

Assessment of Beach Sand Quality of Samandag Beaches, Hatay, Turkey

HASAN GÖKSEL ÖZDILEK

UNESCO 27234307 TUR Coded Project Leader

MKU Lojmanlari Sabanci Kiz Yurdu Arkasi A Block No. 2

31024 Antakya, Hatay, Turkey

Fax: (+90 326) 2455854; Tel: (+90 326) 2455845 (Ext. 1238)

E-mail: gozdilek@mynet.com

This study provides information about trace metal levels along the southern (Samandag) beaches of Hatay Province, which is the southernmost province in Turkey. The Samandag Beaches consist of three beaches: Çevlik, Şeyhizir and Meydan from north to south. Among these beaches, Şeyhizir Beach is densely nested location by green sea turtles during the summer months. The object of this research is to reveal trace metal levels on the beaches. The results obtained from the analysis of trace metals, namely cadmium, copper, lead, zinc, indicated there are somewhat high trace metal concentrations in specific stations close to where raw sewage of Samandag dwellings is discharged by tanker trucks.

Key Words: Beach sand quality, Trace metals, Samandag, Hatay, Turkey.

INTRODUCTION

Samandag is located in the northeastern corner of the Mediterranean Sea. Asi River, an international boundary forming stream between Syria and Turkey, empties its waters into the Mediterranean from this location. Asi River Delta extends about 14 km on NNE direction between two rocky headlands: Çevlik on the north and Sabca on the south. There are three distinctive beaches in Samandag: Çevlik, Şeyhizir and Meydan, from north to south. Due to highly variable flow of the river, strong winds from sea to shore direction between April and October, some agricultural activities, densely populated city centres and their untreated wastewater directly discharged to the river. Some industrial production along the river and some contamination has been occurring in the end point of the Asi and vicinity of the river delta. The degree of environmental contamination on the beaches is not known exactly.

In this study, heavy metal levels in the sediments of Samandag beaches is reported. The beach sand samples were collected in July 2003, in the middle of the highest nesting activity. Some trace metal concentrations and physical parameters, e.g., sand particle size and sand moisture, were determined.

The beaches have the following characteristics: (1) Çevlik Beach is about 5.5 km in length and chiefly the parts of the first two and the last two kilometres are used for tourism and recreation. Being open to flood on stormy days during the nesting season, Çevlik Beach has little turtle nesting activity (2) Şeyhhizir Beach, 4 km in length, is between Şeyhhizir Tomb and Asi river mouth; and (3) Meydan Beach, southern section of the river mouth, 4.5 km in length. There is no inhabitation at the back of Şeyhhizir Beach, with the exception of the first two kilometres. There are some summer resorts and minibus terminal at the tip of Şeyhhizir Beach on its northern side. The artificial sand hills were piled for defending the fields from flooding. This part of the beach is the most important coast of Samandag due to the fact that sea turtles and fishing activity mainly take place in this beach section. However, minor human impacts take place directly, sometimes urban waste waters are discharged into this area. Moreover, untreated wastewater of Antakya (population 1,45,000) via the river and Samandag (population 35,000) is thought to affect this area. There is a summer resort village at the south back on the third (Meydan) beach and agricultural fields near the river mouth. Particularly the segment near the river mouth is important for nesting activity at Meydan Beach.

EXPERIMENTAL

Beach sand samples from three depths of 50 different sampling sites were taken from the Samandag Beach on July 2003. Three depths are (S) surface (0 to 20 cm), (M) moderately deep (30 to 40 cm) and (D) deep samples (60 to 80 cm) from the beach surface. Each sample weighing about 800 to 1000 g was put into sterile plastic containers and then capped. The samples were transported to Mustafa Kemal University, Biology Department, Hydrobiology Laboratory. The samples were naturally desiccated in the laboratory for 20 days.

The moisture content of the samples was computed by deducting dried weight from wet weight and then dividing this result by the natural (wet) weight. Beach sand particle size was measured using a sieving system. For each sand sample the sieve was operated for 15 min.

Samples were prepared for the metal analyses using the method given by Hossner¹. Laboratory grade 3 mL 37% HCl and 1 mL 70% HNO₃ were mixed to pour this mix into the weighed (0.1–0.5 g) sand samples that were previously put into 180 mL polypropylene cups. Scaltec® SBA (31 ± 0.0001 g) balance was used. 1 mL aqua regia was added to the weighed sand samples and then 10 mL HF was put in each cup and immediately capped. Teflon tapes were used to tightly seal the lids and cups. Then, the cups were shaken by Gerhardt® Thermoshake for 2 h at 120 rpm. There was no colour difference between the initial and final phases during 2 h of shaking. Teflon tapes were removed from the cups. A 100 mL saturated boric acid solution was added to each cup. 40 mL deionized water was poured into each cup to make the samples ready. Heavy metal level of beach sand was determined using a Varian Liberty-Series II ICP-AES system situated at Mustafa Kemal University Central Laboratory.

RESULTS AND DISCUSSION

Beach sand particle size was found to be increasing with respect to southward direction. While the smallest sand particle size was found to belong to Çevlik Beach (effective particle size is $367 (\pm 111)$ micrometer) Şeyhhizir and Meydan Beaches were found to have slightly larger effective sand sizes as $380 (\pm 138)$ and $392 (\pm 126)$, respectively. Fig. 1 shows and particle size distribution in the study area. Asi river easily settles down particles carried by stream flow on the northern side of its delta (Şeyhhizir Beach). However, northern bank of the river at its delta is higher than that of the southern side. Therefore, slightly larger particles can accumulate on Şeyhhizir Beach under wet weather events carrying sand particles from inland and longshore transport currents transport coastal sediments from sea. For this reason, standard deviation of sand samples is larger on Şeyhhizir Beach. Hendrickson and Balasingam² postulated that Malayan *Chelonia mydas* turtles prefer sand beaches predominantly formed by less than 353 micrometer sand particles. On the basis of their findings, sand sizes of Samandag Beaches are suitable for *Chelonia mydas* nesting. Karavas *et al.*³ also noted that Sekania Beach (mainly used by *Caretta caretta* sea turtles) on Zakynthos Island is composed of medium to fine sand.

Humidity of sand samples showed a remarkable difference between Şeyhhizir Beach and Çevlik and Meydan Beaches. While humidity at Şeyhhizir was calculated to be 4%, humidity at other beaches was computed to be slightly over 10%. This difference was found to be statistically dissimilar ($P = 0.000$). Mortimer⁴ observed that green turtle eggs are notably sensitive to desiccation.

The pH of the beach sand was found to be $9.41 (\pm 0.38)$, $9.38 (\pm 0.33)$ and $9.59 (\pm 0.32)$ on Çevlik, Şeyhhizir and Meydan Beaches, respectively. Asi river pH is also alkaline⁵ despite the fact that during rainy (wet) season the alkalinity drops

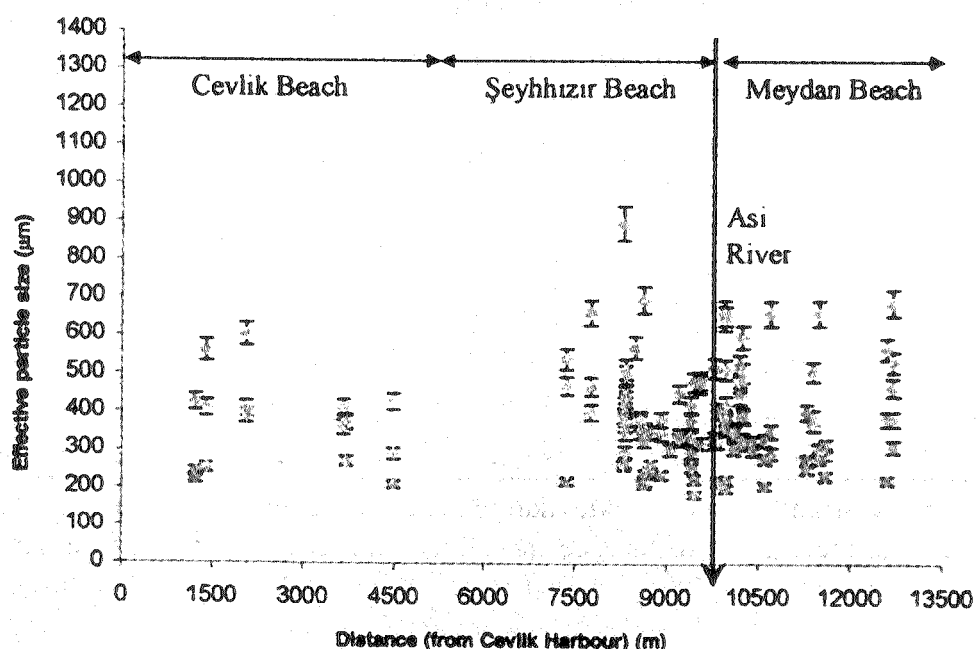


Fig. 1. Effective sand particle size with respect to longshore distance

relatively. The lowest pH, but still alkaline, was found to be on the highly nested beach segment (close to the river mouth) of sea turtles.

Total dissolved solid concentration of the sand was computed to be 183 (± 174), 142 (± 165), and 100 (± 102) ppm on Çevlik, Şeyhhizir, and Meydan Beaches, respectively. Electrical conductivity of the sand was measured to be 339 (± 323), 362 (± 311) and 192 (± 195) mS cm⁻¹ on Çevlik, Şeyhhizir and Meydan Beaches listed from north to south.

Acidic soil could pose a problem to green turtle clutches on Şeyhhizir Beach because of the fact that many trace metals have higher solubility under low (acidic) pH conditions⁶. For instance, zinc chloride is known as a corrosive chemical. Fortunately, zinc concentration of the samples was not found to be problematic as it currently is. However, continuing, excessive and uncontrolled sewer discharge should be avoided here because of the fact that sewer discharges could contaminate groundwater and lead accumulation of some trace metals in the soil environment⁷.

Table-1 summarizes total element concentrations in the study area. In general, element concentrations with respect to deepness do not differ statistically. The total calcium and copper concentration in Meydan Beach was found to be substantially lower than that of the Çevlik and Şeyhhizir Beaches as shown in Fig. 2. Based on statistical computations assuming two-sided two-group (having different variances) t-test, total calcium concentrations between Şeyhhizir and Meydan Beaches is found to be different ($T_{\text{computed}} = 3.573 > t_{\text{critical}} = 1.987$ ($P = 0.0057$)). Calcium is a crucial element needed for embryonic development of sea turtles.

TABLE-1
ELEMENT CONCENTRATIONS IN SAMANDAG BEACHES

Element	Beach			Overall mean (n = 123)
	Çevlik (n = 17)	Şeyhhizir (n = 47)	Meydan (n = 59)	
Ca, mg kg ⁻¹	357 (± 168)	299 (± 123)	233 (± 76)	278 (± 122)
Na, mg kg ⁻¹	141 (± 51)	141 (± 48)	128 (± 54)	135 (± 52)
Mg, mg kg ⁻¹	369 (± 105)	331 (± 84)	287 (± 65)	317 (± 85)
K, mg kg ⁻¹	188 (± 13)	189 (± 25)	168 (± 23)	179 (± 25)
Cr, mg kg ⁻¹	5.96 (± 1.28)	5.99 (± 1.29)	4.71 (± 1.17)	5.39 (± 1.38)
Cu, mg kg ⁻¹	0.29 (± 0.27)	0.29 (± 0.16)	0.12 (± 0.10)	0.22 (± 0.19)
Sr, mg kg ⁻¹	1.34 (± 0.64)	1.41 (± 0.52)	1.34 (± 0.68)	1.37 (± 0.61)
Zn, mg kg ⁻¹	10.3 (± 4.04)	5.05 (± 4.16)	4.20 (± 4.84)	5.44 (± 4.90)

Sodium is slightly low on Meydan Beach. However, based on statistical computations, there is no difference in total sodium concentration of Şeyhhizir and Meydan Beaches. Slightly higher level of sodium at Meydan can be explained by easily intruding estuarine water into the southern section of the Delta. It is known that sea water has approximately 10-fold higher sodium concentration than that of the fresh water.

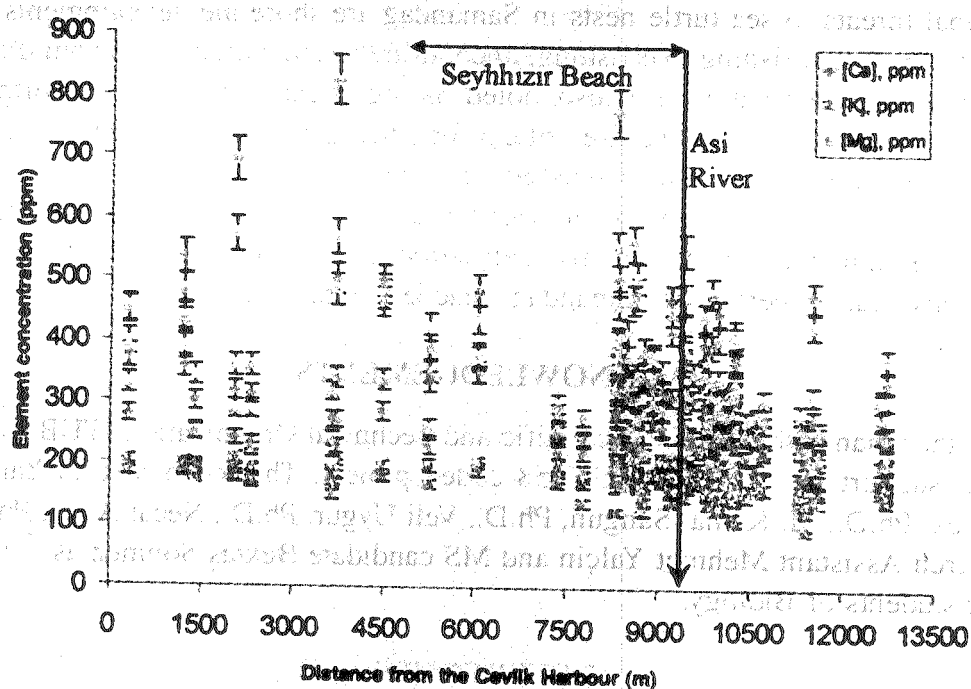


Fig. 2. Calcium, potassium and magnesium concentrations in the study area.

It is interesting that total zinc concentration on Çevlik Beach was found to be more than twice higher than that of both Seyhhizir and Meydan Beaches. Total element concentration at Şeyhhizir Beach was found to be different from Meydan Beach ($t_{\text{computed}} = 3.2245 > t_{\text{critical}} (1.9830)$ ($P = 0.0017$)) for magnesium; ($t_{\text{computed}} = 4.7326 > t_{\text{critical}} (1.9809)$ ($P = 6.41 \times 10^{-6}$)) for potassium; ($t_{\text{computed}} = 5.7888 > t_{\text{critical}} = 1.6583$ ($P = 6.36 \times 10^{-8}$)) for chromium; and ($t_{\text{computed}} = 6.3568 > t_{\text{critical}} = 1.9901$ ($P = 1.18 \times 10^{-8}$)) for copper. However, there is no difference between total strontium concentrations of Şeyhhizir and Meydan Beaches ($t_{\text{computed}} = 0.6517 < t_{\text{critical}} < t_{\text{critical}} = 1.9826$ ($P = 0.5159$)). Based on statistical analysis, there is no difference in terms of total zinc concentration between Şeyhhizir and Çevlik Beaches ($t_{\text{computed}} = 0.4688 < t_{\text{critical}} = 1.9861$ ($P = 0.6403$)); whereas, zinc levels between Çevlik and Şeyhhizir ($t_{\text{computed}} = 4.5213 > t_{\text{critical}} = 2.0423$ ($P = 8.97 \times 10^{-5}$)) and between Çevlik and Meydan ($t_{\text{computed}} = 5.1634 < t_{\text{critical}} = 2.0369$ ($P = 1.24 \times 10^{-5}$)) are significantly different. For sodium, strontium and zinc, a homogeneous distribution is observed at Şeyhhizir and Meydan Beaches. Remarkable human activity, e.g., traffic and summer resorts, in and around Çevlik is the possible explanation of this high zinc concentration. It is also reported that Seyhhizir Beach for sea turtle nesting activity could be slightly higher calcium, potassium, magnesium, chromium and copper concentrations.

An important announcement should be made to the area residents that sand extraction from the beach does not only cause loss of biotic life here but also leads to degradation of beach sand and accelerated erosion on agricultural fields situated behind-beaches and intrusion of salt water into fresh water bodies. The

principal threats to sea turtle nests in Samandag are shoreline developments for tourist use, illegal fishing overfishing, uncontrolled sand extraction for buildings, and beach contamination are also noted as significant problems in northern Cyprus⁸. Natural habitats that are critical for endangered and threatened species should be protected as also discussed by Crain *et al.*⁹ In summary, estuarine environments support a remarkably rich biotic life and should be protected by excessive human activities and this study provides elemental concentrations and some physical properties of Samandag Beaches, Hatay, Turkey.

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