APPENDIX 10

Report on Ecosystem Impacts, Rafe Boulon, M.S.

March 2, 2015

RE: Expert Report for U.S. Army Corps of Engineers Permit Application # SAJ-2004-12518 (SP-JMS)

Prepared By:
Ralf (Rafe) H. Boulon, Jr.
#2 Trunk Bay
5000 Estate Enighed, PMB#68
St. John, VI 00830
T: 340-693-8524 E: rboulon@gmail.com

This report is prepared with regard to a permit application by Summer's End Group to construct a marina in Coral Bay, St. John (US Virgin Islands CZM Permit Application #s CZJ-3-14L and CZJ-4-14W and US Army Corps of Engineers Permit Application #SAJ-2004-12518). The opinions stated below are expressed with a high degree of scientific and professional certainty.

I would like to start by providing my credentials. I was born and raised on St. John, USVI. I have a BA in Marine and Environmental Science from the College of the Virgin Islands (1976) and a Masters of Science in Biological Oceanography (coral reef ecology) from the University of Puerto Rico-Department of Marine Science (1980). I worked for the USVI Department of Planning and Natural Resources - Division of Fish and Wildlife for 18 years as Chief of Environmental Education and Endangered Species and retired (January 2013) after 14 years with the Virgin Islands National Park and Virgin Islands Coral Reef National Monument as Chief of Resource Management and Science. I have worked extensively with coral reefs, sea turtles, mangrove habitats, benthic habitat mapping and protected area management. Much of this work can be identified from the attached Curriculum Vitae and list of publications. This report addresses the impacts of the proposed marina on the marine and coastal natural environment.

The Setting

To begin with, Coral Bay is a deeply indented bay which faces south/southeast, into the predominant trade winds. As such, wind driven surface currents flow into the bay with most of the outflow being back out as sub-surface and bottom currents. There is some tidal influence but wind driven currents are the predominant pattern. The configuration of the bay and the direction of the prevailing winds (together with limited tidal influence) creates a situation of restricted water circulation as well as eventual contact of most surface waters with benthic habitats as the water sinks and flows out of the bay near the bottom. Coral Bay, in its natural state, has evolved to be adapted to and in equilibrium with this system.

Coral Bay contains numerous natural coastal and marine ecosystems and resources. All of these are highly sensitive to changes in the physical and chemical qualities of their environment. This report will later discuss the sea grass, mangrove, coral reef and sea turtle communities found in Coral Bay, as well as discuss wave and wind conditions at the proposed site and potential impacts from TBT containing bottom paints.

The Proposal and Associated Pollutants

Summers End Group is proposing to build a 145 slip marina with 1,333 pilings, approximately 7.5 acres of overhead docks and walkways, and which would accommodate a large assortment of vessels (ACOE Permit Application # SAJ-2004-12518 (SP-JMS)). Many of these vessels will likely be of larger size with deep draft, all with various types of anti-fouling paints on their bottoms, and all with the potential for the discharge of a multitude of pollutants into the surrounding waters. Fuelling and other marine services add additional potential for discharges. Of particular concern is that this structure of pilings and vessels, which will occupy approximately 75% of the bay, will further restrict water flow and circulation in the bay, thus exacerbating potential impacts to the marine and coastal natural environment. As discussed below, increased residence times and concentration of pollutants will certainly have a significant negative impact on the bay and its resources.

Boats generate a lot of waste (Milliken and Lee, 1990).[1] In addition, boats have anti-fouling paints on their bottoms. These paints range from relatively benign to extremely toxic (for example, TBT) containing paints are still available in the BVI), and all of them function by gradually releasing small amounts of the toxic components that inhibit marine fouling (Srinivasan and Swain, 2007; Konstantinou and Albanis, 2004; Alzieu, 2000). With up to 145 boats at one location that has somewhat restricted water circulation like Coral Bay the ecological impacts, as explained below, will likely be significant. Further, if only a portion of the vessels start their engines or run their generators, either diesel or gas/oil mix, the resulting exhaust becomes an air quality issue to environments downwind of the marina; these engines generate emissions – particularly particulate matter carrying pollutants– that drop from the air to the water. Concentration of vessels leads to concentration of pollutants. The larger the vessel, the greater the amount of pollutants into surrounding waters. In addition, it is not uncommon for boat engines to release gas and oil, particularly when they are not well-maintained. As shown below, this can only lead to damage of the sensitive natural resources in Coral Bay.

---

[1] In spite of best intentions (I know, I lived on a boat for 6.5 years) stuff goes overboard. Be it deliberate septic discharge or dish washing water, minor maintenance or simply washing down the decks, pollutants go in the water. Multiply this by up to 145 boats and the waste load into Coral Bay from the proposed marina becomes significant.

Sea Grasses

There are three species of sea grass that occur at the site for the proposed marina: *Thalassia testudinum* (turtle grass), *Syringodium filiforme* (eel grass) and *Halodule wrightii* (shoal grass). The SEG Environmental Assessment Report states that "Dense seagrass, primarily *Thalassia testudinum*, are found in the offshore environment at a depth of between 1 ft. and 11 ft., at which point they begin to diminish and algal species become more prevent. *Syringodium filiforme* also becomes more prevalent with depth" (SEG, 2014, page 6-25). Data from quadrats done in 2012 by BioImpact (SEG Environmental Assessment) shows *Thalassia* in 53 Of 60 quadrats with percent cover ranging from 5 to 100 (avg. of 89.9%). The 2012 data also shows *Halodule* in six of 60 quadrats with percent cover ranging from five to 90 (avg. of 35.8%) and *Syringodium* in just two of 60 quadrats with a percent cover of 1%. The 2014 quadrat data from BioImpact (SEG Environmental Assessment) shows *Thalassia* in 42 Of 50 quadrats with densities ranging from 1 to 100 (avg. of 52). The 2014 data also shows *Syringodium* in nine of 50 quadrats with densities from 3 to 45 (avg. of 14.2). No *Halodule* is shown in the 2014 data. It is not clear how the two data sets relate geographically nor how they relate density and percent cover. However, both data sets indicate relatively high amounts of *Thalassia* at the site with varying amounts of the other two species.

In 2008, Bologna et al (2008) found that Coral Harbour, the most anthropogenetically impacted site that they studied, had the highest *Thalassia* biomass, but the lowest floral diversity. Their study found neither of the other two species of sea grass. The Harbour's faunal community was dominated by small polychaetes with significantly lower secondary production. The most protected and least stressed site in the Harbour, Hurricane Hole, had the highest floral and faunal species richness, faunal density, faunal diversity, and secondary production. The presence of the other two species of sea grass in Coral Harbour in 2012 and 2014 suggests a reduction in anthropogenic stresses and an increase in floral diversity.

Sea grass beds are an important habitat for many species of fish, invertebrates and green sea turtles. This habitat is an important link in trophic transfer between mangroves and coral reefs, serving as an intermediate habitat between the fish nurseries found in mangroves and adult fish populations on coral reefs. Sea grasses both trap sediments in the water column with their leaf/blade structures and, with their rhizomatous root systems, act to hold and stabilize bottom sediments. As plants, they also add significantly to the levels of oxygen in the water through photosynthesis. These functions assist in maintaining water quality and clarity, important for all marine habitats (Zieman, 1985).

As coastal systems are impacted by natural and anthropogenic disturbances, the value and linkages among these habitats may often be altered, degraded or eliminated. It has been noted that human disturbances, such as habitat destruction, and eutrophication, generally lead to significant or permanent ecosystem damage, while natural disturbances, such as hurricanes, are generally followed by natural recovery (Kontos and Bologna, 2008).

Elimination of at least 2.8 acres of sea grasses by shading from the docks (SEG estimate in the EAR)[2] can lead to destabilization of at least 2.8 acres of sea bottom by removing the sea grasses that trap and hold bottom sediments and help maintain water clarity/quality. The impact to submerged aquatic vegetation from shading produced by overwater structures, primarily due to the lack of sunlight available to support photosynthesis, has been well documented (Olson, et al, 1997).

In addition, Due to the shallow nature of this bay, especially in the location of the proposed marina as reflected by the bathymetric charts accompany the SEG application, the turning and movement of large yachts arriving to and departing from the docks will likely scour areas of the sea bottom through the actions of the boats' propellers, commonly known as "prop-wash", thus impacting far more acreage of sea grasses than what is proposed from the dock area alone. The destruction of large areas of sea grasses will enable storm waves to suspend large amounts of exposed sediments that were formerly held in place by sea grass. Suspended sediments, if either as frequent pulse events or chronic, will have direct impact on the remaining sea grasses and any nearby coral and hard bottom communities through degradation of water clarity and reduction of light necessary for the health of these systems (Zieman, 1985; Rogers, 1990). In sum, the project would negatively affect the health of the Harbour's sea grasses, which would lead to increases in suspended sediments and consequential degradation of water quality from turbidity. This impact is particularly significant because the Harbour, as noted above, appears to be increasing its floral diversity; a degradation of water quality would undoubtedly reverse that process.

With respect to the Summer's End Group's proposal to mitigate this loss by "replanting" sea grass elsewhere, this proposed mitigation plan is not sound. If sea grass is not naturally growing someplace nearby, there is an ecological reason why it is not growing there. For example, the substrate may not support sea grasses, nutrients and/or light may be limiting or other biological factors may prevent it (Zieman, 1985). And even if all environmental conditions are right for sea grass to grow, the colonization and growth rates for the different species are so slow that they are easily disturbed by factors such as wave action, decreased water quality and other stressors, resulting in high mortality of the transplanted sea grass (Zieman, 1985). Merely planting sea grass in an area where it is not presently growing will not work. A further pitfall in any mitigation

[2] This estimate is probably very conservative as it does not include shading from vessels tied to the docks, many of the vessels are likely to be owned by non-residents and will be tied up for long periods of time in the non-tourist season.

proposal is that existing, healthy habitat is being destroyed and traded for the promise of replacement habitat, with no guarantee that the replacement habitat will be in any way ecologically similar to what is being destroyed (Fonseca, et al, 1998). The proposed sea grass mitigation proposal is neither adequate nor sustainable mitigation and would not offset the significant adverse impacts on seagrass discussed above.

Mangroves

At the head of Coral Harbour is a basin forest of Red Mangroves (*Rhizophora mangle*) (Zitello, et al, 2009). They lie at the main outflow from the Carolina watershed watercourse which is also at the most downwind location in Coral Harbour. While these mangroves are not as robust a fish nursery habitat as Hurricane Hole due their location at the base of the Carolina watershed, they do provide habitat for a number of juveniles of various species such as sharks, lobster, eagle rays and reef fish (S. Coldren, pers comm) as well as many other ecological benefits. As part of the riparian buffer around Coral Harbour, the mangrove shorelines trap and reduce sediment from reaching marine waters, they may reduce chemical contaminants from land-based sources, they provide carbon-based nutrients to the marine food web of the bay and they provide important wildlife habitat to the ecosystem (Odum, et al, 1982).

Of primary concern for the mangroves in Coral Harbour would be the location of this proposed marina immediately seaward and to windward of them. Any and all pollutants entering the water and air from the marina would flow by wave and wind action towards the mangroves, causing significant adverse impacts. Nutrients from human generated waste would likely cause eutrophication of the mangrove prop-root communities and result in excessive algal growth, which would displace invertebrate and fish communities and in turn eliminate any juvenile fish nursery habitat. Petroleum and other chemical contaminants that float on the surface of the water and originate from the proposed marina will coat the mangrove prop-roots, either causing direct mortality of the trees (I have personally observed this at Red Hook, St. Thomas) or weakening them and increasing susceptibility to other stressors. The exhaust gasses produced from vessel engines and generators would impact the aerial portions of the mangroves and affect all wildlife nesting, roosting and/or foraging there.

Directly across Coral Bay from the proposed marina lies a portion of the Virgin Islands Coral Reef National Monument (VICR - a unit of the National Park Service). This portion of VICR is called Hurricane Hole, made up of four "creeks" and contains the most pristine mangrove and juvenile fish habitat remaining in the northern Virgin Islands (including the British Virgin Islands). Studies done in the 1980s (Boulon, 1992) compared similar areas in St. John and St. Thomas and found Hurricane Hole to have the richest diversity of juvenile fish of all sites. This location has almost entirely undisturbed watersheds above each creek which results in no anthropogenic sources of land-based pollution and extremely pristine waters. The East End Road traverses the ridge high above these creeks. However, runoff from the road is pretty much divided between the north and south sides of the ridge. As it is a very low traffic road, there is little potential for land-based pollutants to be generated that could affect Hurricane Hole. It has been recently documented that Hurricane Hole contains a large number of coral species (Yates, et al, 2014), a further substantiation of the pristine water quality in this area. Off of Turner Point in VICR there is a relatively healthy, well-developed spur and groove reef system that is relatively unique around St. John (Monaco et al, 2009; Zitello, 2009).

While detailed surface and subsurface water current studies have not been done for all of Coral Bay, there is great concern by the National Park Service (B. Fitzgerald, pers comm) that marine pollutants generated by the proposed marina may well be carried to Hurricane Hole and Turner Point by subsurface water currents exiting Coral Harbour. The impacts of these pollutants, if they reach Hurricane Hole, would be devastating to this pristine ecosystem and significantly impact the national treasure known as Hurricane Hole, as well as all coral reefs and hard bottom communities in the area that receive fish from this nursery habitat.

A telling illustration of these impacts is the dredging and virtual elimination of Krausse Lagoon on St. Croix in the 1960s for the construction of the Martin Marietta bauxite processing facility and the Hess Oil refinery. Prior to loss of the lagoon, fishermen caught large quantities of fish along the south side of St. Croix. Within just a few years of the loss of the lagoon, the fishing potential on the south side of St. Croix dwindled to almost nothing (O. Tranberg, pers. comm.) due to the loss of juvenile fish habitat. Any impacts to Hurricane Hole could have similar results to fish populations and recreational fishing on the south and east sides of St. John.

Finally, the same logic that dooms the proposed mitigation for sea grass applies to the project sponsor's proposal to mitigate impacts to mangroves by planting this species along the rocky and high wave action shoreline within the project area. These shorelines are by very definition inhospitable to and would not support mangroves. That is why these trees have not already colonized these areas.

Sea Turtles

There are seven species of sea turtles in the world, two of which are commonly seen in St. John waters; the Green (*Chelonia mydas*) and Hawksbill (*Eretmochelys imbricata).* The Leatherback *(Dermochelys coriacea*) is an open ocean species that infrequently nests on north shore beaches. All are listed as Threatened or Endangered and protected under the U.S. Endangered Species Act of 1973(ESA), 50 CFR 17.11. Green turtles can reach up to around 40 inches in carapace length and weigh up to 500 pounds, although most of the individuals in our nearshore waters are juveniles and sub-adults. Hawksbills can reach approximately 36 inches in carapace length and weigh up to 180 pounds. Sea turtles have evolved such that each species feeds on mostly different food items in the marine environment, thus eliminating or reducing any competition for food between species. Green turtles feed almost exclusively on sea grasses. One of our more abundant sea grasses, *Thalassia testudinum*, is named Turtle Grass due to this. Hawksbills feed mostly on sponges and zooanthids on reefs and hard bottoms although they have been observed feeding on these invertebrates in sea grass beds (pers. observ.).

All species of sea turtles are facing threats to their existence (NRC, 1990). The most obvious threat is the unsustainable harvest of sea turtles for meat or turtle shell and the taking of their eggs from beaches. Loss of or disturbance to nesting and foraging habitats has played a large role as well, with coastal development impacting nesting beaches, shallow seagrass beds and coral reefs (Lutcavage, et al, 1997).

The seagrass beds at and adjacent to the site of the proposed marina are healthy and suitable foraging habitat for juvenile and sub-adult Green Sea Turtle foraging. Several Green turtles were observed near the site during site work for the SEG Environmental Assessment Report (SEG, 2014, page 6-39). From mark and recapture studies done on St. John and St. Thomas (Boulon and Frazer, 1990) and in Culebra, PR (Collazo et al, 1992; Patricio, et al, 2011), there are many cases of the same turtles being recaptured in the same bays over periods of time of up to two plus years. This would indicate that at least some turtles remain in one bay for long periods of time. It has been suggested that when turtles recruit to a specific bay they remain faithful to that area (Patricio, et al, 2011). Therefore, there may be a population of Green turtles that are dependent on the sea grass habitat in Coral Harbour and would be displaced by construction of a marina, in violation of the habitat protection provisions of the ESA and its implementing regulation. These sea grasses may also be an important food resource for green turtles as they move around the island.

Hawksbill turtles are likely not common at the specific site of the proposed marina. However, there are numerous hawksbills within Coral Bay, both in fringing reef and sea grass habitats, as reported by boaters and divers. The SEG Environmental Assessment mentions sightings of hawksbills within the proposed marina site during surveys (SEG, 2014, page 6-39). There are sponge communities growing in hard bottom habitats as well as on mangrove prop roots, vessel bottoms and mooring lines. Hawksbill turtles may forage in these areas, all of which are found nearby to the proposed site for the marina. The type of marine disturbance associated with the project would likely deter all species of sea turtles from foraging in this area.

There are also potentially significant consequences to sea turtles in the waters in and near to the proposed marina from audible impacts from the driving of pilings. Sound attenuates in water at eight times the speed in air, thus magnifying and propagating the audible impacts. Marine organisms are adapted to the low, natural level of sounds in the marine environment. Sea turtles have been found to be most sensitive to vibrational stimuli, such as would be produced by pile driving, between 300 to 400 Hz, although they respond to stimuli above 1000Hz (Dow-Piniak, et al, 2012a; 2012b). Pile driving has been shown to produce extremely loud, far-reaching sound underwater. While the results of this for sea turtles are unknown, it can almost certainly be understood to have negative impacts depending on their proximity to the pile-driving activities. The applicant has not addressed this issue, and should be required to assess the potential physiological and behavioral effects of anthropogenic noise on sea turtles (Dow-Piniak, et al, 2012a). Even distant underwater explosions, such as associated with removal of oil rigs in the Gulf of Mexico, are believed to impact sea turtles that may be some distance away, including disorientation, loss of hearing and possible mortality (Lutcavage, et al, 1997; NRC, 1990).

For a comprehensive review of anthropogenic and natural impacts to sea turtles, see [http://www.widecast.org/Conservation/Threats.html].

Corals

Small individual coral colonies most likely occur on scattered hard bottom areas and can be found in seagrass beds within the proposed marina site, including *Porites sp, Siderastrea radians* and *Manicina areolata*. Other corals are found across Coral Harbour on Fortsberg Point, including the Threatened *Acropora* species and *Orbicella annularis*. The SEG Environmental Assessment Report mentions that "There are a few large coral heads offshore of the culvert discharge in the middle of the property" (SEG, 2014, page 6-25) and identifies them as *Solenastrea bournoni* (SEG, 2014, page 6-28). There would be direct impact to small scattered coral colonies in the seagrass beds and occasional hard bottom outcropping within the proposed site, and likely impacts from the proposed marina to corals some distance away, especially if there is a measurable discharge of pollutants from the marina that exceed EPA/VI water quality standards for this water body (See DPNR-DEP Water Quality Standards).

It is important to note that in the Caribbean approximately 97% of diseased coral are found in areas impacted, either highly or moderately, by human activity (Green and Bruckner, 2000). Disease incidence, community composition shifts and other coral stressors are being linked to human sewage and wastewater disposal into the marine environment (Futch, et al, 2010). While Coral Bay has potential for some contamination from the surrounding watersheds, it is certain that a large marina in the bay would contribute significantly to contamination of the Bay and would adversely affect coral.

Vessel Anti-Fouling Paints

There is a relatively strong cause and effect relationship between measured butyltin concentrations and imposex levels in gastropods which supports the theory that imposex development is caused by TBT-induced endocrine disruption (Strand et al, 2009). Imposex (a masculinization of prosobranch gastropod females) has been described in more than 240 gastropod species almost worldwide (Strand, unpubl.) and has been recognized as a valuable biomarker for baseline surveys and monitoring of biological effects of contaminants in the environment. In the most TBT-contaminated areas, the effects have resulted in visible signs of sterility in gastropod females. However, other types of adverse chronic effects of TBT have been reported such as impaired growth, reduced embryo production, and immune suppression, which may also occur in other sensitive species inhabiting marine ecosystems (Alzieu, 2000).

In the USVI, Strand, et al (2009) found the highest levels of imposex where there were the greatest number of boats and marinas. In Charlotte Amalie harbor, the two species of molluscs sampled both had 100% imposex frequencies. Christiansted and Fredericksted harbors, for the mollusc species sampled, had approximately 70% imposex frequencies. Coral Harbour, for the one species sampled (*Thais deltoidea*) the imposex frequency was 57%. All other locations sampled were under 20% frequency of imposex.

While TBT levels are expected to decline in the coming years, due to enforcement of the international ban on TBT for commercial shipping traffic (IMO, 2008), TBT will probably still be available internationally and in use on private vessels for some decades. Of concern is the development and use of other booster biocides which will substitute for TBT as alternative antifouling agents and for which no studies exist to determine their effect on marine species. It is, therefore, likely that a large number of boats with TBT or other bottom paints would utilize a large marina in Coral Harbour, and that consequently the levels of butyltin and imposex frequencies of molluscs would greatly increase. Such an increase would cause a collapse of an important component of many marine communities in the Coral Bay area.

Furthermore, while TBT has been targeted as one of the most toxic anti-fouling compounds, there is growing concern that even the generally accepted copper-based antifouling paints (many with booster biocides added to improve their effectiveness) may pose unacceptable risks to the marine environment (Srinivasan and Swain, 2007). This study calculated amounts of copper loading at marinas in Florida and at one of the largest marinas sampled (120 boats in the water), calculated a conservative figure of 198 kg of copper per year released into the water. At almost all of the marinas sampled, dissolved copper in the water exceeded Florida state water quality standards. It is also known that copper-based anti-fouling paints produce paint chips that fall off the boats and sink to the bottom. These have been observed at mooring fields in Virgin Islands National Park in high concentrations (C. Downs, Haereticus Labs, pers comm). These chips can be ingested by marine organisms and passed up the food chain, thus causing toxicity at many levels. See Srinivasan and Swain (2007) and Konstantinou and Albanis (2004) for extensive lists of related references.

Wave/Wind Conditions

The proposed location for the proposed marina is far less than ideal, being exposed to wind chop from the east/southeast and wave conditions from the south/southeast. Almost every time a major storm hits St. John, a number of boats end up on shore at this location, some of them quite large. This observed condition clearly makes a statement about the effects of winds and waves at this location. It is well known that everyone wants very calm water at a marina, something that will be in short supply at the proposed location. And, very likely, when the docks, and presumably some boats, break loose during a storm, there will be considerable collateral damage to the marine environment and the downwind mangroves.

The proposed marina would displace all of the existing moorings in the bay and place them in a very close-packed (75 foot diameter) mooring field on the northeast side of the bay. The density of this mooring field would further concentrate any impacts that may result from the vessels currently moored in Coral Bay. With the proposed diameter of 75 feet per mooring, this may severely limit the size of vessels that can safely use these moorings. In comparison, the Virgin Islands National Park uses a 200 foot diameter mooring field for vessels up to 60 feet in length, which allows vessels to safely swing in a variety of wind conditions (as well as provide some level of privacy for vessels that have people on board), while reducing concentration of impacts from moored boats.

Sincerely,

Ralf (Rafe) H. Boulon, Jr.
#2 Trunk Bay
5000 Estate Enighed, PMB#68
St. John, VI 00830
340-693-8524
rboulon@gmail.com

Literature Cited

Alzieu, Claude. 2000. Impact of Tributyltin on Marine Invertebrates. Ecotoxicology, 9: 71-76, 2000.

Bologna P.A.X., R. Papagian, S. Regetz, and C. Dale. 2008. Assessment of turtle grass (*Thalassia testudinum* ex Banks Konig) community structure in a UNESCO Biosphere Reserve. Journal of Experimental Marine Biology and Ecology 365 (2008) 148–155.

Boulon, R.H. 1992. Use of mangrove proproot habitats by fish in the northern U.S. Virgin Islands. Proc., 41st Gulf and Caribbean Fisheries Institute, 41:189-204.

Boulon, R.H. and N.B. Frazer. 1990 . Growth of Wild Juvenile Caribbean Green Turtles, *Chelonia mydas*. J. of Herpetology, 24(4): 441-445.

Collazo JA, Boulon R Jr., Tallevast TL. 1992. Abundance and growth patterns of Chelonia mydas in Culebra, Puerto Rico. J Herpetol 26: 293–300.

Dow Piniak, W.E., D. A. Mann, S. A. Eckert, and C. A. Harms. 2012a. Amphibious Hearing in Sea Turtles. *In* A.N. Popper and A. Hawkins (eds.), The Effects of Noise on Aquatic Life. Advances in Experimental Medicine and Biology 730, DOI 10.1007/978-1-4419-7311-5_18: 83-87.

Dow Piniak W. E., Eckert, S. A., Harms, C. A. and Stringer, E. M. 2012b. Underwater hearing sensitivity of the leatherback sea turtle (Dermochelys coriacea): Assessing the potential effect of anthropogenic noise. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2012-01156. 35pp.

Fonseca, M.S., W.J. Kenworthy and G.W. Thayer. 1998. Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters. NOAA Coastal Ocean Program, Decision Analysis Series No. 12. NOAA Coastal Ocean Office, Silver Spring, MD. 222 pp.

Futch, J. Carrie, Dale W. Griffin, and Erin K. Lipp. 2010. Human enteric viruses in groundwater indicate offshore transport of human sewage to coral reefs of the Upper Florida Keys. Environmental Microbiology (2010), doi:10.1111/j.1462-2920.2009.02141.x.

Green, E.P., and Bruckner, A.W., 2000. The significance of coral disease epizootiology for coral reef conservation. Biol Conserv 96: 347–361.

IMO (The International Maritime Organization). International convention on the control of harmful anti-fouling systems on ships; 2008. www.imo.org.

Kontos, Charles C. and Paul A. X. Bologna. 2008. Assessment of Fish and Decapod Distributions Between Mangrove and Seagrass Habitats in St. John, U.S.V.I. Bull. N.J. Acad. Sci., 53(2), pp. 7–11.

Konstantinou, I.K. and T.A. Albanis. 2004. Worldwide occurrence and effects of antifouling paint booster biocides in the aquatic environment: a review. Environment International, 30 (2004): 235 – 248.

Lutcavage, M.E., P. Plotkin, B. Witherington and P.L. Lutz. 1997. Human Impacts on Sea Turtle Survival. In The Biology of Sea Turtles. Ed. By P.L. Lutz and J.A. Musick. CRC Press, Boca Raton. Pages 387-409.

Milliken, Andrew S. and Virginia Lee. 1990. Pollution Impacts from Recreational Boating: A Bibliography and Summary Review. NOAA – National Sea Grant Depository Publication #RIU-G-90-002 (1990).

Monaco, M.E., A.M. Friedlander, C. Caldow, S.D. Hile, C. Menza and R.H. Boulon. 2009. Long-term monitoring of habitats and reef fish found inside and outside the U.S. Virgin Islands Coral Reef National Monument: A comparative assessment. Caribbean Journal of Science, Vol. 45, No. 2-3, 338-347, 2009.

National Research Council. 1990. Decline of the Sea Turtles: Causes and Prevention. National Academy Press, 1990. 259 pp.

Odum, W.E., C.C. McIvor, and T.J. Smith. 1982. The ecology of the mangroves of South Florida: a community profile. U.S. Fish and Wildlife Service, Office of Biological Services, Wash. DC. FWS/OBS-81-24, 144 PP.

Olson, A.M., S.D. Visconty, and C.M. Sweeney. 1997. Modeling the shade cast by overwater structures. University of Washington. School of Marine Affairs. SMA Working Paper-97-1.

Patrício AR, Velez-Zuazo X, Diez CE, van Dam R, Sabat AM. 2011. Survival probability of immature green turtles in two foraging grounds at Culebra, Puerto Rico. Mar Ecol Prog Ser 440: 217–227.

Rogers, Caroline S. 1990. Responses of coral reefs and reef organisms to sedimentation. Mar. Ecol. Prog. Ser. 62: 185-202, 1990.

SEG. 2014. Environmental Assessment Report for the Development of the St. John Marina, Coral Bay, St. John, USVI. Submitted to DPNR/CZM and US Army Corps of Engineers, April 2014. 116 pp.

Srinivasan, Mridula and Geoffrey W. Swain. 2007. Managing the Use of Copper-Based Antifouling Paints. Environmental Management (2007) 39:423-441.

Strand, J., A. Jørgensen, and Z. Tairova. 2009. TBT pollution and effects in molluscs at US Virgin Islands, Caribbean Sea, Environment International (2009), doi:10.1016/j.envint.2009.01.007.

Yates, K.K., C. S. Rogers, J. J. Herlan, G. R. Brooks, N. A. Smiley, and R. A. Larson. 2014. Mangrove habitats provide refuge from climate change for reef-building corals. Biogeosciences Discuss., 11, 5053–5088, 2014.

Zieman, J.C. 1985. The ecology of the seagrasses of South Florida: a community profile. U.S. Fish and Wildlife Service, Office of Biological Services, Wash. DC. FWS/OBS-82/25, 158 pp.

Zitello, A.G., L.J. Bauer, T.A. Battista, P.W. Mueller, M.S. Kendall and M.E. Monaco. 2009. Benthic Habitats of St. John, U.S. Virgin Islands. NOAA Technical Memorandum NOS NCCOS 96, Biogeography Branch. Silver Spring, MD.

CURRICULUM VITAE

Ralf H. Boulon, Jr.

January 2014

Born : August 22, 1952, St. Thomas, U.S. Virgin Islands
Married to Kimberly Leighton-Boulon, 1979
Children: Devon L. Boulon [1/14/82] and Revel H. Boulon [8/15/84]

Address: No. 2 Trunk Bay, 5000 Estate Enighed, PMB#68
St. John, U.S. Virgin Islands 00830
Tel.: [340] 693-8524/[340] 776-1408
Email: rboulon@gmail.com

Present Position: Resource Management Consultant on topics related to management of marine and terrestrial resources and human impact mitigation.

Education: BA, Marine and Environmental Science, 1976, College of the Virgin Islands, St. Thomas, VI.
MS, Biological Oceanography, 1980, University of Puerto Rico, Mayaguez, Puerto Rico. Specialized in deep coral reef ecology.

Languages: English (Native)
Spanish (Very Good)

Employment and Experience :

September, 1978: Photographic surveys of coral distributions in Salt River, St. Croix, USVI. NOAA Underwater Laboratory System -1 [NULS-1], Mission 78-6 (10-day saturation diving mission).

June - August, 1980: Eilat, Israel, Social control of sex reversal in a coral reef fish, *Anthias squamipinnis* . Dispersion of social groups relative to substrate and other social groups.

October 1978 - November 1980: Community structure of scleractinian corals on the shelf edge reef, southwestern Puerto Rico, and the effects of a hurricane [David] generated swell (MS Thesis).

June 1981 - October 1982: Environmental Specialist II, Endangered Species Coordinator, V.I. Government, Department of Conservation and Cultural Affairs (DCCA), Division of Fish and Wildlife.

October 1982 - August 1983: Acting Director, DCCA, Division of Fish and Wildlife.

August 1983 - June 1988: Environmental Specialist II, Endangered Species Coordinator, DCCA, Division of Fish and Wildlife.

June 1988 - April 1999: Chief, Bureau of Environmental Education, Endangered Species Coordinator, Department of Planning and Natural Resources (DPNR), Division of Fish and Wildlife. This position involved conservation and protection of federal and local threatened and endangered species such as three species of sea turtle, a Tree Boa, a ground lizard and several plants; development of educational materials for use in schools and with the general public; establishment and management of marine protected areas in territorial waters; permitting of research and collection activities in the Territory; review and develop conditions for major CZM projects in St. Thomas and St. John and numerous independent research projects involving sea turtle ecology, mangrove fish nursery habitat, benthic habitat mapping and fish surveys.

February 1999 - April 1999: Acting Director, DPNR, Division of Fish and Wildlife.

April 1999 to December 2012 (Retired): Chief, Division of Resource Management and Science (GS13), Virgin Islands National Park and Virgin Islands Coral Reef National Monument, U.S. National Park Service, Dept. of the Interior. This position involved the management and preservation of all natural and cultural resources found in both park units with responsibility for the preparation of the Resource Management Plan; served as the Endangered Species Coordinator and NEPA Coordinator (prepared compliance documents such as DO-12 Categorical Exclusions, Environmental Assessments, Environmental Impact Statements, Section *106* clearances, Federal Consistency Determinations with DPNR/CZM, COE, NOAA-NMFS and USFWS and Essential Fish Habitat Determinations); reviewed, set conditions and recommended approval or non-approval of requests for collection and research permits to ensure that NPS collection policies are adhered to; was responsible for the maintenance and management of the park's museum and archives collections; served as the principal park representative to the Man and the Biosphere Program; built lines of communication between the Virgin Islands Biosphere Reserve and resource managers/scientists throughout the Lesser Antilles; advised the Superintendent on resource issues and problems, and strategies for addressing or resolving those issues and problems; maintained working relationships with scientists and professionals inside and outside the NPS, such as in institutions of higher learning; was responsible for preparing and submitting the annual land acquisition requests to the Regional lands Office; and was responsible for obtaining funding and acquiring lands that increased the land portion of VI National Park by approximately eight percent. Responsible for installing and maintaining Park and Monument mooring program, including 200+ day and overnight moorings and 150+ regulatory buoys. Developed and oversaw installation of 100+ storm refuge moorings in a pristine system of mangrove embayments to protect the mangroves and provide safe refuge for the boating community. Coordinated damage assessments for coral reef/sea grass groundings and damages to terrestrial habitats and oversaw NRDA/19jj recovery efforts and expenditures of damage settlements.

Professional Societies : (While employed)

Society for Conservation Biology
Network of Tropical Fisheries Scientists
Association of Marine Labs of the Caribbean
George Wright Society

Miscellaneous :

Member, Scientific and Statistical Committee, Caribbean Fishery Management Council [NOAA-NMFS-CFMC], 1984 to 2009.

Member, Habitat Advisory Panel, NOAA-NMFS-CFMC, 1989 to 2012.

V.I. Government Designee, NOAA-NMFS-CFMC; 1985 to 1987, 1991 to 1993.

Member, Major Permit Review Team, USVI Coastal Zone Management Division, 1983 to 1999.

Member, Masters in Marine and Environmental Science Advisory Committee, Univ. of the Virgin Islands, 2007 to 2012.

Program / Research Associate, Island Resources Foundation, St. Thomas, VI, approx. 1985 to present.

Team Leader, U.S. Recovery Plan Teams, Leatherback (1992) and Hawksbill (1993) Sea Turtles.

USVI Country Coordinator, Wider Caribbean Sea Turtle Conservation Network [WIDECAST], 1988 to present.

Sea Turtle and Marine Mammal Stranding Coordinator, USVI, Caribbean Stranding Network, 1981 to 1999.

National Representative, USVI, to the Western Atlantic Turtle Symposia [WATS I (Costa Rica), 1983 and WATS II (Puerto Rico), 1987].

National Representative, USVI, to the First Pan American Congress on the Conservation of Wildlife through Education, Caracas, Venezuela, 1990.

Virgin Islands Representative, NOAA South Atlantic Regional Marine Research Planning Board; 1992 to 1996.

Chairman, Virgin Islands Environmental Resource Station, UVI-ECC, Advisory Board, 1995 to 1998.

Member, Wetlands Advisory Board, University of the V.I.

Member, Network of Tropical Fisheries Scientists (ICLARM), 1987 to 2012.

Member, IUCN/WCU - Species Survival Commission, Marine Turtle Specialist Group, 1995 to present.

Member, Virgin Islands Marine Protected Areas Advisory Committee, 2005 to 2012.

Permit Reviewer, NOAA-NMFS-Office of Protected Resources (Sea turtle research and take permits).

Member, *Acropora* Biological Review Team, NOAA-NMFS, 2005-2006.

Member, Univ. of the VI Masters in Marine and Environmental Studies Advisory Board and graduate student advisor, 2008 to 2012.

Training:

Wetlands Delineation training course, U.S. Army Corps of Engineers, San Juan, P.R., July 1995.

Natural Resource Damage Assessment Workshop, NOAA, St. Croix, V.I., February 1998.

Oil Spill Response and Tropical Marine Damage Assessment and Restoration. NOAA, Key West, Fla., June 2000.

Awards:

Service Above Self Award, Rotary Club of St. Thomas East. 2002.
Coastal America Partnership Award – USVI Marine Park Advisory Committee. 2003.
US Coral Reef Task Force – Acropora Biological Review Team. 2006.
US Coral Reef Task Force – Coral Reef Management. 2006.
Partnership Award, Friends of VI National Park. 2006.

Keeper of the Live Oak Award, National Park Service – SE Region Natural Resource Management. 2007 and 2011.

Publications and Reports :

Boulon, R.H., 1979. Coral distribution in the Salt River submarine canyon, St. Croix , USVI. Final Scientific Report, NULS-1 Mission 78-6, MUS&T Office, NOAA, DOC, Wash., D.C.. 18 pp.

Boulon, R.H. 1986. Distribution of fisheries habitats within the Virgin Islands Biosphere Reserve. Biosphere Reserve Research Report No. 8, MAB, NPS, DOI. 56 pp.

Boulon, R.H. 1986. Adjacent fishery habitats of ecological importance to the fishery resources of the VI Biosphere Reserve. Biosphere Reserve Research Report No. 9, MAB, NPS, DOI. 25 pp.

Boulon, R.H. 1987. A basis for long-term monitoring of fish and shellfish species in the Virgin Islands National Park. Biosphere Reserve Research Report No. 22, MAB, NPS, DOI. 66 pp.

Boulon, R.H. 1989. Virgin Islands turtle tag recoveries outside of the USVI. In : Eckert, S.A., K.L. Eckert and T.H. Richardson. 1989. Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology. NOAA Tech. Memo NMFS-SEFC - 232: 207 - 209.

Boulon, R.H. 1992. Use of mangrove proproot habitats by fish in the northern U.S. Virgin Islands. Proc., 41st Gulf and Caribbean Fisheries Institute, 41:189-204.

Boulon, R.H. 1992. Leatherback turtle (*Dermochelys coriacea*) Nesting Biology, Sandy Point, St. Croix, U.S.V.I.: 1981 to 1990. Proceedings of the Eleventh Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo NMFS-SEFSC-302: 14 - 16.

Boulon, R.H. 1992. Please "Brake for Wildlife". Marine Turtle Newsletter, 59:25.

Boulon, R.H., Team Leader. National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1992. Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic and Gulf of Mexico. NMFS, Wash., D.C. 65 pp.

Boulon, R.H., Team Leader. National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1993. Recovery Plan for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. NMFS, St. Petersburg, FL. 52 pp.

Boulon, R.H. 1993. Nesting Biology of a leatherback turtle, *Dermochelys coriacea*, on Sandy Point, St. Croix, U.S.V.I.: 1979 to 1992. Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo NMFS-SEFSC-341: 25 - 27.

Boulon, R.H. 1994. Growth Rates of Wild Juvenile Hawksbill Turtles, *Eretmochelys imbricata*, in St. Thomas, U.S. Virgin Islands. Copeia, 1994(3): 811 - 814.

Boulon, R.H. 1998. Trends in Sea Turtle Strandings, U.S. Virgin Islands: 1982 to 1997. Proceedings of the Eighteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo NMFS-SEFSC-436: 261-263.

Boulon, R.H. 1998. Leatherback Turtles: An Ancient Species In Peril. Dive Training, May 1998: 44 – 48.

Boulon, R.H. 1999. Reducing Threats to Turtle Eggs and Hatchlings: *In Situ* Protection. In Research and Management Techniques for the Conservation of Sea Turtles, K.L. Eckert, K.A. Bjorndal, F.A. Abreau-Grobois and M. Donnelly (eds.). IUCN/SSC Marine Turtle Specialist Group Publication No. 4.

Boulon, R.H. and D.A. Olsen. 1982. Virgin Islands Turtle Resources: aerial census results 1979 - 1980. Final Technical Report to National Marine Fisheries Service, NOAA Contract Nos. NA-79-GA-A-00133 and NA-80-GA-A-00055. 23 pp.

Boulon, R.H. and D.A. Olsen. 1982. Notes on the population biology of green [*Chelonia mydas*] and hawksbill [*Eretmochelys imbricata*] turtles in the USVI. Final Technical Report , USFWS,DOI. 33 pp.

Boulon, R.H., R.L. Norton and T.A. Agardy. 1982. Status of the brown pelican [*Pelecanus occidentalis occ.*] in the USVI. Final Technical Report, USFWS,DOI. 25 pp.

Boulon, R.H. and I.E. Clavijo.1986. Utilization of the VI Biosphere Reserve by commercial and artisanal fishermen. Biosphere Reserve Research Report No. 11, MAB, NPS, DOI, 40 pp.

Boulon, R.H. , J.P. Beets and E.S. Zullo. 1986. Long term monitoring methods of fisheries resources of the VI Biosphere Reserve. Biosphere Reserve Research Report No. 13, MAB, NPS, DOI. 31 pp.

Boulon, R.H., K.L.Eckert and S.A. Eckert. 1988. *Dermochelys coriacea* [leatherback sea turtle] migration. Herp. Rev., 19(4): 88.

Boulon, R.H. and N.B. Frazer. 1990 . Growth of Wild Juvenile Caribbean Green Turtles, *Chelonia mydas*. J. of Herpetology, 24(4): 441-445.

Boulon, R.H., D. L. McDonald, and P. H. Dutton. 1994. Leatherback turtle (*Dermochelys coriacea*) Nesting Biology, Sandy Point, St. Croix, U.S.V.I.: 1981 to 1993. Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo NMFS-SEFSC-351:190-193.

Boulon, R.H., P.H. Dutton, and D.L. McDonald. 1996. Leatherback turtles (*Dermochelys coriacea*) on St. Croix, U.S. Virgin Islands: Fifteen years of conservation. Chelonian Conservation and Biology, 1996, 2(2): 141-147.

Boulon, R., M.E. Monaco, A. Friedlander, C. Caldow, J. Christensen, C. Rogers, J. Beets, W. Miller, and S.D. Hile. 2008. An Ecological Correction to Marine Reserve Boundaries in the US Virgin Islands. Proceedings, 11th International Coral Reef Symposium, Fort Lauderdale, Florida: 1074 -1077.

Basford, S.S., R.L. Brandner and R.H. Boulon. 1986; 1987; 1988; 1989 and 1990. Tagging and nesting research of leatherback sea turtles [*Dermochelys coriacea*] on Sandy Point, St. Croix, USVI. Tech. Reports , USFWS, DOI. 29; 30; 32; 31; and 31 pp.

Beets, J.P. and R.H. Boulon. 1985. Habitat associations of reef fish assemblages within the V.I. Biosphere Reserve. Abstract, 65th Ann. Mtg., Am. Soc. Ichthyologists and Herpetologists. 1985 : 40.

Collazo,J.A., R.H. Boulon and T.L. Tallevast. 1992. Abundance and growth patterns of *Chelonia mydas* in Culebra, Puerto Rico. J. of Herpetology, 26(3): 293-300.

Dutton, P., D. McDonald and R.H. Boulon. 1992. 1991 a "record year" for leatherback productivity on St. Croix, U.S. Virgin Islands. Marine Turtle Newsletter, No. 57: 15-17.

Dutton, P., D. McDonald and R.H. Boulon. 1992; 1994. Tagging and nesting research of leatherback sea turtles [*Dermochelys coriacea*] on Sandy Point, St. Croix, USVI. Tech. Reports , USFWS, DOI. 25; and 23 pp.

Dutton, D.L., P.H. Dutton and R.H. Boulon. 2000. Recruitment and mortality estimates for female leatherbacks nesting in St. Croix, US Virgin Islands. Nineteenth Annual Symposium on Sea Turtle Biology and Conservation, NOAA Tech Memo NMFS-SEFSC-443:268-269.

Dutton, D.L., P.H. Dutton, M. Chaloupka and R.H. Boulon. 2005. Increase of a Caribbean leatherback turtle Dermochelys coriacea nesting population linked to long-term nest protection. Conservation Biology, 126 (2005): 186-194.

Eckert, S.A., K.L. Eckert and R.H. Boulon. 1982. Tagging and nesting research of the leatherback sea turtle, *Dermochelys coriacea*, Sandy Pt., St. Croix, USVI. Tech. Report, USFWS, DOI. 29 pp.

Goenaga, C. and R.H. Boulon. 1991. The state of Puerto Rican and U.S. Virgin Islands corals: An aid to managers. Special Report to the Caribbean Fishery Management Council. 64 pp.

Grober-Dunsmore, R., et al (incl. Boulon, R.). 2008. Vertical Zoning in Marine Protected Areas: Ecological Considerations for Balancing Pelagic Fishing with Conservation of Benthic Communities. Am. Fish. Soc., 33(12):598-610.

Hayes, M.L., R.H. Boulon and L.E. Ragster. 1995. Protecting Coastal Areas in the U.S. Virgin Islands: The Significance of Public-Private Partnerships. Abstr., Coastal Zone 95, Tampa, Fla.

Helfman, G., J. Beets, R. Boulon, E. Bozeman and D. Stoneburner. 1982. Ultrasonic telemetry of great barracuda, *Sphyraena barracuda*, in the USVI. Tech. Report to USFWS, DOI. 13 pp.

Hillis-Starr, Z.M., R. Boulon and M. Evans. 1998. Sea Turtles of the Virgin Islands and Puerto Rico. In: Mac, M.J.,P.A. Opler, C.E. Puckett Haecker and P.D. Doran (Eds.), Status and trends of the nation's biological resources. USDOI, USGS, Reston, VA. 964 pp.

McDonald, D., P. Dutton, and R.H. Boulon. 1991; 1993; 1995: 1996. Tagging and nesting research of leatherback sea turtles [*Dermochelys coriacea*] on Sandy Point, St. Croix, USVI. Tech. Reports , USFWS, DOI. 23; 22; 20 and 21 pp.

McDonald, D, B. Krueger, J. Ferguson and R.H. Boulon. 1996. Tagging and nesting research of leatherback sea turtles [*Dermochelys coriacea*] on Sandy Point, St. Croix, USVI. Tech. Reports , USFWS, DOI. 20 pp.

Monaco, M. E., A. M. Friedlander, C. Caldow, J. D. Christensen, C. Rogers, J. Beets, J. Miller, and R. Boulon. 2007. Characterizing Reef Fish Populations and Habitats Within and Outside the US Virgin Islands Coral Reef National Monument: A Lesson in Marine Protected Area Design. Fisheries Management and Ecology, 14:33-40.

Monaco, M.E., A.M. Friedlander, S.D. Hile, and R. Boulon. 2008. The Coupling of St. John, US Virgin Islands Marine Protected Areas Based on Reef Fish Habitat Affinities and Movements Across Management Boundaries. Proceedings, 11th International Coral Reef Symposium, Fort Lauderdale, Florida: 1022 - 1025.

Monaco, M.E., A.M. Friedlander, C. Caldow, S.D. Hile, C. Menza and R.H. Boulon. 2009. Long-term monitoring of habitats and reef fish found inside and outside the U.S. Virgin Islands Coral Reef National Monument: A comparative assessment. Caribbean Journal of Science, Vol. 45, No. 2-3, 338-347, 2009.

Olsen, D.A., R.H. Boulon and G.R. McCrain. 1981. An analysis of the St. Thomas fishery with special reference to the benthic communities on the shelf south of St. Thomas, USVI. Final Report, NOAA, DOC, Contract Nos. NA- 79RAC00158 and NA- 81RAA02977. 44 pp.

Platenberg, R.J. and R. H. Boulon. 2006. Conservation status of reptiles and amphibians in the US Virgin Islands. Applied Herpetology 3:215-235.

Rogers, C.S., J. Miller, E. Muller, P. Edmunds, R.S. Nemeth, J. Beets, A. Friedlander, T.B. Smith, R. Boulon, C.F.G. Jeffrey, C. Menza, C. Caldow, N. Idrisi, B. Kojis, M. Monaco, A. Spitzack, E. Gladfelter, J. Ogden, Z. Hillis-Starr, I. Lundgren, W.B. Schill, I. Kuffner, L.L. Richardson, B. Devine, and J. Voss. 2008. Ecology of Coral

Reefs in the U.S. Virgin Islands. pp. 303-374. In: B. Riegl and R.E. Dodge (eds.). Coral Reefs of the USA. Coral Reefs of the World, Volume 1. Springer. 806 pp.

Shapiro, D.Y. and R.H. Boulon. 1982. The influence of females in the initiation of female to male sex change in a coral reef fish. Hormones and Behavior, 16 : 66 - 75.

Shapiro, D.Y. and R.H. Boulon. 1987. Evenly dispersed social groups and intergroup competition for juveniles in a coral reef fish. Behav. Ecol. Sociobiol., 21: 343 - 350.

Taskavak, E., R.H. Boulon and M. Atatur. 1998. An unusual stranding of a leatherback turtle in Turkey. Mar. Turt. Newsletter No. 80:13.

Vicente, V.P., R.H. Boulon and T. Tallevast. 1995. Characteristics of green turtle (*Chelonia mydas*) grazing grounds in some Caribbean islands. Twelfth Annual Symposium on Sea Turtle Biology and Conservation, 1992. NOAA Tech. Memo NMFS-SEFSC-361: 145-149.

Whelan, K.R.T., Miller, J., Waara, R., Loomis, C., Caseau, S., Boulon, R. and M. Patterson. 2006. Long-term temperature record for four United States Virgin Island Reefs. Conference on Ocean Science. 2006

Williams, E.H., I. Clavijo, J.J. Kimmel, P.L. Colin, C. Diaz Carela, A.T. Bardales, R.A. Armstrong, L.B. Williams, R.H. Boulon and J.R. Garcia. 1983. A checklist of marine plants and animals of the South coast of the Dominican Republic. Carib. J. Sci. 19(1-2):39-53.

Williams, E.H., L.B. Williams, E.C. Peters, B.P. Rodriguez, R.M. Morales, A.A. Mignucci-Giannoni, K.V. Hall, J.V. Rueda-Almonacid, J. Sybesma, I.B. De Calventi and R.H. Boulon. 1994. An Epizootic of Cutaneous Fibropapillomas in Green Turtles, Chelonia mydas, of the Caribbean: Part of a Panzootic? J. of Aquatic Animal Health, 6:70-78.

Williams E.H. Jr., L.B. Williams, R.H. Boulon Jr., K.L. Eckert and N.L. Bruce. 1996. Excorallana acuticauda (isopoda, Corallanidae) An associate of leatherback turtles in the northeastern Caribbean, with a summary of isopods recorded from sea turtles. Crustaceana 69(8):1014-1017.

Popular Articles:

Boulon, R.H. 2008. Childhood Memories. St. John Magazine, Spring/Summer 2008: 68 - 71.

Boulon, R.H. 2008. Windswept Beach: Then & Now. St. John Magazine, Fall/Winter 2008: 78-79.

Boulon, R.H. 2009. Life in the Mangroves. St. John Magazine, Issue No. 4, 2009: 8 pp.

Boulon, R.H. 2010. Soldier Crab Saga. In Life in Five Quarters: Selected Readings from the Archives of the St. John Historical Society. Pgs. 166-167.

Boulon, R.H. 2012. Land, the Framework of Our National Parks. Kapok Chronicles, Virgin Islands National Park. 2012.

Boulon, R.H. 2013. St. John Fishing: My Historical Perspective. Five Quarters: Journal of the St. John Historical Society. Vol. XIV, No. 2; November 2013. Pgs. 1-3.

Boulon, R.H. 2013. St. John Crabs. St. John Magazine, Issue No. 7, 2013: 92 - 99.

Boulon, R.H. 2014. Wilbur M. Davis, St. John Artist, Recluse. Five Quarters: Journal of the St. John Historical Society. Vol. XIV, No. 4; May 2014. Pgs. 5-6.

Boulon, R.H. 2015. Sea Turtles of St. John. The St. John 2015 Phone Book. Pgs. 68 – 69.