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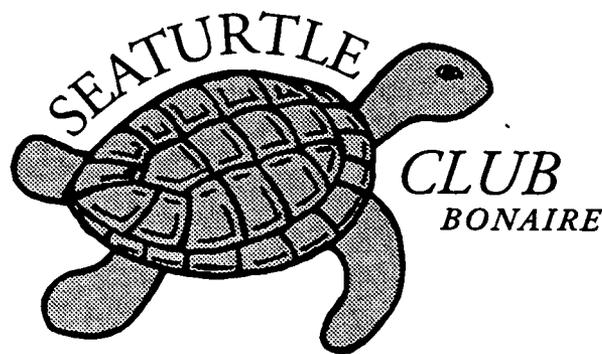
Instituut voor Systematiek en Populatie Biologie (Zoölogisch Museum)

Universiteit van Amsterdam

No. 68

Sea Turtle Conservation on Bonaire

Sea Turtle Club Bonaire 1995 Project Report and Long Term Proposal



N.P. Valkering, P. Van Nugteren & T.J.W. Van Eijck (STCB)

Reviewed by K.L. Eckert (WIDECAST)

May 1996



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The Sea Turtle Club Bonaire is a non-profit, non-governmental organisation, and its main goal is the conservation of Bonaire's sea turtles. The STCB wants to realise this goal by creating public awareness about sea turtle conservation on Bonaire, and by investigation of the local sea turtle populations.

To continue our work, your support is highly appreciated. You can send your donations to:

- (Bonaire) Sea Turtle Club Bonaire, accountno. 10106273 of the Maduro & Curiëls Bank, Kralendijk, Bonaire, Netherlands Antilles;
- (The Netherlands) Sea Turtle Club Bonaire, accountno. 550391150 of the ABN-AMRO Bank, Hilversum, The Netherlands.

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PREFACE

During the last decades, sea turtle populations have declined worldwide frightfully quickly. Animals that have survived about 150 million years, are currently threatened with extinction, through the enormous impact, man has had, and still has on them. For ages man has slaughtered turtles for consumption and ornamentation. These old customs, that prevailed in many cultures, have unfortunately made way for the commercialisation of turtle products. The resulting overexploitation, in addition to the other harmful side-effects of the expansion of human populations, like pollution of sea water and beaches, has produced the dangerous situation that sea turtles face at present.

In an effort to protect the sea turtles, various organisations have been established all over the world. In the early 1980's symposia were organised, like the First Western Atlantic Turtle Symposium (WATS I) in 1983 (Bacon, P. *et al.*, 1983) and WATS II in 1987 (Ogren, L., 1989), to shed light on the problems that turtles deal with, and to design conservation strategies. For the Caribbean region, WIDECAST (Wider Caribbean Sea Turtle Conservation Network) was established in 1981, to organise, supervise and assist all sea turtle conservation projects in the Caribbean. More recently, a comprehensive review of sea turtles throughout the Netherlands Antilles was published by WIDECAST, namely the Sea Turtle Recovery Action Plan for the Netherlands Antilles (STRAP; Sybesma, 1992).

On Bonaire, Netherlands Antilles, the Sea Turtle Club Bonaire (STCB) was founded by Albert de Soet in 1991. In 1993 the STCB performed a local conservation project based upon the recommendations made in STRAP. A thorough survey of Bonaire's sea turtles was undertaken and also implemented was an awareness program on turtle conservation (Van Eijck & Eckert, 1994).

Firstly, the STCB presented a first clear overview of nesting activity on Bonaire and the sea turtle populations residing in Bonairian coastal waters. Before that time, no extensive research had been performed on Bonaire.

Secondly, with the local people, the tourists, the divestaff and the media, an increase in interest and enthusiasm was created through, among others, regular slide presentations and press releases.

However, to yield a good insight in the dynamics of the 'Bonairian' sea turtle populations and to establish a steadfast local interest, a continuation and extension of the project was certainly needed. Therefore the STCB started a STCB 1995 Project, with the intention to realise a yearly follow up and an expansion of projects in the future. Project Coordinator T.J.W. van Eijck set to work to find suitable cooperators, to perform the 1995 Project. To obtain more academic involvement, STCB strived after a cooperation with the University of Amsterdam (UvA). Prof. Dr. R.P.M. Bak from the UvA and the Netherlands Institute for Sea Research (NIOZ), was invited to supervise the ecological research of the STCB. In 1994, Paul van Nugteren and Niels Valkering were engaged and appointed as Project Assistants. Early 1995, based on the 1994 Report, a project proposal was prepared by Van Eijck and was submitted to the STCB board and the major sponsors, World Wildlife Fund of the Netherlands, Foundation DOEN/National Postcode Lottery and the Foundation for Scientific Research in the Caribbean Region. The Project initiated mid-June and was set to end mid-December.

The 1995 Project proceeded very well. Field surveys and a public awareness campaign were performed with positive results. Most of our activities were designed, based on the first report, '1993 Survey Results and Conservation Recommendations' (Van Eijck & Eckert, 1994) and its blueprint, the Sea Turtle Recovery Action Plan (STRAP) for the Netherlands Antilles (Sybesma, 1992). In addition, Roberto Hensen gave valuable advice on Bonaire considering the biology of the sea turtles of Bonaire, through his knowledge about historical issues on Bonairian sea turtles, their habitats and nesting behaviour. The press appeared very interested in the progress of the project.

The results of the project certainly proved satisfying. We learned a great deal, ranging from the implementation of research and education, to organising various activities and overcoming the difficulties that surely arise. A challenge was communicating with the many different people, of different ages and backgrounds. Especially working with children was marvellous. We found, that most children on Bonaire, were getting increasingly aware of the beauty and treasure of the island's nature. The older residents still consider the sea turtle as a delicacy, not an endangered animal, although the consumption of the animal is merely sporadic on Bonaire these days. Though many people were incomprehensible of the importance of conservation of the sea turtle, we did not detect any ill-feeling towards our project. Therefore, the hope is set on the Bonairian children. Fortunately, the schools of the island were again willing to cooperate with STCB, as was the case in 1993, and enabled us to provide them with information about the Bonairian sea turtles. Furthermore, a snorkel program was established by the Bonaire Marine Park to educate the children on snorkelling. The local children enjoyed this very much, thus increasing their interest in Bonaire's unspoilt underwater wildlife.

Still, the work needs to be continued and extended. Particularly on the education of the local people, with the focus on the children. The Bonairians need to understand the importance of their wildlife, not only because the 'foreigners' like it so very much, but because a sustainable way of living needs to be attained for the island's population, in order to ensure a longlasting survival of underwater ecosystems on Bonaire. Moreover, ongoing exploitation of Bonaire and exploitation of Klein Bonaire in particular, will result in a reduction and degradation of, among others, sea turtle nesting sites. Therefore we wish that this STCB 1995 Report will present valuable information to counteract over exploitation of the island at the expense of the wildlife, as well as guidelines for future conservation projects on Bonaire and other locations of similar interest.

Niels Valkering
Paul van Nugteren
Amsterdam
March 1996

ACKNOWLEDGEMENTS

We wish to acknowledge many individuals and institutions for supporting us in making the 1995 STCB Project a success. Without their contribution, it would have been impossible to perform such an extensive project. Therefore, we would like to thank the following people and institutions:

Firstly, we are certainly indebted to Tom van Eijck. He has performed the 1993 Project and was the initiator of the 1995 STCB Project. He designed the blueprint of this project and acted as the Project Coordinator. The 1995 Project would certainly not have got off the ground successfully in such a way, if Tom had not made his efforts in coordinating and financing it. Further, he is the person, to whom we owe our participation. Finally, we are grateful for his suggestions, advice, report editing, moral support and taking time for us when ever needed.

We thank the Sea Turtle Club Bonaire, especially the chairman, Albert de Soet, for giving us the opportunity to work on the 1995 STCB Project, which was the Club's second project.

Bonaire Trading Company Ltd. (BTC), by means of its President, Hugo Gerharts, sponsored the project in various ways. He provided us with housing, food and transport for a very friendly rate. Further, he enabled us to use the BTC computers and copy and fax machines, for which we thank him.

Corine Gerharts, who puts in a lot of work on Bonaire on behalf of the STCB, has also supported us, both morally and through making contacts.

The 1995 STCB Project has been made possible, by the financial support of various organisations like the World Wildlife Fund of the Netherlands, the Foundation DOEN/National Postcode Lottery and the Foundation for Scientific Research in the Caribbean Region, for which we are very grateful.

The advice and cooperation from Roberto Hensen, at that time the Chairman of STINAPA, WIDECAST Island Coordinator, and STCB Chairman in Bonaire was very important. Also the very valuable advice we got from Mr. J. Sybesma, at that time the STCB Secretary and Widecast Executive Coordinator in the Netherlands Antilles, was greatly appreciated. He also provided the STCB with educational material.

Annette van Eeden-Petersman (BTC) can be considered as the indispensable binder of all the STCB activities on Bonaire. She and Marian gave us logistical and administrative support throughout the project. In addition, her friendship and moral support have been of utmost importance for us. We thank her from the bottom of our hearts for her assistance.

We gratefully acknowledge the assistance we received from the manager of the Bonaire Marine Park (BMP), Kalli de Meyer, and her assistants Viser, George, Eki and Edwin, the BMP rangers. Besides giving good advice and cooperation (e.g. snorkel program for local children), the BMP transported us at least once a week to Klein Bonaire with the patrol boat. Also the cooperation with STINAPA was much appreciated, through Roberto Hensen and Jimmy Trinidad, who provided us with easy and gratuitous access to the Washington-Slagbaai National Park. The rangers George and Hilario have also rendered assistance, through the performance of some

beach surveys and providing the idea of putting up a notice board in the museum, dedicated solely to sea turtles, a chance we gratefully accepted. The advice, interest and cooperation received from Eric Newton (BVO) and Edward Berben (LVV) was also greatly appreciated.

We are grateful to Prof. Dr. R.P.M. Bak from the University of Amsterdam for being our supervisor and evaluating our results and report. We thank Drs. W. Los, Director Institute for Systematics and Population Biology (ISP) at the University of Amsterdam for the support and pleasant cooperation.

Members of local and regional press were invaluable in realising the publicity for the project. Especially active was Boy Antoin, from the Extra, who not only covered our progress regularly, and kindly attended a few of our presentations, but also cooperated in printing 1500 booklets for the STCB. Further we would like to thank Hubert Linkels (Amigoe), Eric Beeldsnijder (Beurs & Nieuwsberichten) and Aïda (Algemeen Dagblad) for their coverage of the 1995 Project. The support we received from Anne Louise (BonFM), through various radio interviews and the weekly announcement of our slide shows, is also highly appreciated. In addition, we thank Voz di Bonaire and Flamingo TV for their coverage's and interviews.

The principals and teachers of the various schools on Bonaire, all deserve a word of thanks. Mr. Pourier, the director of the secondary school on Bonaire is thanked for his cooperation, and distributing our information (folders, videos, posters, etc.) among the biology teachers. For the basic schools, we thank all the teachers we worked with, including the principals: Tecla Piar and Mr. Kurban (stand-in) from the Papa Cornes school, Lea Bernabela (Kolegio Reina Beatrix), Juan Jacobs (St. Bernardus school) and Jerome Lo-a-Njoe from the Kolegio Luis Bertran, for enabling and supporting us in giving lectures to the children. Jerome Lo-a-Njoe helped organising a presentation in Rincon for schoolchildren of the Luis Bertran and their parents, for which we are grateful. Walter de Palm, Bonaire's air-traffic controller, has been of great assistance in arranging a presentation in a community centre.

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We owe much gratitude to the management of the Sunset Beach Hotel and Flamingo Dive Resort, for providing us free use of their equipment and meeting rooms. Further, the management of Rum Runners and Consales are thanked for sponsoring beverages on various occasions. The project would not have been possible without the cooperation and support from the diving industry in Bonaire. We were introduced to the managers by Viser (BMP). The increasing enthusiasm, of all dive shops in

participating in the sighting network, is applauded by the STCB. The aid from Jack Chalk (Habitat) has proved very valuable during the 1995 STCB Project. He provided us with weekly transportation to Klein Bonaire, organised our weekly slide shows for the dive tourists and our first slide presentation for the general public, and provided us with the equipment and the location for these activities. Walt Stark (Sunset Beach Hotel) also assisted in transporting us to Klein Bonaire once a week and lent us their slide projector during the entire project (which unfortunately broke down). In addition, he transported the participants of the coastal cleanup to Klein Bonaire. Likewise, Buddy Dive took us to Klein Bonaire, when ever necessary. Al from Black Durgon Inn was very helpful and enthusiastic during the coastal clean up. On his own initiative, he organised the clean up of, among others, Playa Chikitu,. Finally, we are extremely grateful to Stephan and Renée, of the trimaran *Woodwind* (and Renate and Roland of the katamaran *The Blue Goose* in a later stadium, when they acted as stand-ins). They took us to Klein Bonaire every Thursday, giving us the opportunity to present our work to tourists on board and for compiling numerous of very useful sightings, whilst snorkelling along the reef at Klein Bonaire.

The dive personnel have also been of great help during our stay on Bonaire. They were the foundation of the sighting network. Besides the managers of the diveshops: Pascal de Meyer (Buddy Dive), Susan Davis (Bon Bini), Marian Wilson (Great Adventures Bonaire), Franklin Winkelaar (Blue Divers), Babs van der Heetkamp and Ernst (Dive Inn), George (Dive Bonaire), Andre Nahr (Sand Dollar), Bruce Bowker and Kitty Handschuh (Carib Inn) and Patrick van Maaswinkel (Patrick's Divers), we would like to thank all the dive personnel that have cooperated in the sighting network. Especially Marjolijn, Rene, Murphyn, Jean Paul, Tessa, John, Ronald, Jose, Philiep, Catherine, Suzan, Michel and the Dive Inn personnel have contributed to the success of the network. Bart Snelder, employee of Buddy Dive, was one of the most enthusiastic people on Bonaire, when it came to sea turtles. He has continuously supported us through thick and thin, was very interested in our work and assisted us wherever possible. We are very grateful for his friendship.

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SUMMARY

Bonaire (12°12'N, 68°77'W), Netherlands Antilles, is famous for its unspoiled coral reefs. Reefs and lush sea grass provide forage and refuge for two species of endangered sea turtle, the green turtle (*Chelonia mydas*) and the hawksbill (*Eretmochelys imbricata*). Loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) turtles are less common but are occasionally encountered. In the local language (Papiamentu) these species are known as 'turtuga blanku', 'turtuga karet', 'turtuga kawama' and 'turtuga drikil', respectively. Until recently, turtles were routinely captured and processed. This continues at a low level, despite the fact that it is illegal under the Marine Environment Ordinance (A.B. 1984, no. 21), as amended on 27 June 1991. Turtles are killed mainly for their meat and, in the case of karet, for their shell. This, in addition to egg poaching has led to a decline of the local populations on Bonaire.

The Sea Turtle Club Bonaire (STCB) is a non-profit, non-governmental organisation, it's main goal being the conservation of the sea turtles around the island of Bonaire. After the pioneer project in 1993 (Van Eijck & Eckert, 1994), a follow-up of this project was executed in 1995.

In cooperation with WIDECAS, The University of Amsterdam (The Netherlands) and various local organisations such as the Bonaire Marine Park, an extensive sea turtle research and conservation project has taken place from June to December 1995. Main sponsors of this project were the World Wildlife Fund of The Netherlands, the Dutch National Postcode Lottery, and the Bonaire Trading Company.

A main part of the activities in 1995 consisted of in-sea research on the local juvenile green and hawksbill sea turtles residing in Bonairian coastal waters. Through a large sighting network of divers and snorklers, the juvenile populations have been monitored continuously for six months. More detailed information was collected through direct observations on several locations, where turtles are known to be present regularly (most probably being foraging areas), and through a photo-identification trial.

The sighting network is working well on Bonaire. As a result of the publicity given to the project and the enthusiasm of the local diveshops, the STCB is receiving a huge amount of day-to-day information. The studies in 1993 and 1995 revealed that a large group of juvenile sea turtles resides in (mainly east-) Bonairian waters, inhabiting certain fixed locations different periods of time. Photo-identification studies promise to be valuable as a database in the long run.

Also included in the 1995 Project was a thorough monitoring of the nesting activity on Bonairian beaches. Former research revealed that nesting by hawksbill and loggerhead turtles occurs on a small scale (Van Eijck & Eckert, 1994). The nesting activity was examined by ground surveying the nesting beaches regularly.

Nesting still occurs by hawksbill and loggerhead turtles, mainly on Klein Bonaire (39 of the total number of 44 crawls found in 1995). Unfortunately, nothing can be said about any decrease or increase in nesting activity. The total number of crawls documented in 1995 (44) was similar to the number found during the 1993 Project (40). However, new nesting beaches were identified on Klein Bonaire during the 1995 Project. Neither the number of nesting females nor the number of successful nests could be determined, but the data suggests an annual nesting population of 5-12 turtles. Twelve nests were excavated, showing a hatch rate of 0 to 94%.

Since Klein Bonaire is the main location for nesting activity, this islet should retain its unspoiled state. The STCB is urging the Antillean and Dutch Governments to take further action on this point, for example by a 'Debt for Nature Swap'.

A very important part of the STCB 1995 project consisted of enhancing the public awareness about the endangered status of sea turtles. To inform the public, folders were distributed, posters were sold, information about sea turtle conservation was placed in the museum of the national park and weekly slide shows were given. Also, regular press updates, radio and television interviews and a weekly column in the islands main Papiamentu newspaper were published.

Special attention was paid to the local children. Every school on the island received an information package about sea turtles, consisting of a video, various folders, a booklet, posters, and a slide presentation. In cooperation with the Bonaire Marine Park, children were taken on regular snorkel trips to educate them on underwater life in general. Finally, the STCB organised the coastal cleanup as a part of the World Cleanup Day on 16 September, during which several potential nesting beaches were cleaned.

After the first project in 1993, awareness about sea turtle conservation did increase on Bonaire. This is measured by the increasing enthusiasm and participation of the local people, especially the children. Furthermore, the media proved more interested and cooperative towards the 1995 Project, as compared to 1993. However, still a lot needs to be done.

In order to achieve its goals, the STCB is recommended to continue and extend the research and public awareness activities in future years. The beach and snorkel surveys in future projects can be performed in a similar manner. However, the research should be more focused on the photo-identification study and resident juvenile sea turtles along the east coast. The initiatives to enhance the public awareness must also be extended. Firstly, more educational material must be produced, like mini-posters, booklets and folders, to distribute among the schools. Secondly, the STCB should cooperate with other local organisations to establish an environmental centre. Finally, the search for new sponsoring and fundraising must be continued, to enable the STCB to extend its activities.

SAMENVATTING

Bonaire (12°12'N, 68°77'W), één van de Nederlandse Antillen, is o.a. beroemd om zijn ongerepte koraalriffen. Deze riffen, en ook de grazige zeegrasvelden, bieden voedsel en schuilplaats aan twee soorten bedreigde zeeschildpadden: de groeneschildpad (green turtle, *Chelonia mydas*) en de karetschildpad (hawksbill turtle, *Eretmochelys imbricata*). De dikkopschildpad (loggerhead turtle, *Caretta caretta*) en de lederschildpad (leatherback turtle, *Dermochelys coriacea*) zijn minder algemeen, maar worden ook af en toe aangetroffen. In de lokale taal (Papiamentu) heten de zeeschildpadden respectievelijk 'turtuga blanku', 'turtuga karet', 'turtuga kawama' en 'turtuga drikil'. Tot voor kort werden de zeeschildpadden regelmatig gevangen en geconsumeerd. In geringe mate is dit nog steeds het geval, ondanks het verbod middels de Verordening Marien Milieu (A.B. 1984, nr. 21), ingesteld op 27 juni 1991. Zeeschildpadden worden voornamelijk gedood om hun vlees en, in het geval van de karet, om hun schild. Deze jacht, in combinatie met het stropen van de eieren, heeft een afname van de lokale populaties op Bonaire tot gevolg gehad.

De Sea Turtle Club Bonaire (STCB) is een stichting zonder winstoogmerk, met als doel het behoud van de zeeschildpadden rond Bonaire. Na het eerste project in 1993 (Van Eijck & Eckert, 1994), is een vervolg op dit project uitgevoerd in 1995.

In samenwerking met WIDECAST, de Universiteit van Amsterdam en verscheidene lokale organisaties, zoals het Bonaire Marine Park, heeft een uitgebreid onderzoeks- en beschermingsproject plaatsgevonden van juni tot december 1995. Hoofdsponsors van dit project waren het Wereld Natuur Fonds, de Nationale Postcode Loterij en de Bonaire Trading Company.

Een groot deel van de activiteiten in 1995 besloeg onderzoek in zee, naar de lokale juveniele groene- en karetschildpadden, die in de Bonairiaanse kustwateren verblijven. Met behulp van een groot meldingsnetwerk van duikers en snorkelaars, werden de juveniele populaties zes maanden achtereenvolgend onderzocht. Meer gedetailleerde informatie werd verzameld door middel van directe observaties op verscheidene lokaties, waar schildpadden vaak voorkomen (waarschijnlijk fourageergebieden), en door een foto-identificatie onderzoek.

Het meldingsnetwerk functioneert uitstekend op Bonaire. Als gevolg van de publiciteit voor het project en het enthousiasme van de lokale duikscholen, ontvangt de STCB een grote hoeveelheid van dagelijkse informatie. De studies in 1993 en 1995 onthulden, dat een grote groep juveniele zeeschildpadden in (voornamelijk oost-) Bonairiaanse wateren verblijft, en dat deze schildpadden bepaalde vaste lokaties voor verschillende periodes in de tijd bezoeken. Foto-identificatie studies zullen waardevol blijken als database over een lange periode.

Ook opgenomen in het 1995 Project was een onderzoek naar de nest-activiteit op Bonairiaanse stranden. Eerder onderzoek had aangetoond, dat de karet- en de dikkopschildpad op kleine schaal nesten maken op Bonaire (Van Eijck & Eckert, 1994). De nest-activiteit werd bepaald door regelmatig de potentiële neststranden te onderzoeken op nestsporen.

De karet- en dikkopschildpadden blijken nog steeds nesten te maken, vooral op Klein Bonaire (39 van het totaal aantal sporen (44) gevonden in 1995). Helaas kan niets gezegd worden over enige toe- of afname van de nest-activiteit. Het totaal aantal sporen, gevonden in 1995 (44), was vergelijkbaar met het aantal gevonden tijdens het 1993 Project (40). In 1995 zijn echter nieuwe neststranden op Klein Bonaire

geïdentificeerd. Noch de hoeveelheid nestende wijfjes, noch het aantal succesvol uitgekomen nesten kon worden bepaald, maar de gegevens suggereren een jaarlijkse nestpopulatie van 5-12 zeeschildpadden. De twaalf nesten die konden worden uitgegraven, vertoonden succespercentages van 0-94%.

Omdat Klein Bonaire wat betreft nest-activiteit de belangrijkste lokatie is, moet de ongerepte staat voor dit eilandje behouden blijven. De STCB verzoekt de Antilliaanse en Nederlandse overheden om tot handelen over te gaan, bijvoorbeeld door middel van een 'Schuld-voor-Natuurruil'.

Een belangrijk deel van het STCB 1995 Project bestond uit het verhogen van het publieke bewustzijn ten aanzien van de bedreigde status van de zeeschildpadden. Het publiek werd voorgelicht door het verspreiden van folders, de verkoop van posters, het plaatsen van informatie over zeeschildpadden in het museum van het nationale park en door het wekelijks geven van diavoorstellingen. Verder werden regelmatig persvoorlichtingen, en radio en televisie interviews gegeven en een wekelijkse column in Bonaire's grootste papiamentu krant gepubliceerd.

Aan kinderen van het eiland werd speciale aandacht geschonken. Elke school op het eiland ontving een informatie pakket over zeeschildpadden, bestaande uit een video, verscheidene folders, een boekje, posters en een diapresentatie. In samenwerking met het Bonaire Marine Park, werden kinderen regelmatig meegenomen op snorkeltochten, om ze voor te lichten over het onderwaterleven in het algemeen. Tenslotte organiseerde de STCB een schoonmaakbeurt van de kustlijn, als onderdeel van de Wereld Schoonmaak Dag op 16 September, waarbij een aantal potentiële neststranden werden schoongemaakt.

Na het eerste project in 1993 is het bewustzijn, ten aanzien van de zeeschildpadbescherming, verhoogd op Bonaire. Dit wordt afgeleid aan de hand van de toename van het enthousiasme en de deelname van de lokale bevolking, met name van de kinderen. Bovendien waren ook de media meer geïnteresseerd en coöperatief ten aanzien van het 1995 Project, in vergelijking met 1993. Desalniettemin moet er nog veel werk verzet worden.

Om haar doelen te bereiken, wordt aanbevolen dat de STCB de onderzoek en milieu-educatie-activiteiten zal continueren en uitbreiden. Strand- en snorkelsurveys kunnen in toekomstige projecten op vergelijkbare wijze worden uitgevoerd, waarbij er meer aandacht gegeven zal moeten worden aan de foto-identificatie studie en de juveniele zeeschildpadden die langs de oostkust verblijven.

Initiatieven om het publieke bewustzijn te verhogen dienen ook te worden uitgebreid. Ten eerste is er behoefte aan meer educatief materiaal, zoals mini-posters, boekjes en folders, voor distributie onder de scholen. Daarnaast, zou de STCB moeten samenwerken met andere lokale organisaties in het opzetten van een milieu centrum. Tenslotte dient de STCB de zoektocht naar nieuwe sponsoring en fondsenwerving voort te zetten, om een uitbreiding van de activiteiten mogelijk te maken.

RESUMEN

Boneiru (12°12'N, 68°77'W), Antias Hulandes, ta famoso pa su refnan no dañá. Refnan i yerbanan di laman ta proveé kuminda i refugio pa dos spesi di turtuganan di laman ku ta na peliger, e 'green turtle' (*Chelonia mydas*) i e 'hawksbill' (*Eretmochelys imbricata*). E turtuganan 'loggerhead' (*Caretta caretta*) i 'leatherback' (*Dermochelys coriacea*) ta menos komun pero nan ta wordu topá okashonalmente. Na e idioma lokal (Papiamentu) e spesi aki ta konosí komo turtuga blanku, turtuga karet, turtuga kawama i turtuga drikil, respektivamente. Te resientemente, turtuganan tabata wordu kapturá i prosesá regularmente. Esaki ta kontinuá ku menos regularidat, a pesar di e echo ku e ta prohibí segun e Ordenansa di Ambiente Marino (A.B. 1984, no. 21), modifiká dia 27 di yüni 1991. Turtuganan ta wordu matá prinsipalmente pa nan karni i, den e kaso di karet, pa nan kaska. Esaki, huntu ku e herebementu di webu, a resultá den un deniklashon di e poblashonnan na Boneiru.

E Sea Turtle Club Bonaire (STCB) ta un organisashon sin ganashi, no gubernamental, ku e uniko meta konservashon di Turtuganan di laman ront di isla di Boneiru. Despues di e proyekto pionero na 1993 (Van Eijck & Eckert, 1994), kontinuashon di e proyekto aki a tuma lugá na 1995.

Den kooperashon ku WIDECAST, e Universidad di Amsterdam (Hulanda) i varios organisashonnan lokal, manera Bonaire Marine Park, un proyekto di investigashon i konservashon a tuma lugá for di yüni te desèmber 1995. E spònser prinsipal di e proyekto aki tabata World Wildlife Fund Hulandes, e Nationale Postcode Loterij Hulandes i Bonaire Trading Company.

Un parti prinsipal di e aktividatnan den 1995 tabata konsisti di investigashon den laman tokante poblashon di turtuganan blanku i karet hubenil residensiando den awanan kostal di Boneiru. Ku un enkadenashon di bistanan ("sighting network") pa sambuyadonan i "snorklers", e poblashonnan di turtuganan hubenil a wòrdu kontrolá kontinuamente pa seis luna. Informashon mas detayá a wòrdu kolektá ku observashonnan na diférente lugá-unda turtuganan, manera ta konosi, ta presente regularmente (mas probablemente lugá pa kome) -ront di e isla, inkluyendo un "photo identification trial".

E "sighting network" ta funshoná bon na Boneiru. Komo resultado di e publisidat duná na e proyekto i e entusiasmo di e sentronan di buseo lokal, e STCB ta haña un kandidat grandi di informashon di tur dia. E estudionan den 1993 i 1995, a relevá ku un grupo grandi di turtuganan di laman hubenil ta biba den e awanan di Boneiru (prinsipalmente na kosto oost), i ta habitá algun lugá fiho den diferente períodonan. E estudionan "photo identification" ta priminti di ta di balor komo "data base" a lo largu.

Tambe inklui den e proyekto di 1995 tabata un monitormentu intensivo di "nesting activity" (trahamentu di neshi) na beachnan di Boneiru. Investigashon den pasado a relavá ku "nesting" di e turtuganan karet i turtuganan kawama no ta tuma lugá frekuentemente (Van Eijck & Eckert, 1994). E "nesting activity" a wòrdú eksaminá regularmente dor di inspekshon na tera (groundsurveying) di e beachnan pa "nesting".

"Nesting" ta tuma lugá ainda ku e turtuganan karet i e turtuganan kawama, spesialmente na Klein Bonaire (39 fo'i di 44 "crawls" den 1995). Desafortunadamente, nada por wòrdu bisá tokante e kantidat di neshi, si e "nesting" a baha of oumentá. E kantidat total di "crawls" dokumentá na 1995 (44) tabata similar na e kantidat hañá

durante e Proyektu di 1993 (40). Sinembargo, durante e Proyektu di 1995 beachnan pa "nesting" nobo a wordu identifiká na Klein Bonaire. No por anumerá e kantidat di hembra ku ta brui mi e kantidat di nèshi eksitoso, pero datonan ta indiká un bruimentu anual di 5 pa 12 turtuga. Diesdos nèshi a keda habrí mustrandó un averahe di nasimentu di 0% pa 94%.

Komo ku Klein Bonaire ta un di e lugarnan prinsipal di "nesting activity", e isla aki tin ku retené su kondishon natural. E STCB ta urgi e Gubièrnu Antiano i e Gubièrnu Hulandes pa tuma mas akshon riba e tereno aki, por ehèmpel ku un "Debt for Nature Swap" (Kambio pa debe na naturalesa).

Un parti hopi importante di e proyekto STCB di 1995 tabata konsistí di mehorá e konsiensia publiko tokante e situashon di turtuganan di laman na peliger. Pa informá e pueblo, folders a wòrdu distribuí, posters a wòrdu bendé, informashon tokante konservashon di turtuganan di laman a wordú butá na e museo di parke nashonal i slide shows semanal a wòrdú duná. Tambe tabatin informenan na prensa regularmente, entrevista na radio i televishon i un kolumna den e korant Papiamentu prinsipal di e isla a wordú publiká.

Atenshon spesial a wòrdú pagá na e muchanan lokal. Kada skol na e isla a haña un pakete di informashon tokante e turtuganan di laman, konsistiendo di un video, varios foldersnan i posters. Tambe tabatin un slide presentation. En koperashon ku e Bonaire Marine Park, muchanan a wòrdú hiba pa trepdi snorkel regularmente pa siña nan tokante bida bou di awa en general. Ultimamente, e STCB a organisá e limpieza kostal komo un parti di e Dia di Limpieza Mundial na dia 16 di septèmber, durante kua diferente beach di "nesting" a wòrdú limpiá.

Despues di e promé proyekto aki na 1993, konsientisashon tokante konservashon di turtuganan di laman a subi na Boneiru. Esaki ta wòrdú midí ku e oumento di entusiasmo i e partipisashon di e hende lokal, spesialmente e muchanan. Ademas, e media a mostra mas interes i koperashon na e Proyektu di 1995, kompará ku 1993. Sinembargo, hopi mas tin ku wòrdú hasí.

Pa logra su metanan, ta rekomendá pa e STCB pa kontinuá i ekstendé e investigashon i e aktividatnan di konsiensia publiko den e añanan benidero. E inspekshon di beach i snorkel den proyektonan futuro por wordú ehekutá di mesun manera. Sinembargo, e investigashon tin ku wordú enfoká mas riba e "photo identification study" (estudio di identifikashon di portret) i tambe riba turtuganan di laman hoben ku ta biba na e kosta oost. E inisiativa pa mehorá e konsiensia publiko tambe tin ku wòrdú ekstendé. Primeramente, mas material edukativo tin ku wordú produzi, manera "mini posters", buki i foldersnan, pa distribushon na e skolnan. Na segundo lugá, e STCB tin ku koperá ku otro organisashonnan lokal pa funda un sentro ambiental. Finalmente, tin ku kontinuá buska sponsornan y fondanan (fundraising), pa STCB por sigi ekstende su aktividatnan.

I. INTRODUCTION

1.1 The Sea Turtles of Bonaire

There are very few marine-adapted reptiles in the world, of which sea turtles are the most well known members. Some turtle species moved from the marshes and land back to the sea early on, about 150 million years ago. By 100 million years ago, four families of marine turtles inhabited the planet (Lehrer, 1990). Sea turtles inhabit all temperate and tropical oceans, solely depending on land for reproduction. Like all reptiles, sea turtles have lungs and must surface to breathe. Currently, two families of sea turtles exist: Cheloniidae, with six species; and Dermochelyidae, with the leatherback as the sole member. The latter is the single turtle that lacks the protection of a hard, bony carapace; it has a leathery, scaleless skin over a thick, greasy layer of cartilage, in which is embedded a mosaic of thousands of small polygonal bones (Lehrer, 1990)

The seven sea turtle species are: *Chelonia mydas* (green turtle), with a subspecies *Chelonia agarissi* (east pacific green turtle), *Caretta caretta* (loggerhead), *Eretmochelys imbricata* (hawksbill), *Lepidochelys olivacea* (olive ridley), *Lepidochelys kempi* (Kemp's ridley), *Dermochelys coriacea* (leatherback), and *Natator depressus* (flatback, endemic to Australia). Four of these species are encountered in the Bonairian coastal waters. The green turtles and hawksbills (locally called 'turtuga blanku' and 'turtuga karet', respectively) are most common on Bonaire. Especially their juveniles are found in the waters of Bonaire and use the Bonairian reef and sea grass beds as forage area and shelter.

Green turtles are both worldwide and in Bonaire, the most abundant sea turtle species. They are mainly herbivorous, feeding mostly on sea grass (*Thalassia testudinum*) and marine algae (Bjorndal, 1982). The green turtle is the largest hardshell marine turtle, typically growing to a shell length of about 1 meter, with extremes upto approximately 1.7 meters.

The hawksbill is omnivorous. Its diet consists mainly of marine invertebrates of which sponges are preferred. The carapace of the hawksbill, which is known for its beautiful scutes can reach a length of about 0.9 meter, which makes it the smallest of the Bonairian sea turtles. Furthermore, the hawksbill is known to make nests on Bonairian beaches.

Loggerheads and leatherbacks ('turtuga kawama' and 'turtuga drikil', respectively) also visit Bonaire, however less frequently. Currently loggerheads make nests on Bonairian beaches. Very few sightings are recorded of juvenile loggerheads in the waters of Bonaire. Loggerheads are omnivorous, although they have a preference for meat, like crustaceans, molluscs and fish. Their carapace typically grows to a length of 1 meter.

Leatherbacks can be considered as the largest living reptiles. The leathery carapace grows to 2 meters, with 3 meters as a maximum. Leatherbacks are specialised on a diet of jellyfish and are great divers; they are observed to dive as deep as 1300 meters (Eckert, S.A., Eckert, K.L., Ponganis, P., Kooyman, G.L., 1989). Olive ridleys are also known to have passed through the waters of Bonaire, but only rarely.

Traditionally, man has hunted sea turtles for their flesh, carapace, fat, skin, etc.; and their eggs have been poached. In many cultures, the hunting has persisted throughout many centuries, and as a consequence the number of sea turtles has dwindled considerably. Especially the last few decades, due to larger harvests caused by human population growth and the commercialisation of turtle products, sea turtle populations have declined dramatically worldwide. The production of marine pollution has also played a role in this decline. Many turtles die or are debilitated after ingesting plastic debris, become entangled in abandoned fishing gear, or encounter spilled contaminants like oil or industrial waste. Currently, a decrease in the trade of turtle products is ensured, through the Convention on the International Trade of Endangered Species (CITES). Furthermore, several organisations have been established to protect the sea turtles. For instance, the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), which attempts to conserve the sea turtles in the Caribbean. On Bonaire, the Sea Turtle Club Bonaire (STCB) was founded in 1991 to prevent the extinction of the sea turtles on Bonaire (section 1.3). Sea turtles are fully protected in Bonaire (Appendix I).

1.2 Bonaire

A few years ago, a comprehensive review of sea turtles throughout the Netherlands Antilles was published by WIDECAST as a part of the United Nations Caribbean Environment Program (UNEP/CEP). This Sea Turtle Recovery Action Plan for the Netherlands Antilles (STRAP; Sybesma, 1992) resulted from an investigation by Sybesma on the various islands of the territory between 1986 and 1991, assembling both historical and contemporary data on the status and distribution of sea turtles, the laws protecting them, and the extent (and economic/cultural importance) of harvesting and usage. In the STRAP, four dominant threats to sea turtles throughout the Netherlands Antilles are discussed; these are the destruction or modification of habitat, over-utilisation, disease and predation, and inadequate regulatory mechanisms. The main threats in Bonaire are loss of suitable habitat and illegal hunting. There are no data to indicate the extent to which disease or predators have affected the populations of sea turtles in Bonaire, but these natural forces are not likely to be of concern in the long term. Also, inadequate legislation is not a problem in Bonaire since turtles are fully protected (Appendix I).

However, enforcement of the local moratorium (Appendix I) is problematic. Police Corps is understaffed and too often do not place high priority on conservation issues. There is no special enforcement agency for environmental laws and regulations. Only the manager of the Bonaire Marine Park has special enforcement authority. Environmental Service personnel have authority to enforce certain aspects, such as marine pollution. It was not until 1993 that turtle meat was removed from the menus of local restaurants. However the possibility still exists that turtle meat is sold in a secretive manner, for example at the snack bars at Lac Bay. Turtle shell trinkets are also sometimes sold, most likely due to ignorance of the law. During a market survey undertaken in May 1993, tortoiseshell items were encountered in only one shop in Kralendijk. The shopkeeper was informed of the law and the items were subsequently removed (van Eijck & Eckert, 1994). Prior to enactment of the ban on turtle capture and sale, the shells from turtles caught for food were often sold. In June 1991, a fisherman offered Eckert a shell from an adult green turtle he had butchered at Lac Bay, for the price of NAfl. 30,-. The sale of shells today would be clandestine, most

likely to unsuspecting tourists and, as no signs of trade of turtle souvenirs have been observed in 1995, on a very low scale.

Bonaire has a tradition of turtle meat consumption (green turtles are preferred). The number of turtles harvested has never been based on scientific data (e.g., population size, recruitment rates) and there are indications, aside from the noticeable decline in nesting, that the stocks have been over-fished. Historically, the catch consisted mainly of greens and hawksbills brought in by nets, mostly from June to December. Catch was limited during the rest of the year because of rough water conditions. [N.B. The taking of nesting females is opportunistic but rare on Bonaire.] The STRAP quoted "an older, reliable fisherman" that the annual catch in the late 1970's was about 40-50 per month (ca. 500 per annum, greens and hawksbills combined) and that by 1991 the catch had declined to about 20 turtles per month. In addition, the size of the turtles caught had decreased. The STRAP suggested that this was an indication that populations were stressed. Fishermen agree that smaller turtles were once released, but that as the harvest diminished all size classes were treated as catch in the years leading up to the moratorium (Sybesma, 1992). The number of turtles caught illegally in the past couple of years is unknown. However, it is thought, that in 1995 at least once a week a tangling net was placed in Lac Bay. Unfortunately, the results of this action are not known.

The accelerating development of coastal land in general, and sandy beaches in particular, has resulted in fewer and fewer suitable places for sea turtles to nest. The STRAP concludes with the notion that virtually all beaches in the Netherlands Antilles that were once known as nesting beaches are now either no longer visited by gravid turtles or are visited only rarely. The loss is attributed to local exploitation and increasingly heavy use of beaches for recreation and tourism. Further, the removal of sand for building purposes has been very destructive. For example, Playa Grandi vanished after the sand dunes were mined away. Equally important is habitat degradation at sea. There is ample evidence that turtles use the coastal zone for feeding, resting and/or migrating. Domestic pollution, especially around urban areas, poses a threat because not all the raw sewage generated is collected via a sewer system for subsequent treatment. In addition to land-based sources of pollution, ships release operational discharges and other refuse at sea. The effects are especially evident on the east coast of Bonaire, where persistent marine debris accumulates at Lagun and Playa Chikitu. This, in turn, reduces the suitability of these beaches for nesting.

The STRAP recommends that "it is especially important and should be considered a priority to implement surveys of the coastline for contemporary nesting and to interview older residents who may recollect the distribution of nesting in earlier years. To define important foraging habitat is more difficult, but should be integrated to the extent possible with the activities of SCUBA divers, fishermen and research personnel who regularly visit particular areas and who are willing to accumulate sighting data over time. The efforts made during the 1980's under the auspices of both WATS and WIDECAST (Wider Caribbean Sea Turtle Conservation Network) to assemble available information on the status and distribution of sea turtles have been extremely useful, and we must now build on our existing knowledge in order to efficiently identify essential habitats." It also stressed the importance of public awareness initiatives and programs designed to get the public more involved in sea turtle conservation (Sybesma, 1992). Additional information about the history of Bonaire can be found in the 1993 report (Van Eijck & Eckert, 1994).

1.3 Sea Turtle Club Bonaire

The Sea Turtle Club Bonaire (STCB) is a Dutch-Bonairian, non-profit, non-governmental organisation, with the main goal to prevent the extinction of the sea turtles of Bonaire. Its prime objective is raising funds for local sea turtle protection efforts, including research and public awareness activities. In 1990, concerned citizens of Bonaire and The Netherlands became alarmed about the situation, and decided to take action for the conservation of the sea turtles of Bonaire. Their first efforts included the purchase (and release) of turtles, which were still alive, from fishermen. But they realised more was needed. Later, Mr. A.J.Th. de Soet, founded the STCB.

Fund raising efforts included a specially commissioned turtle necktie, sold in The Netherlands for Nfl. 100,- (ca. US\$ 50) and, in February 1992, a benefit dinner in Bonaire attended by wealthy and prominent persons from Holland and the Netherlands Antilles, including the Prime Minister of The Netherlands at that time, and his wife (who is the patron of the STCB). The dinner raised nearly NAfl. 20,000,- (ca. US\$ 14,000), which was donated to the Turtle Club to finance the local conservation efforts. Since that time, various fund-raising dinners have been organised (e.g. one was included in the 1995 Project). Further, the STCB is currently supported by various organisations, like the World Wildlife Fund of the Netherlands, the Foundation DOEN/National Postcode Lottery, the Foundation for Scientific Research in the Caribbean Region, the KLM, Golden Tulip and Ahold.

1.4 Sea Turtle Survey Bonaire: 1993

With funds secured from sales of the "turtle tie" and the February 1992 dinner, the STCB Board decided to hire a sea turtle expert to undertake a sea turtle conservation project on the island. The project was mainly financed by STCB, and was designed and executed under the supervision of WIDECAST. In May 1993, Dr. K. Eckert (Executive Director, WIDECAST) visited Bonaire to assist the Project Coordinator, Drs. T. J. W. van Eijck, with project design. Field work, interviews and public awareness programs were designed based on the recommendations of the WIDECAST Action Plan (Sybesma, 1992). The result was a formal project proposal entitled, Sea Turtle Survey Bonaire: 1993 (Van Eijck, 1993; Eckert, Hensen, Sybesma, Editors).

From May until November, 1993, fifteen potential nesting beaches were ground surveyed, former turtle fishermen were interviewed, a sighting network was established to document encounters with turtles in near shore waters, and an awareness campaign was designed to target schools, the dive tourism industry, law enforcement agencies (Park Rangers, Customs Officers, Police Corps), and the general public. The campaign included public slide shows, regular media updates, a weekly column in the island's main Papiamentu newspaper, and the production of a flyer, booklet, and colour poster focused on the sea turtles of Bonaire.

The beach surveys revealed that nesting by hawksbill and loggerhead turtles occurs on a small scale; a total number of 40 crawls were documented. The majority of crawls were encountered on Klein Bonaire, an uninhabited islet off Bonaire's west coast. From the crawls, it could be determined that Bonaire is still visited by nesting hawksbill and loggerhead turtles, be it on a small scale. Apart from the nesting activity on the beaches, the reefs of Bonaire are inhabited by juvenile hawksbill and green turtles (20-50 cm estimated shell length). It is suggested that these young sea turtles use the reefs

and sea grass beds of the island as a residence where they can grow and forage for several years, until they become mature. Among others Sorobon (Lac Bay) seems to be particularly good foraging areas, but further inventory needed to be done for verification. Although no serious attempt to estimate the number of turtles residing in Bonairian waters could be made, a minimum estimate of 45 juvenile turtles was suggested.

From this inventory it became evident that future research should include in-water surveys of Bonaire's east coast (i.e. Lac Bay), and a more detailed investigation of nesting activity at Klein Bonaire. The results of the 1993 Project were compiled into the first STCB report (Van Eijck & Eckert, 1994), in which recommendations were made for a future research and conservation program. Based on these recommendations, a proposal for the STCB 1995 Project was written.

1.5 The STCB 1995 Project

To obtain more academic involvement, the STCB started a cooperation with the University of Amsterdam (UvA), from which two marine biology graduate students, Paul van Nugteren and Niels Valkering, were appointed as STCB Project Assistants. In addition, Prof. Dr. R.P.M. Bak from the UvA was invited to supervise the ecological research of the STCB. Based on the recommendations in the 1994 Report, a Project Proposal (Appendix II) for a STCB 1995 Project was prepared and in June 1995 the project was launched. It lasted six months. The STCB 1995 Project was supported by various organisations, like the World Wildlife Fund of the Netherlands, the Foundation DOEN/National Postcode Lottery and the Foundation for Scientific Research in the Caribbean Region. All activities of the STCB were undertaken in close cooperation with various organisations on Bonaire, such as STINAPA Bonaire, the Bonaire Marine Park (BMP), Tene Boneiru Limpi and Amigu di Terra. And on regional scale, with Reefcare Curaçao, STINAPA Curaçao, Sea Aquarium Curaçao, StimAruba, Fudena (Venezuela) and Widecast.

The overall goal of the project was similar as the goal set in 1993 (Van Eijck & Eckert, 1994), namely to prevent the extinction of sea turtles around Bonaire by implementing the specific recommendations made by Sybesma (1992).

To accomplish this goal, the following objectives were identified:

- A. Determine the extent of illegal activity, such as harvesting, export/import, and sale of sea turtles and their products;
- B. Determine the distribution, abundance and seasonality of sea turtles and their nesting activity on Bonaire;
- C. Provide detailed recommendations to the island government regarding the protection and conservation of suitable nesting beaches and feeding habitats;
- D. Solicit the active support of the local business community of Bonaire in sea turtle conservation;

- E. Promote public awareness of the importance of sea turtle conservation and legislation on Bonaire;
- F. Develop and sustain cooperation and communication (with governments and non-government organisations) at the national level with The Netherlands and other islands of the Netherlands Antilles, at the international level with Aruba, Venezuela, and other relevant range states, and with WIDECAST and other international non-governmental bodies and events (e.g., the annual Symposium on Sea Turtle Biology and Conservation).

To attain these objectives, a 6-month Work Plan was outlined.

II. RESEARCH: Methods, Results, Discussions.

2.1 Introduction Research

As in the 1993 Project, the research in the STCB 1995 Project consisted of a thorough examination of the nesting activity on Bonaire and of further research on the sea turtle populations residing in the Bonairian coastal waters. The methods used were also comparable. However, due to the increase in manpower, the STCB was able to extend the research in various ways. The beaches could be monitored more regularly, with emphasis on the relatively more important nesting beaches. In a similar manner, the snorkel surveys could be conducted more intensively, more stimulance was given to the dive industry considering a sighting network and a pilot study could be launched. First the assessment of the nesting activity will be discussed followed by the research on the residing juvenile sea turtle populations of Bonaire.

2.2 Nesting Assessment

2.21 Methods

2.211 Survey Schedule

A normal beach survey consisted of close inspection of the beach and the dunes (if present) for turtle tracks, body pits, nest emergences, human/animal presence and traces of poaching. Standard data sheets were developed for the documentation of nesting and hatching activity (Appendix III). The survey schedule was as follows:

Day	Activity	Transportation
MO	Survey South	Car
	Klein Bonaire North	Dive boat
TU	Survey North	Car
WE	Survey South	Car
	Klein Bonaire West	Patrol vessel
TH	Survey West	Car
	Klein Bonaire North	Trimaran
FR	Survey South	Car
SA	Survey North	Car
	Klein Bonaire North	Dive boat
SU	No beach surveys	

All beach surveys took place in the morning. The Project Assistants monitored different areas or stretches of beach. Sometimes the Project Assistants both monitored Klein Bonaire, yet different parts were visited. In this manner, the advantage of more manpower was utilised and the beach surveys were intensified. In addition, people living on or near the beach were interviewed about past and recent track sightings, turtles and/or hatchlings, and nest fate.

2.212 Nesting Habitat Assessments

An extensive assessment of Bonaire's beaches with regard to suitability for sea turtle nesting was already done by Van Eijck in 1993. In 1995, some new potential nesting beaches could be identified. The features recorded were the beach name, the dimensions, energetics, offshore status, threats, and the human and animal activity, vegetation and earlier activity on the beach. The 1993 and 1995 assessment can be viewed in Table 1.

Based on habitat assessment data (as above), 15 beaches were identified in the 1993 Project, as likely to support sea turtle nesting. These were also surveyed in the 1995 Project, except for Lac Bay which was visited infrequently. However, a few beaches were added to the total, namely Boca Catuna, Wayaka, Boca Slagbaai, all in the Washington-Slagbaai National Park and the beaches of the regions West of No Name and West Klein Bonaire (Figure 1). The latter consists of 16 small dynamic beaches, that were not monitored at all in 1993, but nonetheless proved to be of major importance for Bonaire's nesting sea turtle population in 1995. Also documented during the 1995 Project is West of No Name, which consists of 9 small beaches. Therefore the beaches of the whole stretch from the south west point of Klein Bonaire to No Name are numbered from 1 to 25. To facilitate the marking and recollecting nesting attempts, the long stretches beach No Name and East of No Name were divided into sectors, running from -2 to 5. Figure 2 presents a map of Klein Bonaire with the beaches and sectors.

When monitoring Klein Bonaire North, both Project Assistants often went to Klein Bonaire. Subsequently, one of them would survey East of No Name and the other would survey West of No Name and No Name.

The beaches were subdivided into five regions. 'North', 'South' and 'West' beaches were visited using a Suzuki mini-van (courtesy Bonaire Leasing). Klein Bonaire North beaches were visited by means of dive boats from the Sunset Beach Dive Centre, Captain Don's Habitat and Buddy Dive and the motorised trimaran *Woodwind*. Klein Bonaire West beaches were visited by the Bonaire Marine Park patrol vessel (courtesy BMP).

Region	Beach	Sector	Beach##
North	Wayaka (Washington Park) Playa Chikitu(Wash. Park) Boca Chikitu (Wash. Park) Boca Catuna (Wash. Park) Boca Slagbaai (Wash. Park)		
West	Boca Dreifi ('Geowatt') Playa Nukove Playa Frans		
South	Windsock Punt Vierkant Pink Beach Chogogo Southwest Pocket Beaches		

Region	Beach	Sector	Beach##
South (continued)	Sorobon Area Lagun		
Klein Bonaire North	No Name Beach	0 to -2	
	East of No Name	1 to 5	
	West of No Name		25 to 17
Klein Bonaire West			16 to 1

Boca Washikemba, Boca Onima and Playa Grandi were omitted from the 1995 study and Lac Bay and Bachelors beach were visited only opportunistically: these sites support only minimal volumes of sand, and rock or coral mixtures were encountered at shallow depths (10-20 cm). Van Buurt (1984) mentioned Washikemba as suitable nesting habitat, but today nesting is not likely to be successful due to an insufficient amount of sand in combination with an enormous amount of debris. The volume of sand on several of these beaches may have been larger in the past, especially on Playa Grandi where, according to Sybesma (1992), extensive sand mining has taken place. Lac Bay (the beach at Cai) also used to be visited by mainly green turtles (Van Eijck & Eckert, 1994), but no new nesting activity is expected at this location due to the presence of many fishermen and the decline in sand conditions.

In a later stadium of the STCB 1995 Project, a few beaches were less intensively monitored. Windsock, Pink Beach and Boca Slagbaai are subjected to human pressure, in the form of trampling and beachfires and therefore any nesting activity on these beaches is not expected.

2.213 Turtle Activity Assessments

If a crawl or a body pit was found, the following activities were undertaken:

1. Date, time and location were documented;
2. Route and activity of the turtle were established and drawn to a map, showing the activity of the turtle in relation to the sea and other landmarks, the direction of the crawl and the number, location and form of the body pits;
3. Maximum track width was measured and the track inspected or symmetry/asymmetry (for species determination);
4. When necessary, body pits were inspected by careful probing to confirm the presence of eggs;
5. If eggs were found, the exact nest site was marked and triangulated for future reference and determination of nest fate;
6. If no eggs were found, the whole activity-site was marked for future reference;

If a hatched nest was found, it was investigated in the following way:

1. The exact hatching site was drawn on the original map;
2. The nest contents were excavated by hand;
3. Nest contents were inspected and categorised as follows:
hatched shells (H), undeveloped eggs (U), midterm embryo (M),
fullterm embryos (F), dead hatchlings (D), live hatchlings (L),
and total estimated eggs (T) [N.B. live hatchlings trapped in
the nest were regarded as dead hatchlings];
4. All categories were tallied and percentage hatch success (H%)
was calculated as $H/T * 100$. Percentage successfully emerging
from sand (S%) was calculated as $H-D/T * 100$.

2.22 Results

2.221 Turtle Activity Assessments

The beach surveys showed nesting activity of hawksbill and loggerhead turtles, as was the case in 1993. 44 nesting attempts were documented, between 20 June and 15 November (Table 2) and were distributed in time as shown in Figure 3. The 1993 surveys identified Klein Bonaire as a key area for nesting (Van Eijck & Eckert, 1994). For this reason Klein Bonaire was monitored most extensively in the 1995 Project. New nesting beaches were recorded on the west side of Klein Bonaire. Again, Klein Bonaire showed to be of utmost importance as a nesting ground (Figure 4). The majority of crawls were encountered on Klein Bonaire. Activity on Bonaire was determined, be it on a small scale. Of the 44 attempts, 5 (11%) were found on Bonaire and 39 on Klein Bonaire (Figure 4). The majority of the nesting attempts were recorded on the westside of Klein Bonaire, namely 22 of the total 44 (50%). These beaches were not monitored in the 1993 Project. The activity nearly always consisted of a crawl with an amount of body pits varying from 0 upto 6, with Figure 5 presenting the bodypit frequency distribution.

At twelve occasions, eggs were confirmed and excavated post-nesting (Table 3). Ten (83%) of the twelve nests were made on Klein Bonaire. The success of the nests varied greatly. The hatching success ranging from 0% (a total of three nests did not hatch) to 94%. Incubation time was estimated in five cases (range 51-61 days).

Based on the identification of dead embryos and/or hatchlings in the excavated remnants of the nests, and to a lesser extent on track width and the characteristics of the beach and the attempt, species could be identified in only 13 (30%) cases with certainty, mainly through examination of dead embryos and /or hatchlings; of these, 7 were loggerhead and 6 hawksbill turtles. In 20 cases, the species has been identified, yet, the outcome remains unreliable; in these cases, hawksbill dominate loggerheads by 16:4.

2.23 Discussion

2.231 Abundance and Distribution of Nesting

Along with the 1993 study, the 1995 Project can be considered to provide a comprehensive measure of the abundance and distribution of nesting activity, assessment of threats to sea turtles and their eggs, and a preliminary estimate of

nesting population size (Van Eijck & Eckert, 1994). The ground surveys during the STCB 1995 Project of the various nesting beaches on Bonaire and to a higher extent Klein Bonaire revealed a low density of nesting activity of two species. As was the case in 1993, the two species that lay eggs on Bonairian beaches are the loggerhead and hawksbill. This data supports the assumption that nesting activity by the green turtle has stagnated on Bonaire. Leatherback nesting is traditionally low on Bonaire and therefore it is not surprising that no activity has been found by this species in 1993 and 1995. Leatherbacks prefer large and somewhat dynamic sandy beaches and these are not abundant on Bonaire. Playa Chikitu could serve as a nesting beach for Leatherbacks as well as No Name beach. However, plausible is that leatherbacks tend to avoid Bonaire due to its extensive reef formations.

The total of 44 attempts were recorded in 1995. These were distributed over 16 of the 42 beaches that were surveyed. As expected the activity on Bonaire was observed to be far lower than on Klein Bonaire. Only 4 beaches of the 16 where turtles attempted to make nests in 1995 are located on Bonaire. Five of the total of 44 attempts were to be found on Bonaire. On Bonaire, most turtles have left due to the threats of the human population. Firstly, development has taken place extensively, mainly on the westcoast. This results in noise, which scares nesting sea turtles away and prohibits them from laying their eggs. Moreover, nocturnal lights scare nesting turtles and bring about disorientation of the hatchlings after emerging from the sand, as light is their primary cue to orient to the sea (e.g., Mrosovsky, 1972, 1978).

Secondly, extensive poaching has resulted in a decrease in nesting females and a possible decrease in recruitment, in the case of egg poaching. There is also a decrease recorded in nesting attempts on Bonaire compared to two years ago in the 1993 Project. Where Bonaire supported 22.5% of all nesting in 1993 (Van Eijck & Eckert, 1994), the main island contributed merely 11% to the total of 44 attempts documented in 1995 (Figure 7). Furthermore, less nests have been observed on Bonaire. Where 1993 counted 3 of the total of 6 nests on Bonaire, 1995 showed that only two out of twelve nests (nrs. 1 and 7) were made on the main island (Table 3).

Figure 7 depicts the distribution of nesting attempts of 1995 relative to 1993. A shift in regions over the two years is evident. It is interesting to point out the differences and similarities between the two years and attempt to explain them per region. Therefore, this section will discuss per region: the activity in 1995, the comparison of the 1995 data with data from the 1993 Report and earlier, and finally the possible explanations for changes in time, if any. In succession, the following regions will be discussed: Southeast Bonaire, Northeast Bonaire, Northwest Bonaire, Southwest Bonaire and Klein Bonaire.

Southeast Bonaire

Absolutely no activity has been recorded along the Southeast/east coast during the STCB 1995 Project. Sea turtle nesting along this shore has certainly decreased over the years. Plenty examples are recorded (Van Eijck & Eckert, 1994) of nesting on the various beaches in the past. In former times, the southern part consisted of long stretches of dune, which presumably supported a relatively high level of nesting (R. Hensen, pers. comm.). These dunes disappeared completely as AKZO built coral dikes along the south coast.

Lagun has served as a nesting beach in the past. In 1988 an attempt has been made by a leatherback to lay its eggs on Lagun. Unfortunately, fishermen intercepted and

caught the animal (Van Buurt, 1995). In 1993 an unsuccessful attempt was made by a hawksbill (Van Eijck & Eckert, 1994). In 1995 no activity has been documented. It is evident that the beach has deteriorated extensively over the years. This is caused by the presence of man, which causes noise and trampling, but equally important is the hazardous effects of the enormous amounts of debris. Although debris may not withhold adult female turtles to nest, it can act as obstacles for the hatchlings and cause difficulties for the hatchlings to reach the sea.

Neither Lac Bay Cai nor Sorobon have shown any signs of nesting activity over the last couple of years. Green and hawksbill turtles used to lay their eggs on these beaches (Sybesma, 1992; Van Buurt, 1995; R. Hensen, pers. comm.) but this has apparently expired. At Cai this is not astonishing, as its inhabitants are known to be fishermen and regular festivities cause severe disturbances. The stagnation of nesting at Sorobon is more difficult to elucidate. The dunes at this site are somewhat, but not extensively deteriorated due to debris and trampling. More likely, the stagnation is caused by activities of small groups of people at day and at night.

Northeast Bonaire

Nesting along the Northeast shore seems unlikely, especially after the degradation of Playa Grandi due to sand mining activities (Sybesma, 1992). Nowadays, Playa Chikitu appears to be most suitable as nesting beach. In 1995, one nesting attempt has been recorded on this beach. Moreover, Washington Park Rangers state that turtles have laid their eggs on this beach in the past (Van Eijck & Eckert, 1994), however, no quantitative measurements have ever been made. Unfortunately, the beach is often visited at night by local residents, who might disturb turtles when attempting to make nests. Activity on Playa Chikitu has not been observed in years and therefore it was surprising that nesting activity was recorded in 1995. The cause of the undevelopment of the eggs on Playa Chikitu is unclear. Possibilities are human disturbance, by means of trampling or poaching, before 12-24 hours past the time of deposit in the sand (in which case the embryos will not develop), sterile eggs and a high sea water level. Boca Chikitu is less likely to serve as a nesting beach, as it has a difficult offshore access and the beach is small, dynamic and scattered with debris and rocks.

Northwest Bonaire

On the Northwest coast, ranging from Boca Catuna to Boca Dreifi, Nukove is the only beach that is regularly visited by nesting sea turtles. The habitat can be considered marginal, due to an impermeable layer of coral rock that underlies the beach at a depth of 30-40 cm, heavily trampling by tourists, who visit the tiny beach regularly and the presence of a nearby fishermen settlement. Nonetheless, the beach is known to have been visited by at least loggerheads in the past. Within the 1993 Project, loggerhead activity was also documented as well as one nest on this beach (Van Eijck & Eckert, 1994). In 1995, Nukove again proved potentially valuable as a nesting beach. However, the two attempts found did not result in hatchlings, because the eggs may have been dug out by fishermen in the first case; a big hole was left behind. The second attempt could have very well resulted in a productive nest, if it were not destroyed by a storm. A major part of the beach was washed away, due to the extreme wind and the run-off from the island, caused by heavy rainfall.

Without the continuous human and dog presence with its threatening implications, Playa Frans would likely be a potential nesting beach. This expectation is supported by past nesting activity. A beach that is very unlikely to ever produce hatchlings is

Boca Catuna. Although this beach is very nicely situated within a little bay, which ensures a calm sea, and human pressure is minimal, the beach is not suitable, because it is too small, the sand layer is too thin and most importantly it is continuously subjected to saltwater inundation. Therefore it is stupendous that the first crawl of the STCB 1995 Project was found on this beach. Less astounding was that it did not result in an actual nest. No previous activity is known to have occurred on Boca Catuna.

Southwest Bonaire

Of the entire Southwest coast, only one small private beach proves to be an important nesting beach under existing circumstances. Most harmful for the nesting sea turtle population along the Southwest shore is human pressure. Due to proximal development, tourism, both diurnal and nocturnal beach visitors, campfires and litter, the sea turtles have to deal with lights, noise, human presence and shallow, packed sand, severely reducing the suitability of the various beaches within this area. Examples are Windsock, Punt Vierkant and Pink Beach.

The Southwest Pocket Beaches are not heavily subjected to human pressure and activity is known to have occurred in the past and an attempt has also been made in 1994 (M. Van der Sluys, pers. comm.). Nonetheless, both in 1993 and 1995 Projects, no nesting activity has been documented: as individual females return every 2 to 3 years, this may not be surprising. However, it is also possible that the suitability has been diminished, as AKZO may have altered the structure of the beaches, as with Pink Beach by erecting a wall of coral along the landward edge of the beach, and thereby reduced the amount of sand (Van Eijck & Eckert, 1994). This seems plausible as saltwater inundation of these beaches occurred regularly during the 1995 Project.

Chogogo is a private beach in the Southwest corner of Bonaire and is safeguarded against public recreation. A mixture of coral fragments would appear to make the excavation of the egg chamber difficult, but nevertheless the beach is known to have supported nesting by loggerheads over the last couple of years. It can even be stated to be the most important present-day nesting beach on Bonairian mainland. Four attempts, of which two resulted in hatchlings, have been documented in 1993 (Van Eijck & Eckert, 1994) and in 1994 at least two nests have been made (Hager & Oliehoek, pers. comm.). During the 1995 Project only one attempt has been observed, which did prove to be successful. The cause of the decline in nesting activity in 1995 at this site is the presence of five dogs. Resident dogs have always been the main threat for nesting sea turtles on this beach, but five dogs seem to be fatal, especially, when they run free. The dogs scare sea turtles away by barking and tend to dig up nests when laid. The latter occurred with the 1995 nest. Fortunately the land-owners were present and the nest could be restored. The dogs also dug up the hatchlings after hatching.

Klein Bonaire

Klein Bonaire, an uninhabited, undeveloped satellite island supports many more nests than does Bonaire (Van Eijck & Eckert, 1994; Hensen, 1991; Van Buurt, 1984; this report). Two main reasons can be given to explain this situation. Firstly, Klein Bonaire contains far more beach area relative to Bonaire. Extensive reef formations dominate the latter. Secondly, Klein Bonaire is subjected to far less human pressure. In general, it is only visited by day-tourists who use the beaches for recreation.

In total, 39 of the 44 (89%) attempts were recorded on Klein Bonaire. West Klein Bonaire proved to be most important for Bonairian nesting sea turtles. 22 (50%) of the

total amount of the 1995 nesting attempts were observed on 7 of the 16 West Klein Bonairian beaches. Only 4 (18%) of these contained nests, of which 2 did not hatch at all, due to saltwater inundation.

In October 1995 the sea water level started rising on Bonaire, resulting in the inundation of parts of beaches. This was the case on beach 9 of West Klein Bonaire. For weeks, the sea water overran parts of the beach beneath which two nests had been made. Three attempts were made on this beach each two weeks apart. Where the attempts were successful, the nests unfortunately were not. The eggs of the first two nests were inundated in such a manner that none of the eggs hatched. A zonation both within the nests (Figure 6) as between the nests, implies embryo mortality due to saltwater inundation. The second nest was examined one egg at a time, working from top to bottom. The overall trend, as depicted in Figure 6, was that the embryos were the smaller, the deeper down the nest. The embryos could have died as the water elevated, resulting initially in mortality of the lower embryos and with time, the mortality spread upwards (with the rising sea water level). The second trend was overall smaller embryos in the second nest as compared with the first. The first had a longer period of development. The third nest was made in a higher part of the beach; perhaps the adult received signs of inundation of the first two nests as she was attempting to make the third (the crawl initially led to the first two nests). Previous research suggests that nest site selection may be a 'complicated' process (Dodd, 1988) with possible micro-habitat cues which may initiate the digging process (Stoneburner & Richardson, 1981). Unfortunately, the outcome of the third nest is not known.

Three nests on West Klein Bonaire were made by loggerhead turtles and the fourth by a hawksbill turtle. The low percentage of successful attempts is caused by the low suitability of the beaches visited by the turtles. In a few beaches coral rocks are mixed in high densities with the sand, making nesting troublesome. Sometimes it appears that the turtles are ignorant of the suitability of nest sites, because it has occurred quite often that they try to dig through the rubble on some poor nest sites more than once (for example, 8 attempts on beach 8, with a total of 16 bodypits and only one nest) and leave apparently beautiful nesting beaches untouched. Studies have implied that the selection of a nest site is essentially a random process (Mrosovsky, 1983; Eckert, 1987; Hays et al., 1995). Another possibility is that the beach has been visited by the same turtles in the past -hawksbills exhibit high site fidelity (Corliss et al., 1989)- but has deteriorated dramatically over the years, with grave consequences for the turtles which keep returning to the same beach. As mankind is almost completely absent on these beaches, a relatively high level of nesting activity is found here.

Nonetheless, poaching is still known to occur, albeit on a relatively low level on West Klein Bonaire. During the STCB 1995 Project, the poaching of one nesting turtle was observed by the Project Assistants on Beach 9 (nr. 19, Table 2). The poaching of a nesting turtle was noticed by the fact that a landward crawl did not return to the sea, as was also the case in 1993 (Van Eijck & Eckert, 1994).

West of No Name and No Name both received 7 visits (16%). The attempts on No Name, however, were far more successful. Four of the 7 nests (57%) were excavated and examined post-hatching. Three were hawksbill nests, the other was a loggerhead nest. The 1993 surveys resulted in similar figures: 9 of 40 attempts were on No Name Beach of which 8 were identified as hawksbill attempts. The fact that the beach is large, contains few rocks and has an easy access, apparently makes No Name beach the most suitable nesting beach. The reason why a relatively low level of nesting activity is documented on this beach is caused by the recreational activities on this

beach. Despite the lack of commercial development on Klein Bonaire, the island attracts people both at day and at night. No Name is mostly visited, because of the easy access and the big sandy beach. The other beaches are less attractive, as they are less accessible, more rocky and less pretty. On No Name, people occasionally remain on the beach at night, making campfires and noise, and possibly scaring away nesting females. Trampling of the sand is another result of the recreational activities and has a negative effect on the success of a nest. The low number in hatching success of the first nest found on Klein Bonaire, may be the result of trampling by humans: only half of the hatchlings actually came out of the sand.

On West of No Name no nests were evident. Sea turtles made a few attempts to lay their eggs on these beaches but the mixture of coral fragments makes the beaches unsuitable for the excavation of an egg chamber.

Finally, three (7%) nesting attempts were observed at East of No name, of which two attempts led to the emergence of hatchlings. The species could only be determined at one nest. It was a loggerhead nest, which was surprising, because all the attempts in 1993 were presumably made by hawksbills (Van Eijck & Eckert, 1994). Moreover, East of No name is a typical hawksbill nesting habitat: isolated coral beach, with an abundant vegetation (Ryder et al., 1989).

In total, there are more nesting attempts, recorded in the STCB 1995 Project as compared with the STCB 1993 Project. Unfortunately, this does not mean that there has been an increase in nesting attempts. As the Northwest side of Klein Bonaire has not been surveyed in the 1993 Project and this area has been of major importance in 1995, no conclusions can be drawn. Besides this, the majority of nesting attempts (55%) documented in the 1993 Project was at East of No Name and much less attempts have been recorded at this location in the 1995 Project. Although no conclusions can be made about the dynamics of the nesting populations, two presumptions can be given to explain the difference in the nesting behaviour, observed in 1993 and in 1995.

A translocation from east to west Klein Bonaire is possible, considering the decrease in nesting activity on the eastside, but uncertain. It could imply that there is an increase in nesting activity on Klein Bonaire, although the activity on the westside may have already been present in the past. It does appear that the suitability of East of No Name has declined considerably the last two years. The sand has become very hard and both algal and plant growth was becoming visible during the 1995 Project. Possibly, this is the result of a certain cycle of East of No Name, in which the beach is degrading and rebuilding itself in time. This is suggested, because parts of East of No name were crumbling off at the end of the 1995 Project, and a new sand was deposited along the sea side of the old degraded beach. Perhaps a future study will shed more light on this matter.

The second possibility suggests a decrease in nesting activity at East of No Name, in which case an overall decrease on Klein Bonaire has occurred, presuming that the nesting activity at Northwest Klein Bonaire has not increased the last 2 years.

The same trend has been observed with the nests. Although a doubling in the amount of nests in two years has been observed, this does not mean that an increase in nesting activity has occurred on Bonaire. In the 1993 Project a total of 6 nests and in the 1995 Project a total number of 12 nests have been excavated. In addition to that, a few promising attempts were observed late in the 1995 Project, which were expected to

have resulted in nests and in that case, hatched late December 1995 and early January 1996.

A large portion of Klein Bonaire is privately owned by the Development Cooperation of Klein Bonaire. This present-day, specific development plans for the island are presented. Fortunately the Island Government will apparently not permit building on the island. However, the pressure is increasing in a drastic manner. Also rumours of plans to build a mooring dock at No Name beach exist.

At this point, it is necessary to emphasise that any exploitation of this uninhabited islet will have a devastating impact on the nesting turtles. Sea turtles are easily scared away by noise and lights caused by humans. Beaches on the mainland of Bonaire, which were once known as nesting grounds, are now devoid of turtles as a result of ongoing tourist development. Therefore, Klein Bonaire can be considered as a 'last resort' of the nesting populations of Bonaire's sea turtles. The fact that the islet is still uninhabited contributes largely to this situation. Moreover, building activities at the coast of Klein Bonaire, for example a mooring pier at No Name beach, will cause destruction of the nearby reef. According to information of the Bonaire Marine Park, the reef on this location is already quite instable. As a result, landslides in the reef are likely to occur, thereby suffocating an important foraging area for all kinds of reef animals, including juvenile sea turtles. In addition, it is clear that virtually *any* development of Klein Bonaire will inevitably harm the already small and vulnerable nesting population.

2.232 Population Analysis

In the analysis of the nesting populations of Bonairian sea turtles, two difficulties arise each year. Firstly, the identification of the species and secondly, the determination whether or not an attempt has proved successful.

Species identification is complicated in various ways. That is, when merely dealing with a crawl, with or without bodypits. In the case of a nest, providing that the nest contains at least one embryo or hatchling, the species can be identified. However, when the species must be determined by means of a track, it proves to be difficult.

Two features are recorded. The symmetry and the width of the track. The first can hardly be used in the identification of Bonairian species, because the two major nesting species on Bonaire, the hawksbill and the loggerhead, are known to leave asymmetric tracks (Pritchard, 1979; Van Eijck & Eckert, 1994), thus making any distinction between the two impossible on this feature.

Species identification using track width can also be considered as tricky. Despite the fact, that the hawksbill is a smaller species than the loggerhead, an overlap in track widths is certainly present. Moreover, the track width can vary significantly for each individual, depending on the state of the beach. The slope, sand structure, moisture and vegetation are a few examples of conditions that influence the track width. For example, attempt nrs. 21 and 37 (Table 2), present a hawksbill track width of 1.05 meters and a loggerhead track width of 0.73 meters, respectively. Therefore, one needs to seek other indications, to assess the species. The type of beach, of which accessibility, dynamics, amount of coral mixed with the sand, and vegetation are the most important, and the characteristics of the attempt, e.g. location of bodypits (under bushes), the amount of bodypits, etc., are indications which help to make a distinction. The outcome, however remains uncertain.

Finally, with the decision to survey the maximum number of beaches, each beach could not be examined every day. Thus, most crawls and bodypits were detected only after they were a couple of days old, complicating the species identification. Further, the beaches along the Northwest shore of Klein Bonaire, eventually turning out to be the most important nesting sites of Bonaire, was initially not included in the survey because earlier information suggested that they were not likely nesting beaches. West of Klein Bonaire was first surveyed, partly on 31 July and the rest on the second of August. West of No Name was surveyed after 17 August. By then it was difficult or impossible to identify the species by crawl type, because only the remains of multiple crawls and bodypits were found. This necessitated the high number of "unidentified" crawls.

Fresh crawls were more or less found during the entire 1995 Project (Figure 3). Although Figure 3 shows a peak in August, this does not indicate that this period is the peak of the nesting season. As previously mentioned, new nesting sites were encountered during this period, resulting in a boost in the number of nesting attempts. Evident, however, is that the activity somewhat decreased at the end of the year. Nonetheless, nesting continued well into November and it even may have continued after the survey concluded. Overall, due to the decreasing trend in nesting by begin September, a late summer peak appears to be accurate. Other studies in the Caribbean exhibit the same trend (Corliss et al., 1989; Sybesma, 1992). A low level of hawksbill nesting may occur intermittently throughout most of the year, as is the case on other Caribbean islands (Van Eijck & Eckert, 1994), although the attempt on the first of November, almost certainly resulted in a loggerhead nest.

Determining the success of an attempt also proves to be difficult. Although one tends to get some experience and feeling in determining the success of an attempt, by carefully investigating the bodypits, the most reliable method is through probing into freshly made bodypits with a blunt stick. However, due to the danger of piercing an egg, it is preferably not done, in which case a close inspection of the bodypits, especially from 50 days of incubation onwards, is the sole manner to confirm the presence of eggs. This was less than satisfactory because each beach could not be visited every day and hatchling tracks are tiny and disappear easily within a few hours. Moreover, the abnormal weather during a major part of the STCB 1995 Project played a negative role in this, because the rain easily washed away the tiny hatchling tracks.

When the careful observation of the potential nest site did not result in the confirmation of hatchling tracks, the activity site was excavated extensively approximately 63 days after the supposed nesting date. By that time the hatchlings, if present, were supposed to have all left the nest. In twelve cases eggs were confirmed and nests excavated post-hatching. During the 1995 Project, hatchling tracks were never documented. On three occasions (nest nrs. 5, 9 and 36, see Table 2), traces of hatching activity were found, by means of empty egg shells on the sand, resulting in successful excavation of the hatched nests. On two other occasions (nrs. 7 and 39), the sites were excavated after people had informed the Project Assistants of their observation of hatchlings emerging from the sand. Twice (nrs. 2 and 21), the Project Assistants themselves were present at the moment of hatchlings emerging, after which the remnants were excavated. On five occasions (nrs. 34, 35, 37, 38 and 40), the nests were only found after thorough excavation of the site.

Hatch success was calculated for these twelve nests (6 loggerhead, 4 hawksbill, 2 unidentified) by dividing the number of hatched eggs by the total number of eggs laid. Hatch success ranged between 0-94%. Added to the hatch success, was the percentage of successfully emerging from the sand. This figure was calculated by dividing the number of hatchlings successfully leaving the nest (total amount of hatched eggs minus the amount of dead hatchlings in the nest) by the total number of eggs laid. These percentages ranged between 0-93%. It often proved difficult to give an exact number of dead hatchlings in the nest, as in some cases, live hatchlings were encountered during excavation of the nest, for instance when the Project Assistants were present during the emergence from the sand. At least some of these were expected to have suffocated in the nest as they were digging individually. In Table 3, these hatchlings are not considered as dead ones, but corrections, when possible have been made. The estimated number of live but spread hatchlings, which have been dug out, were added to the number of dead hatchlings. Closer examination of the three nests with 0% hatching success showed death of the embryos, probably caused by elevated sea water levels in two occasions (nrs. 10 and 12, see Table 3), while the third could have been human disturbance, sterile eggs or a high sea water level (nr. 7).

In order to accurately estimate population size, individuals in the population must be tagged or numbered in some way. In the case of a nesting population, a nocturnal tagging program should be in place (and established to ensure that every nesting female receives a tag) for at least a decade before serious calculations can be attempted (Van Eijck & Eckert, 1994). The difficulty on Bonaire is that nesting occurs at a very low level, thus the pay-off of an extensive tagging program is far too low. The chance of encountering a turtle nesting on Bonaire is simply very low. On Bonaire, we can solely draw upon the results of two years of ground survey (i.e., crawl count). Nonetheless, an attempt has been made to roughly estimate the number of nesting turtles in 1995, based on the information gathered during the 1995 surveys.

The data suggest that there were at least three females active on the mainland of Bonaire, namely at Boca Catuna (one unidentified crawl), Chogogo (one loggerhead nest), Nukove (two unidentified attempts) and Playa Chikitu (one unidentified nest). The situation on Klein Bonaire is somewhat more complicated. In total, 39 crawls were found on Klein Bonaire. From saturation tagging studies of hawksbill turtles, it is known that individual females show high site fidelity (returning to the same beach with each subsequent nesting) and that nest frequency is quite consistent at 4-6 per female per season (Richardson et al., 1989). Coupling this information, with: (1) not all 39 crawls represented successful nests (the 1995 Project supposes a nest: abortive attempt ratio, as low as 3:8) and (2) the possibility, that a low level of nesting continued beyond the survey, a number of 2-3 loggerheads and 3-6 hawksbills were involved.

In total, the number of loggerheads and hawksbills (combined) nesting in Bonaire in 1995 is estimated to be 5-12, of which the hawksbills presumably slightly dominate. This number is similar to the number estimated during the 1993 Project. In the latter project, an estimated number of 6-12 female turtles made their nests on Bonaire. These calculations, obviously, concern only the nesting adult females. In case of a 'Bonairian' nesting population, it is interesting to note, that the very small numbers emphasise the extreme vulnerability of the nesting population in Bonaire. Poaching of one nesting female could reduce the annual nesting population by as much as 20%. In addition,

the number could represent only one-third or less of the total number of females using Bonaire for nesting [N.B. the number cannot reflect the total because individuals nest every 2-3+ years; hence only a subset arrive each year] (Van Eijck & Eckert, 1994).

However, it has been suggested that such a 'Bonairian' nesting population does not exist whatsoever (L. Pors, pers. comm.): adult sea turtles, whilst migrating to the continental (Venezuelan) beaches, encounter the Lesser Antilles (e.g. Bonaire) and lay their eggs on these beaches. This possibility excludes the existence of a Bonairian nesting population and in that case even less can be said about the future of nesting activity on Bonaire, only about the increase or decrease of the capacity of Bonaire as a nesting ground. Further, our nesting females could be shared to some extent with Venezuela. This could only be confirmed through a tagging program or even population genetical research. Therefore, an intense cooperation, considering research as well as conservation measures, with Venezuela and the other Lesser Antilles, seems evident.

2.3 Research at Sea

2.31 Methods

2.311 Sightings Network

Research was also done on juvenile turtles along the Bonairian coast, which use the reef and seagrass beds as shelter and foraging area. The research consisted of gathering as much information as possible about the whereabouts of the different sea turtle species in the Bonairian waters. This information helps to get a better understanding of the population dynamics of the Bonairian turtles. To achieve this goal, a network was established in cooperation with the diveshops on Bonaire. This network was initiated in 1993 (Van Eijck & Eckert, 1994) and continued and intensified in 1995. Turtle sightings were reported by dive tourists through filling out a special sea turtle sighting sheet (Appendix 4). The STCB provided all the diveshops with these forms by visiting the shop on a weekly basis to collect completed forms and provide replacements. Included in the 1995 Project was the production of a 'turtle corner', which consisted of a folder rack, with a sign attached to it, to attract the divers attention to the sighting sheets. Apart from the dive shops, the crew from the trimaran *Woodwind*, the snorkel club 'Queen Angels' and some selected individual divers also participated in the survey.

2.312 Survey Methods

In addition to the sighting network, more detailed information was gathered, through direct observations on several 'turtle hotspots' around the island. These surveys were preferably performed by snorkelling. Snorkelling enabled the researchers to have a greater overview in the water and a higher mobility, as compared to SCUBA diving. The snorkel surveys were undertaken along the drop-off from reef sections along the whole west coast and a few selected regions along the east coast of Bonaire. Furthermore, after most beach surveys on Klein Bonaire, snorkel surveys were performed along the reef sections: Ebo's Reef - No Name (ca. 750 m; mostly from 10:30 to 11:15), Sampler - Ebo's Special (ca. 2000 m; mostly from 11:00 to 12:15) and Ebo's Special - Mi Dushi (ca. 750 m; mostly from 10:30 to 11:15); (water depth ca. 2-20 m;

sector names are taken from the Bonaire Marine Park Guide). The attempt was made to reach an average of about 3 snorkel surveys every week.

During each survey, bottom, mid-column and surface environments were inspected as closely and repetitively as possible. The surveys around Klein Bonaire were mostly unidirectional, the shore surveys from Bonaire were mostly bidirectional. Periodically these environments were inspected more closely by repetitive free-diving to depths of 5-20 m. If a turtle was spotted, the time and place of the sighting was documented and the animal was followed for a reasonable distance (10-30 m); behaviour and diagnostic characteristics were observed closely and reported. With the latter is meant, the characteristics that help recognising individual turtles. Scars, algal growth, barnacles and characteristic shell patterns are the most important features. In this manner individual turtles were followed in time and location between June and December of 1995.

2.313 Photo Identification

A new study on the juvenile sea turtles, was also performed in the 1995 Project, namely a photo-identification trial. The goal was to identify individual sea turtles by means of taking slides of juvenile sea turtles at a fixed location throughout the project. Individuals are characterised by scars, injuries, algal growth, barnacles, distinct colour patterns, etc. The location chosen was the reef in front of Lac Bay. At daytime, a relative large group of green turtles and a few hawksbill turtles reside along this reef. It is thought, that the green turtles (both juveniles and subadults) reside here all year round, migrating into Lac Bay at night in order to forage in the sea grass beds. The slides were taken with a NIKONOS 5 underwater camera. In addition, photo- and videomaterial was gathered through the divers network and the photoshops. On the sighting sheet, the participants were requested to give photo- and videomaterial, if any, to the STCB as well.

2.32 Results

2.321 Sightings Database

The sighting network survived the interim year 1994. Sheets had still been filled in, albeit at a low scale, thus providing the STCB with valuable 1994 information (195 sightings). Nonetheless, the enthusiasm of the sighting network participants, decreased in intensity and the start of the 1995 Project, clearly brought about a new revival in the sighting network. Figure 8 shows the increase in the amount of sightings in June, the month that the 1995 Project initiated.

A total of 583 sightings were collected through the sighting network in 1995. The spatial distribution of these sightings, on Klein Bonaire and Bonaire is presented in the Figures 9 & 10, respectively (the dive locations are presented in Figure 11). This distribution, however, depicts a misrepresentation of the reality. Some sites are more often visited than other sites. To counteract this, the 1995 sighting data can be standardised by using dive data derived from the Bonaire Marine Park Statistics. A relative distribution of the sightings can be constructed by dividing the number of sightings per location by the number of boat dives per site during comparable periods of time in that year. This was also done in the 1993 Report. Unfortunately, the dive data of the years 1994 and 1995 were not yet available and statistics prior to 1994 are

considered to be outdated. Consequently, a relative distribution of the 1995 sightings can not yet be given.

The sighting data (n=583) presented a majority of hawksbill sightings (47%), and further 33% green turtles, 4% loggerheads, 1% Leatherbacks. 15% of the total amount of sightings were unidentified (Figure 12). An other characteristic that is documented on the sighting sheets, is the size of the turtle sighted. The turtles can be placed in three size classes, resulting in the domination of juveniles in 1995 in the Bonairian waters. Figure 13 shows that 43% of the sightings were turtles with shell lengths smaller than 50 cm, 52% were between the 50 and 100 cm and 5% were longer than 100 cm.

In addition, some behavioural patterns were recorded. Firstly, the activity was documented (Figure 14) of which swimming proved to be the main one with 76% of the sightings, followed by resting (18%), eating (6%) and there was one sighting of turtles mating. Feeding turtles were typically associated with coral (Figure 15). Secondly, turtles were sometimes observed at the surface (11%), somewhat more on the bottom (39%) and the majority swam in the mid-column (50%) (Figure 16).

The direct environment in which the turtle was observed, was also recorded and reef sightings, not surprisingly, constitute the majority (65%) of all records. Further, the turtles were surrounded by sand bottom (22%), sea grass (7%) and rock (6%) as depicted in Figure 17.

Also documented were injured turtles, of which Table 4 gives a summary.

Despite the fact that the data from the divers network yielded far more sightings, more detailed information is brought in through snorkelling data. These data have been produced by direct observations during the snorkel surveys, which were undertaken by the Project Assistants during the 1995 Project. Added to this are the observations that come from the crew of the trimaran *Woodwind*, who organised snorkel trips to Klein Bonaire almost daily. Therefore, most of this data comes from Klein Bonaire, while the data from the STCB snorkel surveys, contains information about Bonaire as well Klein Bonaire coastal waters. When the numbers of observations of turtles made during the snorkel surveys, are divided by the total number of visits per location, a relative distribution per location can be derived (Figure 18). In most occasions, juvenile green and hawksbill turtles could be encountered near shallow reefs around the island at depths of 2-15 m. Most turtles were swimming in one direction along the reef, occasionally surfacing to breathe. The hawksbill appears to be the dominant species along the west coast, the heavily visited, leeward side of Bonaire. However, included in the 1995 Project, was a thorough investigation of the windward east side. In these rough waters, far more turtles were supposed to reside, thus clarifying the necessity of further research in the eastern waters. And indeed, large groups of green turtles, combined with a few hawksbills, reside along the east coast. In the Klein Bonairian coastal waters, a mixture is found of hawksbill and green turtles. All this results in a different species distribution, as compared with the sighting network data. Figure 19 shows the species distribution of the Bonairian sea turtles and presents the green turtle as the dominant species. Not included are the photo-identification sessions, thus excluding a major part of the surveys in the east. However, there existed no time to record turtles during these sessions. The result could be, that the green turtle is still underrated.

The photo-identification trial has proved to be a potential valuable source of long-term information about the dynamics of the Bonairian sea turtle populations. The amount

of pictures/slides gathered in 1995 can not give a good impression of these dynamics. A total number of 133 slides were taken during the study. Furthermore, 30 pictures and 6 slides were received via the divers network and the photoshops. The collection of pictures will continue in future years, which should lead to a database of sightings of individual turtles in time and place.

2.33 Discussion

2.331 Sightings Database

It is very difficult to give an estimation of the population sizes of sea turtles at-sea. The most accurate way to reach an estimation is through the capture-tag-recapture method. Unfortunately, such research implies too much manpower and working-hours, for the STCB to handle at present. Therefore this way of monitoring has not been attempted during the 1995 Project. The methods chosen, a sighting network and direct observations through snorkel surveys, will certainly not result in a valid estimation of the population sizes. This is in consequence of a few reasons. Firstly, the sighting network does not result in a spatial distribution of the resident sea turtles. This distribution is effectively influenced by the preference of the observers for certain dive sites. Further, as juvenile turtles presumably reside at some locations for a certain period of time (Carr et al., 1978), the same turtles can be sighted at several occasions. The network has no discriminative capacity and therefore, the STCB has initiated the photo-identification trial during the 1995 Project. Despite the fact, that information about the residing juvenile populations over a period of a couple of years will not result in conclusions about the population dynamics, a greater insight in and understanding of the whereabouts and movements of the different sea turtle species and individuals has certainly been reached.

The cooperation of the majority of the diveshops in the sighting sheet network has been very promising. A total of 583 sighting sheets have been gathered. In addition, 195 sighting sheets were filled in 1994, which provided the STCB with some valuable information, despite the absence of a STCB Project. Besides the contribution to our data, which is highly appreciated, the STCB also applauds the increasing enthusiasm among diveshops, towards the turtle sightings. This is indicated by an increase in sighting sheets in 1995 as compared to 1993.

The importance of the stimulation of network participants is evident in Figure 8. The Figure depicts a high variance in the amount of sightings during 1995. Two major increases can easily be elucidated. The first boost is evident around week 25 and can be ascribed to the arrival of the Project Assistants, which caused a renewed interest in the sighting network. The introduction of a turtle corner was responsible for the boost in week 46, as it created more vigilance towards sightings. The turtle corners are also promising in providing the STCB with an increased amount of information, when the network participants are not directly stimulated, for instance by means of the presence of STCB collaborators. The decrease in week 36 is presumably caused by a big clean up of the island, in which the STCB organised a coastal clean up. Less attention was paid to the sighting network.

Overall, the sighting network provides the STCB valuable longterm information, with respect to the Bonairian sea turtles. Besides, it proves to be an effective way to keep the public interest in sea turtles at a high level and counteracting the ignorance towards

these animals. It enables the public to contribute to the conservation of an endangered species, to which most people appear to be benevolent.

Although the sighting network has already brought about a better understanding of the dynamics of the Bonairian sea turtle populations, the information gathered during the snorkel surveys has revealed a few behavioural patterns. These have been observed, by identifying and recognising certain individual juvenile sea turtles, thus enabling the STCB to monitor the movements and behaviour of these sea turtles. The recognition of these individuals in 1995, has been performed by both the Project Assistants and by the crew from the *Woodwind*.

The thought that juvenile sea turtles are more or less committed to certain fixed locations has become plausible: the time spent on a certain location varies strongly per individual and per location. Furthermore, a difference exists per location, in how often certain turtles visit the location. Some locations can be inhabited by a few turtles, which choose to reside there for a long period of time. Other locations may provide shelter and/or forage to many turtles which do not visit long. Finally, some locations are not visited at all. There are many causes for this 'residence' pattern, among others, differences in availability and quality of shelter and food per location. Human pressure also differs per site, and effects the suitability of a habitat.

The west (leeward) side of Bonaire, including the whole of Klein Bonaire, is inhabited by mainly juvenile hawksbill and green turtles. The majority appears to be hawksbill, which coincides with the data from the sighting network (Figure 12). The green turtles seem to be more sessile than the hawksbills. This could be the result of a differentiated foraging behaviour. The primary food of green turtles is sea grass (Bjorndal, 1982). Field studies indicate that individual green turtles maintain feeding scars by foraging on the same patch of sea grass meadow each day. The scars or grazing plots are regularly cropped by the turtles for several months, thus providing themselves with the preferred young, protein rich and lignin poor seagrass sprouts (Ogden et al., 1983).

At three occasions during the 1995 Project, the Project Assistants have observed a hawksbill eating. At first sight they appear to be eating coral, which explains the fact that sighting sheets, which mention a turtle eating, most often present coral as the nourishment (Figure 15). However, close inspection of the coral eaten from, reveals little patches of sponge, thus explaining the foraging behaviour of these turtles. Sponge is known to be typical hawksbill food (Meylan, 1988). Moreover, sites which are known to be visited by hawksbills often contain sponges with triangular indentations, indicating turtle bite marks. Especially the stove-pipe sponges (*Aplysina archeri*) were subjected to these supposed bite marks (direct observations STCB; Kalli de Meyer, pers. comm.).

Apparent was further the difference in shyness between hawksbill and green juveniles. With shy is meant, more afraid of human presence. Figure 20 shows that the green is often more shy than the hawksbill turtles. STCB sightings reveal the same trend (Figure 21).

Figure 10 depicts the spatial distribution of sightings in 1995 and presents a few areas of interest: Karpata (nr. 7, see Figure 11), Andrea I (nr. 20), Pink Beach (nr. 50) and Sorobon (nr. 58d). Some of these are intensively used for diving and snorkelling, like Pink Beach, thus accounting for the large number of sightings. Karpata is less intensively visited. The high number of sightings is caused by the accommodation of one to three green turtles which rest and may forage at this site. No sea grass or brown

algae have been found as yet, but the existence of some foraging area seems obvious. The same applies for Andrea I, which provides shelter for a green and some hawksbill turtles. The green turtle has been very well documented, slides have been taken during the photo-identification study and the STCB has received pictures, taken by network participants, of this particular turtle as well.

At some point in September or October, the residing juveniles left Karpata. The departure could be explained by the increasing human pressure (Karpata became the 'turtle'-site), by a degradation of the foraging areas, if present, or coral bleaching, which occurred intensively at this site in 1995 and may have some influence on the suitability of Karpata as a turtle habitat. The latter seems plausible, as Karpata is famous for its massive reef formations, thus providing shelter for turtles. When the green coral turns white/yellow, the camouflage vanishes. The turtles disappeared from this site after the initiation of the bleaching event.

The snorkel surveys have disclosed the most interesting locations on the west side of Bonaire, considering turtle sighting. Karpata, Andrea I, Windsock, Pink Beach and the stretch from Margate bay to Red Slave are all considered to be important in housing sea turtles. Klein Bonaire appears to provide a habitat for a select group of turtles. At least four turtles (two greens and two hawksbills) are almost permanently monitored, in time and place, by both the STCB and the crew from the *Woodwind*. Three have even been given a name. Two juvenile hawksbills by the name of Fuzzy and Friendly, and one juvenile green by the name of Kleintje. They reside along the north coast of Klein Bonaire, between Leonora's Reef and Ebo's Reef.

The east(windward) side of Bonaire is far more richer in sea turtles than the west side. Two main causes are evident. Firstly, both seagrass beds and fields of brown algae are scattered along the east coast. Therefore mainly green turtles are observed here, ranging from juveniles to subadults. Secondly, human activity is limited along the east coast, due to the rough water conditions.

Most sites on the east coast are inaccessible by land, thereby making research difficult. Lac Bay is an exception. The easiest access is through Cai and preferably when the wind is low. Snorkelling is best as quite a distance (approximately 400 meters) has to be covered, overcoming a strong current and large waves to reach the remote site where the highest concentration of green turtles is about.

Lac Bay is separated from the sea by a barrier reef. The bay contains vast fields of sea grass beds. The thought is that green turtles have nocturnal migrations into Lac Bay to forage on the sea grass meadows (Kalli de Meyer, pers. comm.). At daytime the green turtles reside along the sea side of the double reef, incidentally foraging on free floating sea grass blades (an activity once observed by the senior authors). Turtle sightings are guaranteed along the reef of Lac Bay, therefore the photo-identification project was mainly focused on this location.

Loggerhead juveniles have been encountered around Bonaire, during the 1995 Project, but very few in total and misidentification of the species by network participants is also an option. One trustworthy sighting of a loggerhead juvenile came from Boca Onima (F. Scholz, pers. comm.), along the Northeast coast. This is interesting, as there are very few sightings known, at Boca Onima. Boca Onima is inaccessible, and the water conditions are very rough. Diving is only possible, if the wind is down. Sea grass and brown algae beds are also present at this site (P. Müller, pers. comm.), thus making it a potential residence for green turtles. Three sightings revealed, one green,

one hawksbill and one loggerhead turtle. Future research could clarify whether or not Boca Onima provides juvenile loggerhead turtles with a suitable habitat. That would be unique for Bonairian standards.

Table 4 presents a loggerhead turtle, with a shell length between the 50 and 100 cm, that has been sighted three times at more or less the same location (Salt Pier and Salt City are adjacent to one another). This subadult could be identified, due to the absence of a left hind flipper.

Despite the fact, that the immense reef formations of Bonaire cause the leatherback to avoid the island, as this is the only sea turtle species without bony carapace, it has been observed at least three times during the STCB 1995 Project; all sightings were done by employees of Buddy Dive and can be considered trustworthy. Two leatherbacks were located offshore from Klein Bonaire and the other along the reef at Lac Bay. Presumably, local fishermen have seen this species far more often, but this has not been documented. Verification should be considered for future STCB Projects.

Where the green turtles range in age from juveniles to subadults, loggerhead and hawksbill adults are also observed swimming along the Bonairian coastline. This coincides with the observation, that in 1995 only these two species have laid their eggs on Bonairian beaches. On this point it is interesting to note, that adult hawksbill turtles are once observed in 1995 to be mating (North Belnem, 11 Oct.), and once (snorkel surveys STCB), the male and the female were perceived swimming along with each other (Sampler, 3 Aug.). Further, direct observations have revealed that a few female hawksbills have been residing near the coast of Klein Bonaire. It appears that the adult female hawksbills reside in the vicinity of their nesting beaches after copulation with the males. To note, pending the hawksbill nesting in September on No Name beach (nrs. 34, 36 and 39, Tables 2 and 3) various sightings (snorkel surveys and sighting network) of a hawksbill female were documented in the vicinity of No Name beach.

Finally, Figure 23 shows that the number of sightings per network participant varied widely. Not clearly depicted is that the highest number came from the trimaran *Woodwind*. Unfortunately, we did not receive all 1995 sightings from the *Woodwind* in time. Therefore, this data is not included in this report.

2.332 Photo Identification

Although no conclusions can be made at this point, this particular study seems promising to deliver valuable information about the population dynamics of Bonairian sea turtles. The best results will be obtained in the case of a continuation and extension of the project over the following years.

Certain problems immediately presented themselves in this study. As the STCB had no underwater camera, it had to be borrowed. The Sand Dollar Photoshop, was kind enough to lend the STCB a Nikonos 5 camera. This situation implied that turtle sightings had to be a certainty, as the camera obviously had to be returned after each trial and a camera was not always available. Therefore the study was concentrated on the reef of Lac Bay. This is one of the few locations on Bonaire where a sighting is guaranteed. However, green turtles dominate this site and these are the more shy species. In addition, the sea turtles at the east coast are more shy, thus complicating the study enormously. A necessity of photo identification is that the slides must be taken in the vicinity of the turtle, so that distinctive features can be identified. When the turtles swim away, this becomes troublesome. Nevertheless, due to the

concentration of turtles, there were plenty of opportunities to make good slides and therefore the STCB remains optimistic on this particular study. It will prove to be a valuable source of long-term information about the dynamics of the Bonairian sea turtle populations. Especially, when taking in mind the pictures/slides that are sent to the STCB. The collection of pictures will continue in future years, which should lead to a database of sightings of individual turtles in time and place.

It is very interesting to note that one particular picture that has been sent to the STCB (after the 1995 Project had ended), represented the predatory behaviour of the hawksbill turtle (Pictures 1 and 2). The photographer (M. Hellström-Larsson) described that "the turtle was pretending to look like a piece of coral", while waiting for a fish to pass by. It lied motionless for quite a while until a fish approached; the turtle caught and ate the fish. Fishes joined the turtle and foraged on the leftovers. The turtle depicts the very surprising and very typical behaviour of a predator. Further it presents the increasing enthusiasm of the public, which already sends pictures from all over the world, to help the STCB in its attempts to save the sea turtles from extinction.

2.333 At-sea Behaviour and Biases

It is important to note that the sightings, mainly resulting from the sighting network and to a lesser extent from the snorkel surveys, are largely determined by the activities of the observer. As previously stated, the sighting database, assembled by the many participants in the sighting network, reflects in its spatial distribution the activity of the observers (i.e., their dive and snorkel sites) and not an unbiased, actual distribution of the turtles. Unfortunately, more examples can be given of the strong impact, divers have on the sighting data. For instance, the majority of sightings in 1995, were of turtles swimming at moderate depths; approx. 10 meters (Figure 22). This is a direct reflection of the divers which themselves dive at moderate depths. Very few divers, perform their dives in the shallow parts of the reef flat. Whereas, during the direct observations, made by the STCB, turtles were regularly sighted in the shallow elkhorn/staghorn coral reef zones. Mainly hawksbill juveniles were observed swimming out of these coral formations as the observer approached (e.g. at Windsock, Andrea I, Nukove and Sampler). This is not reflected in the sighting network data.

Therefore, turtles are often missed. The limited vision of the divers (as opposed to a snorkler on the surface, who has a much wider scope), can also be held responsible. Moreover, turtles often rest, mostly under coral. In addition to their camouflage, this results in difficulties in recognising the animals. It also proved a difficulty during the snorkel surveys. Firstly, resting turtles were often only recognised when swimming close past the animals and the eye accidentally caught them in sight. Further, snorkel surveys were mainly performed, through swimming a certain stretch back and forth once. Turtles were often sighted when swimming back, during a survey. This indicates, that when passing by the first time, the turtles were missed by the observers, as they were presumably resting under coral. Yet, the turtles were sighted on the way back, as they probably were startled the first time the observers passed their shelter. The percentage of turtles startled by the observer and leaving their resting location is unfortunately not known.

The disturbance of resting turtles is certain to occur with divers as well and the trend in the network data, that swimming is the activity performed by the majority of the

sighted turtles is presumably the result of that. Generally, the activity of the turtle can mostly be considered as a direct response to the activity of the diver. With 'swimming' as the escape reaction and 'resting' as the misguiding tactic (when the turtle depends on its camouflage) of the turtle (Van Eijck & Eckert). This is observed during the 1995 snorkel surveys as well. Regularly, when approached, a turtle would rely on its camouflage to a certain point, and when the observer went beyond this point the turtle would escape. This escape is almost always preceded by a very careful withdrawal of the turtle. This typical behaviour is mostly observed with resting turtles. Free swimming turtles can certainly be curious and attracted by an observer.

The size distribution of sea turtles sighted in 1995, that are reported through the sighting network, contains some uncertainties. A known fact is that objects underwater, appear to be 25% bigger and closer. This implies that observers which are not aware or have no interest in this phenomenon, tend to present a sighting of a bigger turtle than it in reality was. Especially in the case of somewhat larger animals, one often forgets the rule, as the observers often appear to be overwhelmed by the turtle and tend to exaggerate. The same applies for the documentation of tail size (in distinguishing males and females).

The description of the immediate environment of the turtle sighted was most often coral reef. This, however, can not be considered representative of the habitat that the various sea turtle species reside in. It presents a direct reflection of the environment, divers prefer to dive in. The presence of the hawksbill in the coral reef is not surprising, as it contains sponges on which they forage and shelter. That almost all green turtles have been sighted in coral reef is more surprising as they are known to forage in sea grass beds. Divers are not likely to dive in this environment, thereby giving a misrepresentation of the suitable habitats.

The previously mentioned uncertainties in the documentation of the food type, are also the result of an inferior skill of the network participants, considering the determination of the exact nourishment.

Further, it should be assumed that most divers have no experience whatsoever in the identification of turtle species. It has proved a difficult task for a network participant to distinguish between the juvenile green and hawksbill turtles.

Four reasons lead to a misrepresentation of the species distribution of the Bonairian sea turtles in Figure 12 and an overall majority of juvenile green turtles residing on Bonaire:

- divers (the network participants) avoid the east coast, due to its rough conditions
- the majority of juvenile sea turtles residing in Bonaire's coastal waters are present along the eastern shore
- the resident sea turtles at the sites along the east coast are mostly green turtles and very few are hawksbill turtles
- sightings are often un- or misidentified by the network participants

Finally, all the uncertainties imply that the data is far too rough for a thorough population analysis. For instance, the percentage of greens is presumably higher than presented after two years of research. Over the years, a longterm database should be

able to realise more insight in these variables, thereby yielding an increased understanding in the dynamics of the Bonairian sea turtle populations.

2.334 Strandings

Only one stranding was reported during the 1995 Project. It was a juvenile hawksbill, found on 22 November, 1995, on the beach of Lagun (H. Koevermans, sighting network). The turtle was presumably a casualty of an oil spill, as it was covered with oil and was washed ashore, amongst the rest of the oil. Every now and then, Bonaire is subject to a small oil spill. These are caused by oil tankers, which occasionally clean their tanks in open sea. This apparently innocent act, proves to have serious effects, because the oil slick remains intact long enough to wash ashore on Bonairian beaches and killing the wild life it encounters on the way. Sea turtles are potentially very vulnerable to oil spills. Behavioural studies suggest that sea turtles have a limited ability to avoid oil slicks. Furthermore, physiological experiments indicate that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of sea turtles are seriously effected by crude oil (Vargo *et al.*, 1986).

III. PUBLIC AWARENESS AND PARTICIPATION

3.1 Public Awareness Campaign

The success of any local conservation initiative depends on support from the community. In order for the activities of STCB to be effective in protecting endangered sea turtles and the habitats upon which they depend, a consistent and informative public awareness campaign is essential. During the course of the 1995 nesting season, the Project Assistants worked diligently to involve the community of Bonaire in all aspects of sea turtle conservation. In the sections that follow, this public awareness campaign is more fully discussed.

3.11 Slide Presentations

The main method of informing the public was by means of slide presentations on sea turtle biology and conservation. In each case, the content was roughly the same, but the format and the level of the presentation varied greatly depending on the audience. The core slide show consisted of an introduction to the four sea turtle species occurring around Bonaire (hawksbill, green turtle, loggerhead, leatherback), life history of sea turtles such as mating, egg-laying, hatching, at-sea behaviour, habitat needs, diet, threats to the survival of sea turtles, and the activities that are, and need to be, undertaken in order to protect them. Most of the slides were provided by WIDECAS, but some, especially those showing sea turtles in Bonaire, were provided by Jerry Schnabel from Photo Tours and Jim Brandon from Sand Dollar Dive and Photo. A few slides, mainly taken in Mexico, were those of Van Eijck, and one was taken by the Project Assistants.

Each presentation emphasised the following facts: sea turtles are endangered with extinction and sea turtle populations are still declining; sea turtles are late maturing and natural mortality in juvenile classes is high, which makes them susceptible to any kind of disturbance; man-induced mortality (e.g., harvest, pollution such as ingestion of plastic debris) is a serious stress on populations; People can help sea turtles to survive by remembering some simple guidelines: don't disturb turtles at sea or on land, refuse to buy turtle products, refuse to eat turtle meat or eggs, don't keep hatchlings in captivity, dispose of garbage (especially plastic) properly, etc.

3.111 General Public

From August to December, slide presentations were given on a weekly basis at Captain Don's Habitat. This took place every Monday evening, during the last month however only the Wednesday evening was available. Visitors were invited to attend the slide presentations through media announcements and personal communication. These presentations were mainly attended by dive tourists, but a certain interest among residents existed as well. Audiences of 10-30 (average about 20) attended these slide shows. Judging from the discussions arising after these presentation, together with the amount of STCB-folders taken, posters sold and donations received, the interest in sea turtles and their conservation is high among the people attending the presentations.

3.112 Schools

Since the school children are the future of the island, special attention was paid to them with regards to enhancing the public awareness. Board members and principal teachers of all primary schools and the island's secondary school were approached in November and asked to cooperate in an educational program on sea turtle conservation. The interest displayed by the teaching personnel in sea turtle conservation still was high since T.J.W Van Eijck already started this program in 1993. Therefore, no explanatory slide show for this personnel was necessary. In stead, all schools received an information package consisting of a video (e.g. Nos Turtuga di Laman, Reefcare, Curaçao), folders (e.g. STCB, WIDECAS, Buyers Beware and a folder entitled Turtuga di Kòrsou, Antias Ulandes ('Sea Turtles of Curaçao, Netherlands Antilles')), a booklet (see 3.14) and posters (WIDECAS mini poster and STCB/WIDECAS poster (see Van Eijck & Eckert, 1994)).

Moreover, slide shows were arranged for all four primary schools. Each was visited at least once and slide shows, dealing with several aspects of the sea turtles present around Bonaire, were presented to pupils from the 4th, 5th and 6th grades (ages 9-12). During these presentations embryos, a loggerhead skull, and a live hatchling were used as additional educational material. The primary school in Rincon was treated different, however. Together with the board members an evening was organised on which a slide show and the video received from the STCB were presented. Personal invitations were sent to all parents and children, resulting in about 60 attendees (40 children and 20 parents) on this evening. In all cases special emphasis was laid on the endangered status of the sea turtles, and the necessity for their conservation. This message was also passed through to the board members of the secondary school, who decided to let the biology teachers take care of the education on sea turtle conservation. The information package received from the STCB was used as educational material.

One practical problem was often encountered, namely the absence of appropriate devices to darken the classrooms. This problem was solved by covering classroom windows with blankets and sheets brought from the Sunset Beach Hotel. However, this caused an absence of ventilation. Combined with the large amount of children in the room (normally about 60), the classrooms became quite hot inside. This limited the attention span of the speakers and the audience, so no longer than 60 to 70 minutes were spent per classroom. In general, however, the children and teachers remained interested and enthusiastic, as evidenced by the number of questions that were asked during, and at the end of the lecture. In general, teaching personnel appreciated the slide show, but often asked for more information about sea life in general. It is clear that a general environmental education programs (for example, about reefs and their inhabitants) would be highly desirable.

3.113 Local Organisations

In July and December representatives of the government, business community, media, police corps, teaching staff of schools, dive shop personnel, personnel of the Animal Shelter, and 'Centro di Bario' (youth centres), were invited to attend a slide and, in December, video presentation. This was done through mailings, media announcements and personal invitations. The subjects treated in these presentations dealt with a slide show on sea turtle biology and conservation, a summary of the 1993

survey results, presentation of the 1995 Project, evaluation and preliminary results of the 1995 Project. The evaluation of the 1995 Project was done by means of a video. During the project video material regarding the STCB activities on Bonaire in 1995, was gathered (see 3.16). With help from Divi Flamingo dive and photo shop, this material was used to make an overview of the 1995 Project. The presentations were held at Captain Don's Habitat and Divi Flamingo in July and December, respectively. The first presentation was attended by about 50 people, while the latter was more successful with about 80 visitors. Beverages for attendees of these presentations were provided by Rum Runners and Consales.

Employees from Non Government Organisations such as Bonaire Marine Park, Washington Slagbaai National Park, STINAPA, Amigu di Terra, and Tene Boneiru Limpi, were invited to attend these presentations. The absence of personnel from these NGO's, except Tene Boneiru Limpi, could be the result of the fact that the most important members of these organisations were already informed on STCB activities and sea turtle conservation.

A satisfactory interest was displayed by reporters of the newspapers appearing daily on Bonaire, members of radio stations, and dive shop personnel. Both presentations were visited by reporters of the three main newspapers of the Netherlands Antilles: *Amigoe*, *Beurs- en Nieuwsberichten* (both published in Dutch), and *Extra* (published in Papiamentu). Also members of the three main radio stations on the island: *Bon FM* (English), *Voz di Boneiru* (Dutch) and *Ritmo FM* (English, Dutch, and Papiamentu), attended at least one of the presentations. The presentations were often announced and well covered by the newspapers, while enthusiasm from radio makers resulted in announcements and several interviews. The highest interest was however displayed by dive shop personnel, showing a sincere concern about the threatened status of sea turtles. This certainly helped to achieve the enthusiastic participation of these people in the sighting network (see 3.12).

Government officials invited for these presentations were members of the Department of Education, and the Department of Agriculture and Fisheries. It is noteworthy that apart from some interested individuals, no government personnel attended these presentations, indicating their interest in sea turtle conservation is still quite low (as it was in 1993). The same accounts for members of the business community. Only representatives of Bonaire Trading Co. (one of Bonaire's largest companies), AKZO Salt Co. and Maduro and Curièls Bank attended the lectures. No interest in sea turtle conservation whatsoever, was shown by the police corps, since no representatives attended the lectures.

3.114 Fundraiser

In November a fundraising dinner was organised by Corine Gerharts and the Board of the STCB, with the assistance of the Project Assistants. The people who were invited for this dinner were members of the business community, government officials, chairmen of various local organisations, and other celebrities from the Netherlands Antilles and the Netherlands. During this event, the Project Assistants provided the audience with a shortened version of the slide show, in order to inform them on STCB activities and sea turtle biology and conservation in general. Furthermore, all participants received a STCB-newsletter (see 3.13) as additional information. In this

way more members of the business community, government officials and chairmen of local organisations could be reached than was the case in the presentations organised in July and December. Judging from the enthusiasm and compliments received during and after the fundraising dinner, this group of people appears to have a sincere interest in sea turtle conservation. So, in the future, when approached in an other way than before, public awareness among these people can be enhanced.

3.115 General Discussion

Sometimes it appeared a bit difficult for the speakers to estimate the level of understanding of the various audiences. After some presentations, complaints were heard such as: "It was too fast" or "It was a little bit too much for such a short time". However, most of the people who attended the slide shows remarked that they had learned a lot from it. Sometimes people indicated that they did not know that sea turtles were threatened with extinction, and that the lecture had made them to realise the importance of sea turtle conservation. Some individuals even offered to help in one way or the other, in order to contribute to the conservation activities. These people were asked to report any sea turtle and/or crawl they encountered through the sighting network, to make sure no harm is done to sea turtle nesting beaches by disposing garbage, and to donate money.

3.12 Turtle Corners and Sighting Network

Other activities within the 1995 Project with regards to enhancing public awareness, included the production of 'turtle corners', that were placed at all dive shops on Bonaire. A turtle corner consisted of a sign with the following text: "Have you seen a turtle? Please fill out a sighting form... ask dive staff". On the side of the sign, logos of the STCB, World Wildlife Fund and the Dutch National Postcode Lottery, were shown. The purpose of the sign was to attract the attention of the divers to the sighting sheets mentioned below. Underneath this sign, a folder rack was placed which contained three folders: the STCB folder dealing with the history of the STCB, effort taken in sea turtle conservation, and sea turtle biology and conservation with emphasis on the Bonairian sea turtles; a WIDECAST folder about sea turtles and their protection in the Caribbean; a 'Buyers Beware'-folder about the trade and smuggle of animals endangered with extinction, such as turtle products, conch, parrots, etc. This was one of the ways in which the awareness of dive tourists was enhanced.

As previously mentioned, part of the research consisted of gathering as much information as possible about the whereabouts of the sea turtles residing in the Bonairian waters. To achieve this goal, a network has been established in cooperation with the dive shops on Bonaire. Turtle sightings were reported by means of special sea turtle sighting sheets, which are available at every dive shop. All the information about the sightings was entered in a database. Judging from the number of filled out forms received (583 in 6 month), this way of gathering information is making very good progress. In the same manner, information of 1994 has reached the database, so continuity in gathering information was achieved. It is noteworthy that the number of forms received during periods where no STCB activities are taking place on Bonaire, is much lower. This despite the fact that arrangements were made in order to continue the flow of forms during the absence of activities. Fortunately, Bart Snelder (dive instructor at Buddy Dive Resort) took notice of this after the final of the 1995 Project.

Enthusiasm from his side made him take efforts to restore the sighting network, for which he is greatly acknowledged.

Some complaints were received in that some dive tourists had difficulties filling out the form. Therefore, the contents and layout of the forms were changed by the Project Assistants with assistance from Kalli de Meyer from the Bonaire Marine Park, for which the STCB is very grateful. The main goal in this was to make the forms more user friendly. We hope that this, together with the sign mentioned above and efforts made by Bart Snelders, will enable a continuous update of the database throughout future years.

Apart from gathering data, the sighting network also had a function in improving the public awareness. By letting tourists and residents participate in sea turtle conservation in this way, it is obvious that attention is drawn to the endangered status of sea turtles and to other activities of the STCB.

3.13 Newsletter

In November a newsletter was produced in order to inform both national and international organisations, sponsors, government, and others with an interest for sea turtle conservation on Bonaire (see appendix). This newsletter contained information on:

- The history of the STCB.
- A summary of the 1993-Project.
- An introduction of the 1995 Project.
- The preliminary results unto November.
- An overview of the different public awareness activities within the 1995 Project.

The most important organisations and sponsors receiving the newsletter were: STINAPA Bonaire, the Bonaire Marine Park, Department of Education of Bonaire, Department of Agriculture and Fisheries of Bonaire, Tene Boneiru Limpi and Amigu di Terra, Reefcare Curaçao, STINAPA Curaçao, Sea Aquarium Curaçao, StimAruba, FUDENA (Venezuela), WIDECAS, the World Wildlife Fund of the Netherlands, the Foundation DOEN/National Postcode Lottery and the Foundation for Scientific Research in the Caribbean Region.

3.14 Newspaper Column, Booklet and Poster

Starting in August, efforts were made to get the 10 weekly columns in Papiamentu published in the local newspaper *Extra* in 1993, republished. The columns, as mentioned in Van Eijck & Eckert (1994), are about the STCB (part 1), the biology of local species (parts 2-6), and specific threats to sea turtle survival and how to solve them (parts 7-10). It was agreed upon that republishing was going to take place in January. The column was read by a large public, and contained information previously unknown to the public, in 1993. Therefore, we hope that republishing in 1996 took place, since this was not confirmed.

During the 1993 Project, the column series were compiled into an illustrated booklet, entitled 'Nos Mundu Di Tortuga'. Because of a high interest in a copy of this booklet, a thousand copies of the booklet were printed in 1995. These were distributed among

the schools and other local groups on the island, such as the Bonaire Marine Park, Amigu di Terra, STINAPA, Centro di Bario etc. Printing was sponsored by the World Wildlife Fund of the Netherlands and the Foundation DOEN/National Postcode Lottery. It is noteworthy that receiving the booklets was highly appreciated. Apart from the contributions of the press in the form of various publications about the project and about sea turtle conservation in general (see 3.22), the Project Assistants are grateful to Boy Antoin for his advice on various matters and taking care of printing the booklet.

Also during the 1993 Project, a poster about the biology and conservation of sea turtles in Bonaire was designed and printed. The poster was designed in two versions: English (7,500 posters printed) and Papiamentu (2,500 posters printed). The poster included STCB and WIDECAS logos and was largely sponsored by Bonaire Trading Co. Ltd., and WIDECAS. Since the poster contains important information regarding sea turtle conservation, efforts were made to sell more of them in 1995. Dive- and souvenir shops were approached in order to sell the posters in these establishments. However, most of the stores already had the poster in their collection. Managers were asked to lower the price to Nafl. 5,- (prices varying from Nafl. 7,50 to 12,-), as advised by the main sponsor, Mr. H. Gerharts, for which he is greatly acknowledged. Most of the times this advice was not followed, even though the importance of these posters in enhancing public awareness and protecting sea turtles was stressed out to them. A reasonable number of posters was sold to tourists after the weekly slide show (see 3.111). The posters were offered at a price of Nafl. 5,-, which seems to be an appropriate price. Furthermore, the Papiamentu version is distributed at no cost among all the schools visited by the Project Assistants (see 3.112).

3.15 Tourist Education

In addition to education of residents, fostering awareness amongst tourists is also important to the long-term survival of sea turtles. Tourism is important to the economy of Bonaire, but tourists can also unwittingly destroy the beauty they came to enjoy. An effective education effort was put forward by the crew of the trimaran *Woodwind*. They provided the Project Assistants with a weekly trip to Klein Bonaire, food and drinks. In turn, the Project Assistants informed the passengers on sea turtle biology and conservation on Bonaire. Since the crew organised snorkel trips to the reefs of Klein Bonaire, the passengers were told how to react when a turtle was observed. They were asked not to disturb the animal by getting too close, and if they wanted to follow the animal, they were asked to keep their distance (10 meters). The passengers were also asked to report any sightings to a crew member. Many guests showed a sincere interest in sea turtle conservation and marine life in general. This judged from the high number of questions asked during the sail and snorkel trips, and the fact that they repeatedly reported turtle sightings to the crew and to the Project Assistants.

3.16 Gathering Photo, Slide, and Video material

Photo, slide, and video material for various purposes was collected throughout the 1995 Project. The objective was to gather as much material as possible. First of all, material was collected through the sighting network. The form used in the sighting network contained a part in which the divers were asked if any visual material was

taken, and in case they did, if they were willing to provide the STCB with a copy. In this way a fair number of photo, slide, and video material was passed through, including photographs showing predatory behaviour of a hawksbill turtle (provided by: Mr. M. Hellström-Larsson). These pictures show a hawksbill turtle catching a small parrot fish. As far as our knowledge goes, this has never been photographed before, which stresses the uniqueness of these pictures. Moreover, video and slide material of the different activities within the 1995 Project was taken by the Project Assistants with the help of Chris Bloodwell, Corine Gerharts, Johan Hager, Sander Valkering, and Mariëlle Valkering. Furthermore, July Morgan, Jim Brandon, David Elliot (all Sand Dollar Dive and Photo Shop), Janice Huckaby (Divi Flamingo Dive an Photo Shop), and Gerrie Fokke (Watertaxi 'Baka den Laman'), provided us with slide, and video material of turtles swimming in Bonairian waters, which is highly appreciated by the STCB. The last source of visual material mentioned here is the slides taken by the Project Assistants in the photo identification study.

The visual material collected is used for different purposes. Firstly, the material will be included in the photo identification database, which might prove to be a useful tool regarding a better understanding of Bonairian sea turtle population dynamics in the future. Secondly, the material was used to make an overview of the activities within the 1995 Project (see 3.113). Thirdly, the video material will be used to make a STCB promotion video, which in the future also will be used as educational material. Furthermore, photographs can be used to start an 'adopt a turtle' project on Bonaire, in order to get extra funding (see 3.4). Moreover, the camera crew of a Dutch television program ('Toppers' from television station RTL4) covering the fundraising dinner (see 3.114), was provided with a copy of a section of the material.

3.17 Keeping an Eye Out

In order to get insight in the enforcement of the Bonairian law regarding sea turtle conservation and protection, the Project Assistants kept an eye out for any illegal activities at all times. Whenever a souvenir shop was visited, the collection was checked for any turtle products. During the 1995 Project, no turtle products were encountered in any shop, implying souvenir shop owners are aware of the fact that the trade of turtle products is forbidden by Bonairian law.

According to Board-members of STINAPA and the Bonaire Marine Park, the harvest of sea turtles and egg poaching still exists on Bonaire, be it on a small scale. Fishermen in the Lac Bay area were under the biggest suspicion of harvesting sea turtles. Establishing this, however, proved to be very difficult. Efforts were made to look out for any turtles brought ashore by these fishermen. In the first couple of weeks the Project Assistants snorkelled several times in the Lac Bay area. This was done at sunrise since this is the time the fishermen return from open sea. No turtles being brought ashore at that time were encountered. The suspicion proved to be right however, since rangers of the Bonaire Marine Park encountered one of the fishermen harvesting sea turtles in February, 1996. As a result of this the entangling net used in this was confiscated by the Bonaire Marine Park. Actually, this was the first time that the part of the Marine Environment Ordinance (A.B. 1984, no. 21) concerning sea turtles, had to be put in use since it's amendment in 1991.

3.2 Cooperation

3.21 Government

In July, the Project Coordinator made contact with representatives of the Department of Education in order to take advantage of all opportunities to integrate sea turtle conservation themes into planned school programs. Later, the Project Assistants contacted the head of the Department of Education (Mrs. R Orman) for further consideration of the possibilities for cooperation, for which she is highly acknowledged. At that time it was not possible for her to make arrangements in order to get the education program on marine conservation started. There was a sincere interest in this however, and therefore permission was given to organise school slide shows. One of the members of the Department of Education attended a slide show, afterwards displaying appreciation and satisfaction on the contents and the quality of the presentation.

Meetings were also arranged with representatives of the Department of Fisheries and Agriculture for the purpose of identifying gaps in the regulatory framework concerning sea turtle protection on Bonaire. The head of the Department of Fisheries and Agriculture (Ir. E. Berben) participated in various discussions about legislation and law enforcement concerning the development of Klein Bonaire. The participation and commitment displayed by him is highly appreciated by the STCB.

3.22 Media

Press releases and updates about the STCB project were provided regularly to reporters of all daily newspapers, and personnel of the radio and the television stations in Bonaire. This resulted in a total of at least 35 newspaper articles, 5 radio interviews and 2 television interviews. Some of the newspaper articles that were published (about 20), also reached Curaçao and Aruba. The most dedicated and enthusiastic reporters were Boy Antoin (*Extra*), Hubert Linkels (*Amigoe*) and Eric Beeldsnijder (*Beurs- en Nieuwsberichten*). Moreover, Anne-louise Tuke (*Bon FM*) cooperated to every extent within her possibilities. Also Flamingo TV- news kindly cooperated in covering some of the activities. The STCB is grateful to all of these people for their support and enthusiasm.

3.23 Business Community

In July, contact was made with the president of one of the main sponsors of the STCB, Mr. H. Gerharts of Bonaire Trading Co. Ltd. During this meeting, which was attended by the Project Coordinator and the Project Assistants, the objectives of the STCB 1995 Project were explained. Gerharts was as supportive of the project as he was in 1993, and the STCB is grateful for the many services provided.

In late July, the chairman of the Maduro and Curiëls Bank (MCB) in Bonaire was provided with the 1993 report, a poster, a booklet, and an introduction to the STCB 1995 Project. During this meeting he was also informed on the plans of making a STCB promotion video, and was offered the possibility of sponsoring this. Although he appeared to be willing to cooperate, no definite was received up to this moment.

Furthermore, the chairman of CURO (Council of Underwater Resort Operators) was provided with an introduction to the STCB 1995 Project. Throughout the duration of the project, the chairman of CURO (Mr. J. Chalk) was kept updated on data and developments. The continuing support was much appreciated.

Throughout the 1995 Project, dive shops were visited at least on a weekly basis to collect completed sighting forms. Through personal communications with the dive masters and dive instructors, details about the various sightings were shared with the Project Assistants. In turn, these personnel received regular updates about the results of the project, and in some cases were invited to accompany us when a nest was hatching.

3.24 Local Non-government Organisations

3.241 STINAPA

In July, contact was made with STINAPA Bonaire (Stichting Natuurpark Bonaire). STINAPA, one of Bonaire's largest NGO's, manages the Bonaire Marine Park and the Washington-Slagbaai National Park. The chairman at that time (Mr. R. Hensen), was informed about the STCB 1995 Project, and STINAPA Bonaire was invited for cooperation. Subsequently, the Bonaire Marine Park provided the Project Assistants with weekly transportation to Klein Bonaire, and free entrance to the Washington-Slagbaai National Park for the duration of the project was arranged.

In November, the chairman of the STCB (Mr. A. de Soet), Corine Gerharts, and the Project Assistants contacted Kalli de Meyer of the Bonaire Marine Park. In this meeting arrangements were made for closer cooperation in the future. Extensive communication in order to match the goals of the Bonaire Marine Park and the STCB, was agreed upon.

In December, the STCB provided the museum of the Washington-Slagbaai National Park with photographs and information about the sea turtles of Bonaire and their protection. Translation of this information to Papiamentu was taken care of by R. Hensen of STINAPA.

In 1995 the Bonaire Marine Park (BMP) and the Tourism Corporation Bonaire started a snorkel program for children called 'Turtuganan di Boneiru' (the sea turtles of Bonaire). During the program the children were educated about the coral reef by means of slides. Furthermore, they were taught to snorkel, during which emphasis was laid on behaving properly in the marine environment. As an extension to this, the STCB, in cooperation with the Bonaire Marine Park, organised educational snorkel trips to Klein Bonaire for the children that finished the program. On a three weekly basis, on average 20 children, were taken to Klein Bonaire by the Project Assistants, together with the rangers of the Bonaire Marine Park and volunteers. Boat transportation was provided either by Captain Don's Habitat or by Divi Flamingo. After arrival on Klein Bonaire one of the rangers made sure the children remembered what they were taught in the snorkel program. For example, they were told not to touch anything, to collect any garbage they encountered, to stay close and listen to the person accompanying them etc. Furthermore, they were educated on sea turtles with regards to their behaviour in and out of the water whenever a sea turtle is

encountered, by one of the Project Assistants. They were asked not to disturb any sea turtle, to keep their distance, and to leave any pits on the beaches alone. Moreover, when snorkelling, the children were educated on marine life in general, by means of pointing out organisms and asking them for the names. Because this took a lot of the attention from the persons accompanying them, groups of no more than 2-4 children per adult were taken out in the water.

3.242 Other Non-Government Organisations

Another project in which the STCB cooperated is the World Clean Up Day, which on Bonaire took place on the sixteenth and the seventeenth of September. The Clean Up was organised by Tene Boneiru Limpi ('Keep Bonaire Clean') and the Tourism Corporation Bonaire. The contribution of the STCB, in this case Corine Gerharts and the Project Assistants, consisted of coordinating the Coastal Clean Up. Due to the fact that the entire area of the Bonairian coastline was too big to clean in this project, the STCB limited the clean up to several beaches which are of importance to the sea turtle. These were mainly potential nesting beaches. The STCB recruited groups and individuals (160 participants in total) and assigned these to the various beaches. With the help of these people 80 bags (with a volume of approximately $1/4 \text{ m}^3$ a bag) of garbage were collected and quantified on Klein Bonaire, and 145 on the several beaches on the Bonairian mainland (among others, Playa Chikitu, Lagun, and part of Playa Grandi). Quantification was done by listing every piece of garbage on a form provided by the Centre for Marine Debris. The information gathered this way was entered in their data bank, with which it was tried to determine the origin of the marine debris in order to diminish the amount. More detailed information about the quantification of the debris is available at the STCB. Although complaints were heard about listing the garbage, the value of this information in trying to stop the flow of debris appears to be high enough to continue this in the future. It is noteworthy that debris collected on the windward side of the island mainly originated from Venezuela, while debris from the leeward side and Klein Bonaire mainly originated from Bonaire itself. During the clean up the people were informed about the negative impact that the trash has on sea turtles. This information dealt with the floating debris, which the sea turtle can swallow or get entangled in and drown, as well as the harmful effect of the trash when lying on the beaches. Although the adult female turtles will probably be able to find their way through the trash and make their nests, the young hatchlings will have great difficulty in getting past these manmade obstacles to make it to the sea.

In late August, the board of Amigu di Tera ('Friends of the Earth') invited the STCB for a meeting with Mr. T. van het Hoff (World Wildlife Fund), representatives of the government (Mr. Beukenboom, Mr. R. Zonneveld), representatives of SELIBON, Mr. R. Hensen (STINAPA), and Mr. E. Berben (Department of Agriculture and Fisheries). The purpose of this meeting was to determine areas on Bonaire which need to be protected. This was done because WWF wants to structure their funding on the Netherlands Antilles, so also priorities were appointed to the different areas. Klein Bonaire was given a high priority, partly due to the importance of this islet for sea turtles as determined by the STCB.

From August on efforts were made to contact the board of the 'Centro di Bario' (Youth Centres) on Bonaire. Because of difficulties in finding the right person, this succeeded no earlier than November when contact was made with Walter de Palm. Enthusiasm

from his side regarding education in the youth centres, opens this opportunity for future projects.

3.25 Regional Cooperation: Curaçao, Aruba and Venezuela

During the third week of July 1995, a working visit was made to Curaçao by the Project Coordinator. During this visit, contact was made with J. Sybesma (former WIDECAS Executive Coordinator for the Netherlands Antilles), personnel of CARMABI (Caribbean Marine Biological Institute), the board of STINAPA, and the board of Reefcare Curaçao, to inform them on the STCB 1995 Project. After visiting Curaçao, the Project Coordinator travelled to Aruba to meet with T. Barmes (Country Coordinator WIDECAS-Aruba) for the same reason.

In the third week of November, a second working visit was made by the Project Assistants. On Curaçao meetings were arranged with, J. Sybesma, L. Pors (WIDECAS Executive Coordinator for the Netherlands Antilles), D. Debrot (CARMABI personnel and representative of STINAPA), P. Hoetjes (representative of Reefcare Curaçao and Curaçao Seaquarium), and G. van Buurt (National Fisheries Officer and author of 'de Schildpadden van Curaçao en Bonaire' (the Turtles of Curaçao and Bonaire), 1995). During these meetings, mutual updates about various projects were exchanged, and advice was received as mentioned below.

The meeting with J. Sybesma emphasised the importance of habitat protection in the future. The most important habitats needing protection regarding sea turtles are Lac Bay and Klein Bonaire. In order to do so, the scope of the STCB needs to be expanded to other organisms from these habitats (e.g. conch, mangroves etc.) in the future. To achieve this, a ranger needs to be appointed to manage these areas, something that could partly be financed by the STCB and STINAPA Bonaire. Furthermore, the advice was given to include a long-term proposal in the 1995 report, in order to make an assessment on the growth of the STCB in the future. Finally, he provided us with a folder in Papiamentu dealing with sea turtle biology and conservation on Curaçao (see 3.112).

The meeting with L. Pors and D. Debrot revealed an interest in a cooperation between the STCB and CARMABI in the future. This can be thought of as the STCB providing CARMABI with students to perform a sea turtle conservation project on Curaçao. Moreover, since nesting activity on Klein Bonaire is relatively high, assessment of nesting activity on Klein Curaçao has a high priority. This has not been done up to now because of logistic problems. P. Hoetjes was also very interested in assessment of nesting activity on Klein Curaçao. Furthermore, he asked us to provide Reefcare Curaçao with a couple of posters in Papiamentu (see 3.14), to use them in an educational program for children. This was done in November.

G. van Buurt advised us to send copies of the booklet, the STCB 1994- and 1996-report, to the library of the University of the Netherlands Antilles (Jan Ordenweg, Curaçao) and the department Caribbiana of the public library on Curaçao. This in order to keep the information in these writings available to everyone who is interested.

After this visit to Curaçao, a visit was paid to Aruba where meetings were arranged with T. Barmes and E. Boerenwinkel (Chairman of StimAruba, the largest non-

government organisation on the island). During these meetings, mutual updates about various projects were exchanged, and the STCB Project Assistants were taken on a field trip around the island.

FUDENA (Fundacion para Defensa de la Naturalesa), one of Venezuela's largest non-government organisations, is a counterpart organisation active in regional sea turtle conservation. Throughout the STCB 1995 Project, updates on the proceedings of our work and a newsletter were provided to G. Solé (Country Coordinator, WIDECAS-T-Venezuela) and G. Medina (Executive Director, FUDENA), and to various other persons involved in Venezuelan sea turtle conservation projects. The exchange of information between STCB and Venezuela is important, since sea turtle stocks are surely shared between our two jurisdictions; further, there is continuing concern about illegal trade in sea turtle products between Venezuela and islands of the Netherlands Antilles.

3.26 International Cooperation

3.261 WIDECAS-T

In May, at the start of the STCB 1993 Project, cooperation with WIDECAS-T was established. WIDECAS-T is sponsored by CEP (Caribbean Environmental Program) which in turn is a counterpart organisation of UNEP (United Nations Environmental Program). In the international WIDECAS-T Project, a network was established to coordinate sea turtle conservation projects in the Caribbean region. As a result of this, WIDECAS-T provided the STCB with logistic and technical advice, as well as financial support, since cooperation was established.

Throughout the 1995 Project, Dr. K. L. Eckert (Executive Director of the international WIDECAS-T project) assisted the STCB by providing educational material (sea turtle mini-posters, folders, and slides), logistic and technical advice. In turn, WIDECAS-T received regular updates concerning STCB activities as well as a newsletter.

The STCB is very grateful to Dr. K.L. Eckert (e.g. WIDECAS-T), for the cooperation and support throughout the past.

3.262 16th annual sea turtle symposium. Hilton head, SC. February 1996

The 16th annual sea turtle symposium was visited by one of the Project Assistants of the Sea Turtle Club Bonaire (STCB). This has to be viewed at as an important extension to the STCB 1995 Project. The importance of this visit lies in the fact that during this convention information and knowledge is exchanged with governmental and non-governmental organisations, as well as scientific organisations, which are concerned with sea turtle research and conservation. First of all, the STCB presented the most important results of the 1995 Project by means of two posters entitled:

- **AWAKENING AWARENESS: THE SEA TURTLE CLUB BONAIRE 1995 PROJECT.**
Paul van Nugteren, Niels P. Valkering, and Tom J.W. van Eijck (editor).

- THE SEA TURTLE CLUB BONAIRE 1995 PROJECT: RESEARCH ON RESIDING JUVENILES AND NESTING ADULTS.
Niels P. Valkering, Paul van Nugteren, and Tom J.W. van Eijck (editor)

Furthermore, a better knowledge about sea turtles in general has been achieved from discussing the contents of both the STCB-posters as well as other posters, but also from attending lectures. This knowledge is of great importance in the actualisation and standardisation of future STCB activities. Moreover, abstracts of the posters are going to be published in the proceedings of the symposium. Finally, the symposium enables to display the STCB towards the attendees, so the name and the activities of the STCB are spread.

The experience and knowledge gathered by the STCB in past years can be very useful to people who are starting up any kind of sea turtle conservation project. During the poster sessions advice was given to people who were interested in this information. Most advice dealt with questions about how to put up a sighting network for tourists, what age-class of children to inform, how to organise snorkel trips for children, where to get educational material, to what extent the cooperation with local and international organisations and media was established. Also questions related to this arose, like how many inhabitants, tourists, dive schools, schools, newspapers, television and radio stations are present on Bonaire. The information about the public awareness was mainly passed through to people who are active in South-America. Hopefully this information helps to extend and improve public awareness activities in other countries, so sea turtles are better protected throughout the world.

Discussions regarding the poster dealing with the survey results revealed an interest in the effective gathering of data through the sighting network and the importance of Klein Bonaire as a nesting habitat. The sighting network proved to be unique for Bonaire, and was received with enthusiasm by people attending the poster. Because of this uniqueness, the STCB was able to set an example for other sea turtle research and conservation projects, which has a positive influence on the display of the STCB. Some discussion regarding the threat of developing Klein Bonaire also came up. Although the number of nests on Bonaire is marginal compared to other regions in the Caribbean, a certain importance of Bonaire as a nesting habitat in the Caribbean was agreed upon during these discussions.

The general interest in the STCB activities was satisfactory. A lot of positive reactions were received and acknowledged. Furthermore, it proved that, although all STCB-activities (except for the sighting network) are also undertaken in other parts of the world, a combination of these in one project is unique for sea turtle conservation.

Attending poster sessions and lectures provided the STCB Project Assistant with information on sea turtles in general, and, in case of the poster sessions, to exchange information with other symposium participants. From this information and exchanging information some ideas came up with regards to future STCB Projects. The most important aspects of gathering information with respect to the research and conservation activities undertaken by the STCB deal with diving physiology of sea turtles, age determination of hawksbill and leatherback turtles, orientation by sea turtles, nest ecology and relocation, mating behaviour, genetics, conflict resolution workshops, 'adopt a turtle' project, and the importance of continuation of exchanging

information with governmental, non-governmental, and scientific organisations concerned with sea turtle research and conservation in the Caribbean region (see appendix VI and recommendations).

3.3 Project Sponsors

The Turtle Club 1995 Project was largely sponsored by Bonaire Trading Co. Ltd. During the project, STCB leased a Suzuki mini-van from Bonaire Leasing Co. Ltd. and paid for room and board at the Sunset Beach Hotel. The costs for the room, board and phone use were considerably lower than average tourist rates, and comparable to in-board hotel trainee costs (Antillian rate). Bonaire Trading Company also provided copy and fax service at a courtesy cost and kindly donated the regular assistance of various members of its administration. Furthermore, several Apple Macintosh computers could be used by the STCB whenever available.

Local hotels were also very supportive. Slide presentations were given in the Divi Flamingo and Captain Don's Habitat. In each case, the hotels were invited to sponsor the event by providing free use of a conference room and slide- and video equipment. In both cases this request was received positively, as well as the request for boat transportation during snorkel trips (see 3.241). Beverages for attendees of the slide presentations were provided by Rum Runners and CONSALES.

The Sunset Beach Dive Centre, and the dive shops from Captain Don's Habitat and Buddy Dive Resort provided unlimited free transportation by (dive)boat to and from Klein Bonaire whenever possible. Sand Dollar Photo Shop assisted in the photo identification study by providing the STCB with a camera whenever available on request. On most Thursday mornings, the trimaran *Woodwind* assisted in beach and at-sea (snorkel) surveys to Klein Bonaire by providing the Project Assistants with free transportation, food and drinks. The Bonaire Marine Park provided free transport to and from Klein Bonaire by patrol vessel; assistance from Park Rangers was kindly given whenever required and possible.

The STCB 1995 Project was financially supported by various organisations, like the World Wildlife Fund of the Netherlands, the Foundation DOEN/National Postcode Lottery, the Dierenrampenfonds and the Foundation for Scientific Research in the Caribbean Region.

The printing of this report is partially sponsored by the University of Amsterdam.

IV LONG TERM PROPOSAL 1996 - 2000

4.1 Commitments of the Sea Turtle Club Bonaire

As an answer to the many threats facing Bonaire's wildlife, the Turtle Club takes the spreading of knowledge about nature as a starting point.

Most of the destruction of Bonaire's natural treasures takes place out of ignorance. This ignorance can be replaced by conscience through the creation of more public awareness and more cooperation on a local basis.

The public should come to realise that sea turtles are 'flagship' species, and that complete habitats need to be protected (including coral reefs, sea grass and sandy beaches). With this protection will come the protection of a large part of the island's wildlife, not just sea turtles.

For this reason, it is very important for the Turtle Club to cooperate intensively with other organisations with an interest in nature conservation, such as other non-governmental organisations (e.g. Bonaire Marine Park, STINAPA Bonaire, Tene Boneiru Limpi, Amigu di Tera Bonaire), governmental institutions (e.g. education, fisheries, forestry) and commercial entities (trade organisations, banks, diving tourism industry and hotels).

The emphasis in the long term activities of the Turtle Club will be laid on this local cooperation. Numerous initiatives have already been taken, initiatives which will hopefully lead to cooperation on a larger scale. Besides the work on Bonaire, however, regular contact with the regional counterpart organisations on Curaçao and Aruba and in Venezuela is also needed.

At the moment, the Sea Turtle Club Bonaire has an established position in nature conservation on Bonaire, and the time has come to extend future plans to a wider scope, in which local cooperation is taken as a starting point.

In the recent past, the STCB successfully cooperated with several organisations in order to integrate the sea turtle conservation on Bonaire in more general programs for nature conservation. Examples of these programs are the World Cleanup Day (in which the STCB assisted Tene Boneiru Limpi in the beach cleanups) and the assistance in the 'Turtuganan di Boneiru'- Program from the Bonaire Marine Park. In the future, the STCB will continue to support these local initiatives as much as possible.

At the same time, the STCB wants to intensify the cooperation with the Bonairian Dept. of Education, and with the schools and school boards of Bonaire. The goal of this cooperation is to provide the schools with updated educational materials about the natural environment of Bonaire. In this way, the STCB hopes to increase the public awareness of future generations of the island population.

Finally, by continuing the biological research on the sea turtles of Bonaire, more detailed information about the local sea turtle stocks will be obtained.

The biological data gathered over the years can serve as a strong basis for future management plans for the conservation of sea turtles, but also for the conservation of their habitat.

4.2 Present Status of Sea Turtles and their Habitats on Bonaire

From the results of the STCB 1993 and 1995 Projects, it has become clear that Bonaire offers a habitat for sea turtles in two different ways: some beaches of the island offer a nesting habitat for adult hawksbill and loggerhead turtles and the reefs and sea grass beds are a foraging habitat for juvenile hawksbill and green turtles.

Although the capture of turtles and selling of turtle meat is forbidden by law since 1991, illegal harvest of sea turtles in Bonairian waters is still continuing at a low rate. It is thought that this is being done traditionally by a small group of local fishermen, but others may also be involved, such as fishermen from Curaçao and Venezuela.

A more serious threat to the survival of the turtles, however, are the human developments onshore. Bonaire has a history of being protective to nature, which, for example, resulted in the establishment of the Bonaire Marine Park in order to protect the coral reefs around the island. However, some very important sea turtle habitats, like Klein Bonaire and Lac bay, are under a continuous threat of irresponsible exploitation.

There is a delicate balance between nature and culture on Bonaire, and the natural marine resources such as coral reefs, mangroves and salt lakes are still relatively unharmed. In this way, Bonaire acts as an important refuge and foraging area of sea turtles and numerous other endangered species in the southern Caribbean, including flamingos, parrots and other rare birds, not to mention the hundreds of species that inhabit the mangroves, sea grass beds and coral reefs.

Although these natural treasures are recognised and appreciated by a main part of the Bonairian (and non-Bonairian) people, other aspects, such as creation of employment and commercial expansion sometimes prevailed, without taking notice of the socio-economic demands of the island. In the past this has led to some large building projects, for example at Punt Vierkant and Sorobon, which first destroyed virgin parts of the Bonairian coast, and then were halted because of financial problems. There has been no other investments in these project since then, nor any funding to break the half-finished constructions down.

It is hoped that we learn from those lessons. Bonaire is a quiet island, so mass tourism is doomed to fail. But, although most of the present construction of new buildings is taking place in inland areas, some important coast and marine areas are still under threat.

4.3 Key Areas for Sea Turtle Conservation on Bonaire

4.31 Klein Bonaire

One of the most important areas for sea turtle survival is Klein Bonaire, the uninhabited island in front of Bonaire's west coast. Klein Bonaire has an unique combination of sea turtle activity: nesting of adult hawksbill and loggerhead turtles on the sandy beaches, and populations of juvenile green and hawksbill turtles offshore. Klein Bonaire is almost completely surrounded by vivid coral reef, and offers many high-quality dive sites.

Boats from diveshops with groups of up to 15 divers visit the island at least twice every day.

A large part of Klein Bonaire itself, however, is in private hands. Real estate investors are considering the construction of a mooring pier on No Name Beach, Klein Bonaire's main sandy beach. From research done by the Bonaire Marine Park it is clear that this, or any other construction, will lead to massive reef avalanches in front of this beach, since this region is very unstable. A mooring pier will result in a complete destruction of a very important coral reef area. Moreover, virtually any construction on Klein Bonaire will completely eliminate the seasonal sea turtle nesting population and degrade the coral reef surrounding (and protecting) the islet. The Sea Turtle Club Bonaire is urging the Bonairian, Antillean and Dutch Governments to take appropriate action on this point.

4.32 Lac Bay

A second area of interest is Lac Bay, an important mangrove and sea grass area at the southeastern coast of Bonaire. Unfortunately, Lac Bay is declining in size because of inadequate sea water flow, caused by construction activities nearby. Since the mangrove area in Lac Bay provides extensive nursery habitat for many animals which will later inhabit coastal areas (especially reef fish), its existence is of crucial importance for the survival of a respectable source of Bonaire's income and touristic activity: the coral reef.

Although Lac Bay received the status of a Marine Reserve and RAMSAR-site some years ago, little has been done to protect the area from degradation or outright appearance. The main reason is a lack of funding and personnel needed to restore and protect the area.

Lac Bay is also thought to be a foraging area for sea turtles. In the past, sea turtles were caught here with special turtle-nets, slaughtered ashore, their meat being sold to the public as turtle-steak. After this was prohibited in 1990, the capture of sea turtles continued illegally, but on a smaller scale. The last souvenirs made out of sea turtle were encountered in a shop in Kralendijk in 1993. Although sea turtles are still illegally captured in Lac Bay, juveniles of various size classes can be found here.

4.4 The Sea Turtle Recovery Action Plan for Bonaire

4.41 Public Awareness Initiatives

Public awareness activities are essential for the survival of Bonaire's fragile ecosystems. The local and visiting public needs to be informed as much as possible, in order to avoid any irresponsible behaviour to the island's environment. In spreading the word about Bonaire's natural treasures, the Turtle Club especially focuses on young people, such as schoolchildren, because they are the future of the island.

4.411 Production of Educational Material

In the past, the Turtle Club produced and/or distributed an array of educational materials about the sea turtles of Bonaire. Examples include:

(1) a brochure about the sea turtles of Bonaire and activities of the Turtle Club;

- (2) a full-colour sea turtle poster, sponsored by the Bonaire Trading Company and WIDECAS [N.B. This poster, with photographs and information about the four species of sea turtle that visit Bonairian waters, has been sold to the public and distributed through the schools since 1993];
- (3) a 'miniposter' created by WIDECAS explaining sea turtle species identification and a brochure about Caribbean sea turtles;
- (4) in cooperation with the newspaper Extra, STCB annually produces and distributes a booklet about the sea turtles of Bonaire, written in Papiamentu, the local language of the Netherlands Antilles [N.B. In 1995, this booklet was co-sponsored by the WWF Netherlands and the Dutch National Postcode Lottery];
- (5) the Sea Turtle Club Bonaire 1995 Newsletter, which was distributed on Bonaire during the 1995 Project.

The activities mentioned above should continue in the future, and new educational materials need to be produced as well. The following activities are proposed:

(1) the production and distribution of a new STCB brochure. In this brochure the four sea turtle species that visit Bonairian waters will be described, the threats facing them (as well as possible solutions) will be presented, and information about how to get involved in the preservation of Bonaire's wildlife will be offered. The folder will be produced both in Papiamentu and in English.

(2) the production of a Dutch version of the columns and the booklet, which were originally written in Papiamentu. The schools on the island are highly interested in additional Dutch and English versions. Since the higher classes all receive their education in Dutch, this version can be used as educational material for these higher classes (ages 10-18). An updated, Dutch version of the column can be used for publication in one of Bonaire's largest Dutch newspaper, such as Amigoe and Beurs-en Nieuwsberichten.

If extra funding will be obtained, both versions of the booklet, as well as a possible English version, will be re-edited. Moreover, the booklets will be illustrated with full-colour photographs.

(3) the production and distribution of slide shows about wildlife conservation on Bonaire. The schools of the island, the Bonaire Marine Park, as well as the diving industry, need to obtain copies of this slide show, accompanied by an appropriate narrative. Since some of the slides will most likely be provided by WIDECAS, the latter organisation will be asked for copyright for these slides. The same is true for several professional underwater photographers that provided slides to the turtle club for scientific purposes.

Furthermore, a video on which slide shows of the STCB and the Bonaire Marine Park are combined can be produced. The Bonairian Youth Centres showed sincere interest in such a video.

(4) the production and distribution of a video about Bonaire's wildlife.

Sponsorship has been solicited from the Maduro & Curiëls bank.

At this moment, the Turtle Club is already collecting underwater videos of sea turtles, mostly made by diving instructors and underwater photographers. This is partly done for scientific purposes, but the quality of some of the videos is high enough for further editing and processing.

The video about Bonaire's wildlife will have a general message. Also other (endangered) species will be profiled, such as the bird life on the island and the coral reef and its inhabitants. An important target group for this video will be the schools and youth centres of the island and other local public, so again a Papiamentu version is highly desired.

In all projects, the Turtle Club will invite the collaboration of the Bonaire Marine Park/STINAPA Bonaire, Tene Boneiru Limpi and Amigu di Tera. Some schools on Bonaire lack adequate equipment for the use of the educational materials (slides, videos). Therefore, the STCB will have to provide these schools with borrowed slide projectors and video recorders, until additional funding is found to solve this problem. In a later stage, the Turtle Club should consider the distribution of video equipment to the schools.

Other educational materials include:

- (5) Dutch STCB/UNEP/WIDECASST sea turtle miniposters, which can be used as an educational tool at the local schools and as hand-outs during the various presentations and as aid for species identification for dive tourists.
- (6) a wider array of folders concerning the protection of endangered species, also for distribution through the turtle corners.
- (7) STCB T-shirts and caps, which can be produced during the 1996 Project.

4.412 School Programs

The cooperation with the local schools and school boards, as well as the Department of Education, needs to be intensified. In the first instance, this will be done by the production and delivery of educational materials by the Turtle Club. Of course, this should be general education programs about Bonaire's wildlife, not only sea turtles. The educational materials need to be suited for all age groups (a diversification needs to be made for the several schools). Materials will include: folders, posters, booklets, slide shows, videos, educational methods, and other educational tools, such as slide projectors and video recorders.

In all cases, other organisations concerned with wildlife conservation will be invited for cooperation. An active involvement from the latter organisations (especially the Bonaire Marine Park, STINAPA Bonaire and Tene Boneiru Limpi) in environmental education programs for schools is highly desirable.

Further, an integration of environmental education initiatives such as the 'Turtuganan di Boneiru'-program from the BMP and the World Cleanup Day from Tene Boneiru Limpi into the regular school programs should be sponsored and assisted by the Turtle Club on a long-term basis. Furthermore, the STCB can enable local children to buy a snorkel set of their own, by providing the sets for a low price.

It is recommended to organise slide presentations on a day to day basis, for example in a centre for environmental education, where all parties mentioned above are represented.

4.413 Environmental Centre

On the long term, the cooperation mentioned above should lead to the establishment of a centre for environmental education and research. In the first instance, this centre should be a working place for all people interested in the protection of Bonaire's natural environment. Organisations such as the Turtle Club, the Bonaire Marine Park, STINAPA Bonaire, Tene Boneiru Limpi, Amigoe di Tera Bonaire and others will be able to present themselves here and to provide the public with information about their activities.

4.42 Sponsoring and Fundraising

Since 1991, the Sea Turtle Club Bonaire is sponsored by various large companies, such as the Bonaire Trading Company, the Maduro & Curiëls Bank, the Royal Dutch Airlines, Royal Ahold BV and Golden Tulip.

Since 1994, the STCB is supported by the WWF Netherlands, Stichting DOEN/Nationale Postcode Loterij, the Dierenrampenfonds and the Foundation for Scientific Research in the Caribbean Region.

Future sea turtle conservation projects, undertaken by the STCB, will require a sustainment of this funding in future years, although the long-term goal of the STCB is to become financially independent. Until that time, the STCB is continuously and actively seeking for new ways of funding and sponsoring.

As an example, an 'Adopt a Turtle'-project should be started. This means that certain individuals or companies will get the opportunity to adopt a turtle for a certain contribution. In return, they will get information about 'their' turtle and Bonairian turtles in general. This can be achieved by producing a folder with photographs of sea turtles swimming in Bonairian waters as collected during the 1995 Project. Companies must be given the opportunity to choose a turtle from this folder, which can be 'adopted' for a certain donation. In turn, the sponsor will be displayed in the adoption plan. The funds which will come in through the 'Adopt a Turtle'-project will be spent on research and awareness activities.

4.43 International Cooperation

It is evident, that continuation of exchanging information with other organisations all over the Caribbean region is necessary in order to keep the sea turtle conservation on Bonaire integrated into a wider setting.

For the Netherlands Antilles, these organisations are STINAPA Curaçao, CARMABI, Kuida Ref Korsou/Reefcare Curaçao and LVV Curaçao (Department of Fisheries). For Aruba, the counterpart organisations are StimAruba and LVV Aruba. For Venezuela, FUDENA (Fundacion para Defensa de Naturaleza) is a counterpart, while further international cooperation takes place through the Wider Caribbean Sea Turtle Conservation Network (WIDECAST).

Furthermore, with regards to international recognition and the exchange of scientific data, it will be necessary to attend the annual international Sea Turtle Symposium regularly.

Since the newsletter, produced during the 1995 Project, proved to be useful in exchanging information, it is recommended to produce at least two newsletters in the course of the 1996 Project and continue this in future years.

Finally, it is recommended to provide libraries in the Caribbean, the U.S.A. and the Netherlands with copies of STCB publications from the past, present and future in order to make these available to a much larger public.

4.44 Biological Research

The biological data gathered over the years can serve as a strong basis for future management plans for the conservation of sea turtles. Therefore, the STCB will sustain the cooperation with the University of Amsterdam. In the following sections, the focuses of the future biological research of the STCB will be outlined.

4.441 Sea Turtle Nesting Activity

Yearly monitoring of the nesting beaches is very important for the collection of biological data about the adult sea turtles, especially gravid females. Key locations for this monitoring are: Klein Bonaire, the Northwest region, the Southwest region and several locations on the east coast, like Lagun and Playa Chikitu. Beaches in these regions are visited yearly by nesting hawksbill (*Eretmochelys imbricata*) and loggerhead (*Caretta caretta*) turtles, which is shown by the distinctive tracks they make in the sand.

The monitoring needs to be done from the beginning of May through the end of December. During the peak of the nesting activity (June-September) most of the monitoring needs to be done by the Project Assistants, since the main portion of the total number nests laid can be encountered during these months; during other months, volunteers and/or STINAPA rangers can make an important contribution.

When nesting data will be collected over the years, more solid conclusions about the population dynamics of the nesting population can be drawn, since individual sea turtles do not nest every year. As a result, the number of nests laid on Bonaire may show considerable fluctuations.

In two years time, a fluctuation has already been documented in the spatial distribution of nests made on Klein Bonaire. It appears that the suitability of East of No Name has declined considerably. Possibly, this is the result of a certain cycle, the beach degrading and rebuilding itself over a certain time span. It has been observed that parts of East of No name were crumbling off at the end of the 1995 Project, while new sand appeared along the sea side of the old degraded beach.

Future nesting habitat assessments will shed more light on this matter.

Nesting females can be part of a larger nesting population, which normally nests in Venezuela. It is suggested that gravid females from this population coincidentally run into the Netherlands Antilles on their way to Venezuela, and then make their nests on Bonaire, Curaçao or Aruba (j. Sybesma, pers. comm.). This could only be confirmed through a close comparison of the nesting results of these islands over the years. In a later stage, population-genetic research will be a valuable tool. Genetic research with turtles can best be performed with blood samples. Methods in analysing the blood samples are developed by Dr. N.N. FitzSimmons (University of Queensland) and Dr. B.W. Bowen (BEECS, Florida).

In the Netherlands, BIOTOPIC (a non-profit organisation for conservation of coast-related ecosystems) is active in genetic research on the sea turtles of Suriname (Hoekert *et al.*, 1996). It is recommended to contact them in case of a possibility for genetic research on the sea turtles of Bonaire.

Klein Curaçao (Curaçao), Islas Aves (Venezuela), and Islas Roques (Venezuela) are also of interest. These are uninhabited islands, which are known to support some level of turtle nesting. However, extensive research has never taken place in these areas. The fact that Klein Bonaire provides the majority of nesting attempts on Bonaire, due to its unspoilt character, makes research on Klein Curaçao, Islas Aves, and Islas Roques even more interesting. In any case, an intense cooperation with Venezuela and the other Lesser Antilles, considering research as well as conservation measures, seems evident.

4.442 Juveniles and their Foraging Activity

In order to collect more data about the juvenile sea turtles that inhabit the coral reefs and sea grass beds around Bonaire, yearly underwater research is highly desirable. Potential foraging areas need to be patrolled by snorkelling and diving regularly. In this way, more information will be obtained about population dynamics and feeding ecology of the juvenile green and hawksbill turtles.

There are strong indications that individual turtles may reside in the foraging areas for several years. Observations from divers, naturalists and snorkelling guides, as well as observations made by the authors, suggest that the same turtles can be found in roughly the same areas over several years. The juvenile and subadult sea turtles differ considerably in size, going from 15 to 50 cm in carapace length.

In order to collect further evidence for this 'residential' hypothesis, the Turtle Club undertook a pilot-study for photo identification of individual sea turtles. The results of this study are expected in the near future, but since the time for the study had to be reduced because of other research and conservation activities, another pilot study is included in the 1996 Project.

A relative high number of green turtles are present along the east coast. These vary in age from juvenile to subadult and forage on the various sea grass and algae beds. An extensive research should be undertaken to understand the population dynamics of these turtles. The research should implement snorkel and diving surveys, eventually resulting in tagging studies. Besides the movements in time and place of the turtles, the study should include a thorough investigation of the location of the foraging areas and the feeding behaviour at these sites. Due to the rough sea conditions along east coast, it is recommended for the STCB to purchase a boat in the near future. This would enable the STCB Project Assistants to undertake a thorough research of this area.

The sighting network does not represent a spatial distribution of the sea turtles. Some sites are more often visited than other sites. To counteract this, the sighting data can be standardised by using dive data derived from the Bonaire Marine Park Statistics. A relative distribution of the sightings can be constructed by dividing the number of sightings per location by the number of boat dives per site during comparable periods

of time in that year. This was done in the 1993 Report. Unfortunately, the dive data of the years 1994 and 1995 were not yet available and statistics prior to 1994 are considered to be outdated. Consequently, a relative distribution of the 1995 sightings can not yet be given. Future projects should include this calculation of the relative distribution, not only for the 1995 sighting data, but eventually for the data collected over several years.

Bonaire is regularly subjected to small oil spills. During the 1995 Project, at least one sea turtle died due to an oil spill at Lagun. The oil spills are result of ships, which occasionally rinse their oil tanks in open sea. Future research could shed light on the impact of the oil on the reefcommunity. The STCB urges the Antillian government to take action in this matter. Moreover, the STCB will assist local organisations in awareness initiatives concerning this point.

4.443 Local Assistance and Cooperation

The STCB will continue to admit suitable local volunteers. Since many individuals displayed sincere interest and enthusiasm, it is recommended to appoint more local STCB Project Assistants in the near future.

Apart from the data-collection done by the Project Assistants themselves, a large part of the data about the sea turtles of Bonaire comes in through the dive shops on the island. This kind of data is collected since 1993, by means of standardised sea turtle sighting sheets, designed by the STCB. When divers observe a sea turtle in Bonairian waters, they are requested by dive shop personnel to fill out a report form. As a result, the Turtle Club is receiving a huge amount of day-to-day information about the sea turtles around Bonaire.

On the report form, there is also a call for underwater photographs and videos of sea turtles. The collection of such materials started in 1995.

In the future, the Turtle Club will intensify this kind of cooperation, since any new information about the juvenile and adult turtles in Bonairian waters is constantly needed for evaluations of population status (i.e. whether or not local stock numbers are stable or not). These data will also assist in the diagnosis of any decline in turtle numbers.

Apart from the cooperation from the diving industry, data about the sea turtles of Bonaire is coming in through the Bonaire Marine Park, since rangers patrol the reefs regularly. In turn, the Project Assistants assist the Bonaire Marine Park by reporting reef damage and other abnormalities when encountered during their in-water patrols. In the future, the Turtle Club desires to intensify this kind of cooperation, since the Turtle Club is highly committed to participate in general reef protection activities, such as reef cleanups and surveys in order to detect specific coral reef threats (e.g. 'bleaching' and black band disease).

Since the degradation of important coral reef and sea grass habitat can be caused by the flow of sewage into the sea, produced by human activity on the island itself, the Sea Turtle Club Bonaire strongly advises the Bonairian, Antillean and Dutch Governments and Tourist Industries (i.e. hotels, diveshops and other resorts) to take serious steps in order to reduce the sewage problem on Bonaire. If the sewage flow

into the reefs will not be reduced, Bonaire's underwater world will encounter most serious environmental problems within a couple of years.

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Beach	Dimensions	Energetics	Debris	Animals	Vegetation	Human activity	Threats	Earlier Act.	Crawls	Offshore Status
Playa Chikitu	110 x 20	high	moderate		low bushes in dunes	low	humans	yes	1	sand, rocks
Boka Chikitu	12 x 30	moderate	light		none	very low	crabs	unknown	none	sand, reef
Boka Catuna	10 x 4	low	very light		none	low	humans, crabs	unknown	1	sand, reef
Wayaka	6 x 2	low	very light	iguanas	none	low	humans	yes	none	sand, reef
Playa Frans	33 x 10	low	very light	dogs	low grasses	high (settlement)	humans, dogs	unknown	none	sand, reef
Playa Nukove	10 x 3	low	very light		none	moderate	humans, crabs	yes	2	reef
Boka Dreifi	40 x 15	low	very light	goats, iguanas	bushes, cactae	low	humans, crabs	yes	none	reef
Windsock	200 x 8	low	light	donkeys	low bushes	high	humans	yes	none	sand, reef
Punt Vierkant	20 x 5	low	light		none	high (s.)	humans	yes	none	sand, reef
Pink Beach	450 x 17	low	light	donkeys	none	high	humans	yes	none	sand, reef
S.W.P.B.	4-10 x 2-4	low	light	sea birds	low bushes	high	humans	yes	none	sand, reef
Chogogo	15 x 5	low	light	dogs	none	low	humans	yes	1	sand, reef
Sorobon Area	270 x 5	very low	light	sea bs., iguanas	low bushes	high	humans, dogs	yes	none	sea grass
Lagun	84 x 15	moderate	heavy		low grasses, mangrove	moderate	humans	yes	none	sand, sea grass
E.O.N.N.	1500 x 0-5	moderate	moderate	iguanas	bushes, trees	very low	humans, crabs	yes	3	sand, reef
No Name	530 x 7	moderate	light	iguanas	grasses, bush, trees	moderate	humans, crabs	yes	7	sand, reef
W.O.N.N.	4-15 x 2-5	low	very light		low bushes	low	humans, crabs	unknown	8	sand, reef
W.K.B.	30-4 x 2-9	moderate	very light		none	very low	crabs, sea	unknown	21	sand, reef

Table 1. Habitat assessment of 41 potential sea turtle nesting beaches on Bonaire and Klein Bonaire, Netherlands Antilles (see figure 1).

S.W.P.B = Southwest Pocket Beaches (Bonaire), E.O.N.N. = East of No Name (Klein Bonaire), Beach 25-17 = West of No Name (Klein Bonaire), Beaches 1-16 = West Klein Bonaire.

No.	Location	Se/Be	Date	Time	Act.	Spec.	TW	O/F	BP	Miscellaneous Remarks
1	Boca Catuna		20-jun	14:45	Cr.	?	0.75	F	0	
2	Chogogo		22-jun	23:00	Cr., Bp. & Ne.	Cc	?	F	1	Time is when the nest was made.
3	NN	-2	27-jun	10:00	Bp.	?	?	O	2	Could be a bodypit from 1994.
4	EONN	1	3-jul	9:30	Bp.	Cc	?	O	3	Could be a bodypit from 1994.
5	EONN	2	5-jul	AM	Bp. & Ne.	Cc	?	O	6	Nest was Found.
6	Nukove		11-jul	AM	Bp.	?	?	F	1	Nest was probably destroyed by fishermen.
7	NN	-1	17-jul	20:00	Bp. & Ne.	Cc	?	O	1	Date & time of excavation.
8	Nukove		19-jul	AM	Bp.	?	?	F	1	Storm destroyed beach (21-jul).
9	EONN	2	22-jul	10:15	Cr., Bp. & Ne.	?	1.1	F	1	Excavated 23- oct.
10	WKB	2	31-jul	9:37	Cr. & Bp.	Cc	0.95	F	1	
11	WKB	3	31-jul	10:05	Bp.	Cc	?	O	3	Crawl was hardly visible.
12	WKB	1	2-aug	9:30	Bp.	?	?	O	1	First time on WKB.
13	WKB	2	2-aug	9:40	Bp.	?	?	O	1	First time on WKB.
14	WKB	8	2-aug	10:00	Bp.	Ei	?	O	3	First time on WKB. Lots of coral in sand.
15	WKB	8	2-aug	10:00	Bp.	Ei	?	O	3	First time on WKB. Lots of coral in sand.
16	WKB	8	2-aug	10:00	Bp.	Ei	?	O	1	First time on WKB.
17	WKB	9	2-aug	10:10	Bp.	?	?	O	4	First time on WKB.
18	WKB	13	9-aug	9:30	Cr. & Bp.	Cc	1.1	F	1	Lots of coral in the sand.
19	WKB	8	9-aug	10:15	Cr.	Ei	1	F	0	Remarkably no crawl back.
20	WKB	8	16-aug	9:40	Cr. & Bp.	Ei	?	F	3	Crawl was hardly visible.
21	WKB	8	16-aug	9:40	Cr., Bp. & Ne.	Ei	1.05	F	1	First Ei nest. Excavated 12-oct.
22	WKB	3	16-aug	10:05	Cr. & Bp.	?	0.85	F	1	Crawl on top of old bodypit.
23	WONN	23	17-aug	10:46	Cr. & Bp.	Ei	0.85	O	3	About 2-3 weeks old when found.
24	WONN	21	17-aug	11:00	Cr. & Bp.	Ei	?	O	2	Lots of coral in the sand.
25	WONN	21	17-aug	11:00	Cr. & Bp.	Ei	?	O	2	Lots of coral in the sand.
26	WONN	21	17-aug	11:00	Cr. & Bp.	Ei	?	O	3	Lots of coral in the sand.
27	WONN	19	17-aug	11:15	Bp.	Ei	?	O	2	Bp. under bush.
28	WKB	13	30-aug	9:45	Cr.	?	0.85	F	0	Only crawl found.
29	WKB	8	30-aug	10:00	Cr. & Bp.	Ei	0.8	F	3	Lots of coral in sand.
30	WONN	18/19	31-aug	11:00	Bp.	Ei	?	O	1	Bp. on coral in between beach # 18 & 19.
31	WKB	8	31-aug	11:30	Cr. & Bp.	Ei	0.8	F	2	Lots of coral in the sand.
32	WONN	23	2-sep	10:44	Cr. & Bp.	Ei	0.8	F	1	Part of this beach was washed away.
33	WONN	23	2-sep	10:50	Cr. & Bp.	Ei	0.9	F	2	Part of this beach was washed away.
34	NN	-2	8-sep	10:30	Cr., Bp. & Ne.	Ei	0.8	F	2	Crawl 45 ft into the hind lands.
35	Playa Chikitu		23-sep	10:15	Cr., Bp. & Ne.	?	0.9	F	2	None of the eggs hatched.
36	NN	-2	23-sep	10:30	Cr. & Ne	Ei	0.8	F	0	Very close to nesting attempt 34.
37	WKB	2	27-sep	9:45	Cr., Bp. & Ne.	Cc	0.73	F	2	May have been the same turtle as in # 36.
38	WKB	9	4-okt	10:15	Cr., Bp. & Ne.	Cc	0.85	F	3	Eggs did not hatch.
39	NN	-2	7-okt	11:20	Ne.	Ei	?	O	?	Hardly visible crawl under a bush.
40	WKB	9	18-okt	9:19	Cr., Bp. & Ne.	Cc	0.75	F	2	Overlap with # 38.
41	WKB	9	1-nov	10:00	Cr. & Bp.	Cc	0.8	F	1	Could be the same turtle as # 38 & 40.
42	NN	-2	7-nov	9:50	Cr. & Bp.	Ei	?	O	1	Crawl & bodypit about 1 week old.
43	NN	-2	7-nov	10:00	Cr. & Bp.	Ei	0.85	O	2	Cr. & Bp. about 1 week old.
44	WKB	7	15-nov	10:00	Cr. & Bp.	Ei	0.8	O	5	Tracks difficult to see because of rain.

Table 2. Sea turtle crawls documented between 15 June and 17 December in Bonaire, Netherlands Antilles. No= number of observation and corresponding datasheet; Se/Be= which sector or beach; Date= survey date (typically 1-2 days after nesting); Time= time of the observation; Act= activity (Cr= crawl, Bp= bodypit and Ne= nest); Spec= species (based largely on hatchling/embryo identification and crawl characteristics), bold is trustworthy, not bold is uncertain; TW= track width (m); O/F= age of crawl and/or bodypit(s): 'old' (>2 days) or 'fresh' (<2 days); BP= number of bodypits at the site. NN= No Name beach (divided in sectors 0 to 2), EONN= East of No Name (divided in sectors -1 to -5), WONN= West of No Name (beaches 25 to 17), WKB= West Klein Bonaire (beaches 16 to 1).

No.	Date	Excav.	EIT	Location	Und.	Mid.	Full.	Dead	Shells	Total	H%	S%	Spec.	Potential Corrections
1	3 Jun.	15 Aug.	54	Chogogo	5	1	3	2	149	158	94	93	Cc	Necessary, not applicable
2	5 Jul.	10 Aug.		EONN (sect.2)	8	0	50	4	80	138	58	55	Cc	None
3	17 Jul.	17 Jul.		NN (sect.-1)	7	0	80	5	62	149	42	38	Cc	15 hatchlings, S%=28
4	22 Jul.	25 Oct.		EONN (sect.2)	10	0	2	0	100	112	89	89	Un.	Not applicable
5	16 Aug.	12 Oct	55	WKB 8	6	9	1	3	117	133	88	86	Ei	15 hatchlings, S%=74
6	8 Sep.	8 Nov.		NN (sect.-2)	11	3	22	3	127	166	77	75	Ei	None
7	23 Sep.	25 Nov.		Playa Chikitu	77	0	0	0	0	77	0	0	Un.	None
8	23 Sep.	13 Dec.	61	NN (sect.-2)	12	5	15	1	113	146	77	77	Ei	None
9	27 Sep.	15 Nov.	51	WKB 2	51	1	1	1	102	155	66	65	Cc	None
10	4 Oct.	6 Dec.		WKB 9	47	47	18	0	0	112	0	0	Cc	None
11	7 Oct	13 Dec.	61	NN (sect.-2)	15	8	5	0	118	146	81	81	Ei	None
12	18 Oct	13 Dec.		WKB 9	142	12	3	0	0	157	0	0	Cc	None

Table 3. Sea turtle nest contents verified by post-hatch excavation. Date = survey date; Excav.= excavation date; EIT= Estimated Incubation Time (days); Loc.= location of the nest site.

Nest contents were recorded as: Und.= number of undeveloped eggs; Mid.= number of mid-term embryos; Full.= number of fullterm embryos; Dead= number of dead and pipped dead hatchlings; Shells= estimated number of hatched shells; Total= estimated total number of eggs; H%= estimated percentage of hatch success; S%= estimated percentage emergence from sand. Cc= loggerhead (*Caretta caretta*); Ei= hawksbill (*Eretmochelys imbricata*); Un= unknown. Hatchling in potential corrections= estimated number of hatchlings spread and dug out.

Location	Date	Species	Comments
Karpata	14-Dec-95	Ei	most of right front flipper gone
Small Wall	20-Sept-95	Ei	incision in flipper
La Machaca	18-Sept-95	Ei	healed bite mark on right flipper
Buddy Reef	27-Oct-95	Ei	bite mark on right hind flipper
Salt Pier	29-June-95	Cc	left hind flipper missing
Salt City	27-June-95	Cc	left hind flipper missing
Salt City	11-Aug-95	Cc	left hind flipper missing
Tori's Reef	6-Dec-95	Cm	upper carapace cracked lengthwise
Red Beryl	24-Nov-95	Un	missing piece of left hind flipper
Atlantis	3-Dec-95	Ei	missing right hind flipper
Bon Adv.	30-July-95	Ei	old injury on carapace

Table 4. Comments made regarding sightings of eleven injured turtles in Bonaire, 1995. Sightings ordered per location number. Ei= hawksbill (*Eretmochelys imbricata*), Cm= green turtle (*Chelonia mydas*), Cc= loggerhead (*Caretta caretta*), Un= unknown.

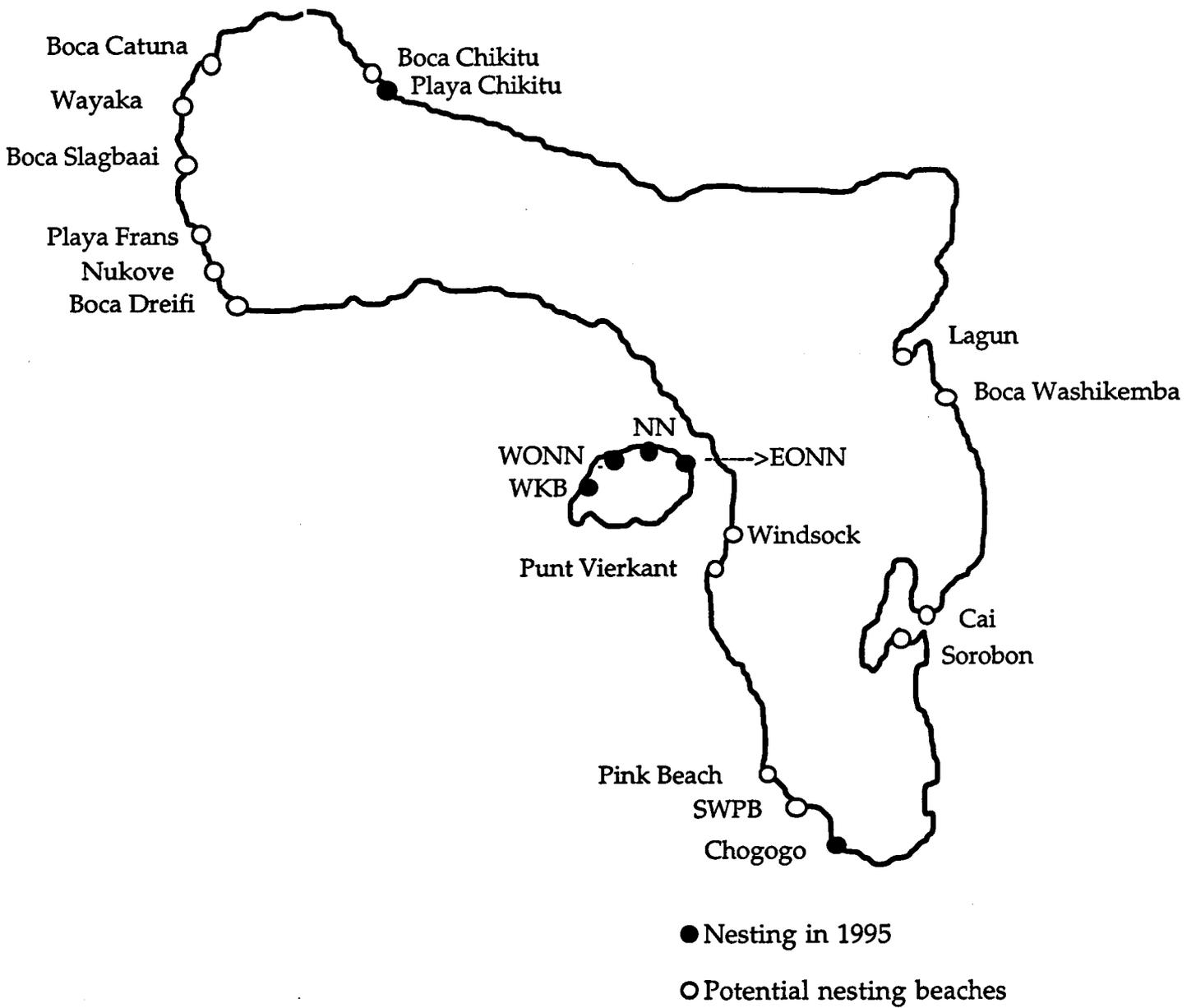
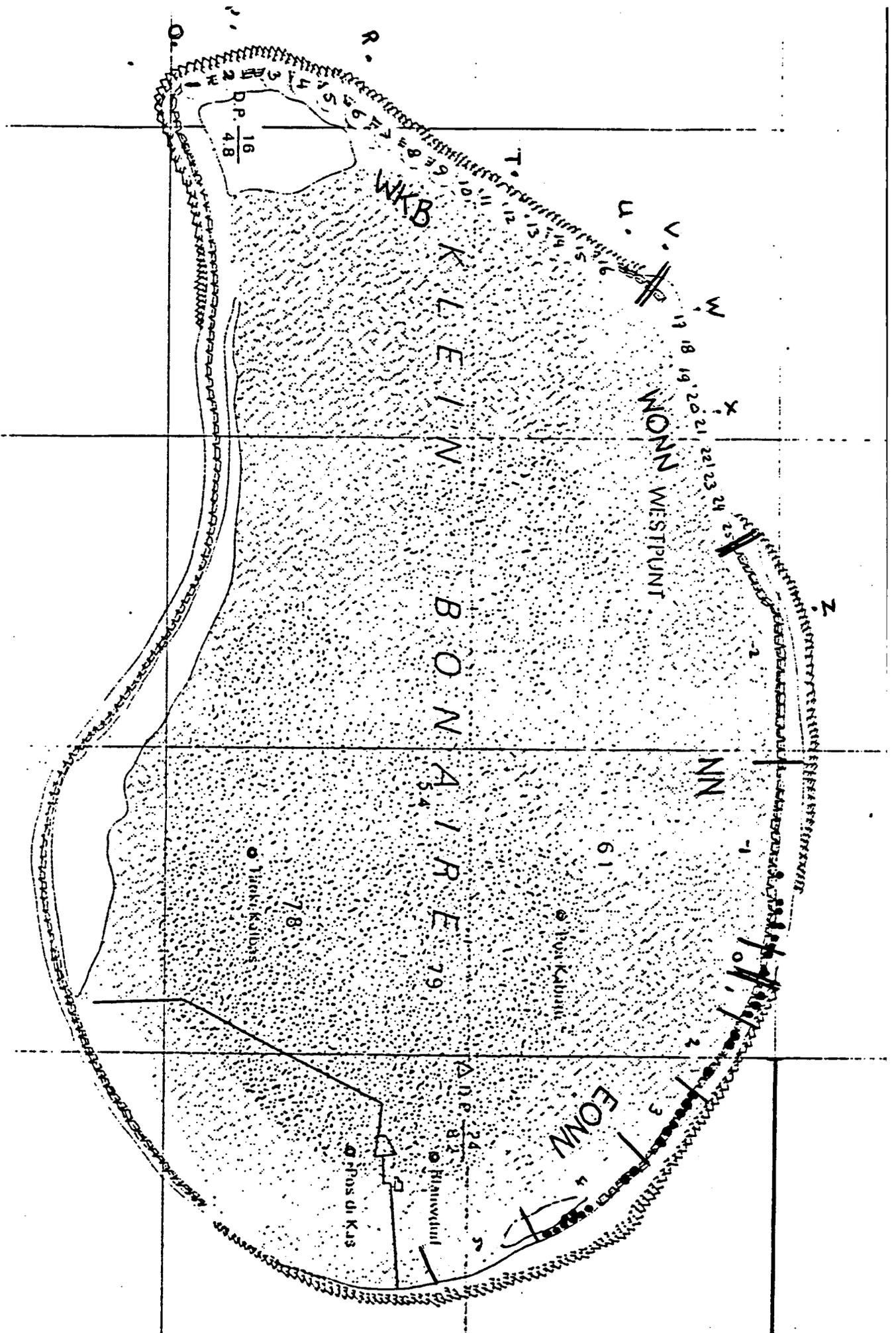


Figure 1. Potential sea turtle nesting beaches on Bonaire (Netherlands Antilles). WKB= West Klein Bonaire, WONN= West of No Name, NN= No Name, EONN= East of No Name, SWPB= South West Pocket Beaches.

Figure 2. Potential sea turtle nesting beaches on Klein Bonaire. WKB= West Klein Bonaire, beaches 1 to 16; WONN= West of No Name, beaches 17 to 25; NN= No Name beach, sectors 2 to 0; EONN= East of No Name, sectors 1 to 5.



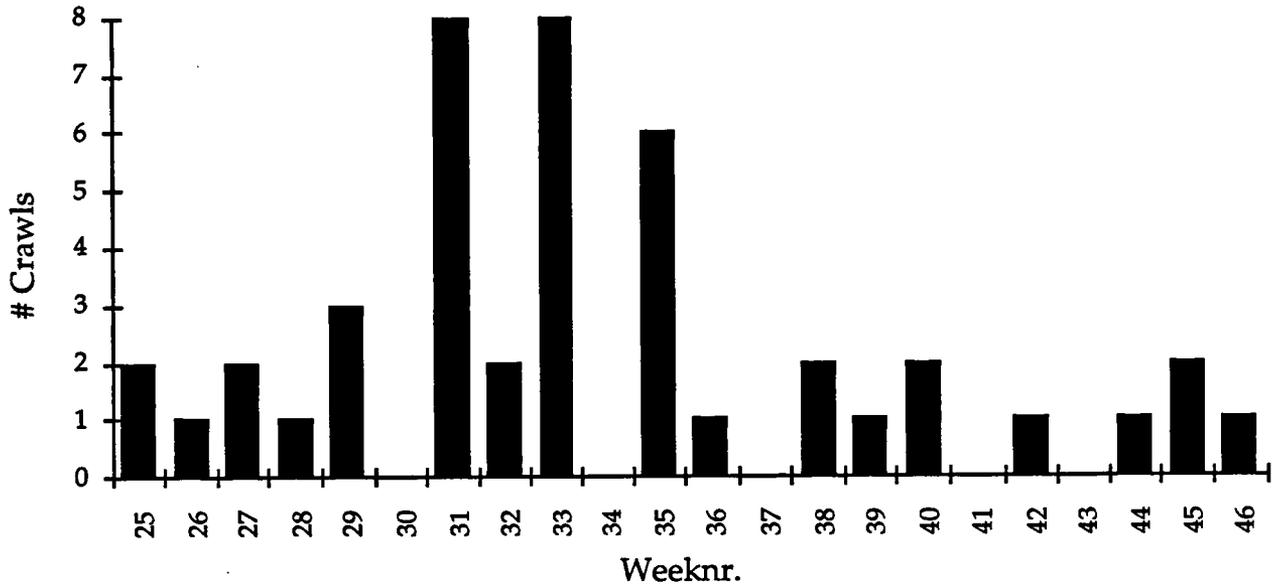


Figure 3. Temporal distribution of sea turtle crawls (n=44) in Bonaire, Netherlands Antilles, in 1995. Weeknumber refers to the week in which the crawl was documented.

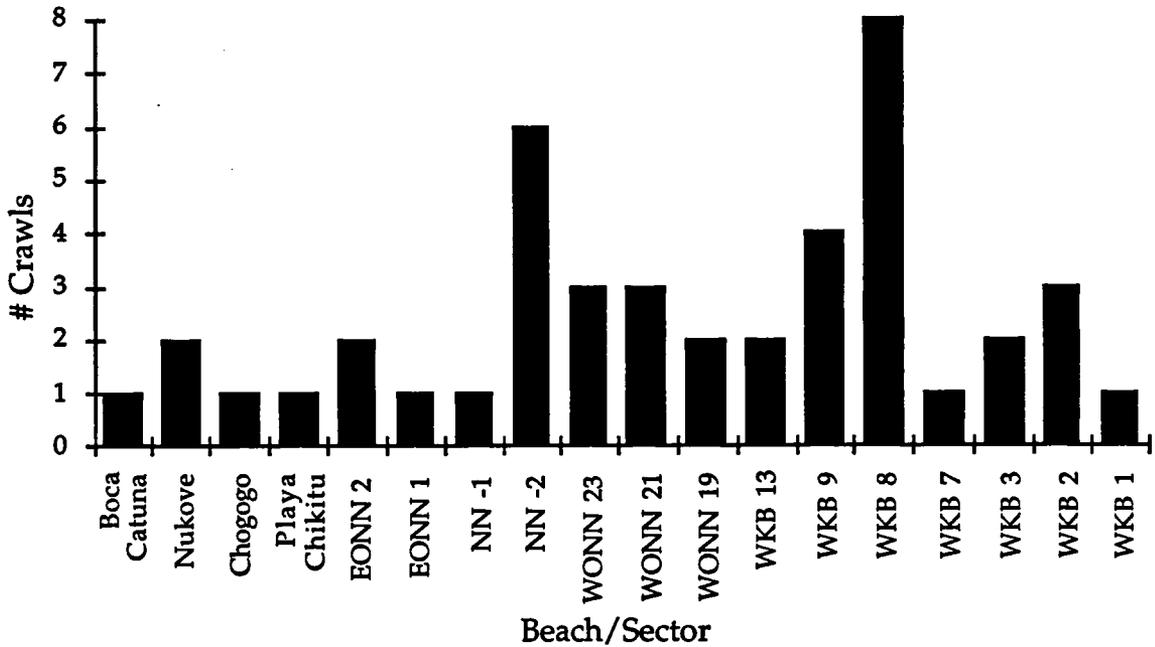


Figure 4. Spatial distribution of sea turtle crawls (n=44) in 1995 on Bonaire and Klein Bonaire. EONN= East of No Name (Klein Bonaire), NN= No Name (Klein Bonaire), WONN= West of No Name (Klein Bonaire), WKB= West Klein Bonaire. See Figure 1 for locations.

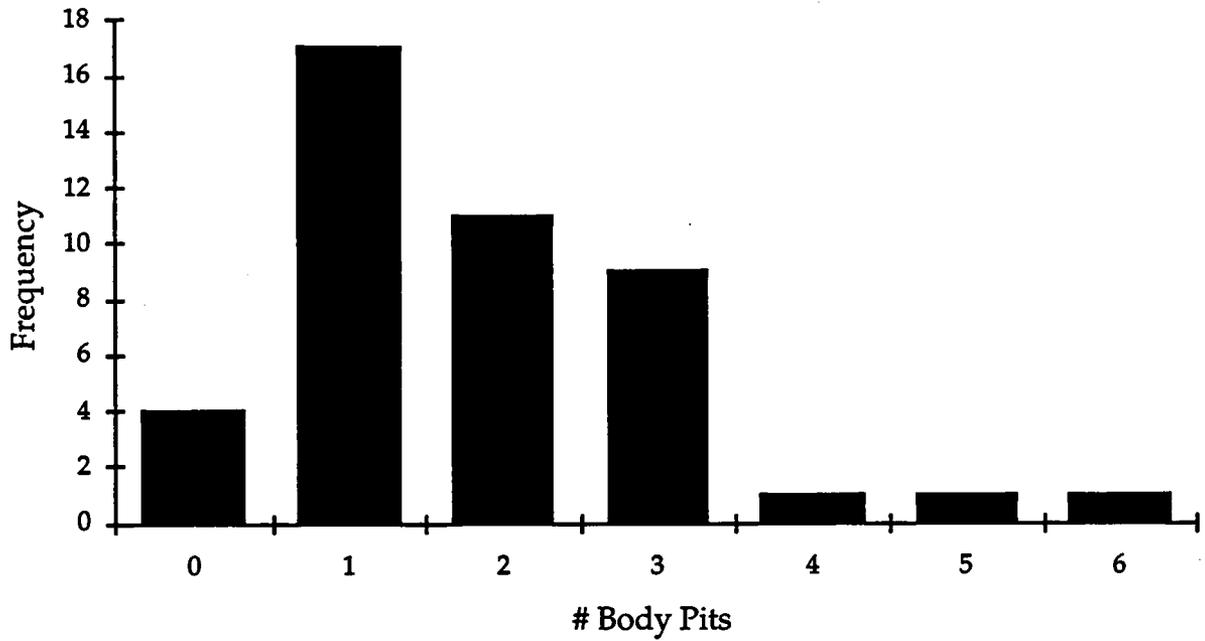


Figure 5. Frequency distribution of bodypits per attempt (n=44).

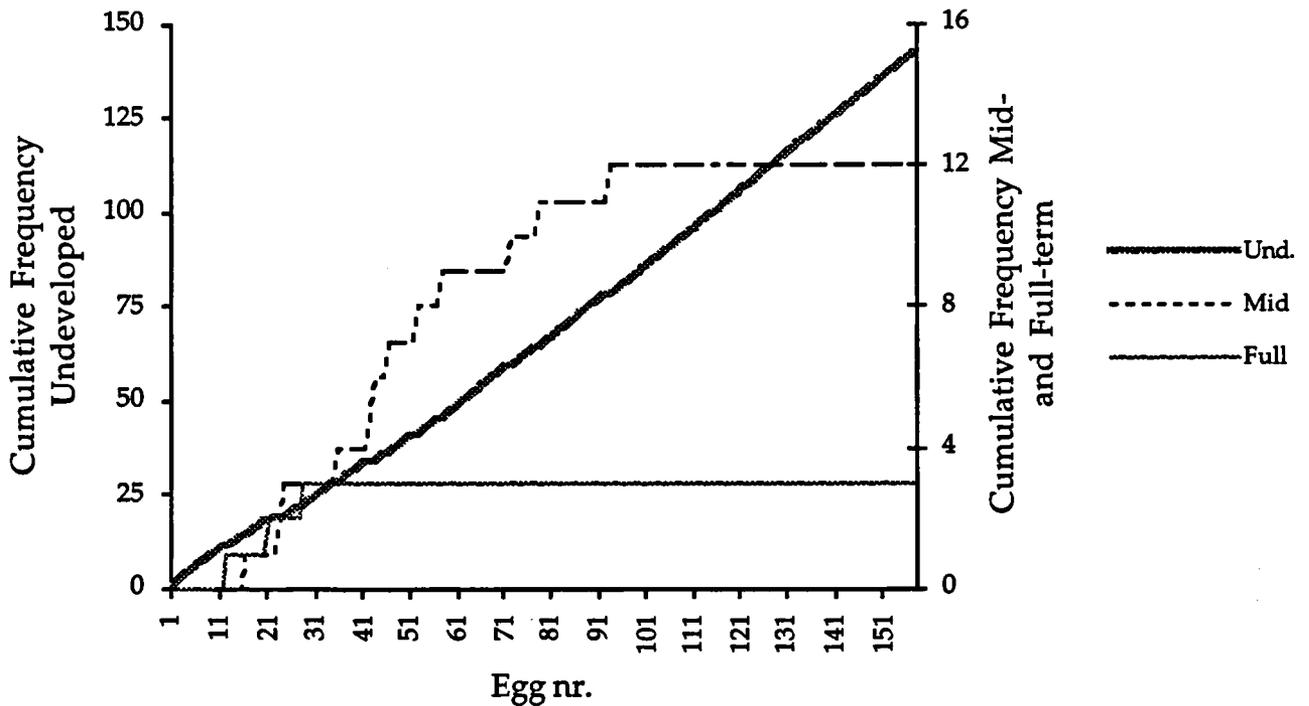


Figure 6. Distribution of the embryonic stadia after excavation of an unhatched nest (nr. 40) on Beach 9 in West Klein Bonaire. The eggs (n=157) were inspected one at a time, going downwards in the nest. This resulted in the documentation of the vertical distribution of the undeveloped embryos, the midterm embryos (small, without blood), and the fullterm embryos (large, with blood) in the nest.

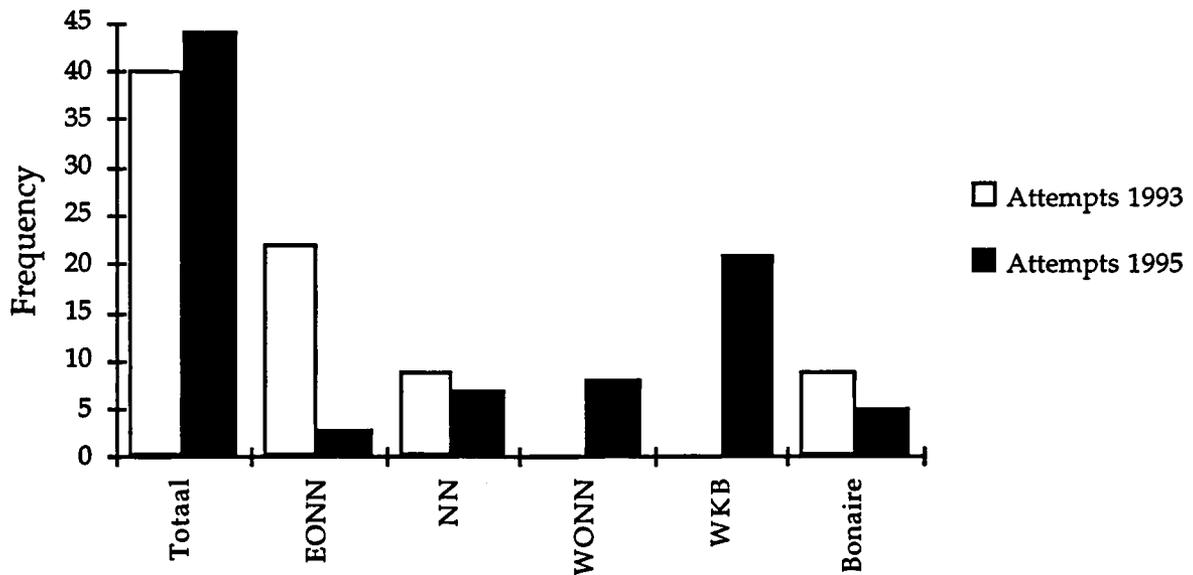


Figure 7. Spatial distribution of sea turtle crawls (n=40) in 1993 on Bonaire and Klein Bonaire, compared to the spatial distribution as recorded in 1995 (n=44). EONN= East of No Name (Klein Bonaire), NN= No Name (Klein Bonaire), WONN= West of No Name (Klein Bonaire), WKB= West Klein Bonaire.

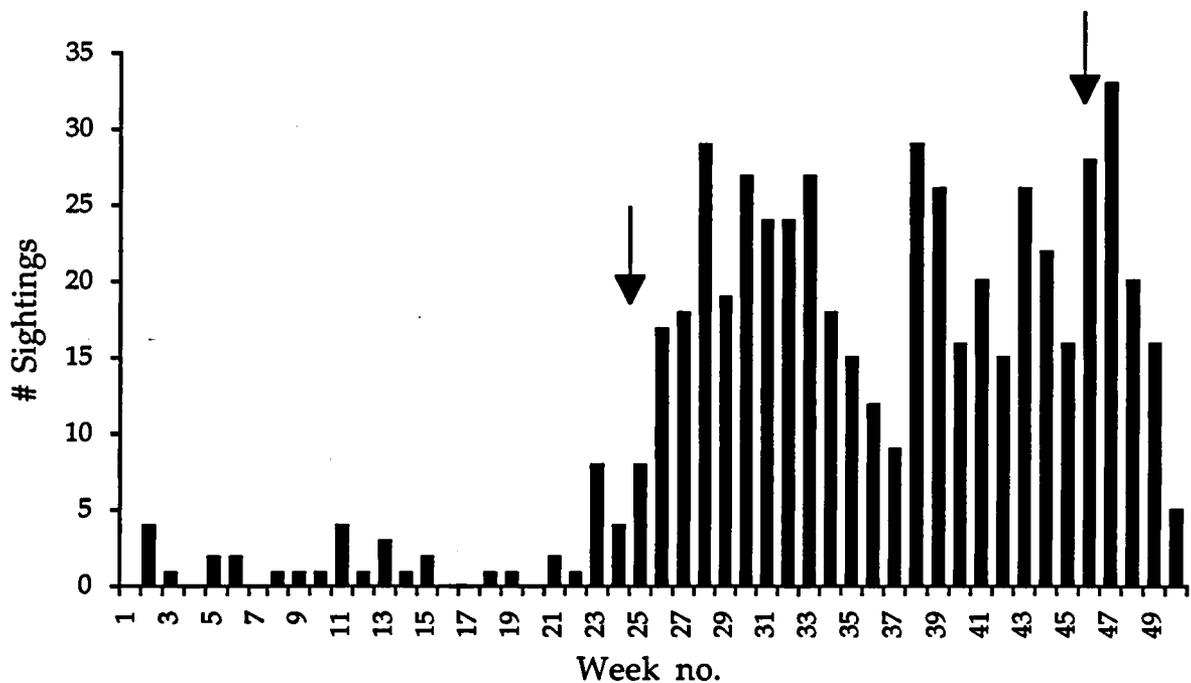


Figure 8. Number of sightings per week (n=583) from 9 January-14 December 1995, Bonaire. The arrows depict the start of the awareness campaign in week 25, and the introduction of turtle corner in week 46. Sighting network data.

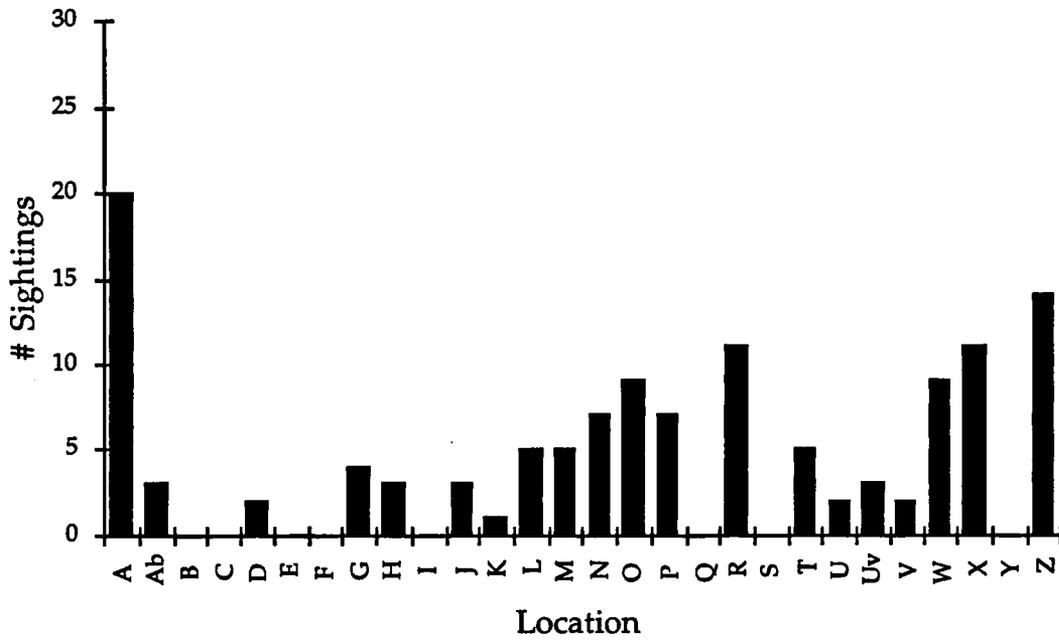


Figure 9. Spatial distribution of sightings (n=138) in 1995 in the waters of Klein Bonaire. See Figure 11 for dive locations. Sighting network data.

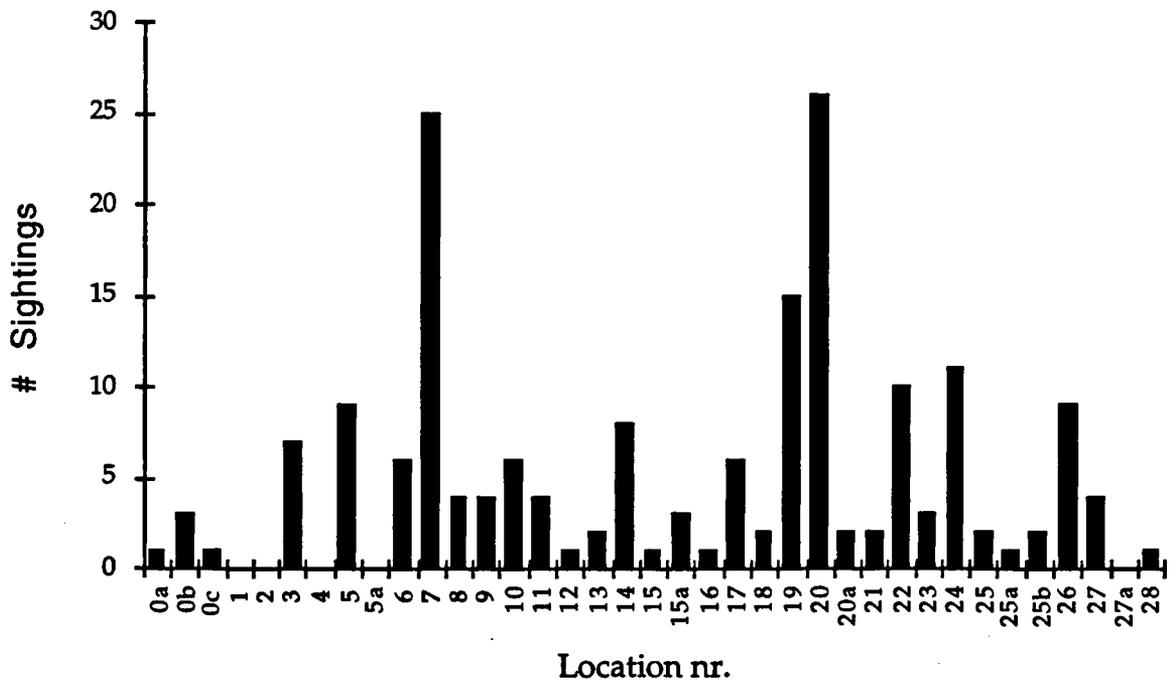


Figure 10 a. Spatial distribution of sightings (n=185) in 1995 the waters of Bonaire (dive location nrs. <29). See Figure 11 for dive locations. Sighting network data.

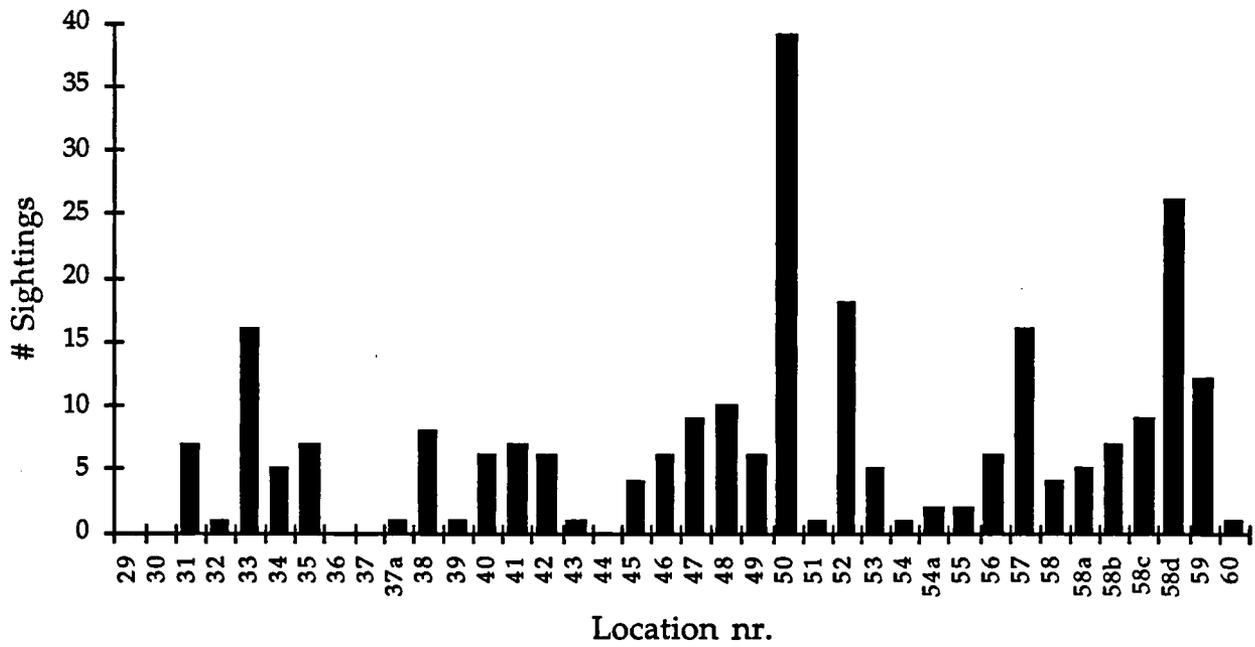


Figure 10 b. Spatial distribution of sightings (n=260) in 1995 the waters of Bonaire (dive location nrs.>28). See Figure 11 for dive locations. Sighting network data.

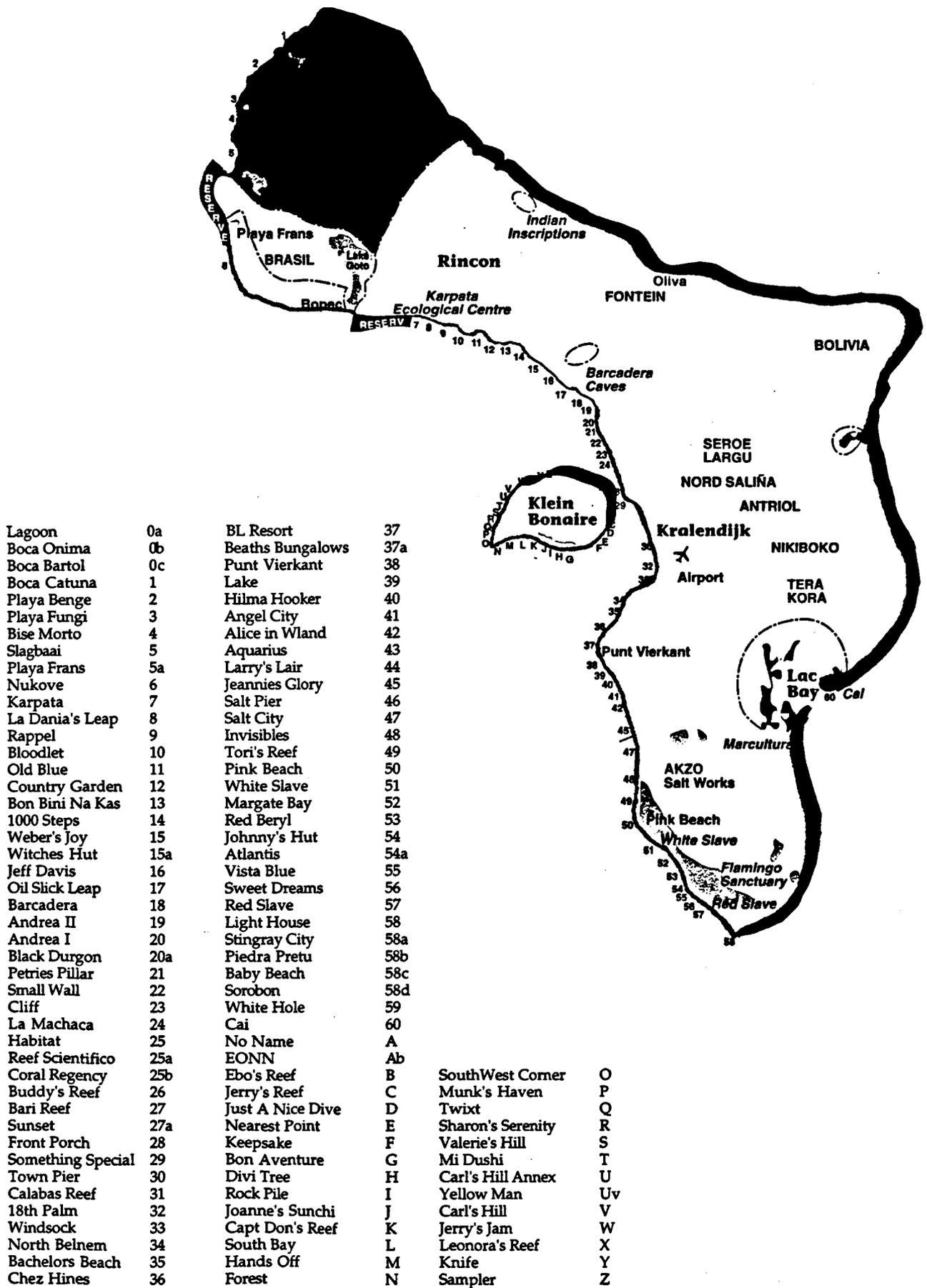


Figure 11. Dive locations in the Bonaire Marine Park (source: Bonaire Marine Park Guide). The location numbers with an additional letter present unregistered dive sites.

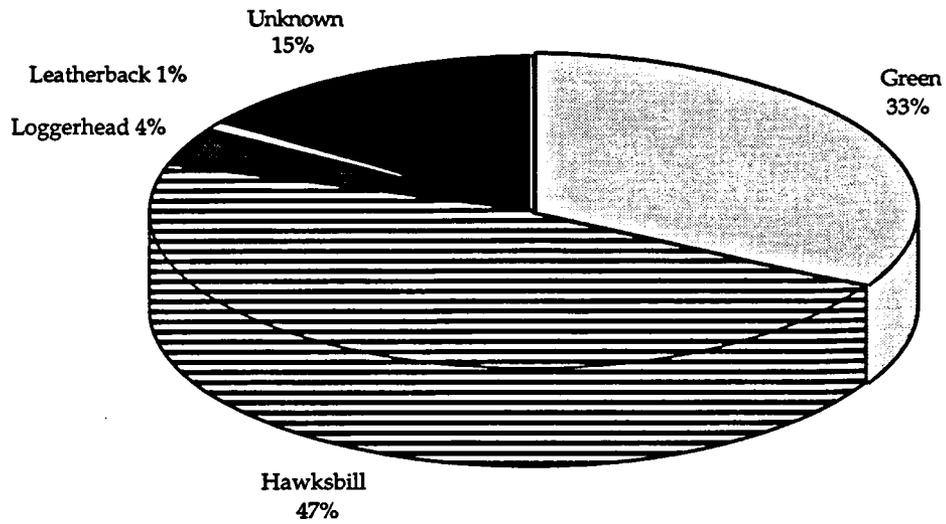


Figure 12. Species distribution of sea turtles sighted in 1995 (n=583). Sighting network data.

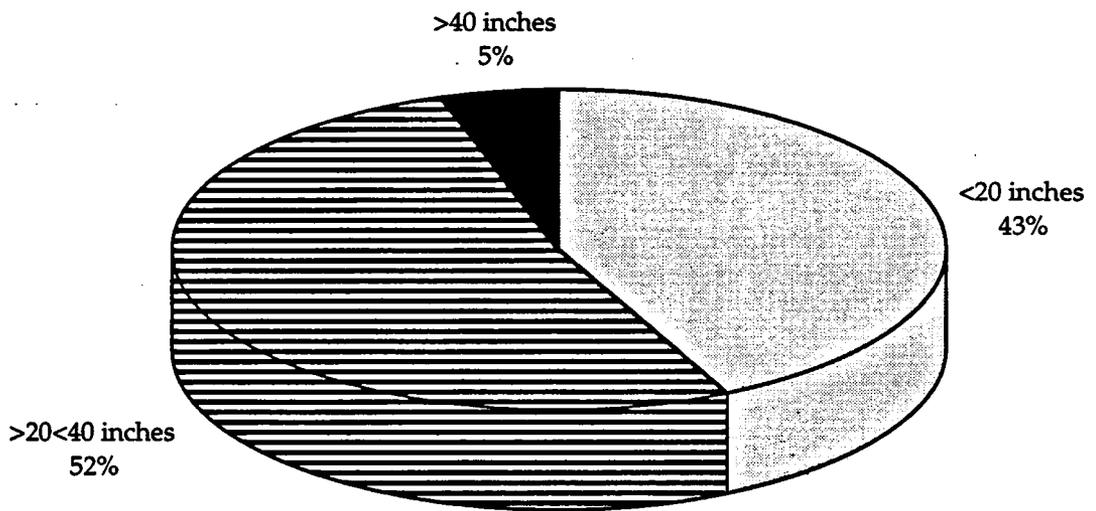


Figure 13. Size distribution of sea turtles sighted in 1995 (n=583). Sighting network data.

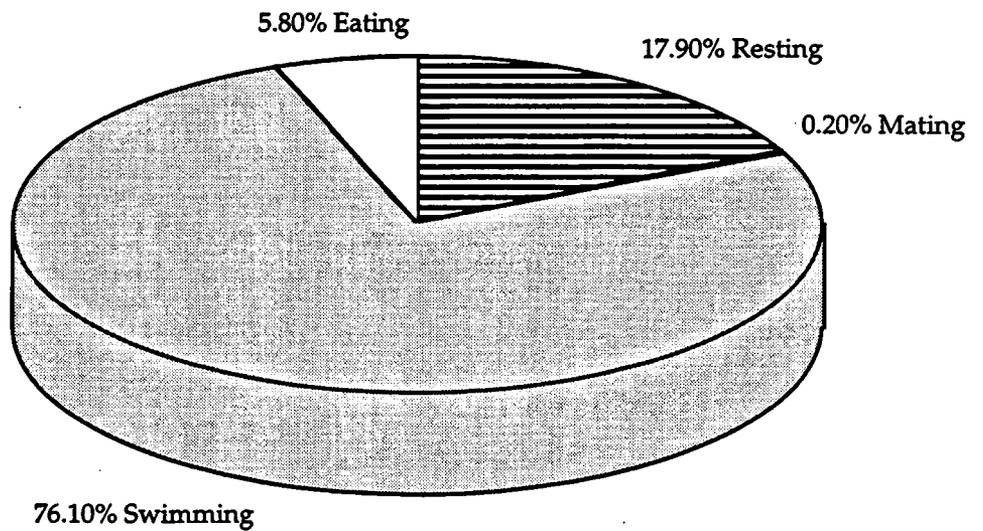


Figure 14. Activity distribution of sea turtles sighted in 1995 (n=583). Sighting network data.

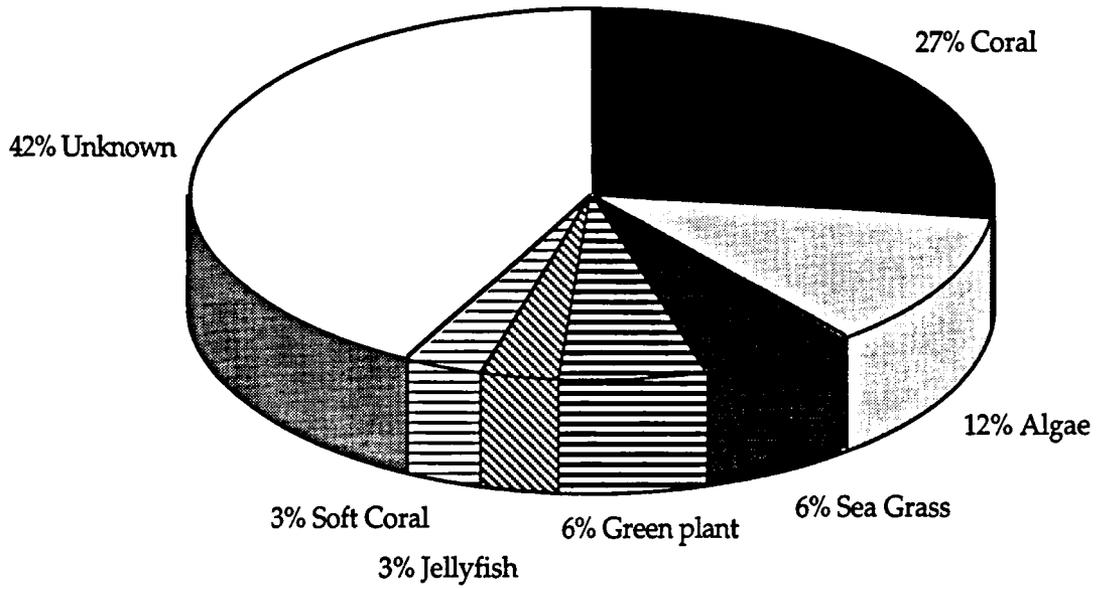


Figure 15. Food type distribution of foraging sea turtles sighted in 1995 (n=38). Sighting network data.

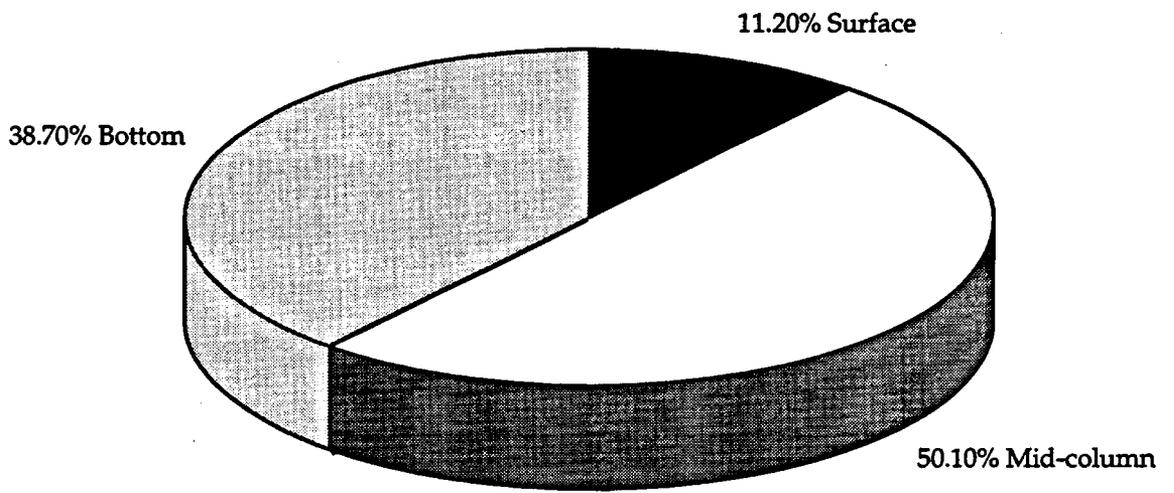


Figure 16. Depth class distribution of sea turtles sighted in 1995 (n=583). Sighting network data.



Figure 17. Environment distribution of sea turtles sighted in 1995 (n=583). Sighting network data.

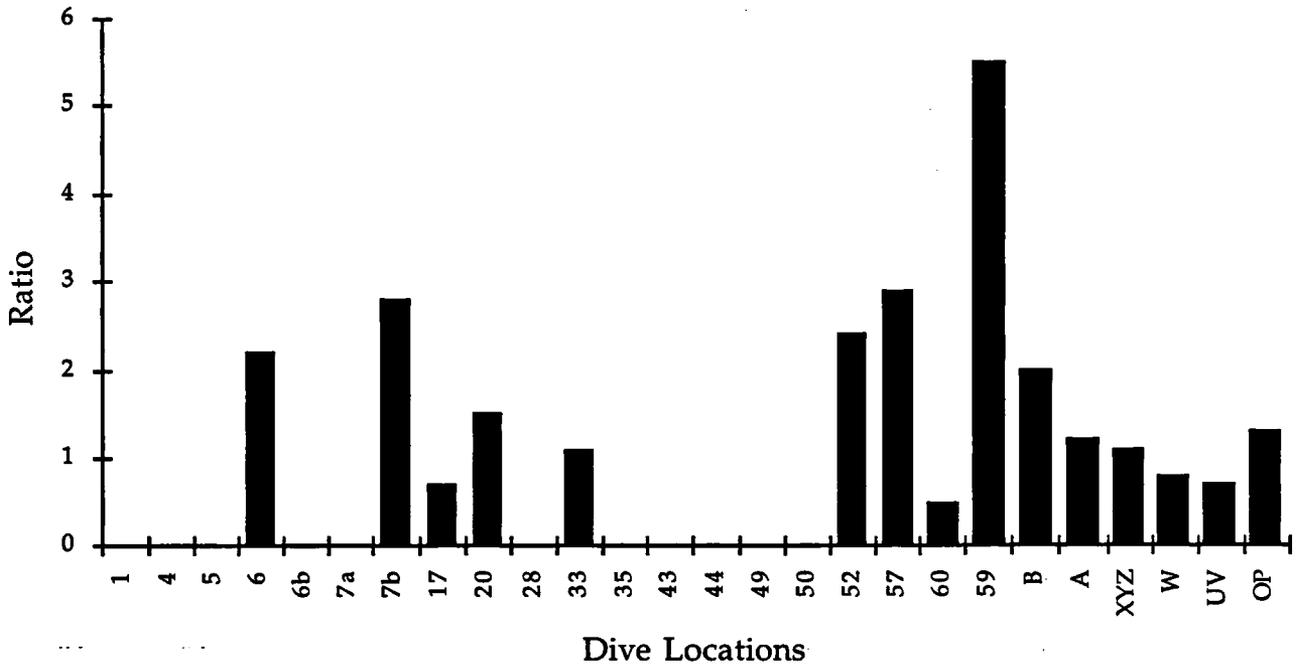


Figure 18. Relative distribution of sightings (n=77) at locations visited during STCB snorkel surveys, 17 June-7 December 1995. See Figure 11 for dive locations. The joint dive locations, e.g. XYZ, present snorkel surveys, which have been performed past these locations.

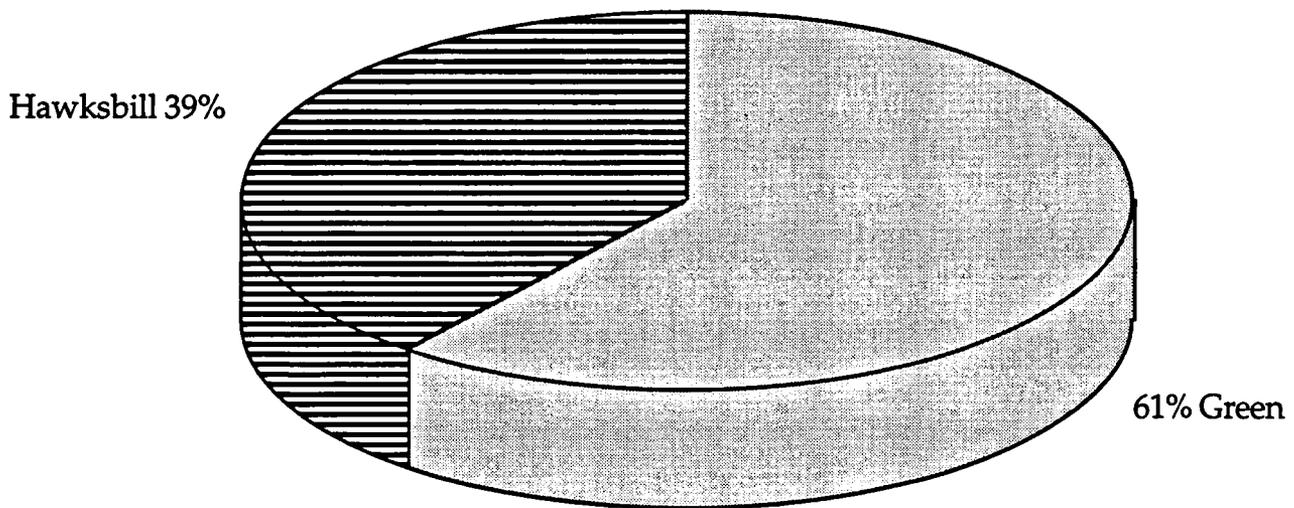


Figure 19. Species distribution of sea turtles sighted during snorkel surveys (n=77).

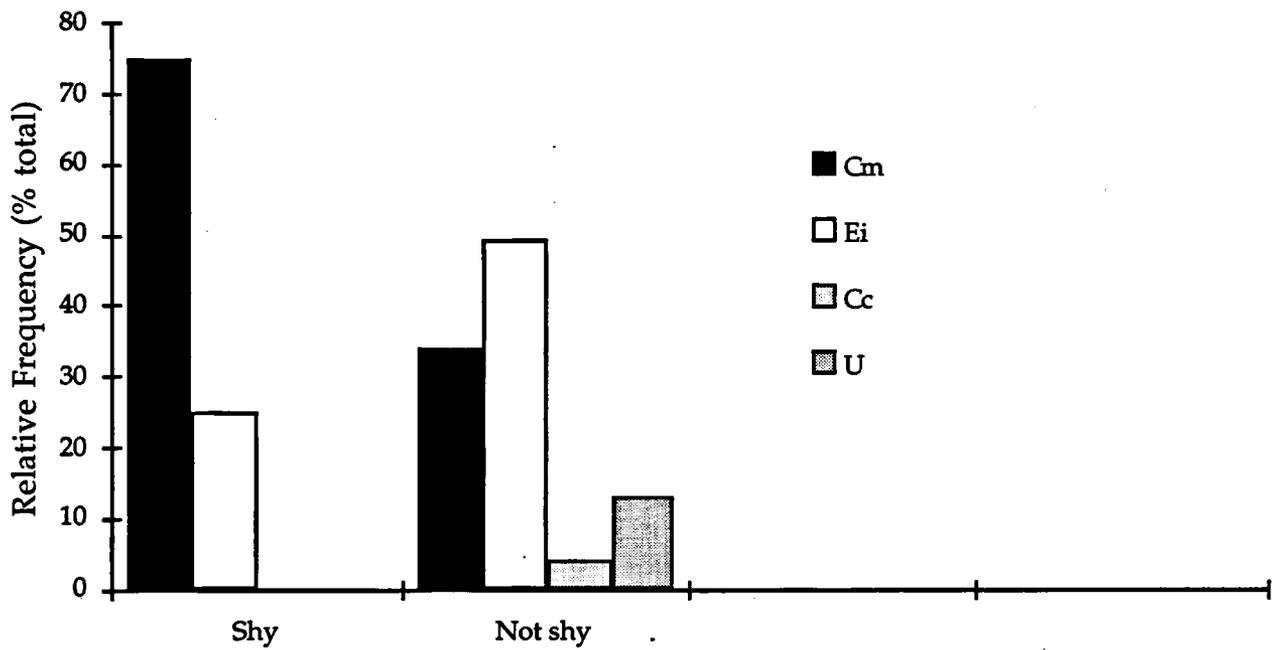


Figure 20. The 'shyness' related to the species of sighted sea turtles recorded through the sighting network in 1995.

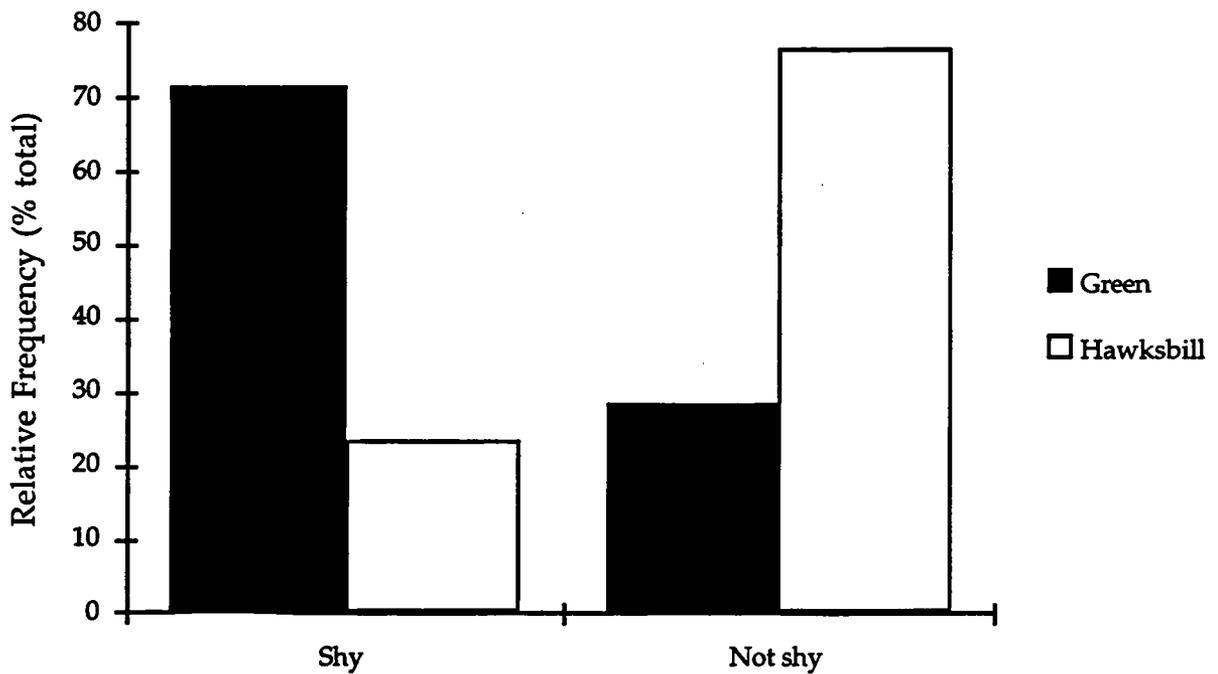


Figure 21. The 'shyness' related to the species of sighted sea turtles during the snorkel surveys in 1995.

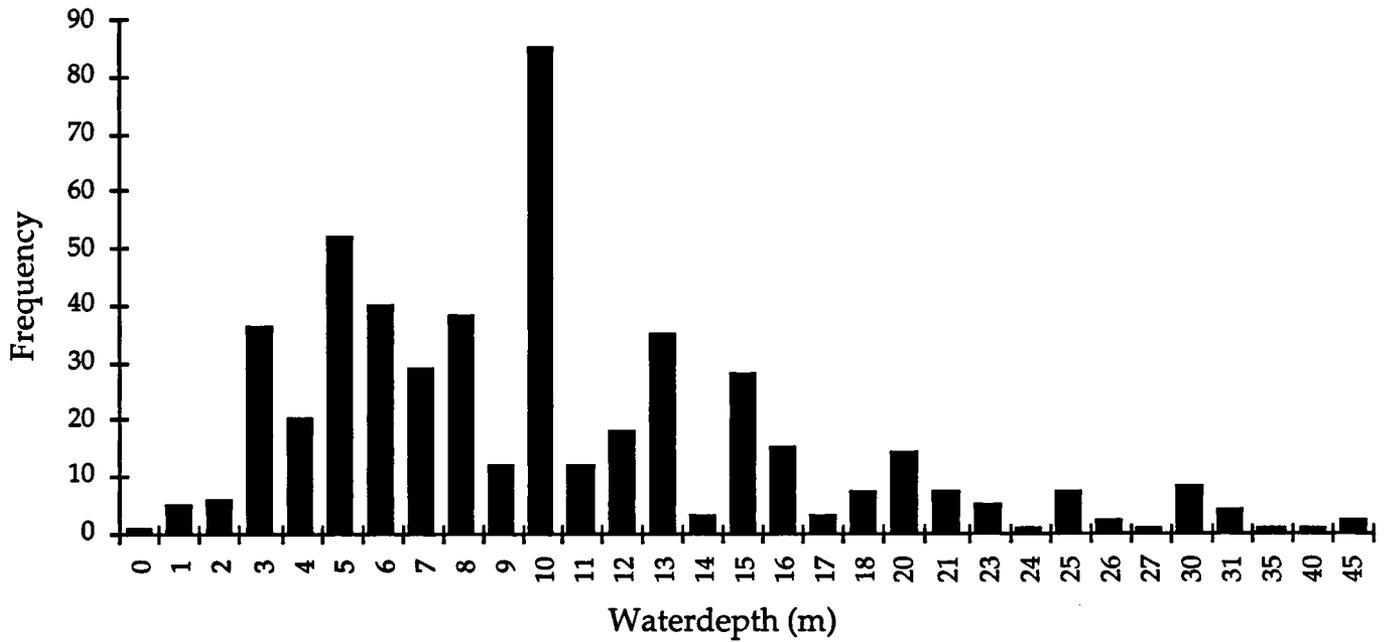


Figure 22. Depth distribution of sea turtles sighted in 1995 (n=583). Sighting network data.

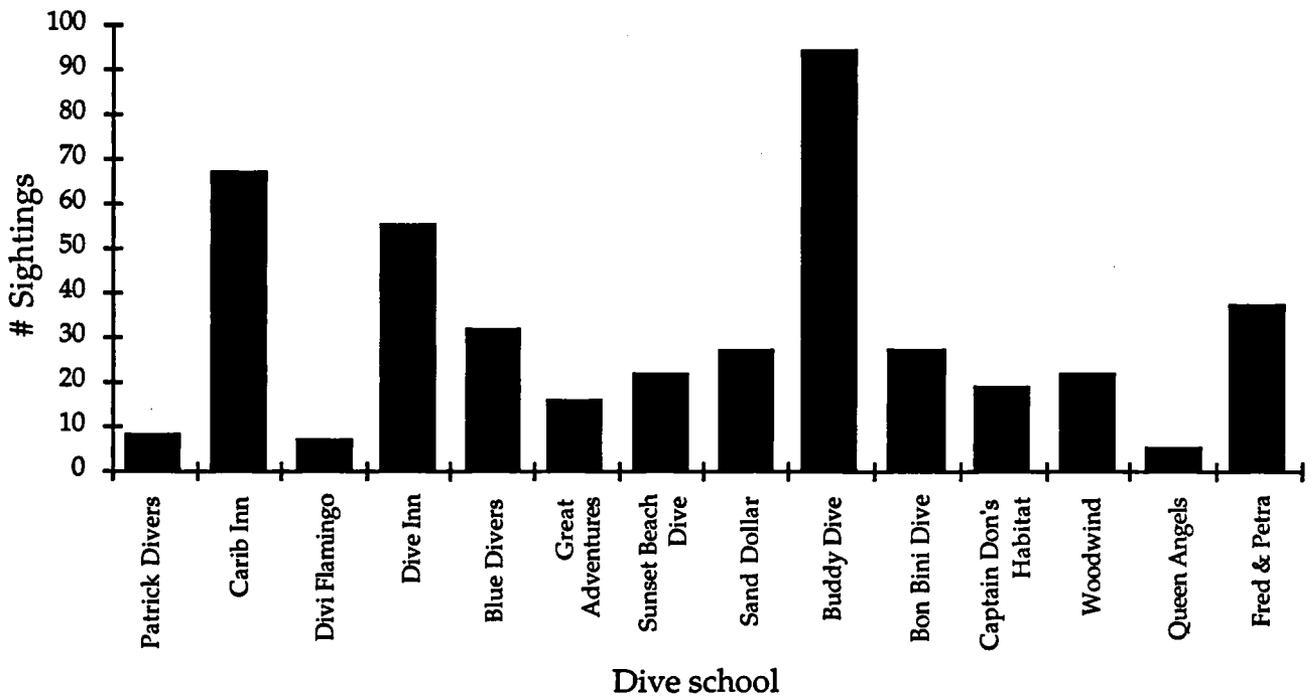


Figure 23. Number of sightings (n=583) per network participant from 9 January-4 December, 1995.

APPENDIX I

Bonaire Marine Environment Ordinance, as amended in 1991

On 27 June 1991, the Island Council of Bonaire amended the Marine Environment Ordinance (A.B. 1984, no. 21) to include the total protection of all sea turtle species. Article 14 reads:

1. It is prohibited to disturb or destroy sea turtle nests or to remove eggs from the nests; it is prohibited to be in possession of, to have for sale or delivery, to offer for sale, to sell, to buy, to trade in, to donate or to transport eggs of sea turtles.
2. It is prohibited to kill, catch or be in possession of sea turtles.
3. It is prohibited to offer for sale, sell, buy, trade in, donate, or offer as a dish in any way in public, sea turtles, sea turtle meat or other products of sea turtles.
4. Sea turtles are understood to comprise the following species: Chelonia mydas (tortuga blanku), Caretta caretta (kawama), Eretmochelys imbricata (karet), Dermochelys coriacea (drikil), and Lepidochelys kempfi.
5. The prohibition as meant in paragraph 2 can be suspended for periods of up to one year (renewable as necessary), after a hearing by the Marine Environment Commission and provided that the condition of the sea turtle population permits such a measure. This action would be administered through an Executive Council decree, which would provide regulations for the catch of sea turtles, the species, the season, quota, and minimum and maximum sizes.

The penalty for convicted violators is a maximum of NAfl. 5000,- and/or one month in jail; relevant equipment (spear gun, car, boat) can be confiscated.

APPENDIX II

Work plan

- I Objectives of the project:**
- 1/ to gather knowledge about the biology of the sea turtles of Bonaire by scientific research and data collection;
 - 2/ to increase awareness about the endangered status of the sea turtles of Bonaire by means of environmental education to locals and visitors.

II Activities

II A Research

- Continuously - Beach surveys: all significant beaches twice a week and Klein Bonaire four times a week
- Snorkel surveys: index sites/non-index sites six times a week, including underwater photography;
- Divers network: dive shop tour once a week, turtle posters and folders, "turtle corners", distribution of information via newsletter;
- August - Inventory nesting activity 1993 - 1994
- September - Meetings with fishermen
- Continuously - Data input, updating log, reporting to Bak/Van Eijck/De Soet/Hensen
- August - Setting up volunteer network for surveys
- Continuously - Gather slide, photo and video material
- Sept/Oct - Making of a pre-compilation of the video material

II B Publicity

- August - Turtle corners dive shops
- Poster sales
- Continuously - Media updates
- Slide shows Habitat
- Sept/Nov - Big presentations Flamingo, Sunset
- September - Development of folder
- Aug/Oct/Dec - Newsletter, twice to three times
- August - Booklet "Nos mundu" Boy Antoin
- October - Radio, television
- December - Presentation video Stinapa Curaçao to teachers.

II C Cooperation

- Aug/Sept - Turtle corners dive shops
- Continuously - Tortuganan di Boneiru with BMP
- Visit Klein Bonaire with Sunset, BMP, Habitat and Woodwind;
- October - Updating Curaçao (be careful!), Aruba, if necessary via newsletter (mailing via Bonaire Trading ?)
- November - Searching for sponsor possibilities

- September - Filing the subsidy requests: Everything not mentioned in project proposal
- August - Rangers Washington Park: turtle presentation
 - Consult with the school boards (swimming lessons ?)
 - Cooperation SEF

III Schedule

Afternoon	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	Habitat "slide show"				Tortuganar di Bonaire	Dive shop tour
	Meeting Org. Act.			Data processing log	Correspondence	Dive survey
Morning	Klein Bonaire Sunset	Snorkel survey	Klein Bonaire BMP	Klein Bonaire Woodwind	Snorkel survey	Klein Bonaire Habitat
	Survey South	Survey North	Survey SWP P.V., Lagun	Survey Dreifi Nuk. Frans	Survey SWP, P.V. Lagun	Survey North

VI Planning

August

- * Inventory nestings 1993 - 1994
- * Voluntary work: presentation script
- * Turtle corners (dive shops)
- * Poster sales (dive shops, shops)
- * Newsletter Δ all logo's ! (update on sponsors (WNF and NPL),
- * cleanup with TBL, Tortuganan di Boneiru
- * Distribution of booklet (Boy Antoin) Δ receipt !!
- * Clean up met TBL
- * Presentation rangers Washington park and Bonaire Marine Park
- * 50 STCB posters (40 English plus 10 Papiamentu to Karen Eckert ?)

September

- * Making of pre-compilation video and slide material (edit possibility?)
- * Interviews with fishermen (via Max, Marjolein)
- * Presentation video material (see October; prepare)
- * Folder development (Tom, Larry)
- * Organisation/coordination cleanup (TBL, Corine Gerharts)
- * Writing subsidy requests (in cooperation with Tom)
- * School presentation video & package distribution (in cooperation with Anneke Oliehoek, Ramona Orman)
- * Reef identification charts/snorkel equipment (BMP)
- * Order "Buyer beware"-folders (US embassy Venezuela)
- * Sea Turtle Poster of Widecast (order: 20 pieces via Karen Eckert)

October

- * Video material 1993 up to now o.k.
- * Newsletter updates Curacao, Aruba and Venezuela
- * Television: video presentation
- * Regatta
- * Folder distribution
- * T-shirt development
- * Preparation fundraising dinner (Corine, Albert)
- * Presentation (Flamingo, with video)
- * Subsidy request congress (sea turtle symposium 1996)
- * Turtle signs plan

November

- * Working visit Curacao/Aruba Δ invitations ?
- * Fundraising dinner
- * Find sponsors
- * Final presentation Sunset end of November/December
- * Guarantee continuity (low profile)
- * Distribute video STINAPA Curaçao
- * Preparation interim reporting WNF and ST. DOEN and other subsidy providers (2nd newsletter)

Standard activities Δ Plan in weekly schedule !!!

- * Beach surveys (every day)
- * Snorkel surveys (every day)
- * Divers network (weekly)
- * Data-input (weekly)
- * Log (daily)
- * Reports (monthly)
- * Video material (collect)
- * Slide- and photo material (collect)
- * Media updates (monthly)
- * Habitat slide shows (Monday/every other week)
- * Tortuganan di Boneiru (Friday/every other week, starting August 11)

December

- * Final briefing
- * Prepare for departure
- * Finalising
- * Packing
- * Leaving

1996

January

- * Data processing
- * Writing final report
- * Correspondence
- * Prepare symposium

February

- * Complete final report
- * (Prepare) symposium USA
- * Subsidy requests
- * Publications

March

- * Recruiting of students
- * Publication '95 report
- * Correspondence
- * Project proposal STCB 1996
- * Video STCB 1995

APPENDIX III

1995 Beach Survey Data Sheet

BEACH SURVEY DATA SHEET

Stichting Turtle Club Bonaire

Date: _____ Time: _____ No. _____
Beach: _____ Observer: _____
Activity: Nest Crawl False crawl Undetermined Hatch None
Species: _____ Track Width: _____ m. Symm. Asymm.
Nest: Disturbed Undisturbed;
if disturbed, how: _____
Nest disguised: Yes No Eggs moved: Yes No
If so, why: _____
Triangulation landmarks: _____ (....m.) _____ (....m.)
Nest profile:

Nest fate: _____ Date: _____
Hatch data: Hatch date: _____ Excavation date: _____
No. undeveloped _____ Comments: _____
Midterm embryos _____
Full term embryos _____
Dead hatchlings _____
Hatched shells _____
TOTAL _____
% Hatch success _____

APPENDIX IV

1995 Sea Turtle Sighting Data Sheet

SEA TURTLE DISTRIBUTION SURVEY

Thank you very much for your willingness to participate in this survey! Sea turtles are declining throughout the Caribbean (indeed, throughout the world) and are generally classified as endangered or threatened species. Consequently, we need to know as much as possible about them in order to plan and implement effective conservation and management programs. Sea turtles are an integral part of the ecology of the oceans, and this is certainly true here in the West Indies. Yet we know very little about their distribution in our offshore waters. You can help us to collect this important information by sharing your observations with us. Please fill out this form as completely as you can; descriptions are provided on the reverse side. Thank you!

My name is: _____ Date: (d/m/y) _____

Location / Dive site _____ Time: _____

Dive Shop / Dive Master _____

Water depth (ft/m); Turtle was seen: Surface _____ Mid-column _____ Bottom _____

Condition of the turtle: Live _____; Injured _____; Dead _____

If injured, please describe _____

Activity of the turtle: Resting _____; Mating _____; Swimming _____; Eating _____

If eating, what type of food? _____

The turtle's shell length was:

Less than 20 inches (<50 cm) _____

Between 20-40 inches (50-100 cm) _____

More than 40 inches (> 100 cm) _____

The turtle was a hatchling, total length < 4 inches (< 10 cm): Yes _____; No _____

The tail extended more than 6 inches (> 15 cm) beyond the shell: Yes _____; No _____

The species of turtle could be determined [see reverse]: Yes _____; No _____

If yes, please check one: Green turtle _____ Loggerhead turtle _____

Hawksbill turtle _____ Leatherback turtle _____

The turtle had a metal or plastic tag on its flipper: Yes _____; No _____; Unknown _____

The immediate environment is best described as: Sand _____; Sea grass meadow _____;
Coral reef _____; Rocks _____; Other (cave, wreck, etc.) _____

General comments: _____

Did you make a good picture of the turtle? You could contribute to our project by providing us a copy. Slides are preferred, but prints will do as well. Almost any picture of a sea turtle in Bonairian waters can be used for scientific and/or educational purposes. You can contact us through your diveshop. Thank you very much !!!



APPENDIX V

1995 STCB Newsletter

NEWSLETTER

News from the Sea Turtle Club Bonaire

1 october 1995

HISTORY OF THE SEA TURTLE CLUB BONAIRE

Over the last thirty years, sea turtle populations have decreased all over the world. This is mainly due to persistent overexploitation, increased tourism, and marine pollution. Also in the Caribbean region, sea turtle populations have decreased considerably in size, and sea turtles are now in danger of extinction. A few years ago, concerned citizens of Bonaire and The Netherlands became alarmed about the situation, and decided to do something about it. Their first efforts included the purchase (and release) of live turtles from fishermen. But they knew something more was needed. In 1990, Mr. A.J.Th. de Soet established the Sea Turtle Club Bonaire (STCB) with the objective of raising funds for the protection of local sea turtle populations. Fund raising efforts included a specially commissioned turtle necktie (sold in The Netherlands for US\$ 50) and, in February 1992, a benefit dinner in Bonaire attended by wealthy and prominent persons, including the Prime Minister of The Netherlands at that time, and his wife (who is the patron of the STCB). The dinner raised US\$ 10,000.

In May 1993, the STCB appointed Drs. T.J.W. van Eijck as their project coordinator to undertake the first thorough survey of Bonaire's sea turtles,

and to implement an awareness program on sea turtle conservation. The project was designed based upon data and recommendations published in the Sea Turtle Recovery Action Plan for the Netherlands Antilles (Sybesma, 1992). The STCB invited Dr. K.L. Eckert of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) to visit Bonaire in May 1993 and assist the project coordinator in developing the project.

The 1993 Project

From May until November, 1993, 15 potential nesting beaches were groundsurveyed, former turtle fishermen were interviewed, a sighting network was established to document encounters with turtles in nearshore waters, and an awareness campaign was designed to target schools, the dive tourism industry, law enforcement agencies (Park Rangers, Customs Officers, Police Corps), and the general public. The campaign included public slide shows, regular media updates, a weekly column in the island's main Papiamentu newspaper, and the production of a flyer, booklet, and colour poster focused on the sea turtles of Bonaire.

The First Results

Beach surveys have revealed that nesting by hawksbill and loggerhead turtles occurs on a small scale. The majority of crawls were

encountered on Klein Bonaire, an uninhabited islet off Bonaire's west coast. From the crawls, it could be determined that Bonaire is still visited by nesting hawksbill and loggerhead turtles, be it on a small scale. Apart from the nesting activity on the beaches, the reefs of Bonaire are inhabited by juvenile hawksbill and green turtles (20-50 cm estimated shell length). Most probably these young sea turtles use the reefs and sea grass beds of the island as a residence where they can grow and forage for several years, until they become mature. Karpata and Sorobon (Lac Bay) appeared to be particularly good foraging areas, but further research needed to be done in order to confirm that. Although no serious attempt to estimate the number of turtles residing in Bonairian waters could be made, a minimum estimate of 45 juvenile turtles was suggested.

From this research it became evident that future research should include inwater surveys of Bonaire's east coast (i.e. Lac Bay), and a more detailed investigation of nesting activity at Klein Bonaire. The results of the 1993 Project were compiled into the first STCB report (van Eijck & Eckert, 1994), in which recommendations were made for a future research and conservation program. Based on these recommendations, a proposal for the STCB 1995 Project was written.

The 1995 Project

To obtain more academic involvement, the STCB started a cooperation with the University of Amsterdam (UvA), from which two marine biology graduate students, Paul van Nugteren and Niels Valkering, were appointed as STCB Project Assistants. In addition, Prof. Dr. R.P.M. Bak from the UvA was invited to supervise the ecological research of the STCB. The STCB 1995 Project is supported by various organizations, like the World Wildlife Fund of the Netherlands, the Foundation DOEN/National Postcode Lottery and the Foundation for Scientific Research in the Caribbean Region. All activities of the STCB are undertaken in close cooperation with various organizations on Bonaire, such as STINAPA Bonaire, the Bonaire Marine Park, Tene Boneiru Limpi and Amigu di Terra. And on regional scale, with Reefcare Curaçao, STINAPA Curaçao, Sea Aquarium Curaçao, StimAruba, Fudena (Venezuela) and Widecast.

The STCB 1995 Project started last June. In the past three months, good progress has been made, both in the research and the public awareness activities.

Research Update

As in the 1993 Project, the research consists of a thorough examination of the nesting activity on Bonaire and of further research on the sea turtle populations residing in the Bonairian coastal waters.

Up to now, a total of 30 nesting attempts have been found. In three cases, the remnants of the nests could be excavated after hatching. All three nests showed to be loggerhead nests, with hatching successes of respectively 40%, 60% and 95%. In the latter case, the Project Assistants were present when the nest hatched,

and a video coverage of the event has been made. This nest was one of the very few attempts found on the mainland of Bonaire. The low number in hatching success of the first nest, found on Klein Bonaire, can be the result of trampling of the nest by humans, who visit the beach regularly. Only half of the hatched turtles in this nest, actually came out of the sand.

Besides the loggerhead nests and nesting attempts, hawksbill nesting attempts are also observed and there is good reason to believe, that at least a few of these were successful. So far, none of these potential hawksbill nests have hatched, but the first hatched hawksbill nest is eagerly waited for. Nesting activity of the green turtle is seldom encountered on the Bonairian beaches and up to now no attempts have been found by this species in the 1995 project.

It is not certain how many of the various attempts actually contain a nest, because the nests are very well camouflaged and there is a risk of damaging the nest in the process of searching for it. Therefore all probable nesting sites will be monitored continually, in order to make sure that any activity on the spot will be notified. However, the abnormal weather of the last weeks plays a negative role in this, because the rain easily washes away the tiny hatchling tracks.

Klein Bonaire

Like in 1993, the largest part of the nesting activity is found on Klein Bonaire. Again, this points out the importance of Klein Bonaire as a nesting ground for Bonaire's sea turtles. In the continuation of the 1995 Project, this area will receive a great deal of attention.

On this point, it is necessary to emphasize that any exploitation of this uninhabited islet will have a devastating impact on the nesting turtles.

As we have seen in the past, sea turtles are easily scared away by human presence, which often cause noise and lights. Beaches on the mainland of Bonaire, which were once known as nesting grounds for sea turtles, are now devoid of turtles as a result of ongoing touristical development. Therefore, Klein Bonaire can be considered as a 'last resort' of the nesting populations of Bonaire's sea turtles. Moreover, building activities at the coast of Klein Bonaire, for example a mooring pier at No Name beach, will cause avalanches in the nearby reef. According to information of the Bonaire Marine Park, the reef on this location is already quite instable. As a result, landslides in the reef are likely to occur, thereby suffocating an important foraging area for all kinds of reef animals, including juvenile sea turtles.

Juveniles

As previously mentioned, research is also done on the juvenile turtles residing along the Bonairian coast, which use the reef and seagrass beds as shelter and foraging area. The research consists of gathering as much information as possible about the whereabouts of the different sea turtle species residing in the Bonairian waters. This should enable us to get a deeper understanding of the population dynamics of the Bonairian turtles. To achieve this goal, a network is established in cooperation with the diveshops on Bonaire. Turtle sightings can be reported by filling out a special sea turtle sighting sheet, which is available at every diveshop. All the information about the sightings will be entered in a database. This way of gathering information is making very good progress. In the same manner, information of 1994 has reached the database and is being processed this moment. In

addition to this network, the project assistants also perform snorkel surveys, in order to collect more detailed information about the behaviour of the turtles.

The first impressions are, that more juvenile sea turtles are residing along the Bonairian coastal waters this year. The students have no reference to others years, other than the results of the STCB 1993 Project (Van Eijck & Eckert, 1994). In addition to these observations, interviews with various people who dived and/or snorkeled around Bonaire for years support the indication, that more juveniles reside around Bonaire this year. A few ideas about the cause of this increase in sea turtles are brought up but need to be proven.

It is thought that juvenile sea turtles are more or less committed to certain fixed locations. Individual sea turtles are often recognized by us and various other people, thanks to certain characteristics such as scars, barnacles or distinct colour patterns. It has appeared very likely, that the turtles can be spotted at the same place for a considerable amount of time (at least months in some known cases). Although this seems to be the case, further research needs to be done to prove it.

Photo Identification

Recognizing individuals on picture, slide and video material could be of assistance in this further research. Therefore the 1995 project includes a photo identification study, performed by the project assistants. This consists of taking as much pictures as possible on certain (hot)spots and trying to identify and recognize the individual sea turtles. Besides that, photo- and videomaterial is gathered through the divers network and the photoshops. Anyone who can and is willing to provide the STCB with photo- and videomaterial of sea turtles on

Bonaire can contact the project assistants via the diveshops or Sunset Beach Hotel tel: 5300 room# 130.

The focus of the photo identification research from the project assistants will be on the Lac Bay area, which is thought to be a feeding area for green turtles. Also, interviews with fishermen who work around Lac Bay will shed more light on this particular study.

Public awareness.

Besides research done on the sea turtles, the project also contains a public awareness campaign. Improving the public awareness about the situation of the Bonairian sea turtles is done in several ways. First, the press is regularly updated on the progress of the 1995 project. The publicity around the STCB and its project is clearly present. In this way the STCB hopes to inform the public about the alarming situation.

Furthermore, there are slide and video presentations planned on the Bonairian schools. Moreover presentations are also scheduled for the different districts on Bonaire. Therefore contact is made with the Cultureel Centrum Bonaire (CCB) and in cooperation with the CCB slideshows will be given there. At first a English and a Dutch version will be given both in Kralendijk and in Rincon. Depending on the reactions of the local people and instances, the presentation will be extended to other districts. The project assistants Niels Valkering and Paul van Nugteren also assist in a snorkelprogram meant for Bonairian schoolchildren, named 'Tortuganan di Boneiru' (the sea turtles of Bonaire). Hereby, the STCB arranges, in close cooperation with the Bonaire Marine Park and Tourism Corporation Bonaire, educative snorkeltrips about conservation of the nature of Bonaire, mainly underwater.

Also, weekly slideshows are about the sea turtles of Bonaire and the work of the STCB. These presentations are given each monday evening, 8.45 pm at Captain Dons Habitat. Everybody who is interested in hearing more about sea turtles, is more than welcome.

Turtle Corners

Other activities within the 1995 project include the making of a 'turtle corner' that will be placed at the dive shops on Bonaire. This turtle corner will consist of a sign, made out of driftwood, which will attract the attention of the divers to the previously mentioned sighting sheets. Underneath this sign a folder rack will be placed which contains three folders: the STCB folder, a WIDECASST folder and a Buyers Beware folder. The latter is a folder about the trade and smuggle of animals endangered with extinction, such as turtle products, conch, parrots, etc.

World Clean Up Day

To conclude, attention is drawn to one other project in which the STCB cooperated. This is the World Clean Up Day, which on Bonaire took place on the sixteenth and the seventeenth of September. The Clean Up was organized by 'Tene Boneiru Limpi' (keep Bonaire clean) and the Tourism Corporation Bonaire. The contribution of the STCB, in this case Corine Gerharts, Paul van Nugteren and Niels Valkering, consisted of coordinating the Coastal Clean Up. Due to the fact that the entire area of the Bonairian coastline was too big to clean in this project, the STCB limited the clean up to several beaches which are of importance to the sea turtle. This were mainly potential nesting beaches. The STCB recruited groups and individuals (160 participants in total) and assigned these to the various beaches. With the help of these

people 80 bags of garbage were collected and quantified on Klein Bonaire, and 145 on the several beaches on the Bonairian mainland. During the clean up the people were educated on the negative impact that the trash has on sea turtles. This information dealt with the floating debris, which the sea turtle can swallow or get entangled in and drown, as well as the harmful effect of the trash when lying on the beaches. Although the adult female turtles will probably be able to find their way through the trash and make the nest, the young hatchlings will have great difficulty in getting past these manmade obstacles to make it to the sea.

Literature

Sybesma, J. 1992. WIDECAST Sea Turtle Recovery Action Plan for the Netherlands Antilles (K.L. Eckert, Editor). CEP Technical Report No. 11, UNEP Caribbean Environment Program, Kingston, Jamaica. 63 P.

Van Eijck, T.J.W. & K.L. Eckert. 1994. Sea Turtles in Bonaire: 1993 Survey Results and Conservation Recommendations. Sea Turtle Club Bonaire, Amsterdam, The Netherlands. 89 p.

Donations

To continue our work, your support is highly appreciated. You can send your donations to: -Sea Turtle Club Bonaire, accountno. 10106273 of the Maduro & Curiëls Bank, Kralendijk, Bonaire (N. A.); or -Sea Turtle Club Bonaire, accountno. 550391150 of the ABN-AMRO Bank, Hilversum, The Netherlands.

Sponsors

The sponsors of the Sea Turtle Club Bonaire are: KLM, Curaçao Sonesta Hotel, Bonaire Trading, World Wildlife Fund of the Netherlands,

Foundation DOEN/National Postcode Lottery, Foundation for Scientific Research in the Caribbean region, WIDECAST (United Nations), Grand Hotel Amsterdam, Hotel Barbizon Centre GT, Paul Huf Studios, G. van Lennep Productions, Villapark Oogduyne, Sunset Beach Hotel, Rum Runners, Sand Dollar Photo shop, Captain Don's Habitat, Woodwind, Sunset Beach Dive shop, Biodermal Baarn Holland, ING Bank Central America & Caribbean, Van Lindonk Special Projects B.V., Red Bullet B.V., Royal Ahold N.V.

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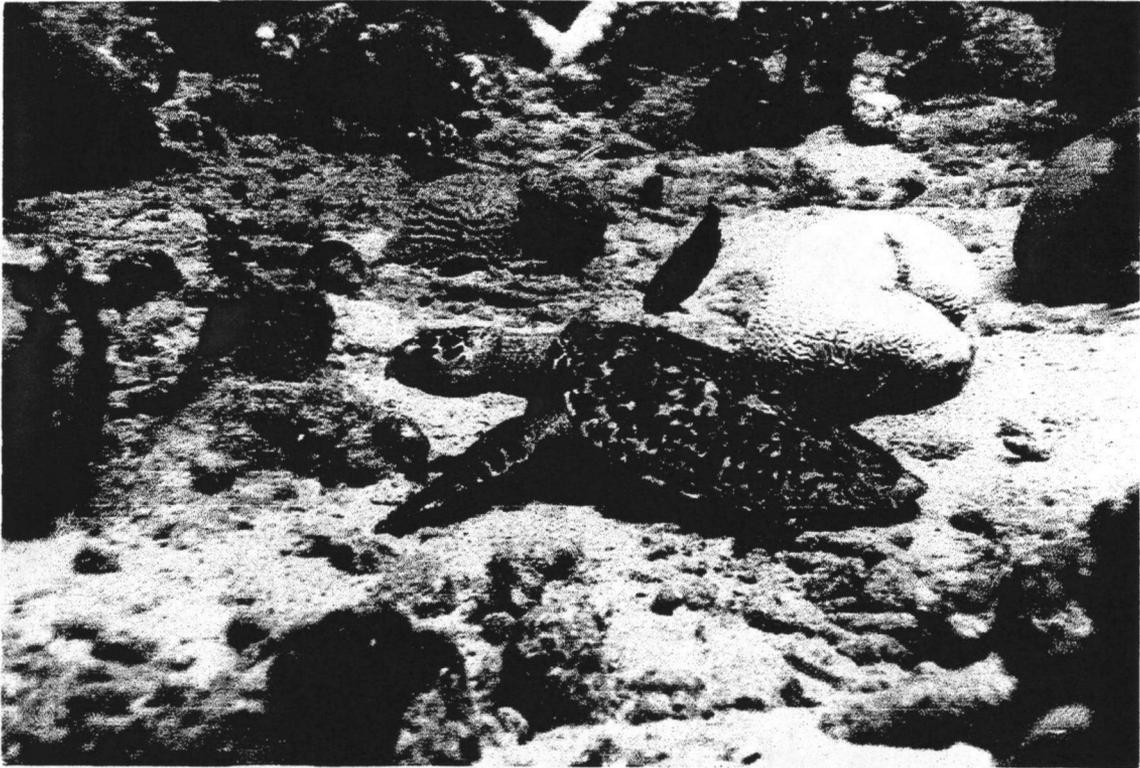
The 1995 Project has been made possible by, among others, the World Wildlife Fund of the Netherlands and The Foundation DOEN/National Postcode Lottery.

APPENDIX VI

Ideas regarding future conservation projects

- In making an effort to determine guidelines for egg poaching and harvesting adults, it became evident that to sustain a population a maximum of 30% of the eggs can be poached and 10% of the nesting adults (equal amount male and female) can be harvested. This, however, may not account for Bonairian sea turtle populations, since their numbers are low.
- Physiological mechanisms of diving sea turtles can explain the relative large amount of time that turtles can stay under. Sea turtles are for example able to lower their heartbeat rate to 1-2 beats/minute compared to 40 in a normal situation. Furthermore, sea turtles have the highest gas exchange levels in the lungs, compared to reptile and mammal lungs. Additional to this they can have very high oxygen levels in the blood, to compensate the lack of oxygen in the lungs during a deep dive.
- Age of Hawksbill and Leatherback sea turtles can be determined by counting annual layers in the scutes and a bony structure near the eye, respectively. This might be important in determining the age structure of a population.
- The ability of sea turtles to determine their position and to return to their nesting grounds (i.e. Bonaire), might be a combination of being able to sense both the intensity of the earth magnetic field and the angle in which the magnetic field hits the surface of the earth (every spot on earth has a unique combination of these two).
- Sex ratios in nests might be determined by a combination of incubation time and pivotal temperature (temperature inside the nest which is the borderline between hatchlings developing as a male or as a female). Incubation time is influenced by sand type and nest temperature and thus varies. Pivotal temperature also varies both interspecific and intraspecific. Sex ratios within nests therefore varies depending on species, sand type, pivotal temperature and incubation time.
- Genetic research revealed a good possibility of multiple paternity (female mates with several males, so the offspring has more than one father), in green turtles.

PICTURES



Picture 1. Hawksbill photographed in Bonairian waters (picture by: M. Hellström-Larsson).



Picture 2. The hawksbill catching a fish (picture by: M. Hellström-Larsson).

