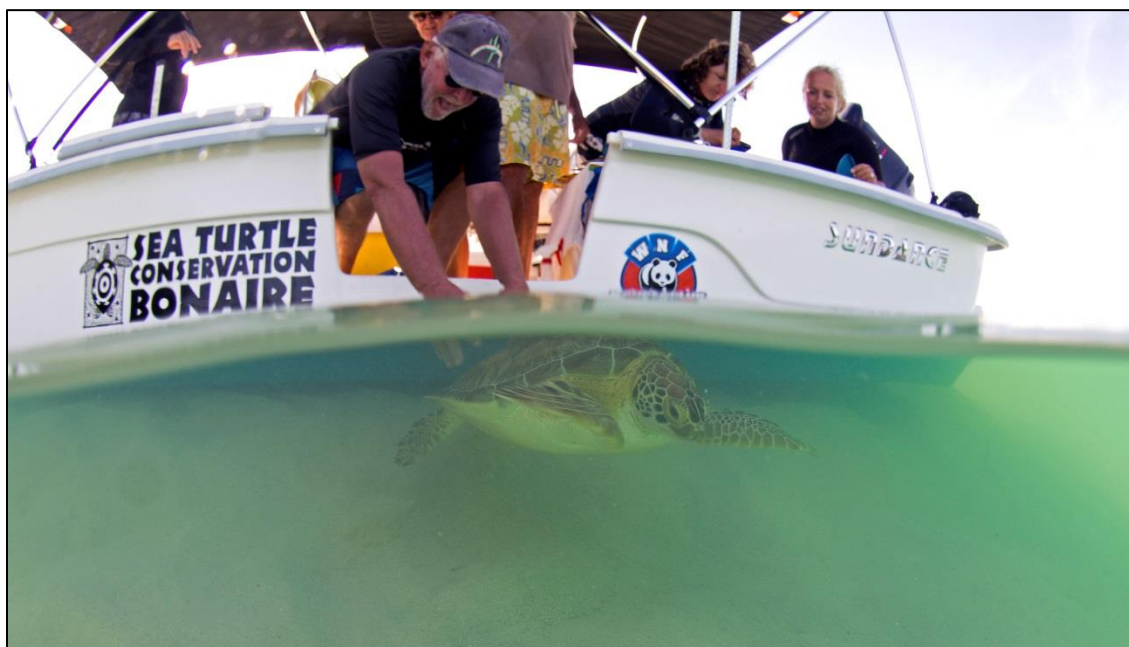




Research and Monitoring of Bonaire's Sea Turtles:
2014 Technical Report



Report prepared by
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Executive Summary

Sea Turtle Conservation Bonaire (STCB) was initiated in the early 1990s to protect the island's marine turtle populations. Our current research and monitoring efforts, which were standardized more than a decade ago, include monitoring nesting beaches around Bonaire, conducting intensive in-water netting and snorkel surveys (capture-mark-recapture), and tracking post-breeding migration using satellite telemetry. These techniques provide us with a better understanding of Bonaire sea turtles' breeding success, abundance, health, growth rates, migratory paths and distant feeding grounds, residency duration, habitat quality, and threats.

During the 2014 season, we recorded 63 nests at our index beach on Klein Bonaire. Total hawksbill (45) and loggerhead (18) nests documented there were similar to numbers observed during recent years. Across Bonaire and Klein Bonaire, we observed three species crawling 260 times, including 83 confirmed or suspected nests. Only two green turtle nests were recorded in northeastern Bonaire, whereas hawksbills and loggerheads exclusively nested on Klein Bonaire and the beaches of southern Bonaire. Total nesting activities peaked during June through August, with nesting extending through December.

We documented a much higher number of false crawls (unsuccessful nesting attempts) for both hawksbills and loggerheads in 2014 than in 2013. This phenomenon may result from a small number of individuals which were inefficient nesters (i.e., false crawled multiple times before successfully laying a nest), disturbance to turtles during nesting, and / or indicate deterioration in the quality of particular nesting sites, perhaps due to factors such as removal of vegetation. Estimates of clutch size and hatch success suggest that nearly 8,700 turtles hatched on the beaches of Bonaire and Klein Bonaire during 2014, including some 6,300 hawksbills, 2,200 loggerheads and 160 green turtles.

During in-water snorkel surveys, we observed and captured green turtles and hawksbills in all regions sampled, including Klein Bonaire, along the west coast of Bonaire, and near the reef bordering Lac. Netting in Lac and Lagoen resulted in a record number of captures during 2014, primarily green turtles. The aggregation of green turtles near Lac remains much larger than sites along the west coast, and greens captured there were bigger than conspecifics elsewhere, perhaps a result of the composition and high densities of sea grasses in Lac. Analysis of the 2013 and 2014 capture data from Lac indicates that netting during the second week of a two-week session is less efficient at capturing turtles. These results suggest that conducting netting sessions during non-consecutive weeks may be a more effective sampling strategy.

We received reports from the WIDECAST Marine Turtle Tagging Centre of 5 green turtles caught in nets by Nicaraguan fishers in the sea turtle harvest during the past 18 months. These recoveries provide invaluable information about international movements and migratory behaviors. The prevalence of fibropapillomatosis (FP) among green turtles captured in and near Lac again increased in 2014, as roughly one-third of all captures were observed with external tumors. However, we recaptured two green turtles that were previously treated to eliminate the fibropapilloma tumors. In both cases, the results were positive, perhaps suggesting that removing tumors via surgery or ligation can improve the health of individual turtles and reduce the incidence of FP in Lac.

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Background

Twenty-three years ago, STCB began monitoring the status of and threats to Bonaire's sea turtles, using the resulting knowledge to protect them. Comprehensive local laws, as well as international treaties, now protect sea turtles, their nests, and eggs from harvest and harassment. The community and tourism industry generally understand the importance of sea turtles to a healthy ecosystem and their value to an economy centered on dive tourism. And it is a rare resident or guest who is not captivated by encounters with these beautiful and endangered species.

Today, the conservation landscape has changed. The most serious challenges facing Bonaire's sea turtles are not direct threats like poaching or lack of support for sea turtle protection. The main threats now are indirect, related to a rapidly increasing human population and the development that goes along with it. These indirect threats to sea turtles are also the major threats to Bonaire's rich ecosystems, biodiversity, and our own quality of life.

In this landscape, we no longer look at sea turtle conservation as something apart from society. To ensure a secure future for Bonaire's sea turtles, we must address the issues that threaten sea turtles, biodiversity and social well-being, because they are inter-related. Sea turtles can thrive only when their ecosystems are healthy and the human community thrives.

Conservation and applied research remain the core work of STCB, as is clear from our mission. Our work spans education and outreach, policy, and research and conservation. This technical report summarizes STCB's scientific findings from the 2014 season. STCB's research program is designed to better understand Bonaire's nesting population and foraging aggregations, to contribute to the body of scientific knowledge in the greater Caribbean region, and to inform sound management policies on national and regional scales. Our work includes regular foot patrols of nesting beaches to assess the volume of nesting activities, post-hatch nest excavations to estimate how many hatchlings are released from Bonaire's beaches each year, and extensive snorkel and netting surveys of key sea turtle foraging grounds.

Nesting Beach Surveys

Monitoring Bonaire’s nesting beaches remains a fundamental component of our research program. No Name Beach on Klein Bonaire continues to serve as our index beach for assessing abundance and species composition. We patrolled this beach three mornings per week, beginning in early May and continuing through December. We documented all crawls, identified species, and recorded the outcome as a false crawl (unsuccessful nesting attempt; no eggs were laid), confirmed nest (eggs were sighted), or suspected nest (eggs were not observed, but site disturbance suggested that a nest was laid). We recorded 45 total (i.e., confirmed and suspected) hawksbill nests and 18 total loggerhead nests on No Name Beach. Although hawksbill numbers have modestly declined since 2012 (Figure 1), Bonaire’s nesting populations are relatively small, and fluctuations in nesting numbers are not unexpected. The long-term trends in nesting for both hawksbills and loggerheads suggest relative stability (Figure 1).

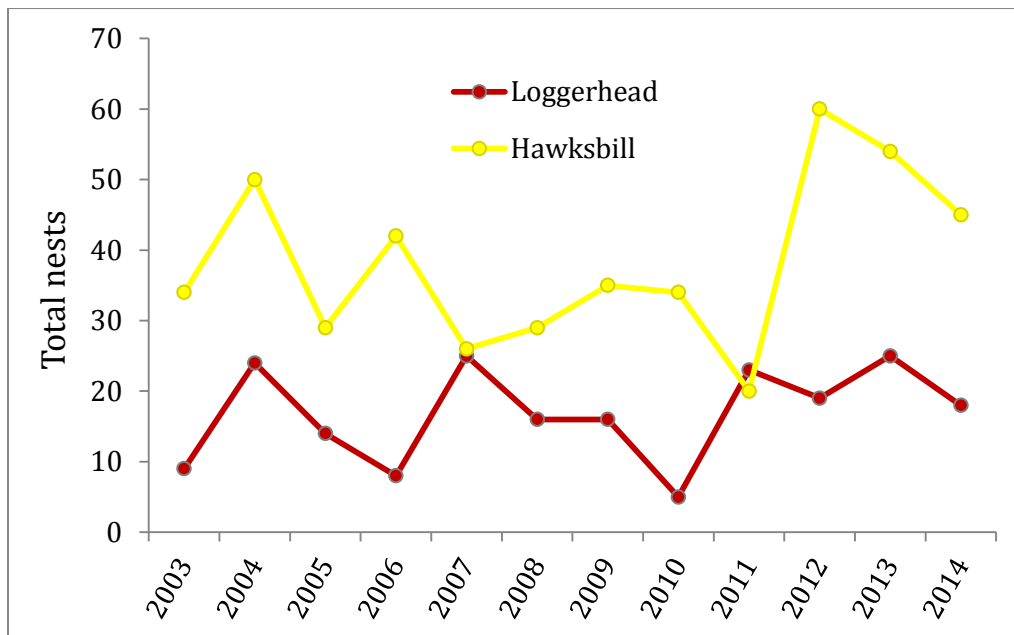


Figure 1. Historical nesting trends of loggerheads and hawksbills at No Name Beach on Klein Bonaire, which serves as the index site for nesting activities. Number of nests includes confirmed and suspected nests.

Sea turtles are late maturing and likely do not reproduce until at least 15 – 20 years of age. As such, hatchlings that crawled from Bonaire’s beaches when monitoring began in 2003 and 2004 will only return to nest here in the next several years. Thus, although 2014 marked STCB’s 12th year of standardized monitoring on Klein Bonaire, this is a relatively short time period from which to assess trends in our nesting populations. For example, colleagues studying a large hawksbill rookery at Jumby Bay in Antigua documented 15

years of stability in the nesting population before recording significant increases in numbers. Continued monitoring will provide a better understanding of long-term trends and allow us to realize the impacts of conservation efforts.

On Bonaire, we recorded 13 hawksbill nests, 5 loggerhead nests, and 2 green turtle nests. Species composition was consistent between Klein Bonaire (KB) and the beaches of southern Bonaire: hawksbills were the predominant species recorded, and loggerhead nesting was less common (Figures 2 and 3). Conversely, green turtles nested exclusively on Playa Chikitu in northeastern Bonaire. Green turtle nesting was markedly lower in 2014 than 2013, but such inter-annual fluctuations are common for greens in the Caribbean region.

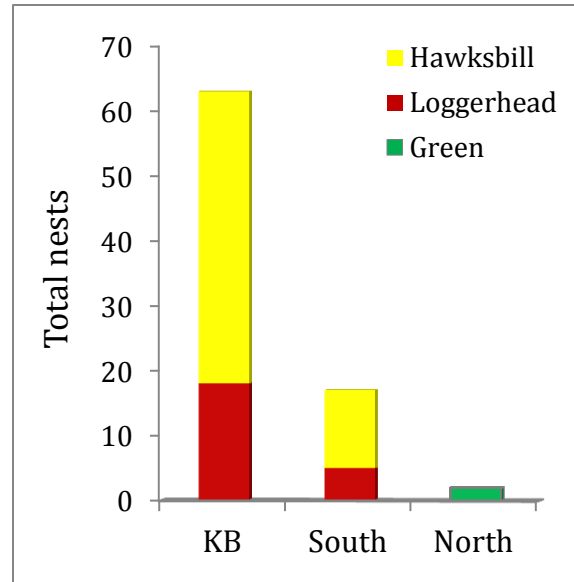


Figure 2. Total nests, categorized by geographic region, recorded during the 2014 research season. “North” and “South” denote general regions of mainland Bonaire.

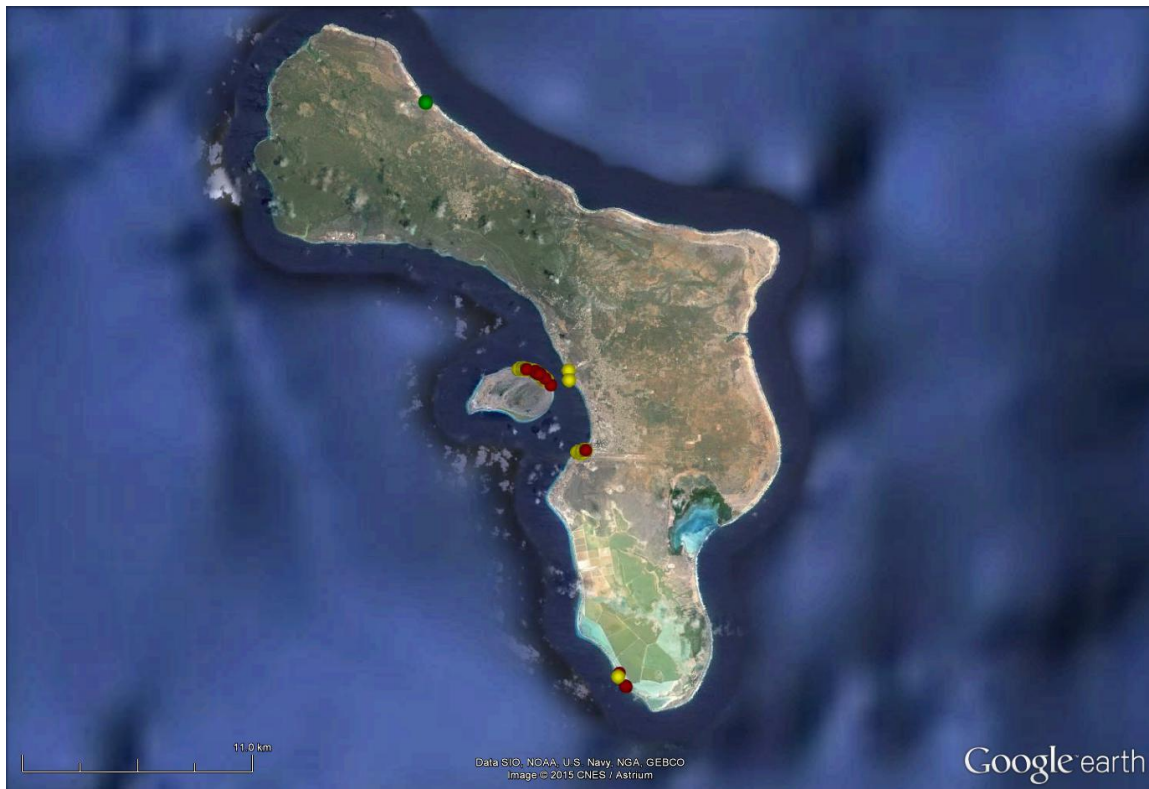


Figure 3. Distribution of nests laid by green turtles (green), loggerheads (red), and hawksbills (yellow) on Bonaire and Klein Bonaire during the 2014 monitoring season.

On Klein Bonaire, loggerhead nesting was highly concentrated in the central portion of No Name Beach, whereas hawksbills nested across most of the beach (Figure 4). Nesting attempts on the western reaches (i.e., low beach marker numbers) were often unsuccessful and resulted in false crawls. The far eastern end of the site also appeared to provide less suitable nesting habitat; we infrequently observed crawls there and recorded only a single loggerhead nest.

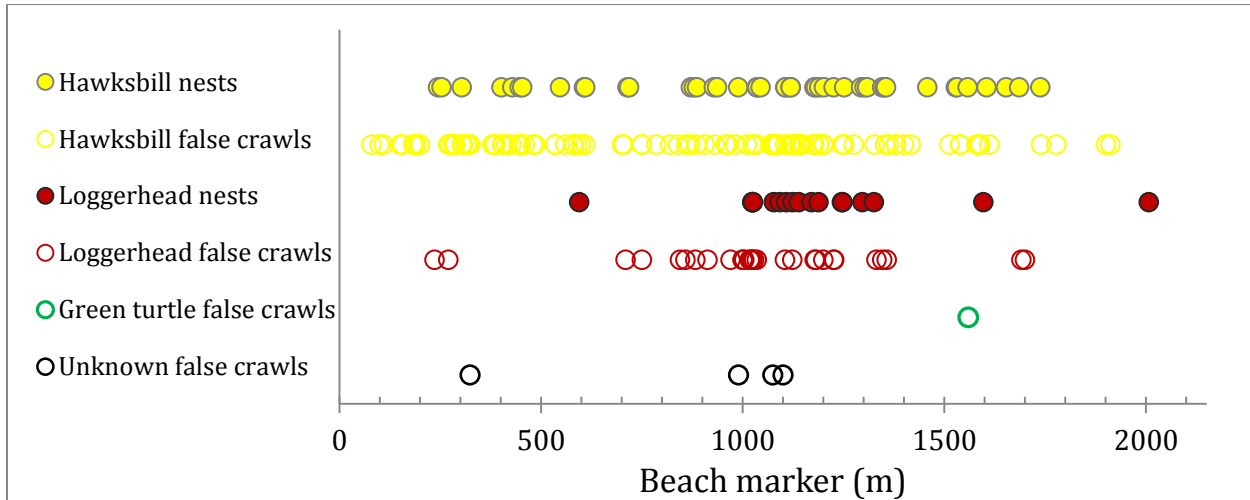


Figure 4. Distribution of nesting activities, including successful nests and false crawls, at No Name Beach on Klein Bonaire during the 2014 season.

Because Klein Bonaire is systemically monitored, these data provide the most reliable indicators of seasonality. We first observed nesting on Klein Bonaire in early May, and we documented hawksbill nests through December (Figure 5). Consistent with previous years, the loggerhead nesting season spanned May – September, whereas hawksbill nesting remained relatively stable from June – October and continued at lower levels through December.

Sea turtles may false crawl several times before laying a nest and individuals vary with respect to nesting efficiency. Hence, confirmed and suspected nests provide a more accurate picture of seasonal trends. False crawls can be informative, however. We recorded a much higher number of false crawls during 2014 than in 2013 for both loggerheads and hawksbills. The observed false crawl : nest ratio for loggerheads in southern Bonaire and Klein Bonaire was 2.1 false crawls / nest in 2014 versus 0.7 / nest in 2013; for hawksbills, ratios increased from 0.9 false crawls / nest to 2.1 false crawls / nest.

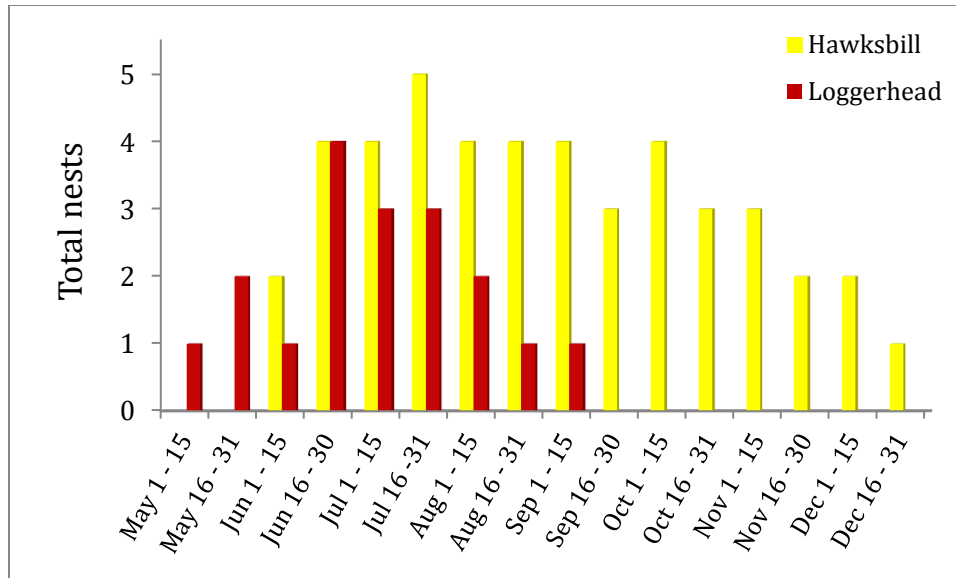


Figure 5. Seasonality of total nests (confirmed and suspected) recorded on Klein Bonaire during the 2014 research season.

Because Bonaire’s nesting populations are small, we speculate that a few individuals who are inefficient nesters – in other words, turtles that false crawled several times before successfully nesting – may have contributed to this discrepancy. However, such a high volume of false crawls also may result from changes to nesting habitat and other challenges with beach management. During 2014, vegetation protecting the landward side of Te Amo Beach was removed. This landscape modification may have allowed the strong lighting in the area to reach the beach, thereby disorienting turtles, inhibiting successful nesting, and influencing the high false crawl to nest ratio.

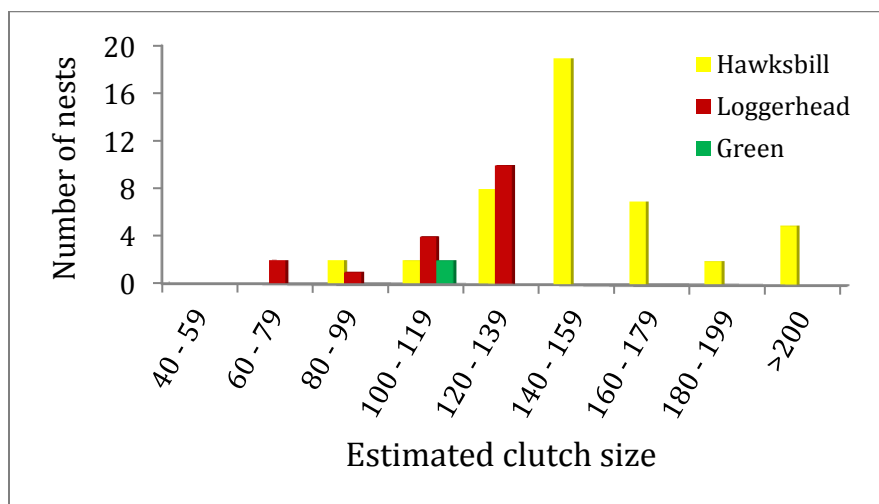


Figure 6. Clutch sizes of loggerhead, hawksbill, and green nests recorded on Bonaire and Klein Bonaire during the 2014 research season.

Evaluating reproductive success is another core component of our research program. Estimated clutch sizes (number of eggs / nest) varied by species [loggerhead (mean: 118; Standard Deviation: 21); hawksbill (mean: 154; SD: 29); green (mean: 115; SD: 35); Figure 6]. Hatch success, defined as the percentage of eggs per clutch that successfully hatch, was slightly less for hawksbill nests remaining in situ (mean: 73%; SD: 28%) than loggerheads (mean: 80%; SD: 19%; Figure 7). Loggerhead nests that were relocated due to proximity to the high water mark (i.e., potentially lost due to flooding) or other threats (n=2) had similar hatch success (mean: 84%), but hatch success of relocated hawksbill nests (n=6) was considerably lower (59%). Based on the clutch size and hatch success data, we estimate that a total of ~8,700 turtles hatched on Klein Bonaire and Bonaire in 2014, including about 6,300 hawksbills, 2,200 loggerheads, and 160 green turtles.

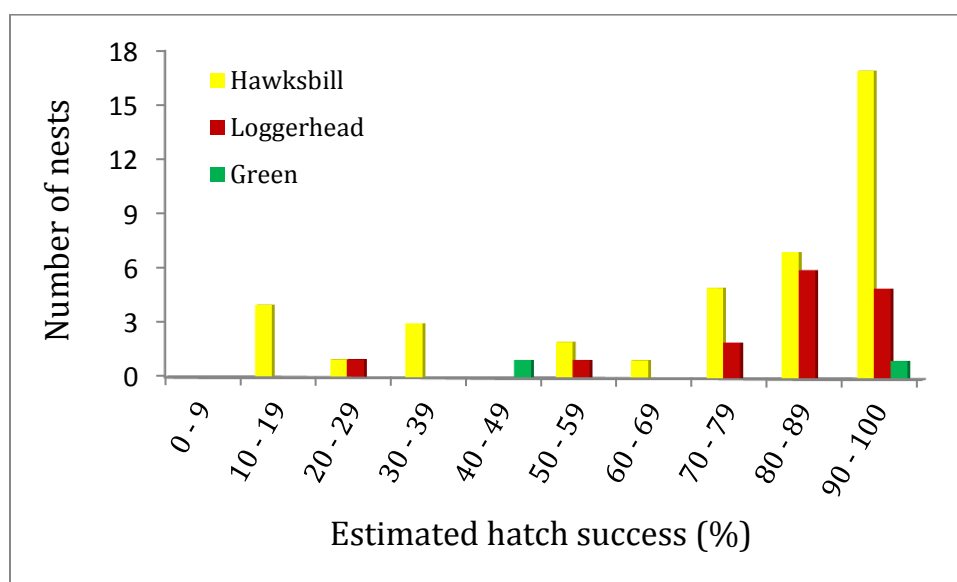


Figure 7. Estimated hatch success of loggerhead, hawksbill and green nests recorded on Bonaire and Klein Bonaire during the 2014 monitoring season. Nests that were relocated due to proximity to the high-water mark or other threats are excluded.

On Klein Bonaire, we observed spatial differences in hatch success for hawksbills: nests laid in the central portion of the beach had higher hatch success than nests at the ends of the beach [Central (nests remaining in situ between stakes 500 – 1500) mean: 80%; Ends: (nests remaining in situ beyond stakes 500 and 1500) mean: 38%; Figure 8). This finding does not necessarily indicate lower quality sites for incubation at the ends of the beach and simply may be an artefact of relatively small sample sizes. Alternatively, a few individuals who produce nests with lower hatch success due to some non-environmental reason (e.g., reduced fertility) may exhibit tendencies to nest at the ends of the beach. We note, however, that despite very small sample sizes, hatch success of loggerhead nests suggests similar spatial variability in hatch success (Figure 8).

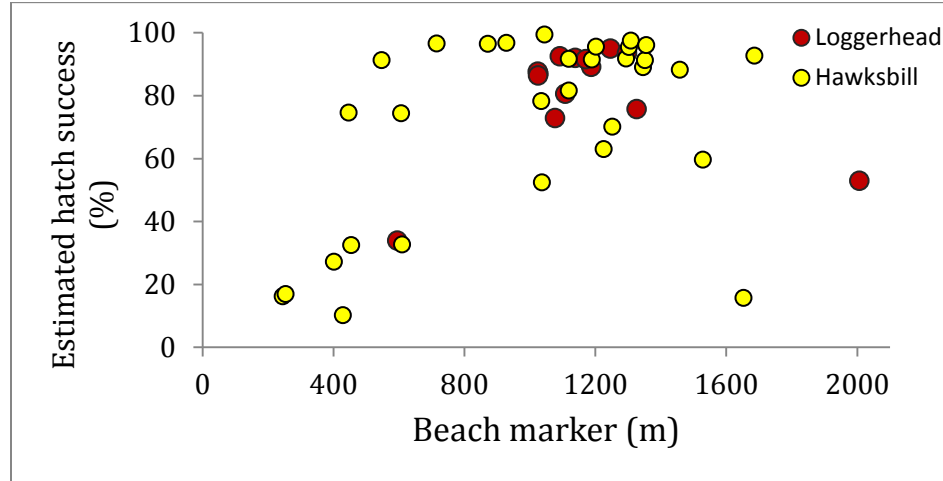


Figure 8. Estimated hatch success of hawksbill and loggerhead nests recorded on Klein Bonaire during the 2014 monitoring season. Nests that were relocated due to proximity to the high-water mark or other threats are excluded.

Foraging Ground Surveys

A rigorous in-water research program constitutes the other primary element of our work. This program, which seeks to better understand the sea turtle aggregations foraging in Bonaire’s waters, collects both capture and observational data and is implemented with two techniques. First, we conduct snorkel surveys along the entire west coast, around Klein Bonaire, and on the reef outside Lac (Figure 9). During these surveys, turtle sightings are recorded and, when possible, turtles are captured for measuring and tagging by the research team. In 2014, sampling around Klein Bonaire and along the west coast was completed during February – March. The lone transect along the reef adjacent to Lac was sampled in December. Although we observed hawksbills and green turtles island-wide (Figure 9), densities of greens were much higher than hawksbills at all sites (Figure 10). Similar to previous years, we recorded the highest concentrations of green turtles outside Lac: an estimated 250 individuals were observed during sampling there.



Figure 9. Snorkel surveys (red lines) completed around Bonaire during 2014. Green turtles and hawksbills tagged during snorkel surveys are denoted in green and yellow, respectively.

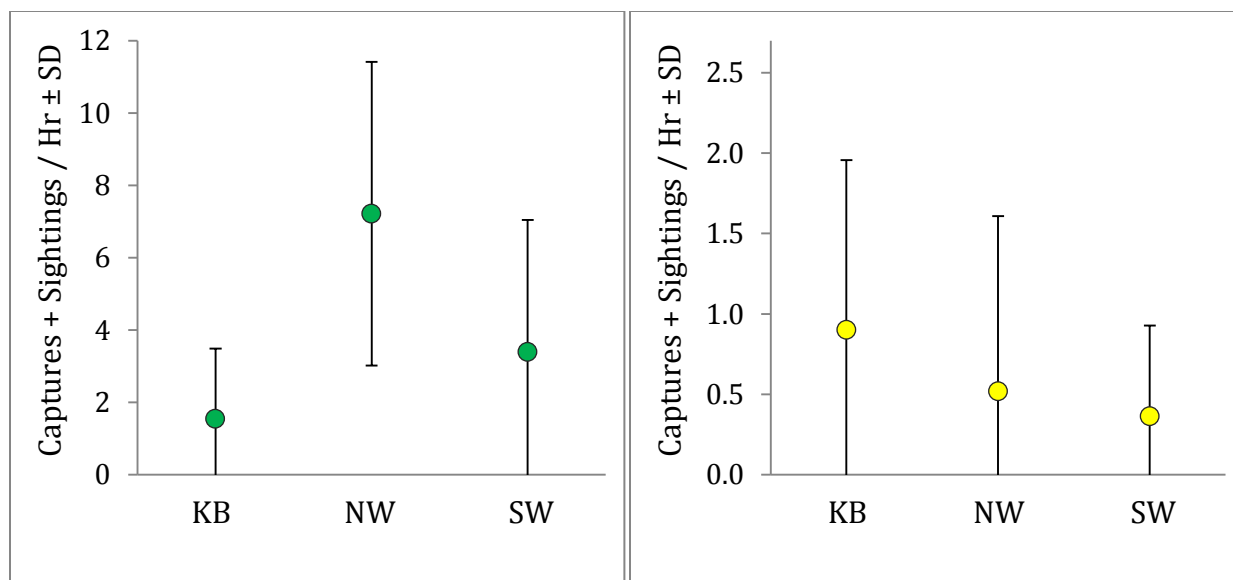


Figure 10. Captures per unit effort (total sightings and captures ± standard deviation) recorded during snorkel surveys for green turtles (green) and hawksbill turtles (yellow) in 2014, categorized by geographic region. KB: Klein Bonaire; NW: Northwestern Bonaire; SW: Southwestern Bonaire.

We conducted netting, the second in-water method used to gather information about Bonaire's sea turtle aggregations, in Lac (Figure 11) and, to a lesser extent, in Lagoon to the north. During 2014, we more widely distributed net sets across the north-central portion of Lac to ensure that our sampling reflected the entire region. Sampling near Sorobon (to the south) also allowed us to increase captures of hawksbills. Total captures during 2014 were the highest on record. However, capture rates for both species were consistent with 2013 levels, and we continued to document much higher capture rates for green turtles than hawksbills (Figure 12).

We suspected that the timing of our netting sessions might impact capture efficiency. Specifically, we hypothesized that capture rates during the second week of multi-week netting sessions were lower due to 'trap shyness' (i.e., turtles becoming accustomed to and avoiding nets). To evaluate this hypothesis, we examined netting data during 2013 and 2014. We calculated captures per hour for individual netting sessions in Lac and

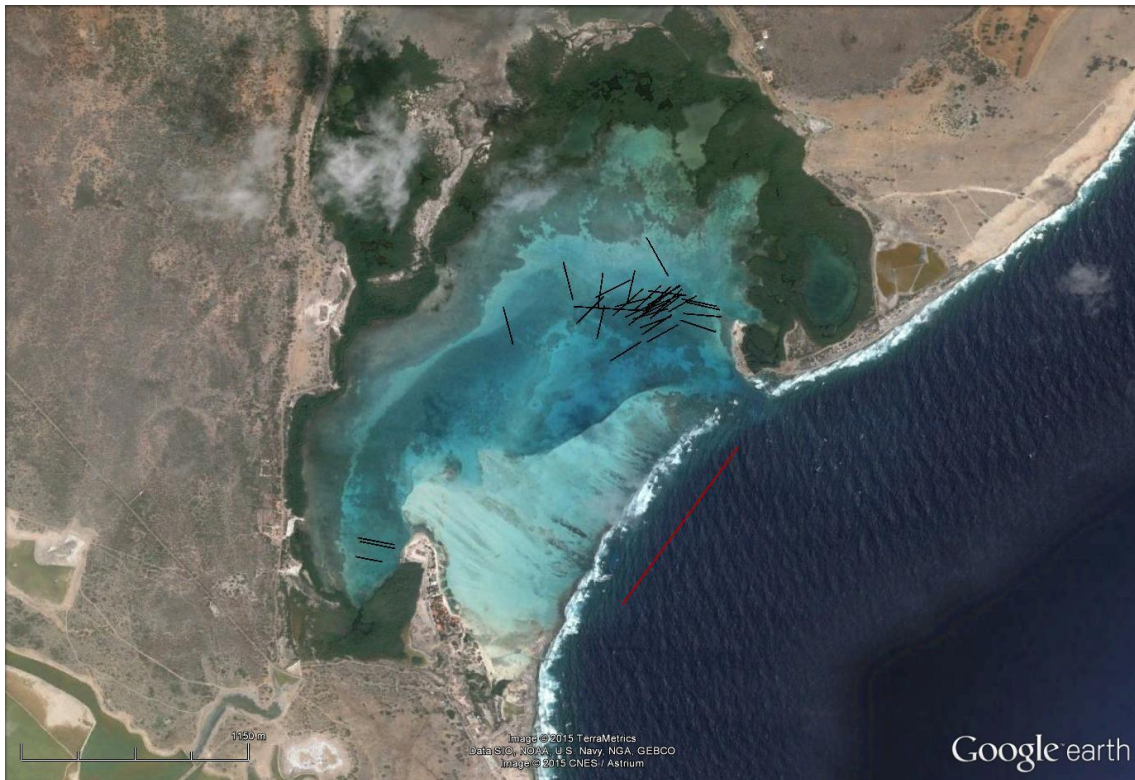


Figure 11. Locations of net sets (black lines) at Lac in southeastern Bonaire to capture juvenile green and hawksbill turtles during the 2014 research season. The single snorkel survey transect completed in 2014 is denoted with a red line.

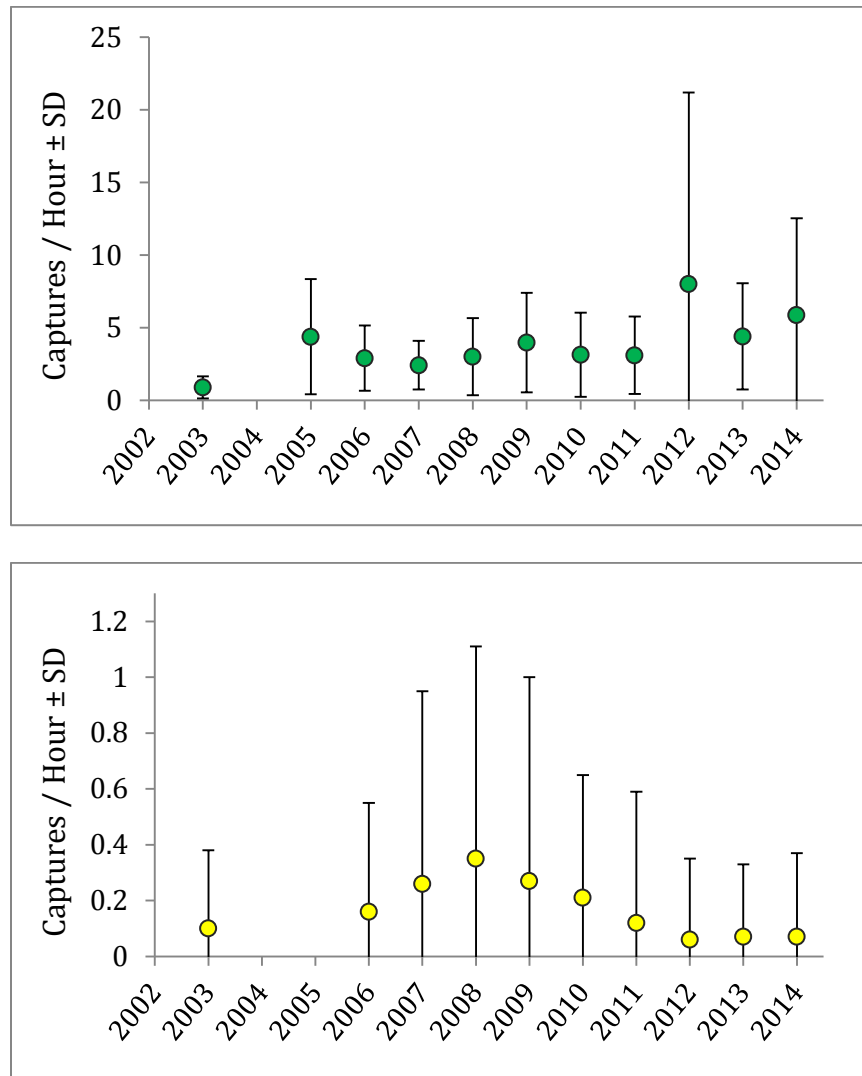


Figure 12. Captures per unit effort (total captures per hour \pm standard deviation) recorded during net surveys for green turtles (green) and hawksbills (yellow) conducted at Lac in southeastern Bonaire, 2003 – 2014.

divided data into Week 1 and 2 categories. As hypothesized, capture rates were significantly lower for Week 2 sessions than Week 1 (Week 1 mean: 6.9 captures / hr; Week 2 mean: 3.3 captures / hr; non-parametric Mann-Whitney *U*-test: *U*-value = 335, *z*-score = 2.5, 1-tailed test, *P*<0.01). To improve netting efficiency, we will attempt to space our sessions such that sampling is not conducted in consecutive weeks. These results also suggest that assessing long-term trends in captures per unit effort requires using only data gathered in the initial week of sampling. During 2012, for example, sampling was not conducted in multi-week sessions; comparing data collected during the first week of netting will ensure that results are comparable across years.

Green turtles captured in and near Lac were significantly larger than those captured elsewhere during 2014 (Figure 13; Lac straight-line carapace length mean: 49.3, SD: 9.8; Other locations SCL mean: 34.3, SD: 6.0; *t*-test: *t*-value: 13.9, $P < 0.0001$). We suspect that foraging conditions in Lac provide an environment that better promotes rapid growth. Consistent with this hypothesis, capture data indicate that green turtles travel to Lac from elsewhere around Bonaire, but generally do not emigrate from Lac to other sites in Bonaire. Captures in 2014 suggest that hawksbills observed in and near Lac may have been larger than those captured elsewhere, but small samples preclude reliable statistical inference.

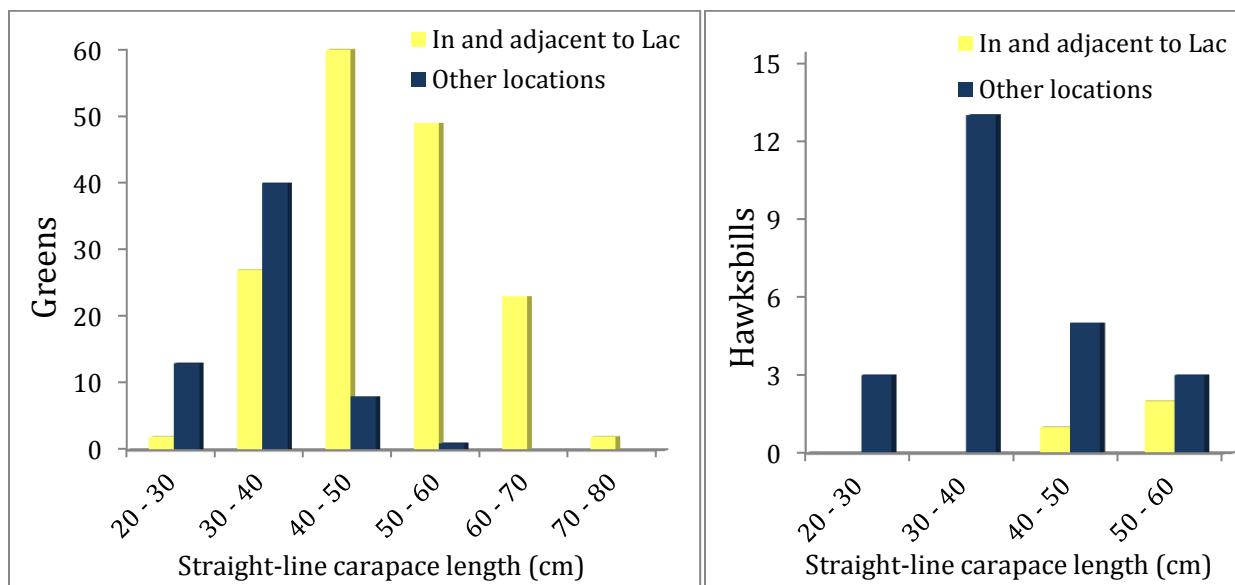


Figure 13. Size classes of green and hawksbill turtles captured in and around Lac in comparison to other locations around Bonaire and Klein Bonaire during the 2014 research season.

Prevalence of Disease

Fibropapillomatosis (FP) is a disease characterized by tumors concentrated around soft skin tissues, the eyes, and the base of flippers. FP tumors, which primarily afflict green turtles, interfere with daily functions and ultimately may result in death. Causes of the disease are not fully understood, but factors such as environmental pollutants and urbanization may be associated with FP's occurrence (e.g., Aguirre and Lutz 2004: EcoHealth 1:275-285). Unfortunately, the proportion of green turtles captured in and adjacent to Lac that were infected with FP tumors exceeded 33% in 2014 (Figure 14). This continues a 4-year trend of increasing prevalence of the disease.

In an effort to curb the spread of FP and improve the health of individual turtles afflicted with the disease, STCB has been collaborating with a local veterinarian to remove tumors through surgery or ligation (i.e., tying off). Thus far, the results are encouraging. During 2014, we recaptured two previously treated green turtles. The treatments proved effective in both cases, perhaps suggesting that removal of tumors can provide an effective means to counteract FP at the individual and population-levels.

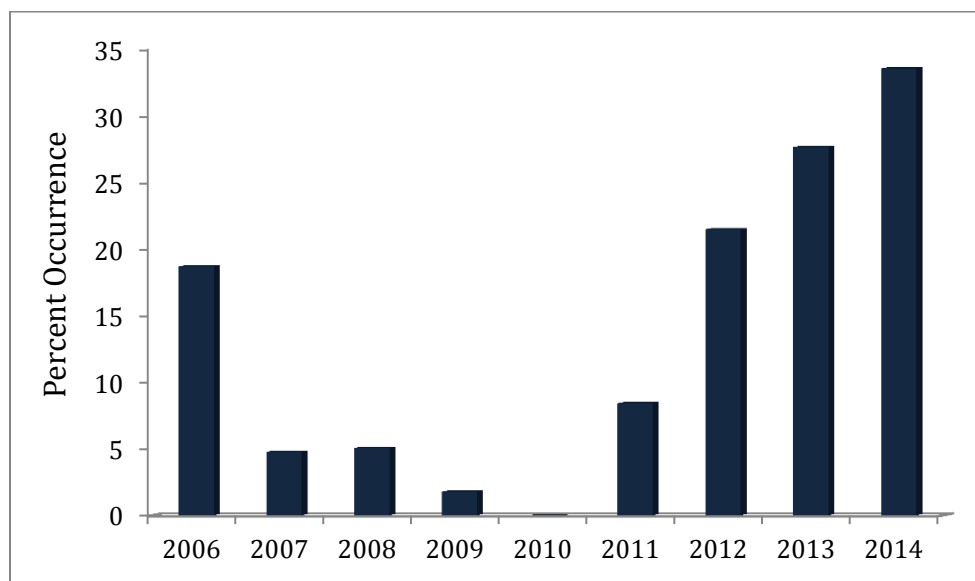


Figure 14. Occurrence of visible fibropapilloma tumors on green turtles captured in and near Lac, Bonaire during 2006 – 2014.

International Tag Returns

Tagging turtles allows us to track individuals over time, yielding valuable information about growth, foraging aggregation and population size, migratory behaviors and residency in specific regions. Tagging also provides a means for researchers and fishermen elsewhere in the Caribbean to identify turtles when they are captured or observed. Sharing these data helps us to better understand where our foraging and nesting populations travel after leaving Bonaire.

Between July, 2013 and April, 2014, we received reports from the WIDECAST Marine Turtle Tagging Centre of five green turtles initially tagged in Bonaire that were subsequently harvested in Nicaragua. Two of these individuals were first tagged during 2005, one was initially tagged during 2006, and one each during 2007 and 2009. Carapace lengths at initial capture varied from ~43 cm to ~58 cm. Tag returns help to improve our understanding of the regional movements of sea turtles and underscore the importance of

continued international collaboration to ensure wise and sustainable management policies and conservation practices.

Turtle Strandings

Stranded turtles are animals found dead, injured, or sick, or sometimes apparently healthy but in an unsuitable circumstance, such as entangled in debris along the shoreline. Strandings are reported to STCB directly via the Sea Turtle Hotline (599-780-0433).

In 2014, there were a total of 16 stranding incidents reported. Four of these 16 turtles were found dead (all green turtles), and one other green turtle that was stranded with severe fibropapillomatosis died in surgery during treatment by the veterinarian. Necropsy was carried out on all the dead turtles, unless decomposition was too severe. Trauma was established as the cause of death in one green turtle found in Lac Bay in May 2014, likely caused by a strike by a boat or windsurf board. One green turtle was also found to have died due to entrapment in fishing lines. The green turtle with fibropapillomatosis was found to have severe internal tumors. The other two greens died of unknown causes.

One of the biggest threats Caribbean-wide to sea turtles continues to be the fishing industry and associated by-catch. In 2014, of the 16 incidents, five (31%) were related to fisheries, including three turtles with fishing hooks in their mouths, one hawksbill that was caught and untangled from fishing lines that were wrapped around its flippers, and the dead green turtle that was snared by fishing lines already mentioned above.

One particularly noteworthy stranding event occurred on 22nd September, 2014. The regular STCB nest monitoring patrol arrived on Klein Bonaire around 7am and saw a nesting crawl going towards a nest, but no return track could be seen. The turtle's tracks were followed into the bushes on Klein Bonaire and, after searching for an hour, STCB staff and volunteers located a tagged, adult female hawksbill ("Piffie" – ID 10-176) stranded and motionless in the full sun. With help from volunteers, she was carried back to the shore and released, undoubtedly saving her life.

Three of the "stranding" incidents involved hatchlings found in unsuitable situations, generally in the mangroves on the East Coast of Bonaire. STCB has a strict protocol for these incidents which was followed in each of these cases.

In five cases in 2014, it was not possible to locate the turtle that was reported as being in trouble, often despite extensive searching.

Once again STCB is very grateful to volunteer Sjoukje Hiemstra for her help in conducting necropsies and with the data management of turtle strandings. Thanks also go to Craig

Dewey and Kathy Pound for housing the STCB rehabilitation pool and to volunteers Hans & Jannie Koning who act as STCB “First Responders” to assist STCB staff.



Figure 15. “Piffie” (turtle ID 10-176) being returned to the sea after her disorientation and stranding incident.

Appendix I. 2014 Funders and Donors

STCB is a non-profit, non-governmental organization. We raise funds through conservation and research grants and contracts, merchandise sales and from individual and business donors.

Flagship Funder 2008 – 2016



Since 2008, WWF - Netherlands has been the flagship funder for STCB's sea turtle conservation work on Bonaire. The WWF-NL grant is administered through STINAPA Bonaire.

Major Funder

Dutch Ministry of Economic Affairs, Agriculture and Innovation (EZ)

Platinum Funders/Donors

Dutch Caribbean Nature Alliance (DCNA)

STINAPA Bonaire

Foundation to Preserve Klein Bonaire

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Rob Hulsbergen

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Fred, Carmen, Jap and Hincka

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Mabel Nava

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Dr Sue Willis, Project Coordinator

Gielmon Egbreghts, Contractor Field Technician

Scientific Advisor

Dr Seth Stapleton

Interns

Carli van Mil

Irene van der Sluis

Valentina Brenzini

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Guido Wiersma

Tom van Eijck, *Advisor, first field project coordinator (1993)*

Appendix III. 2014 STCB Partners, Supporters and Volunteers

International Partners

Wider Caribbean Sea Turtle Conservation Network (WIDECAST)

World Wildlife Fund Netherlands (WWF-NL)

Regional Partners

Dutch Caribbean Nature Alliance (DCNA)

Nature Foundation St. Maarten

Parke Nacional Arikok (Aruba)

Saba Conservation Foundation

St. Eustatius National Parks Foundation

Turtugaruba

Sea Turtle Conservation Curacao (Carmabi)

Environmental Protection in the Caribbean (EPIC)

Barbados Sea Turtle Project

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Bonaire Department of Environment and Natural Resources (DROB)

CIEE Research Station Bonaire

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Jong Bonaire

EZ Ministry of Economic Affairs

NGO Platform

STINAPA Bonaire

Bonaire National Marine Park

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STINAPA Junior Rangers

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Captain Don's Habitat
Carib Inn (Bruce Bowker)
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CARGILL Salt Bonaire
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Dive Friends Bonaire
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Firgos Bonaire
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Flamingo Communications
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Harbour Village Marina
Hotel Roomer
Kantika di Amor
JanArt Gallery
Krioyo Paint
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Woodwind Snorkel Sail

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Fulco de Vries

Hans & Jannie Koning

IN-WATER SURVEY/NETTING VOLUNTEERS

Junior Rangers

Kolegio Kristu Bon Wardador students

Linda Maas

Liseo Boneiru students

Louise Holder

Mamita Fox

Marianne Jacobs

Nat Miller

Nicole, Martin & Noa Roomer

Papa Cornes students

Patrick Holian

Patti Dougherty

Paul Westerbeek

Ralph 'Moogie' Stewart

Richard Willis

Rick & Lila Nicholson

Rob & Adrie Hulsbergen

Sjoukje Heimstra

SGB students

Appendix IV. Ways to donate

You can help protect Bonaire's sea turtle populations by donating to STCB. We welcome – and depend on – the financial support of people like you. Whether it's \$10, \$100, or \$10,000, whatever you give makes an important difference.

Online

Go to our website at www.bonaireturtles.org

Donate by mail

Make check payable to: Sea Turtle Conservation Bonaire
Then mail to:

STCB
PO Box 492
Kralendijk, Bonaire
Dutch Caribbean (Netherlands Antilles)

Donate by bank transfer

To make a donation locally on Bonaire:

Maduro&Curiel's Bank (Bonaire) N.V.
Account name: Sea Turtle Conservation Bonaire
Account number: 101.169.209

To make a donation from the USA:

Beneficiary: Sea Turtle Conservation Bonaire
Account number: 101.169.209
Beneficiary Bank: Maduro&Curiel's Bank (Bonaire) N.V.
Swift code: MCBKBQBN
Correspondent Bank: Standard Chartered Bank
ABA # 026002561
Swift Code: SCBLUS33

To make a donation from Europe:

Beneficiary: Sea Turtle Conservation Bonaire
Account number: 101.169.209
Beneficiary Bank: Maduro&Curiel's Bank (Bonaire) N.V.
Swift code: MCBKBQBN
Correspondent Bank for Euro: Rabo Bank Nederland
Swift Code: BBRUBEBB

To discuss other ideas for giving, please call STCB Manager, Mabel Nava, on +599-717-2225, or email us at stcb@bonaireturtles.org