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Causes of Morbidity and Mortality in Free-Ranging Sea Turtles Found Stranded on St. Kitts and Nevis (2015–2024)

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Abstract.—**Sea turtles face many anthropogenic threats to survival including fisheries interactions, vessel collisions, pollution, disease, predation, and even environmental factors such as sargassum blooms causing entrapment. Here we summarize sea turtle strandings on the Caribbean islands of St. Kitts and Nevis from 2015–2024. Necropsies were performed to determine causes of morbidity and mortality on all dead sea turtle strandings and those sea turtles that passed soon after starting rehabilitative care, all of which were reported to the St. Kitts Sea Turtle Monitoring Network or the Nevis Turtle Group via their respective Sea Turtle Hotlines. Most sea turtles (29) processed during the study period were Green Sea Turtles (*Chelonia mydas*) with one Hawksbill Sea Turtle (*Eretmochelys imbricata*) processed. Of these necropsies, three life stages were documented and included eight juveniles (26.7%), six sub-adults (20%), and 16 adults (53.3%), of which 15 were males (50%), nine females (30%), and six classified as sex unknown (20%). Anthropogenic threats were the cause of 10 (33%) mortalities (fisheries interactions and vessel strikes), non-anthropogenic threats were the cause of 12 (40%) mortalities, including predator interaction (predation/ scavenging), protozoal infection, and sargassum entrapment. Our study helped identify mitigation targets, such as the need for more public awareness campaigns regarding spent fishing line management and vessel activities, in addition to knowledge gaps that still need further research, particularly from the perspective of a small island state.**

Key Words.—disease; *Chelonia mydas*; *Eretmochelys imbricata*; Green Sea Turtle; Hawksbill Sea Turtle; mortality; parasites; predation; research; threats

Introduction

Five species of sea turtles have been documented either foraging, nesting, or stranded in coastal waters and on the shores of St. Kitts and Nevis, which are sister islands located in the Leeward Islands of the Lesser Antilles in the eastern Caribbean (17.3578°N, 62.7830°W). The St. Kitts Sea Turtle Monitoring Network (SKSTMN) is a community-based sea turtle conservation organization that has been operating since 2003 in St. Kitts and their conservation efforts include monitoring sea turtle nesting beaches and nearshore waters, operating a national Sea Turtle Hotline, and conservation education programs (Stewart et al. 2016, 2018, 2022, 2023). The Nevis Turtle Group (NTG), also formed in 2003, operates a sea turtle conservation program that includes monitoring sea turtle nesting beaches and providing sea turtle education programs. Both projects maintain Sea Turtle Hotlines (a phone number that can be called 24 h a day, 7 d a week to report sea turtle stranding events) and work collaboratively to respond to strandings and other sea turtle events.

Of the five species of sea turtle documented in St. Kitts and Nevis, two species (the Green Sea Turtle, *Chelonia mydas*, and the Hawksbill Sea Turtle, *Eretmochelys imbricata*) can be found foraging nearshore and nesting on beaches regularly. Green Sea Turtles, previously categorized as Endangered by the International Union for the Conservation of Nature

(IUCN), were downlisted in 2025 to a classification of Least Concern (Wallace and Broderick 2025). Hawksbill Sea Turtles are currently categorized as Critically Endangered by the IUCN (Mortimer and Donnelly 2008). Sea turtles have an economic importance to the Leeward Islands for multiple reasons including human consumption and in recent years, ecotourism. Ecotourism generates revenue from both the tours themselves, and tourism-related income, such as overnight stays and merchandising. In Barbados, Swim With Turtle Tours bring in an estimated $33.8 million USD annually to the island nation (Jake Gutman et al., unpubl. report); however, with tourism activities also comes increased boat traffic, jet ski activity, and other pastimes that can pose issues for sea turtles.

The popularity of sea turtle ecotourism demonstrates that marine turtles can provide more economic value from tourism than harvest (Troëng and Drews 2004; Stewart et al. 2016). Globally, knowledge of sea turtle threats is based primarily on data from developed countries rather than small island developing states (Stacy et al. 2010; Cantor et al. 2020). Threats fall into two main categories: anthropogenic and non-anthropogenic. Direct anthropogenic threats include negative marine activity interactions such as vessel collisions, entanglement in fishing gear, and ingestion of foreign bodies (hooks, fishing line, and macroplastics; Chaloupka et al. 2008; Flint et al. 2010; Work et al. 2015), habitat loss at foraging and nesting grounds, marine pollution, legal and illegal harvest, and climate change and these have resulted in dramatic declines in Green and Hawksbill sea turtle populations over the last decade (Hays et al. 2025). Non-anthropogenic causes of morbidity and mortality observed include predation from sharks and infectious or proliferative diseases such as fibropapillomatosis, coccidiosis, and spirorchiidosis (Stacy et al. 2010; Goldberg et al. 2013; Chapman et al. 2017; Corbagi and Bertoluci 2024). Although classified for the purposes of our study as non-anthropogenic, there is evidence to suggest that the increase in fibropapillomatosis and coccidiosis cases may be influenced by anthropogenic causes, such as pollution, and there may also be other concurrent anthropogenic drivers (Ban de Gouvea Pedroso et al. 2020; Manes et al. 2022).

Sea turtles that fall ill can strand on beaches for a variety of reasons including traumatic injuries and disease. If they do not perish prior to landing on the beach, they are often taken into a sea turtle rehabilitation facility for treatment, recovery, and optimally, eventual release. Performing investigations on mortalities can provide valuable information for sea turtle conservation by providing insights into their biology and impacts of various threats (Flint et al. 2009). Information that can be gathered from these investigations include body condition, life stage, diet, reproductive status, morphometric information, health status, and cause of death (Bugoni et al. 2001; Zug et al. 2002; Work et al. 2004; Foley et al. 2005; Chaloupka et al. 2008). Tissue samples that are collected can be archived and used for a variety of different research purposes, such as genetic studies (Komoroske et al. 2017), retrospective pathogen discovery (Laovechprasit et al. 2024), toxicology (Finlayson et al. 2016), forensic investigations (Pertiwi et al. 2020), and education (Stewart et al. 2018). The objectives of our study were to: (1) determine species, life stage, and sex of individuals to better understand demographics of sea turtles found stranded on St. Kitts and Nevis; (2) to determine the causes of morbidity and mortality of these animals; (3) to categorize causality of these mortalities when possible (anthropogenic and non-anthropogenic); and (4) to further identify areas in which sea turtle conservation could be improved through threat mitigation.

Materials and Methods

Data was compiled from stranding reports to the Sea Turtle Hotline of SKSTMN, including those reported by the Nevis Turtle Group. Volunteers of the SKSTMN responded to all calls, traveled to the site, and assessed the condition of each turtle. If the sea turtle was alive, it was brought to Ross University School of Veterinary Medicine (RUSVM), Basseterre, St. Kitts, West Indies, for further assessment by an experienced veterinarian who elected either euthanasia or attempted treatment and rehabilitation. If the turtle was dead, it underwent a field postmortem examination (if too big for transport to a necropsy facility or was found on Nevis) or was brought to the RUSVM Pathology Laboratory and processed to determine a possible cause of death.

The data collected from all strandings included; (1) location of stranding; (2) date of stranding (3) body condition, which was scored subjectively based on Stacy 2015 protocol; (4) carcass condition (Stacy 2015); (5) gross abnormalities; (6) morphometric measurements; and (7) any signs of direct anthropogenic interactions (Table 1). If dead and

Table 1. Types of data collection, observations, and measurements performed and their descriptions for sea turtle strandings in St. Kitts and Nevis in the Caribbean.

Data Collected from Strandings	Description
Body Condition	
Poor	Emaciated: very little skeletal muscle and/or fat stores.
Fair	Thin with some fat stores and skeletal muscle.
Good	Robust skeletal muscle and fat stores.
Carcass Condition	
Mild	Fresh carcass, little to no decomposition.
Moderate	Foul odor, scutes dislodging from carapace, internal organs still distinguishable.
Severe	Foul odor, scutes dislodging or absent, integument sloughing, and organs liquefied and/or hard to distinguish.
Abnormalities on Body	
Gross Abnormalities (amputations, bite marks, tumors, lacerations etc.)	Unusual marks or features on body that is not normal.
Morphometric Measurements	
Curved Carapace Length	Measured from top (behind the head) to the most ventral part of the carapace using a cloth measuring tape.
Curved carapace width	Measured at the widest part of the carapace with a cloth measuring tape.
Direct Anthropogenic Interactions	
Fishing line/ nets	Fishing line/nets found wrapped around individual or evidence observed of such interactions.
Propeller/vessel strike wounds	Evidence observed of such injuries caused by vessel/propellers.
Spear gun wounds	Evidence observed of such an injury caused by a spear gun.

in mild or moderate carcass condition (severe state of decomposition individuals did not undergo a full postmortem examination), postmortem examination included the acquisition of representative samples, which were fixed (in 10% neutral-buffered formalin) and/or frozen and then archived. Postmortem examinations were done by veterinary and graduate students, often supervised by a veterinary pathologist, or were conducted following protocols set by RUSVM and the SKSTMN and guidelines from Flint et al. (2009) and Work (2014). Histopathology and interpretation of the findings was performed by an experienced veterinary anatomic pathologist.

We used curved carapace lengths (CCL) to categorize life stage of individuals and categories included juvenile, subadult, and adult. For Green Sea Turtles, individuals < 65 cm were classified as juvenile, 65–90 cm as subadult, and > 90 cm were considered adult (Bresette et al. 2010; Almeida et al. 2011), and for Hawksbill Sea Turtles, individuals < 50 cm were classified as juvenile, 50–78 cm subadults and > 78 cm adult (Boulon 1994; Wood et al. 2017). Sex was determined by gonad examination during histopathological evaluation using protocols established by Ceriani and Wyneken (2008) when unclear from an external examination, although it could not be determined in highly decomposed cases.

Causes of mortality were separated into three main categories which include anthropogenic (fisheries and vessel interactions), non-anthropogenic (sargassum related, parasitism, disease and predator interactions [predation/scavenging]), and unknown (all undetermined cases fell into this category). Trauma, as in the case of vessel interactions, was diagnosed by presence of injuries consisting of fractures, abrasions, lacerations, and contusions caused by boat bows, propellers, rudders, and bottoms (DiMaio and DiMaio 2001; Foley et al. 2019). Asphyxiation was interpreted as the likely cause of mortality in cases with observations consistent with entanglement in fishing gear. These included edema, congestion and hemorrhage around the neck, often associated with linear ligature marks. In some presumed entanglement cases, exophthalmos, fluid and foam within the major airways, and foreign material identified in the lung on histological examination were noted, which is consistent with a diagnosis of likely asphyxiation (Kuiken 1996). Predator interaction such as shark bites was confirmed based on bite patterns on the carapace/plastron/in tissues/bone, as well as amputations and decapitation with obvious associated bite trauma (Stacy 2015; Stacy et al. 2021). Sea turtles that had gross/microscopic evidence of hemorrhage, fibrin, inflammation and or muscle injury at wound sites were considered predated. Those that did not show any evidence of vital response at wound sites were considered scavenged (Stacy et al. 2021). If no obvious cause of mortality was found, they were categorized as undetermined.

We performed binomial exact calculations using an online calculator (https://www. sample-size.net/) to determine prevalence and 95% confidence intervals (CI) of populations such as species, life stages, cause of mortalities, and spirorchiid egg locations. We used a Chi-square Test with Yates correction to compare the ratio of males to females to 1:1 for Green Sea Turtles. For all statistical tests, significance was accepted if $P \leq 0.05$.

Results

Between 2015 and 2024, 29 of 44 sea turtles reported to the St. Kitts Sea Turtle Hotline as stranded, in distress, or were dead, with the remaining 13 stranded but then released once medically cleared and were not included in the study. Two live stranded animals brought in for evaluation died soon after treatment was initiated, these were included in the sample collection. Of the 30 turtles subject to postmortem examination, all had mild-moderate postmortem decomposition, 27 were on St. Kitts, and three were on Nevis. Of these, 29 (93%) were Green Sea Turtles (95% confidence interval [CI] = 79–99%) and one was a Hawksbill Sea Turtle (7%; 95% CI = 0.8–21%; Table 2). An additional Hawksbill Sea Turtle was excluded from the study as it was severely decomposed when brought in and a postmortem examination was not completed (Table 2). During the study period, strandings occurred year-round with 24 strandings (80%; 95% CI = 61–92%) occurring April to October (Northern Hemisphere Spring and Summer months) and the most strandings (21) were recorded between 2021 to 2023 (70%; 95% CI = 50–85%).

Three main life stages were documented: eight juveniles (26.7%), six subadults (20%), and 16 adults (53.3%). Postmortem examinations included 15 males (50%), nine females (30%), and six that were classified as unknown sex (20%; Table 2). The ratio of males to females was not significantly different from 1:1 ($X^2 = 0.399$, df = 1, $P = 0.560$).

The most commonly observed lesions were traumatic skin wounds (n = 9; 30%), subcutaneous edema in neck area (n = 6; 20%), partial or full limb amputations (n = 8; 26.7%), bilateral exophthalmos potentially caused by entanglement (n = 3; 10%) and spirorchiid egg granulomas, which were found in almost every system, especially digestive (n = 20; 67%) and respiratory (n = 18; 60%) tracts (Appendix Table). Causes of mortality were divided into three main categories: (1) anthropogenic; (2) non-anthropogenic; and (3) undetermined. Anthropogenic factors were determined as the cause of death of 10 (33%) individuals and included four fisheries interactions resulting in asphyxiation/drowning, one chronic erosive gastroenterocolitis caused by a plication from ingested fishing line, two cases of direct harm from spear gun wounds (penetration trauma), and three vessel collisions (Fig. 1). Non-anthropogenic causes were identified in 12 (40%) turtles and included eight amputations of all limbs and head consistent with predator interaction and/or scavenging. One case of severe coccidial

Table 2. Overview of presumed causes of mortality of 30 sea turtles stranded on St. Kitts and Nevis between 2015 and 2024. Abbreviations are J = juvenile, SA = subadult, A = adult, M = male, F = female, U = unknown, HST = Hawksbill Sea Turtle, GST = Green Sea Turtle, and n = sample size.

	Life Stage			Sex			Species			
Cause of Death	J	SA	A	M	F	U	HST	GST	n	%
Anthropogenic										
Vessel collision	0	0	3	2	1	0	0	3	3	10
Speargun	2	0	0	1	0	1	0	2	2	6.7
Asphyxiation (entanglement in fishing line/nets)	1	2	2	4	0	0	0	4	4	13.3
Gastroenterocolitis (fishing line)	0	0	1	1	0	0	0	1	1	3.3
Non-Anthropogenic										
Sargassum entrapment (emaciation & starvation)	1	0	0	1	0	0	1	0	1	3.3
Coccidiosis	1	0	0	1	0	0	0	1	1	6.7
Fibropapillomatosis	1	0	1	0	2	0	0	2	2	26.7
Predator interaction	0	3	5	2	4	2	0	8	8	26.7
Unknown	3	1	4	3	2	3	0	8		
Total	9	6	16	15	9	6	1	29	30	

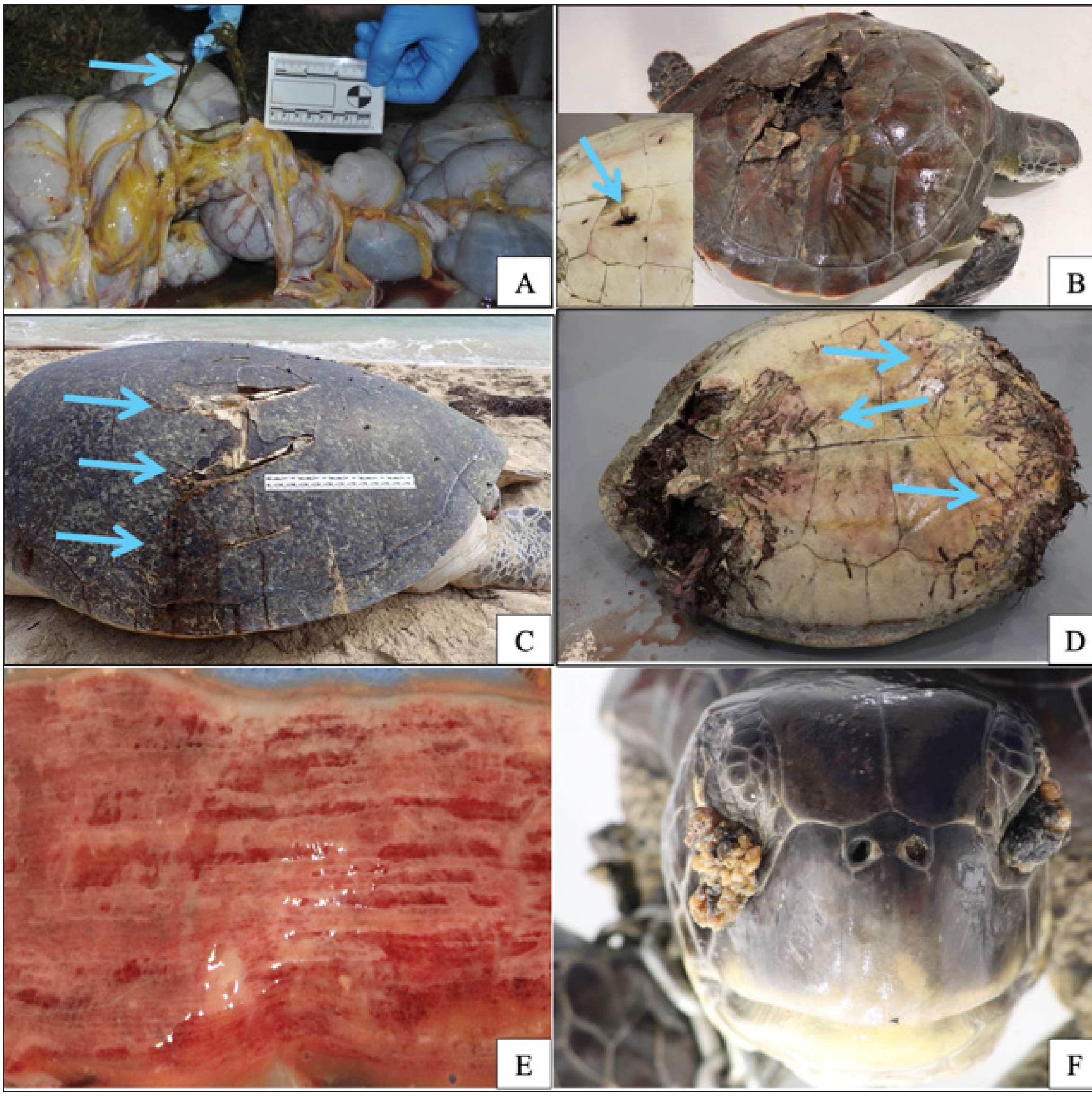

Figure 1. Gross lesions of stranded Green Sea Turtles (*Chelonia mydas)* undergoing necropsy in St. Kitts between 2015–2024. (A) Gross image of a highly plicated intestine with chronic erosive gastroenterocolitis caused by ingested fishing line (arrow). (B) Exit wound a transcoelomic puncture likely caused by a spear gun resulting in severe external and internal injuries (photograph insert shows arrow pointing to the entry wound. (C) Three parallel lacerations (arrows, chop wounds) interpreted to be injuries from collision with the propeller of a motorized vessel. (D) Multiple irregular linear indents (arrows) caused by teeth into the plastron and absence of all limbs and head consistent with shark predation and/or scavenging. (E) Small intestine with severe enteritis associated with *Caryospora* sp. with segmental, linear, ulcerations on the mucosal surface from a Green Sea Turtle found stranded on St. Kitts. (F) Bilateral fibropapilloma lesions located at the medial canthi of a Green Sea Turtle found stranded on St. Kitts (Photographs courtesy of St. Kitts Sea Turtle Monitoring Network).

gastroenterocolitis (enteric coccidiosis) was observed. Two cases of fibropapillomatosis; one turtle had tumors on both eyes that had punctured the palpebral fissure (1–3 cm in size), as well as multiple on the neck (3–10 cm in size), inguinal, axillary regions and cloaca (1–10 cm in size), no internal lesions were noted (Fig. 1). On the second individual, tumors were seen on left eye, inguinal, axillary regions, and cloaca (ranging between 0.4 and 17 cm in size). A single raised, focal lesion was seen in the stomach lining of two turtles but was deemed subclinical (Fig. 1), and there was one case of severe emaciation associated with sargassum entrapment based upon the history. In eight (27%) turtles, a cause of death was not identified (Table 2). Co-morbidities in these cases included gastrointestinal impaction, renal oxalosis, excessive sargassum ingestion, and multifocal granulomatous myocarditis, gastroenteritis, nephritis, and oophoritis

Table 3. Organ location of parasitic ova observed histologically in 25 sea turtle mortalities infected with spirorchiid trematodes from 2015–2024 in St. Kitts and Nevis.

Organ	Juvenile	Subadult	Adult	n
Liver	1	2	4	7
Kidney	1	3	5	9
Heart	3	0	6	9
Skin	1	1	1	3
Stomach	3	1	5	9
Small intestine	3	2	7	12
Large intestine	4	3	7	14
Esophagus	0	0	2	2
Gonads	0	0	3	3
Lung	4	4	10	18
Spleen	2	0	3	5
Eye	1	0	0	1
Adipose tissue	0	0	2	2
Urinary bladder	1	1	0	2
Brain	1	0	1	2
Skeletal muscle	0	0	1	1

associated with spirorchiid eggs.

Spirorchiid trematode infection was seen in 25 (83%) of the sea turtles examined, although the infections were typically mild except for one case. Trematode infections were documented in all three turtle life stages in 13 adults (52%) compared to 24% (n = 6) in juveniles and 24% (n = 6) in subadults. Of the turtles that had infections, spirorchiid-type eggs were seen in multiple organs including but not limited to the liver (n = 7; 28%), kidney (n = 9; 36%), heart (n = 9; 36%), stomach (n = 9; 36%), small intestine (n = 12; 48%), large intestine (n = 14; 56%), and lung (n = 18; 72%; Table 3).

Discussion

The majority of strandings in St. Kitts and Nevis involved Green Sea Turtles, although Hawksbill Sea Turtles are commonly observed on both islands, and the factors underlying these species-specific differences in stranding frequency are unclear. Postmortem examinations were performed on multiple life stages, but the underrepresentation of post-hatchlings in our study complements the hypothesis of other studies that indicate the first few years are spent in oceanic waters around the Sargasso Sea (Mansfield et al. 2021) and that it is the juveniles that return to nearshore foraging grounds. Peak nesting season for Green Sea Turtles in the Caribbean is between April and October (Laloë et al. 2016), which coincides with the documented timeframe for peak numbers of strandings that we found. Adults tend to have high nesting site fidelity and will often return to their native nesting beaches from which they hatched when ready to nest to continue the cycle (Miller 1997; Shimada et al. 2021). Some of the mortalities could be caused by excessive energy expenditure from reproduction and the arduous migration these species undergo leading to chronic debilitation and potentially death as has been observed in stranded Loggerhead Sea Turtles (*Caretta caretta*) in the southeastern U.S. (Stacy et al. 2018).

While the ratio of males to females was not significantly different than 1:1, it is important to note that males were documented, which could be related to detection bias as the males found stranded were on the larger side (about 5%) and are more likely to be seen versus smaller carcasses that are more likely to be overlooked or not make it onto land. It is also unclear as to whether environmental or other factors that may determine the sex ratio of free-ranging turtles played a role, especially with studies demonstrating a female-skewed sex ratio of hatchlings due to increased incubation temperatures along with concerns of population feminization (Blechschmidt et al. 2020). Studies conducted in St. Kitts and Nevis on nests of Leatherback Sea Turtles and Hawksbill Sea Turtles demonstrated that all dead in nest hatchlings examined were female (Laloë et al. 2016; Hill et al. 2019; Mau et al. 2024). The loss of any adult turtle from the population is potentially problematic from a conservation standpoint as Green Sea Turtles can take 20–50 y to reach sexual maturity (Balazs 1982; Frazer and Ehrhart 1985) and populations in the wider Caribbean region and globally are already facing declines (Blechschmidt et al. 2020).

For deaths categorized as anthropogenic, we found that vessel strikes were a particular concern in St. Kitts and Nevis, which has a growing water tourism sector with speed boats, water taxis, catamarans, and jet skis operating within the nearshore environment posing a significant risk to sea turtles (pers. obs.). Conservation strategies that may help mitigate this threat include protection or exclusion zones for boating activities, reducing speed in nearshore/shallow areas, and increasing education to make boaters more aware of their surroundings (i.e., having a person who specifically looks out for animals and objects; Fuentes et al 2021). Deaths categorized as fisheries interactions included fishing line ingestion, entanglement, and spearfishing. Monofilament fishing line is incredibly durable and can last in the marine environment for years (He 2006). The SKSTMN has implemented a fishing line disposal initiative through placement of monofilament disposal bins around the island of St. Kitts in conjunction with fisheries sites and/or piers (Kimberly Stewart, pers. comm.). The actions of humans could be mitigated with enforcement of regulations related to spear gun licenses and other fishing activities. A literature review by Castillo et al. (2024) concluded that in other countries, compliance with fisheries regulations is achieved when enforcement, deterrence, and cooperative management between fishers and government agencies are in place.

Other anthropogenic threats that sea turtles face in St. Kitts that were not immediately evident in our analysis include impacts of sandmining operations on nesting beaches, vehicular traffic on both beaches and in the water, coastal development impacting nesting and foraging habitats, and direct harvest (Stewart et al. 2016, 2018). The Federation of St. Kitts and Nevis is one of the few Caribbean nations that still has a legal sea turtle harvest. Current regulations as stated in the St. Christopher and Nevis statutory rules and orders 2002 (Fisheries Regulations. 2002. Saint Christopher and Nevis, Statutory Rules and Orders. 1995, No. 11. St. Kitts and Nevis) allow for harvest of all species between 1 October to 28 February annually if they meet minimum weight requirements (Green Sea Turtles: ≥ 81.6 kg (180 lbs); Hawksbill Sea Turtles: ≥ 35.5 kg (85 lbs); and Leatherback Sea Turtles ≥ 158.7 kg (350 lbs). No fishing for sea turtles (including use of spear guns) can be conducted within the nearshore area, which is defined as within 300 yards of shore (Fisheries Regulations. 2002. *op. cited*). Preceding 2007, it was estimated that 340 turtles were being captured for consumption and/or sale annually (Stewart et al. 2016). As a result of the development of alternative livelihoods for sea turtle fishers, capture numbers decreased following 2007, but current harvest numbers are not available. In addition to direct harvest, small scale fisheries on the islands can result in additional drowning events for undersized sea turtles and other species caught in the nets or traps used for fish.

For non-anthropogenic causes, Sargassum is a growing concern in the wider Caribbean region and is a genus of macroalgae that originates from the middle of the North Atlantic subtropical gyre (the Sargasso Sea; Schell et al. 2015). It is important to sea turtle ecology as the mats can act as nurseries for neonatal and juvenile sea turtles (Mansfield et al. 2021); however, since 2011, these Sargassum mats have been growing rapidly and have been found in abundance far away from the Sargasso Sea (Schell et al. 2015; Wang and Hu 2016). The Caribbean region has been inundated with these mats, which have hindered females from nesting and trapped individuals within the mats, resulting in a likely multifactorial cause of death with a combination of hyperthermia, dehydration, starvation and/or drowning (Louime et al. 2017; Maurer et al. 2019). One death in our study included a Hawksbill Sea Turtle that stranded in St. Kitts associated with entrapment within a mat of Sargassum with consequent dehydration and starvation.

Two sea turtles from our study presented with lesions indicative of fibropapillomatosis. While both turtles were moderately decomposed, one was emaciated and the probable cause of death was likely starvation as tumors can hinder movements and ability to feed. The other individual had severe lesions on both eyes completely impairing vision, but as the carcass could not be immediately processed due to COVID lockdown restrictions, it had been frozen and stored for several months prior to defrosting and undergoing a postmortem examination hindering further analysis. Fibropapillomatosis is associated with chelonid herpesvirus 5 (ChHV5) and is thought to trigger disease when occurring in combination with certain adverse environmental conditions including pollution (Jones et al. 2016). Herpesvirus can be transmitted between sea turtles; however, it is not fully known how this occurs (Jones et al. 2016). Fibropapillomatosis has increased globally over the last two decades and was reported in the Caribbean in 2011 in Trinidad and Tobago (Cazabon-Mannette and Phillips 2017), in 2020 in Grenada (James et al. 2021), and was first observed in 2010 in St. Kitts (SKSTMN, unpubl. data).

One case of severe enteric coccidiosis (likely *Caryospora* sp.) from our study was detected in a juvenile Green Sea Turtle. This parasite has been observed in Green Sea Turtles in the Atlantic Ocean since 2012. Severe cases of systemic and enteric coccidiosis have been reported in Australia, which are molecularly similar to those in Florida indicating that it has potentially spread across oceans (Stacy et al. 2019). In 2014–2015, there was a mass mortality event associated with enteric coccidiosis in Green Sea Turtles in southern Florida (Stacy et al. 2019) and since then, there have been sporadic published cases, one in 2018 in Hawaii (Stacy et al. 2019) and one in St. Kitts in 2022 (unpubl. data). The ecology of this parasite in the wild is poorly understood, and it has been hypothesized that oocytes or infected intermediate hosts are being transported by ballast water in ships contributing to global spread (Stacy et al. 2019). Other conditions thought to facilitate the spreading of this pathogen include visitation of different habitats by sea turtles, increasing chances of exposure to pathogens and areas that have high concentrations of environmental contaminants, and toxins and algal blooms can also increase the susceptibility to infections by turtles (Stacy et al. 2019).

We found that predator interaction by sharks was suspected in the majority of cases classified within the non-anthropogenic category. There is anecdotal evidence that Tiger Sharks (*Galeocerdo cuvier*) inhabit nearshore areas associated with sea turtle strandings. It must be noted that it is possible that there may have been unidentified underlying factors such as exposure to toxicants or harmful algal compounds that could have predisposed the animals to predation. Because most of the postmortem examinations were conducted in the field by veterinary and graduate students, and findings later interpreted by veterinary pathologists, critical data such as observing wound sites for evidence of hemorrhage, fibrin, inflammation or muscle injury that could prove an animal was alive when predation occurred were not always noted. In many cases, carcass preservation may have also impacted interpretation. The prevalence of shark interactions recorded in our study is unusual compared to other studies/regions and warrants further investigation.

An additional documented co-morbidity, renal oxalosis, which was reported in around 10% of cases in this study was also found in about 26% (18/69) of Green Sea Turtles by Stacy et al. (2008) on stranded sea turtles found on the Atlantic and Gulf coasts of Florida and Tortuguero National Park, Costa Rica, but is not generally considered a cause of mortality. Oxalosis is thought to be the result of ingestion of ethylene glycol in food sources or oxalate-accumulating plants (Maxie 1993; Stacy et al. 2008). It is still unknown which food sources for Green Sea Turtles may contain these substances and further research needs to be conducted to understand its full impact.

The majority of sea turtles in our study were incidentally affected by a typically mild degree of spirorchiidiasis. Currently there are three main spirorchiid species that have been identified in stranded Green Sea Turtles in Florida and these include *Neospirorchis* sp., *Learedius learedi*, and *Hapalotrema postorchis* (Stacy et al. 2010). It is likely that these species are present in the Caribbean, but no extensive testing has been performed and was not available for our study. The high prevalence of spirochiids coincides with the hypothesis that these turtles are exposed to infection in nearshore foraging habitats as it has been seen in Green Sea Turtles and not in Leatherback Sea Turtles which forage in pelagic environments (Chapman et al. 2019). These trematodes are considered endemic parasites of cheloniid turtles and thus these turtles are their natural hosts; however, more severe infections have been reported in compromised hosts (Stacy et al. 2010). Overall, environmental, host, and pathogen relationships for spirorchiidiasis are not completely understood in marine species and warrant further investigation to determine what species of trematodes are present and if spirorchiids have any significance to sea turtle health in St. Kitts and Nevis. Examination of the morphotypes and molecular identification of parasitic ova recovered from intestinal scrapings could help elucidate the different genera present in the Eastern Caribbean (Wolke et al. 1982).

Our findings highlight potentially important mitigation targets for anthropogenic mortalities, such as public awareness campaigns targeted at fisheries regulations, better provisions for disposal of waste fishing line, and stricter regulations around vessel activities. There were some limitations to our study, such as the low sample size and inherent biases in passive wildlife health surveillance based on examinations of stranded animals (Fuentes et al. 2023). Similar analyses on other islands with a standardized approach would be an important step toward determining causes of morbidity and mortality in sea turtles on a wider scale and the lessening of existing knowledge gaps. Continued investigation of sea turtle mortality events can assist in monitoring changes over time and position scientists to better predict potential impacts of land-use and climatic change.

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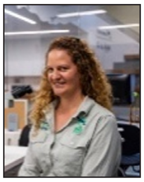
Angela Picknell holds a Bachelor's degree in Biology and Ecology and has a Master's degree for Research. She worked with the Ross University School of Veterinary Medicine and the St. Kitts Sea Turtle Monitoring Network as a Field Researcher, focusing on nesting beach surveys, rehabilitation, husbandry, stranding response and population monitoring. Her work emphasized data collection to support conservation and management of sea turtle populations. Angela is currently collaborating with the Wider Caribbean Sea Turtle Conservation Network to develop a regional Sea Turtle Stranding Network, advancing coordinated response efforts and conservation initiatives. (Photographed by Angela Picknell).



Heather Fenton joined the Australian Registry of Wildlife Health in October 2022 as a Wildlife Veterinary Pathologist. Heather trained with the Canadian Wildlife Health Cooperative in Prince Edward Island and earned her American College of Veterinary Pathologists diplomate status in 2014 (Schaumburg, Illinois, USA). She led the wildlife diagnostic program at the University of Georgia, Athens, USA. She later served as Wildlife Veterinarian and Chief Veterinary Officer for Northwest Territories, Canada, and taught Veterinary Pathology at Ross University School of Veterinary Medicine in St. Kitts. Her research focuses on emerging diseases, wildlife health surveillance, and conservation. She currently serves as Vice President of the Wildlife Disease Association. (Photographed by Grace Black).

Michelle Dennis is a board certified Veterinary Anatomic Pathologist and Professor of Anatomic Pathology at the University of Tennessee College of Veterinary Medicine, Knoxville, USA. An experienced diagnostician, her career has focused on investigation of natural disease with a special interest in the diagnosis of aquatic animal diseases and mortality events. Her research addresses disease in wildlife species of ecological and economic importance, including corals, spiny lobster, sea urchins, queen conch, freshwater mussels, marine and freshwater finfish, perinatal Hawksbill and Leatherback sea turtles, and Greater Caribbean Manatees (*Trichechus manatus*). (Photographed by Michelle Dennis).

Kimberly Stewart is the Founder and Director of the St. Kitts Sea Turtle Monitoring Network (SKSTMN); Executive Director of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST); and an Associate Professor of Exotic and Avian Medicine at Ross University School of Veterinary Medicine (RUSVM). Her research focuses on management and health of sea turtles, shorebirds, and seabird populations in St. Kitts, policy development as it relates to sea turtle conservation and management, and conservation education. (Photographed by Angela Picknell).

Gary Buckles served as an Army aviator and an Air Traffic Controller with the Federal Aviation Administration, Georgia, USA for 29 y. Following his retirement in 2007, he began volunteering in the Husbandry Department at the Georgia Sea Turtle Center on Jekyll Island, Georgia, USA. In 2008 he began volunteering with the St. Kitts Sea Turtle Monitoring Network and the Barbados Sea Turtle Project (2009). During leatherback sea turtle nesting season in St. Kitts, he directs morning and night patrols, stranding response, and education activities. Gary was awarded the Ed Drane award for volunteerism for his dedication. (Photographed by Kimberly Stewart)

María Jose Navarrete Talloni is a Veterinary Anatomic Pathologist dedicated to science, education, and community engagement. She earned her D.V.M. at the University of Chile, Santiago, a Masters in Preventative Veterinary Medicine at University of California, Davis, USA, and a Ph.D. from the University of Veterinary Medicine, Hannover, Germany as a Marie Curie Fellow. She has held academic roles in Chile, the Caribbean, and now serves as Associate Professor and Assistant Dean at Long Island University, Brooklyn, USA. Her research follows a One Health approach, addressing infectious diseases and antimicrobial resistance. (Photograph courtesy of Long Island University).

Pompei Bolfa earned his D.V.M. in 2004 from the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca in Romania and joined Ross University School of Veterinary Medicine in 2014 after 3 y in mixed practice. He pursued a Ph.D. in Equine Infectious Diseases and began teaching before transitioning to a full-time pathology role. In 2016, he became a Diplomate of the American College of Veterinary Pathologists, Schaumburg, Illinois, USA. Passionate about teaching, his research interests include comparative pathology, viral diseases, and epidemiology. Pompei has led major initiatives, and actively serves in leadership, mentorship, and scientific roles within international veterinary pathology organizations. (Photograph courtesy of Ross University School of Veterinary Medicine).

Emile Lemuel Pemberton holds a B.A. in Geography (University of the West Indies, Mona) and an M.Sc. in Natural Resources Management (University of the West Indies, Cave Hill). He taught for 25 y before serving as Fisheries Development Officer, Director of Fisheries in Nevis, and Deputy Director of Marine Resources. He has led the Nevis Turtle Group as President since 2003 and was a Global Fellow in Marine Conservation at Duke Marine Lab. He is also a licensed tour guide, PADI-certified diver, and has coached and played cricket and football. (Photographed by Jevaunito Huggins).

Nickhail Sutton is a marine conservation practitioner specializing in sea turtle research and stranding response. He previously served as a Lab Technician in the Chelonian Research Laboratory at Ross University School of Veterinary Medicine (RUSVM). He is also a Senior Conservationist with the St. Kitts Sea Turtle Monitoring Network (SKSTMN) in Saint Kitts and Nevis, where he supports sea turtle monitoring, rescue, and public outreach. His work focuses on advancing conservation strategies and contributing to the protection of endangered marine turtle populations in the Caribbean. (Photographed by Nickhail Sutton).

Noah Makela graduated from the University of Hawai'i at Mānoa, USA, with a degree in Marine Biology in 2016. After 3 y as a husbandry specialist in the aquarium industry, he discovered a passion for animal health and attended Ross University School of Veterinary Medicine. During his education, he joined the St. Kitts Sea Turtle Monitoring Network (SKSTMN) and the World Aquatic Veterinary Medical Association. With the SKSTMN, he contributed to rehabilitation, nest relocation, conservation outreach, necropsies, and in-water field collection efforts, supporting marine wildlife research and conservation initiatives. (Photograph courtesy of Ross University School of Veterinary Medicine).

Melinda Massey earned her veterinary degree from Ross University School of Veterinary Medicine (RUSVM) and completed her clinical year at University of Wisconsin - Madison, USA. While at Ross, she worked with Kimberly Stewart and the St. Kitts Sea Turtle Monitoring Network (SKSTMN), performing necropsies and assisting with sample collection. She also completed an externship at the Milwaukee County Zoo, Wisconsin, USA, gaining hands-on experience with diverse wildlife and zoo medicine practices. After graduating in 2024, Melinda joined Vetco Total Care and is building her exotic animal clientele. (Photographed by Melinda Massey).

Hanna Millar is a small animal general practitioner Veterinarian. She completed her studies at Ross University School of Veterinary Medicine (RUSVM) and the University of Florida College of Veterinary Medicine, Florida, USA. While studying at RUSVM, she volunteered with the St. Kitts Sea Turtle Monitoring Network (SKSTMN), where she developed strong skills and a keen interest in marine wildlife and ecosystems, contributing to sea turtle monitoring and field studies. She now brings this diverse training and passion for animal care to the patients she serves in Baltimore, Maryland. (Photographed by Mason Lichliter).

Mason Lichliter is a small animal Veterinarian focused on general medicine. He completed his preclinical training at Ross University School of Veterinary Medicine (RUSVM), followed by his clinical year at the University of Florida College of Veterinary Medicine. While at RUSVM, he spent time volunteering with the St. Kitts Sea Turtle Monitoring Network (SKSTMN), gaining practical experience in wildlife conservation. That background continues to influence his perspective in practice, where he emphasizes thoughtful, high-quality care and a strong connection between animal health and the environment. (Photographed by Hanna Millar).

Liam Kitson is originally from New York, USA, and is now a practicing Veterinarian in the state, contributing to marine conservation through his work with the St. Kitts Sea Turtle Monitoring Network (SKSTMN). Serving as a member, he performed necropsies, sample collection, and collected morphometric data that contributed to this study. He is deeply grateful to have been part of this effort and to have contributed to research supporting the conservation of these species. (Photographed by Madison Hanna).

Appendix

Appendix Table. Summary of lesions documented in different life stages and sexes from post-mortem examinations of 30 sea turtles- 29 Green Sea Turtles (*Chelonia mydas*) and one Hawksbill Sea Turtle (*Eretmochelys imbricata*) between 2015 and 2024 in St. Kitts and Nevis. One asterisk (*) indicates traumatic skin wounds consisted of plastron wounds, puncture wounds, and lacerations affecting flippers, head, and/or neck. Two asterisks (**) indicates gastroenterocolitis: one case was caused by fishing line found in digestive tract and second case was caused by coccidiosis.

		Life Stage			Sex			Species			
System	Lesions	Juvenile	Sub-adult	Adult	Male	Female	Unknown	Hawksbill	Green	Number (n)	%
General Status											
	Mild autolysis	4	1	5	7	2	2	1	9	10	33.3
	Moderate autolysis	4	5	11	7	8	4	0	20	20	66.7
Nutritional Status											
	Poor	3	1	0	2	2	0	1	3	3	10
	Fair	3	2	5	3	2	4	0	9	9	30.0
	Good	2	4	11	9	6	3	1	17	18	60.0
Integumentary											
	Traumatic skin wounds*	3	3	3	4	3	2	0	9	9	30.0
	Fibropapillomas (eyes, limbs, cloaca)	1	0	1	0	2	0	0	2	2	6.7
	Edema around neck and mandible	2	2	2	5	0	1	0	6	6	20
	Cutaneous hemorrhage	0	1	1	2	0	0	0	2	2	6.7
	Spirorchiid egg granulomas	1	1	1	1	2	0	0	3	3	10.0
Muscoskeletal											
	Carapace fractures	0	0	3	2	1	0	0	3	3	10.0
	Partial and full amputation of limbs and/or head	0	3	5	2	4	2	0	8	8	26.7

Appendix Table, continued

		Life Stage			Sex			Species			
System	Lesions	Juvenile	Sub-adult	Adult	Male	Female	Unknown	Hawksbill	Green	Number (n)	%
Digestive											
	Gastroenterocolitis**	1	0	1	2	0	0	0	2	2	6.7
	Gastrointestinal impaction	0	0	1	1		0	0	1	1	3.3
	Hepatic lipidosis	1	1	2	3	1	0	1	3	4	13.3
	Spirorchiid egg granulomas	5	4	11	10	8	2	0	20	20	66.7
Cardiovascular											
	Spirorchiid egg granulomas	3	0	6	6	2	1	0	9	9	30.0
Sensory											
	Exopthalmus		1	2	3	0	0	0	3	3	10.0
	Conjunctivitis	1	0	0	0	0	1	0	1	1	3.3
	Keratitis	1	0	0	1	0	0	0	1	1	3.3
	Spirorchiid egg granulomas	1	0	0	1	0	0	0	1	1	3.3
Urogenital											
	Renal oxalosis	2	1	0	1	1	1	0	3	3	10.0
	Chronic Lymphocytic nephritis	0	0	2	1	1	0	0	2	2	6.7
	Spirorchiid egg granulomas	2	4	6	7	5	0	0	12	12	40.0
Reproductive											
	Burst ovarian follicle	0	0	1	0	1	0	0	1	1	3.3
	Spirorchiid egg granulomas	0	0	3	1	2	0	0	3	3	10.0

APPENDIX TABLE, continued

System	Lesions	Life Stage			Sex			Species			
		Juvenile	Sub-adult	Adult	Male	Female	Unknown	Hawksbill	Green	Number (n)	%
Respiratory											
	Spirorchiid egg granulomas	4	4	10	9	8	1	0	18	18	60.0
Endocrine											
	Spirorchiid egg granulomas	1	0	2	2	1	0	0	3	3	10.0
Immune											
	Spirorchiid egg granulomas	2	0	3	4	1	0	0	5	5	16.7