Asian Journal of Chemistry Vol. 19, No. 1, (2007), 807–809

NOTE

Impact of Corrosive Trace Elements on Sea Turtle Eggs during Embryonic Growth

HASAN GÖKSEL ÖZDILEK* and SUKRAN YALCIN ÖZDILEK†
UNESCO 27234307 TUR (2004–2005 Program) Project Leader
Department of Environmental Engineering
Faculty of Engineering and Architecture
Canakkale Onsekiz Mart University, Terzioglu Campus, 17020, Canakkale, Turkey
Tel: (90)(537)9680654; E-mail: goksel-ozdilek@turkserve.net

In the present work, the authors have tried to define harmful elements in the sand that cause unsuccessful hatchlings. These elements are most probably in the untreated domestic wastewater that is discharged by tanker trucks nearby densely nested locations.

Key Words: *Chelonia mydas* eggshell, Embryonic growth, Trace metals, Eggshell corrosion.

Chelonia mydas is listed under threatened species and lays its eggs to certain parts of only some beaches around the globe. It is known that natural nesting habitats are important to allow recovery of this species. Despite the fact that some elements are thought to be taken externally from nesting sand during embryonic growth of *C. mydas* eggs, some elements cause serious corrosion on the eggshells. Therefore, easy parasite infestation occurs if suitable conditions exist.

Samandag Beaches (located in Hatay, Turkey) are used by nesting green turtles (critically endangered) and loggerhead turtles (threatened). More than 10% of *Chelonia mydas* (green turtles) that belong to the whole Mediterranean population nest in this location. However, untreated domestic wastewater discharge of Samandag near sea line close to the densely nested locations is common in the area. Furthermore, a trans-boundary river, Asi (Orontes) river, discharges all types of untreated domestic and, in some degree, industrial wastewaters from this location. Therefore, contamination of nesting beach sand is likely to occur. In this research, deformed, naturally infertile and normal eggshells of *Chelonia mydas were* examined. A Varian® Liberty Series II ICP-AES situated at Mustafa Kemal University Central Laboratory was engaged in he determination of eggshell element concentrations.

Thirty eggs were collected from different green turtle nests constructed at Samandag Beaches. Eggs were collected from nests subsequent to completion of embryonic growth in the year 2003 nesting season. Out of 30 samples, 12 belonged to deformed eggs (abnormal and parasite infested), 10 successfully hatched eggs, 8 infertile eggs were studied. Before starting digestion, eggshells

†Faculty of Education, Canakkale Onsekiz Mart University, Anafartalar Campus, 17100, Canakkale, Turkey

were carefully cleaned by sterile paper tissues. At least three replicates from each eggshell were prepared by nitric acid digestion method. Corresponding standards were prepared before determinations of elements in the eggshell samples. At least 99.5% calibration curves were obtained prior to the readings.

It was found that chromium, zinc, potassium, which form corrosive substances with chloride, are 1.8–3.2 times higher in deformed (abnormal) eggs yielding no successfully hatched green sea turtles compared to that in successfully hatched eggshells (Fig. 1). Sea water is the main chloride source.

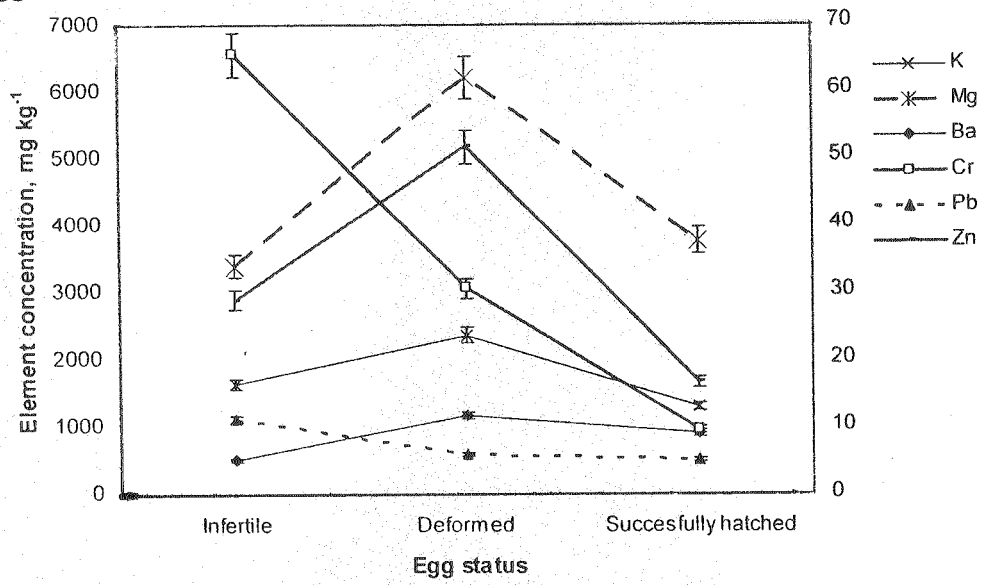

Fig. 1. Metal concentrations in eggshells of infertile, deformed and healthy eggs (K is on the left-hand side of y-axis. Ba, Cr, Pb and Zn are on the right-hand side of y-axis).

The eggshells which yielded successfully hatched eggs were found to be around 28% lower in barium than in deformed eggs, the infertile eggshells had 44% less barium than that in the eggshells that yielded successfully hatched eggs. Half of the infertile and successfully developed samples had non-detectable amount of barium. All the abnormal eggs were found to have barium concentrations above 2.5 mg kg^{-1} concentration.

In deformed eggs, eggshells had 220% more chromium than the eggshells that yielded successfully hatched eggs. Furthermore, 590% more chromium in infertile eggshells was detected compared to successfully yielded eggs. This finding indicates that excessive chromium in fertile female turtles causes infertile eggs.

Eggshell potassium concentration was found to be 82% higher in deformed eggs than that in successful eggs. Furthermore, 27% higher potassium in infertile eggs was found when healthy eggs are taken as reference.

16% more lead was detected in eggshells of deformed eggs compared to healthy eggs. More than twice higher lead in infertile eggshells compared with healthy eggs was observed. Sakai *et al.*[1] noted that the green turtle eggshell of only one egg collected from Haha-Jima Island (Japan) had less than 0.03 mg kg^{-1} (as wet basis). This reported value is 167 times higher than that in eggshells yielding healthy hatchlings in the present study.

212% more zinc was detected in eggshells of deformed eggs compared to that

in healthy eggs. Moreover, 74% more zinc was found in eggshells of infertile eggs when compared to the mean eggshell zinc level in eggshells yielding successfully hatched eggs. In one egg chamber, approximately 4 mg kg^{-1} zinc was found in the eggshell of a successfully developed egg and 197 mg kg^{-1} zinc was determined in the eggshell of a deformed egg. Sakai *et al.*[1] reported eggshell zinc concentration in only one green turtle egg collected from Haha-Jima Island of Japan to be 0.555 mg kg^{-1} (wet weight basis). In this study, eggshells of successfully hatched eggs were detected to have about 30 times more zinc level compared to the value given by Sakai *et al.*[1] Chromium and zinc were observed to be extremely high in eggshells of deformed eggs. Potassium in deformed eggshells is also notably high. Lead and chromium in infertile eggs are remarkably higher than that in eggshells yielding healthy hatchlings. Lead is noted to cause birth defects[2]. For this reason, eggshells of infertile eggs were found to be remarkably high in lead. This indicates that lead and chromium in sea turtles might cause higher lead and chromium in eggshells that are infertile. Chromium is noted to be corrosive on tissues. This explains why deformed eggs were found to have large chromium levels in the examined eggshells.

At pH = 8, lead is 100 times more soluble than zinc and zinc is approximately 100 times more soluble than copper[3]. However, natural background metal levels, with the exception of chromium at some locations, are not currently at alarming concentrations. Excessive and continuous untreated domestic wastewater discharge close to the nesting locations may cause an increase in metal levels in sand because it was reported by Shrivastava and Banerjee[4] that sewage sludge application to soil causes metal increase. Furthermore, excessive and uncontrolled fertilizer use can be dangerous since such applications cause increases in dissolved metal concentrations in soils[5]. From environmental health concern, both uncontrolled agricultural aid use and excessive untreated domestic wastewater discharges should be optimized in Samandag, Hatay, Turkey. Sea pollution from inland, *e.g.*, river[6] and oceanic sources is another concern for sea ecosystem health. Elevated chromium in eggshells of the examined infertile eggs may indicate that fertile sea turtles produce infertile eggs if their habitat is contaminated with chromium and other pollutants.

REFERENCES

1. H. Sakai, K. Sakei, H. Ichihashi, H. Suganuma, S. Tanabe and R. Tatsukawa, *Mar. Pollut. Bull.*, **40**, 701 (2000).
2. Metcalf and Eddy, Wastewater Engineering: Treatment and Reuse, 4th Edn., McGraw-Hill, New York (2003).
3. M.D. La Grega, P.L. Buckingham and J.C. Evans, Hazardous Waste Management, McGraw-Hill, New York (1994).
4. S.K. Shrivastava and D.K. Banerjee, *Water, Air, Soil Pollut.*, **152**, 219 (2004).
5. R.S. Lavado, C.A. Porcelli and R. Alvarez, *Sci. Total Environ.*, **232**, 185 (1999).
6. H.G. Özdilek, *Turkish J. Aquat. Life*, **1**, 176 (2003).

(*Received*: 29 December 2005; *Accepted*: 30 June 2006) AJC-5017