Mass mortality of sea turtles *Chelonia mydas* in El Salvador

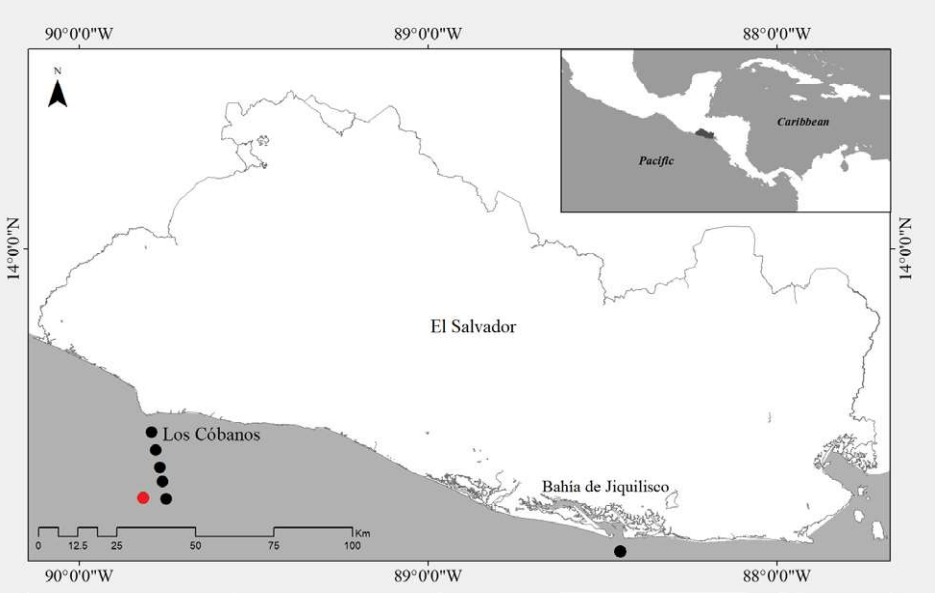

Fig. 1. Map of El Salvador, Pacific coast of Central America, with location of sampling stations and place where dead sea turtles were found in 2017.

During late October and early November 2017, hundreds of sea turtles, mainly green turtles (*Chelonia mydas*) were found dead floating off the coast of Jiquilisco, in western El Salvador coastal waters (Figs. 1,2). Paralytic shellfish toxins (PST) were suspected to be the cause of the mortality since similar events had occurred in El Salvador in 2005 [1], 2010 [2] and 2013 [3], and the mortality was attributed to high levels of PST (associated with blooms of *Pyrodinium bahamense* var *compressa*) found in several turtle tissues.

A total of 25 tissue samples from green turtles (*Chelonia mydas*) from Jiquilisco Bay and Los Cóbanos beach was analyzed (Table 1). The samples were delivered on November 6 and 7, 2017 at the Laboratorio de Toxinas Marinas from the University of El Salvador (LABTOX-UES) by technical staff of the Wildlife Unit, Ministry of Environment and Natural Resources. All samples belonged to dead sea turtles, except blood samples from a living turtle and a dying turtle. PST analyses by the Receptor Binding Assay (RBA), an official AOAC 2011.27 method [4,5], were carried out on November 8, 2017.

Toxic and harmful microalgae were sampled in Los Cóbanos, with the support of technicians from the Ministry of the Environment on November 7, 2017 (Fig. 2). Water samples for quantitative analyses were collected at two depths, along a 15 nm transect perpendicular to the coast; net-haul (20 µm mesh) samples were collected for qualitative analysis. Quantitative analyses were carried out under a inverted microscope (Carl Zeiss, Germany) applying the Utermöhl method. In addition, optical microscopy was performed on the intestinal contents of one specimen of *Chelonia mydas* found 15 nautical miles from Los Cóbanos beach, and on the stomach content of a dead olive ridley turtle (*Lepidochelys olivacea*) that stranded on El Sunzal Beach, department of La Libertad. Table 2 shows the average density of the most abundant microalgae detected in the samples. The diatoms *Dactyliosolen fragilissimus* (110,235 cell L^{-1}) and *Pseudo-nitzschia* spp. (4,033 cells L^{-1}) were the most abundant. All Pseudo-nitzschia species were counted together, given the difficulty in their identification and the existence of both toxic and harmless species within the genus. *Dactyliosolen*

Fig. 2. Collecting dead sea turtles off El Salvador during the mass mortality event, October-November 2017. Source: Ministry of Environment and Natural Resources of El Salvador.

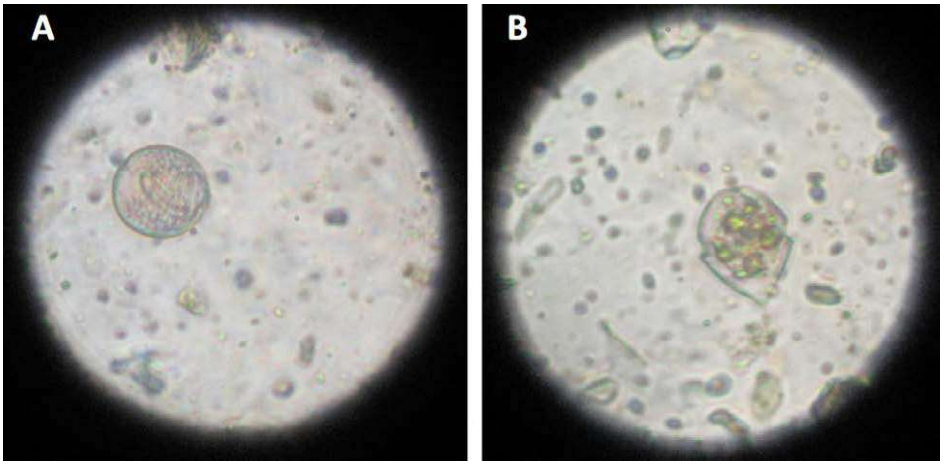

Fig. 3. Micrographs of microalgae found in intestinal and stomach contents of marine turtles. A) Prorocentrum sp. B) Scrippsiella cf trochoidea

fragilissimus was classified as harmless according to the Taxonomic Reference List of Harmful Microalgae of UNESCO. Potentially toxic and noxious species belonging to *Alexandrium* and *Gonyaulax* were also detected, but at cell concentrations far below those associated with noxious events.

Fragments of diatoms and dinoflagellates and whole cells of species such as *Planktoniella sol, Scrippsiella* cf *trochoidea, Prorocentrum* cf *compressum* and *Prorocentrum* sp., but no PST-producing species, were found in the gastrointestinal content of dead sea turtles (Fig. 3). Paralytic shellfish toxins were found in the liver and intestinal content in samples from dead specimens (Table 1). The highest cell concentrations were of species classified as harmless; while potentially toxic and noxious species were not found in cell concentrations high enough to categorise as an episode of a harmful microalgae bloom.

There is no information available in the scientific literature about saxitoxin levels in marine turtles, because most of them are endangered species under protection. The PST levels found in the sea turtle tissues suggest they died from a PSP intoxication, but the causative organisms bloomed elsewhere and escaped detection.

Acknowledgements

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Table 1. Toxicity (µg STX eq./kg) in different tissues from dead sea turtles estimated using the Receptor Binding Assay AOAC 2011.27. <LD = Below the detection limit of the analysis (100 µg STX eq/kg).

Location	Tissue	Number of samples	PST Concentration (µg STX eq./kg)
Jiquilisco Bay	Blood	2	<LD
	Flipper	20	<LD
Los Cóbanos	Intestinal content	1	294.51
	Liver	2	252.87

Table 2. Most abundant phytoplankton species detected in Los Cóbanos on November 7, 2017. [1]According to the Taxonomic Reference List of Harmful Microalgae of UNESCO. [2]Some species are classified as toxic and others as harmless.

Species	Density (cells L^{-1})	Category[1]
Dactyliosolen fragilissimus	110,235	Innocuous
Pseudo-nitzschia spp.[2]	4,033	Potentially toxic/innocuous
Guinardia striata	3,361	Innocuous
Chaetoceros affinis	2,689	Innocuous
Oxytoxum sp	1,344	Innocuous