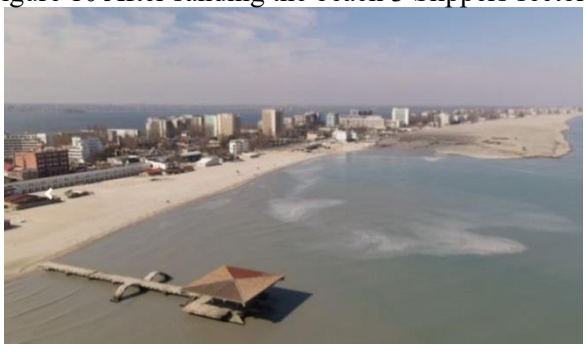

Figure 11a, b Before sanding the beach Mamaia sector and the procedures took for sanding the water

Figure 11c Before sanding the beach Mamaia sector and the procedures took for sanding the water

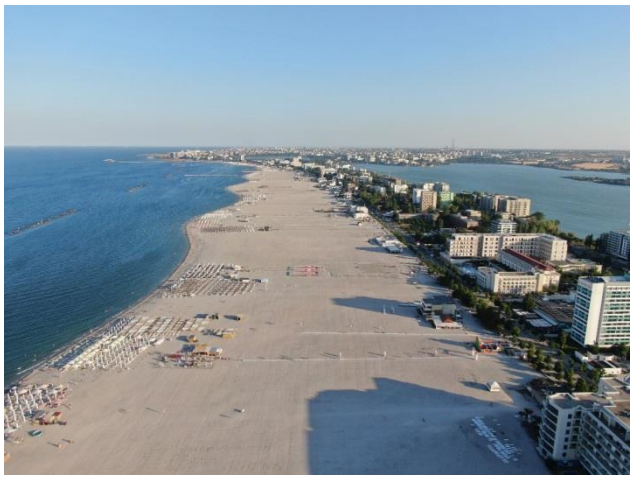

Fig 12a After sanding the beach Mamaia sector

Fig 12b After sanding the beach Mamaia sector

3.Results and Discussions

Coastal Erosion Mitigation its one of the main goals of beach sanding is to mitigate coastal erosion. By adding sand to eroded beaches, it may help protect the shoreline from wave action and storm surges, thus reducing the risk of property damage and loss of natural habitats. Beach Nourishment: Sand replenishment can enhance the recreational value of beaches, making them wider and more attractive to tourists. A wider beach may also provide more space for beachgoers, promoting tourism and local businesses. Beach Nourishment its another one main goal that has to use sand replenishment can enhance the recreational value of beaches, making them wider and more attractive to tourists. A wider beach may also provide more space for beachgoers, promoting tourism and local businesses. Cost and Sustainability: Beach sanding can be a costly endeavor, and the effects may only be temporary. Therefore, sustainable management practices and long-term planning are essential to ensure the continued success of beach nourishment projects.

It's essential to conduct thorough scientific studies and environmental assessments before undertaking any beach sanding project to understand the potential impacts and ensure its effectiveness and sustainability.

4.Conclusions

Erosion and rehabilitation of degraded beaches requires a deep understanding of the hydrodynamic and sedimentological processes specific to coastlines, Danube and rivers. The beaches that have been extended offer better protection against coastal storms in the future as well against the effects of sea level rise.

Sand quality and compatibility, the type and quality of sand used for beach sanding are crucial factors. The sand should be compatible with the existing beach sediment to avoid issues like erosion of newly added sand or changes in the beach's natural characteristics.

Beaches that have benefited from artificial nourishment are created intentionally to expand the recreational space for people and to avoid the destruction of the city.

Environmental concerns the process of dredging sand from offshore sources can have environmental impacts. It may disturb marine ecosystems, affect sediment transport, and alter underwater habitats.

In conclusion, the geomorphological evolution of the Romanian coast is influenced by beach sanding actions, and human intervention and other factors can have a significant impact on this process.

Proper coastal management is needed to maintain the natural balance of beaches and protect coastal ecosystems.

Acknowledgement

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