



<b>Evolution of the Black Sea Shore in the Danube Delta Biosphere Reserve Area</b> <i>(Dănuț Diaconeasa, Silică Petrișoiaia, Gheorghe Munteanu, Răzvan Doru Mateescu, Alina Daiana Spînu)</i>	<b>“Cercetări Marine“</b> <b>Issue no. 43</b> <b>Pages 139-147</b>	<b>2013</b>
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## **EVOLUTION OF THE BLACK SEA SHORE IN THE DANUBE DELTA BIOSPHERE RESERVE AREA**

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### **ABSTRACT**

The intensification of erosion at the Romanian Black Sea coast has resulted in the implementation of measures for protection since 1962. So, in this sense, in the shore area included in the Danube Delta Biosphere Reserve, 60 topographic concrete landmarks were placed in 1962. In 2012, only 16 landmarks were measured (for two landmarks, their status is unknown). Based on the measurements made on the landmarks, changes from the land - sea interface for 50 years have been estimated. This way, two zones with accretion and erosion were analyzed. The accretion phenomenon is for 25 km of shoreline length with a maximum value of 250 m for CSA 28/1962. Erosion processes occur for about 95 km of shoreline length, with an evaluated value over 600 m for the CSA 50/62 transect. Of the 115 km of shoreline studied during 1962 - 2012, coastal erosion was prevalent and was determined on about four times greater seashore length than the accretion phenomenon.

**KEY-WORDS:** delta beach, morphodynamics, erosion, accretion



## AIMS AND BACKGROUND

Due to the expansion of the erosion phenomenon in the Romanian coastal area, measures for the protection against erosion and for the improvement of the hydrotechnical planning of the Romanian shore have been taken since 1962. For this purpose, the first phase refers to the location of a landmark database in the coastal area. So, as a result of the study “Complex Development Plan of the Danube Delta“, the location of topographic landmarks from Gura Buhazului (Vadu) to the Sulina Channel was performed, on a length of approximately 140 km [1]. This network consists of 60 topographical concrete landmarks type CSA/62 (State Water Supplies) (Fig. 1).

## MATERIAL AND METHODS

Data analysis regarding seashore changes was carried-out using transects of beach from CSA/62 type landmarks as far as sea-land interface. For the year 1962, we used the distances extracted from 1962 maps and from literature. From 1980 until 2012, the National Institute for Marine Research and Development “Grigore Antipa” Constanța carried-out yearly measurements from CSA/62 type concrete landmarks using topographic devices, Ni 025 and Sokkia level, with medium accuracy class. The measurements carried-out were analyzed using BMAP-CEDAS software, to establish seashore changes.

### *Shoreline changes*

When geomorphological measurements were performed in the 2012, only 16 of the 60 landmarks implemented in year 1962 were found (Fig. 1 and Table 1). Note that landmarks CSA 1/62 and CSA 2/62 were located in areas with special regime and we have no information about them.

In these areas of shore, the type CSA/62 landmarks have generally disappeared and the beach area has retired by sea advancing.

To assess the changes of sea-land interface in the Sulina - Vadu area, based on geomorphologic measurements since 1962, the intermediate years and the year 2012, two areas of beach were analyzed: one with accretion and another with erosion.

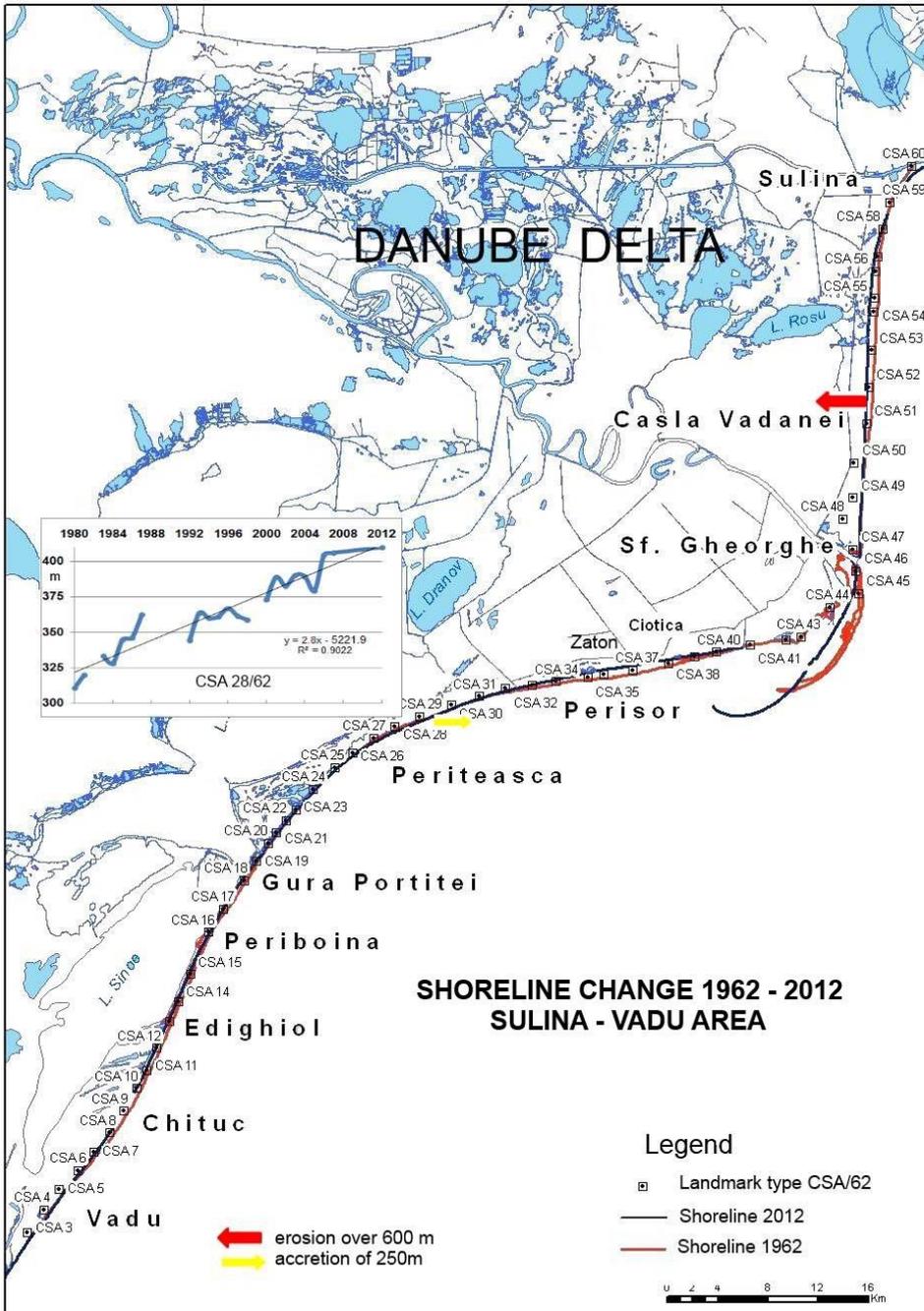


Fig. 1 - Diagram of the location of type CSA/62 landmarks

**Table 1 - CSA/62 type landmarks position**

<b>Landmark no.</b>	<b>Distance (m) 1962</b>	<b>Distance (m) 2012</b>	<b>Landmark no.</b>	<b>Distance (m) 1962</b>	<b>Distance (m) 2012</b>
CSA 60/62	50	changed	CSA 30/62	240	324
CSA 59/62	70	242/2007	CSA 29/62	150	365
CSA 58/62	90	1979*	CSA 28/62	150	400
CSA 57/62	60	E	CSA 27/62	80	286
CSA 56/62	60	E	CSA 26/62	70	200
CSA 55/62	70	E	CSA 25/62	80	147
CSA 54/62	80	E	CSA 24/62	50	67
CSA 53/62	100	E	CSA 23/62	50	E
CSA 52/62	150	1978*	CSA 22/62	40	1982*
CSA 51/62	200	1983*	CSA 21/62	180	E
CSA 50/62	600	E	CSA 20/62	70	2010*
CSA 49/62	140	E	CSA 19/62	60	E
CSA 48/62	8	E	CSA 18/62	55	E
CSA 47/62	400	427	CSA 17/62	60	E
CSA 46/62	40	E	CSA 16/62	100	E
CSA 45/62	120	E	CSA 15/62	50	E
CSA 44/62	400	E	CSA 14/62	60	E
CSA 43/62	30	E	CSA 13/62	70	E
CSA 42/62	50	1978*	CSA 12/62	80	E
CSA 41/62	50	E	CSA 11/62	60	1978*
CSA 40/62	40		CSA 10/62	200	E
CSA 39/62	25	E	CSA 9/62	150	1985*
CSA 38/62	25	E	CSA 8/62	160	1993*
CSA 37/62	40	E	CSA 7/62	180	71
CSA 36/62	120	E	CSA 6/62	250	208
CSA 35/62	60	E	CSA 5/62	300	467
CSA 34/62	100	E	CSA 4/62	300	1987**
CSA 33/62	180	1992*	CSA 3/62	220	468
CSA 32/62	200	178	CSA 2/62	140	no data
CSA 31/62	200	182	CSA 1/62	180	no data

Data source [2,3]

E - destroyed as a result of erosion

\*near the sea-land interface

\*\*destroyed by works carried-out in the area

## RESULTS AND DISCUSSION

### *Coastal areas undergoing accretion during 1962 - 2012*

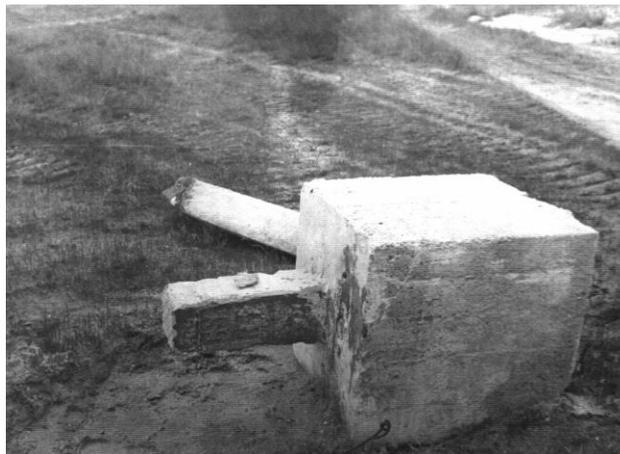
In these areas of shore, the type CSA/62 landmarks have generally been preserved and the beach surface has expanded to the detriment of the sea. The shoreline zones where the beach has extended are: Sulina, St. George, South Perişor - South Periteaşca and the southern side of the Chituc Levee (Vadu).

The *Sulina shore*, located on the southern bank of the Danube branch of the same name, is a barrier beach, which is supplied from the circular current generated by the Sulina jetty and sand dredged for the Sulina fairway. In 1962, landmark CSA 59/62 was located 70 m away from the shoreline and in 2007 it was at 242 m from it (see Table 1), so the width of the beach in the past 50 years has increased with 172 m.

The *St. George shore* is the old shoreline of an accumulative beach (Sărăturile Levee) formed by the juxtaposition of many barrier sands. Landmark CSA 47/62, located at 400 m in 1962, was in 2012 at 427 m distance.

The *shore between South Perişor and South Periteaşca*, with a length of about 15 km, corresponds to the Perişor accumulative shore. The shore is well represented by the barrier sands and a beach whose width varies between 15 m and 40 m, height from 0.4 m to 1.5 m. The shoreline in this area is relatively stable (during 1980-2005), with changes of 5 m - 10 m in the annual rate. The shore in this sector preserved 7 type CSA/62 landmarks from CSA 30/62 to CSA 24/62. In the central part of this sector (CSA 29/62, CSA 30/62 and CSA 31/62), the beach rose with values between 100 m and 250 m (see Tab. 1). The last value of 250 m, recorded at landmark CSA 28/62, represents the maximum width during the past 50 years determined by surveying the beach.

The *shore in Vadu*, about 5 km in length, is an accretion shoreline. In this sector are to be found 3 landmarks, CSA 6/62, CSA 5/62 and CSA 3/62). The landmark CSA 4/62 was destroyed in 1987, as a result of works carried-out in the area (Photo 1).



**Photo 1 - Landmark CSA 4/62 was destroyed in 1987**

The beach in this sector has expanded over the past 50 years from 167 m, at CSA5/62, to 248 m, at CSA3/62 (see Table 1).

### ***Coastal areas undergoing erosion during 1962 - 2012***

The shoreline areas where the beach has reduced are: North Gârla Împuțita - South Cășla Vădanei, Sachalin Island, Ciotica - North Perișor and North Portița - South Edighiol.

The *shore between North Gârla Împuțita - South Cășla Vădanei*, with a length of approx. 20 km, corresponding to the Roșu-Lumina depression, is characterized by a sedimentary budget deficit. The shore is more fragile, with heights from 0.5 m to 2 m and widths of 10-30 m, and most of reeds and set into the ground plaur go directly into the the sea and are washed by waves (Photo 2).



**Photo 2 - Reed rhizomes flooded by the sea (Cășla Vădanei, 2003)**

Frequently, in this section, during the spring-summer high water, seawater streams flow into the delta (Photo 3).



**Photo 3 - Lake - sea canal (Împuțita Sondei, 2008)**

During 1962 - 2002, the shoreline was constantly eroded, the beach retreated by 5 - 40 m/year. This sector is located in a historic area, with an age of more than 2000 years, the tendency to withdraw of the beach is evident and the sea-shore contact line migrated

westward by more than 10 - 12 km [4]. In this sector of the beach, 11 type CSA/62 landmarks were located, from CSA 58/62 to CSA 48/62, which disappeared as a result of severe erosion in this shore area and because they were located too close to the sea. The landmark CSA 58/62, which was placed at 90 m of the shoreline, was, in 1979, 5 m away from the sea. The landmark CSA 52/62, which was placed at 150 m from the sea was 8 m away in 1978 and CSA51/62, which was placed at 200 m, was on the shoreline in 1983 (Photo 4). The greatest advancements of the sea, of over 600 m, to the detriment of the beach are evaluated in the alignment of CSA 50/62 (see Table 1).

On the *Scahalin island*, a landmark was placed at its northern end at 122 m distance. This island was formed during extreme floods in 1897 and has a length of 19 km. Currently, it is translated westward, so that, in 1992, its northern end joined with land becoming a peninsula.

The *shore between Ciotica - Perișor*, with a length of about 20 km, is strongly erosive and, of the 12 landmarks set originally (CSA 42/62 ÷ CSA 31/62), in 2012, only 3 landmarks were found. During 1871 - 1971, the shoreline retreat was about 750 m [5]. The landmark CSA 41/1962 is only in this sector, which has a trend of balance. The coast expanded by 24 m during 1962 ÷ 2012, generally due to biogenic debris. Landmark CSA 42/62, located at 50 m, was at 4 m distance from the shoreline to the sea in 1978 and landmark CSA 33/62, located at 180 m, was at 4 m from the shoreline in 1992.



**Photo 4 - Landmark CSA 51/1962 on the shoreline in 1983**

The beach area of landmarks CSA 32/62 and CSA 31/62 alignment, Perișor shore, retreated by 22 m and 18 m during 1962-2012 (see Table 1).

The *shore between North Portița - South Edighiol*, with a length of about 35 km, represents a complex beach with dune and depressions and active erosion of a coast. In this sector of beach, 18 type CSA/62 landmarks were initially placed, from CSA 23/62 to CSA 6/62, but in 2012 we have not found more than two landmarks, CSA 7/62 (Photo 5) and CSA 6/62.



**Photo 5 - Landmark 7/62 in 2012**

Landmarks on this shore were originally laid in 1962 at distances ranging between 40 m, CSA 22/62, and 200 m, CSA 10/62. The landmark CSA 22/62, set in 1962 at 40 m, CSA 20/1962 at 70 m, CSA11/62 at 60, CSA 9/64 at 150 m and CSA 8/62 at 160 m were very close to the front of the water in 1982 (CSA 22/62), 2012 (CSA20/62), 1978 (CSA 11/62), 1985 (CSA/9/62) and 1993 (CSA8/62). The greatest erosion occurred in the alignment of landmark CSA 10/62, with over 200 m, next to the landmarks CSA 7/62 - over 109 m - and the CSA 6/62 - over 42 m (see Table 1).

## CONCLUSIONS

In conclusion, it is found that, in the seashore area included in the Danube Delta Biosphere Reserve, from 60 topographic concrete landmarks placed in 1962, in 2012, only 16 landmarks were measured (for two landmarks their status is unknown). Based on measurements made on the landmarks, changes of the land - sea interface for 50 years have been estimated. Thus, two zones were analyzed, one with accretion and one with erosion.

The accretion phenomenon occurred on 25 km of shoreline length, with a maximum value of 250 m for CSA 28/1962. The erosion processes occurred for about 95 km of shoreline length, with an evaluated value over 600 m for the CSA 50/62 transect.

From the 115 km of shoreline studied during 1962 - 2012, coastal erosion was prevalent and was determined for about four times greater length of seashore than the accretion phenomenon.



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