

VERSLAGEN EN TECHNISCHE GEGEVENS

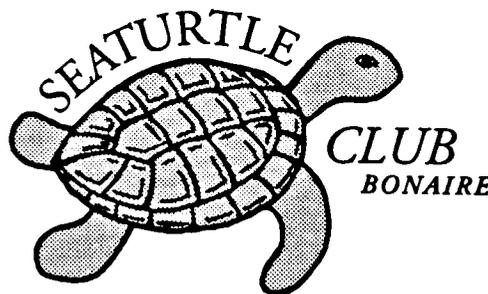
Instituut voor Systematiek en Populatie Biologie (Zoölogisch Museum)

Universiteit van Amsterdam

No. 78

Sea Turtle Conservation on Bonaire

Sea Turtle Club Bonaire 1997 Project Report



M. Schuit and A.L.L.M. Van Put
N.P. Valkering and T.J.W. Van Eijck

September 1998



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The Sea Turtle Club Bonaire (STCB) is a non-profit, non-governmental organization, and its main goal is the conservation of Bonaire's sea turtles. The STCB wants to realize this goal by creating public awareness about sea turtle conservation on Bonaire, and by biological research on the local sea turtle populations. To continue our work, your support is highly appreciated. You can send your donations to:

- Sea Turtle Club Bonaire, accountn° 10106273 of the Maduro & Curiëls Bank, Kralendijk, Bonaire, Netherlands Antilles.
- Sea Turtle Club Bonaire, accountn° 550391150 of the ABN-AMRO Bank Hilversum, the Netherlands.

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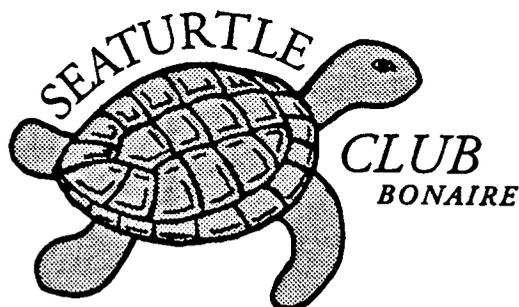
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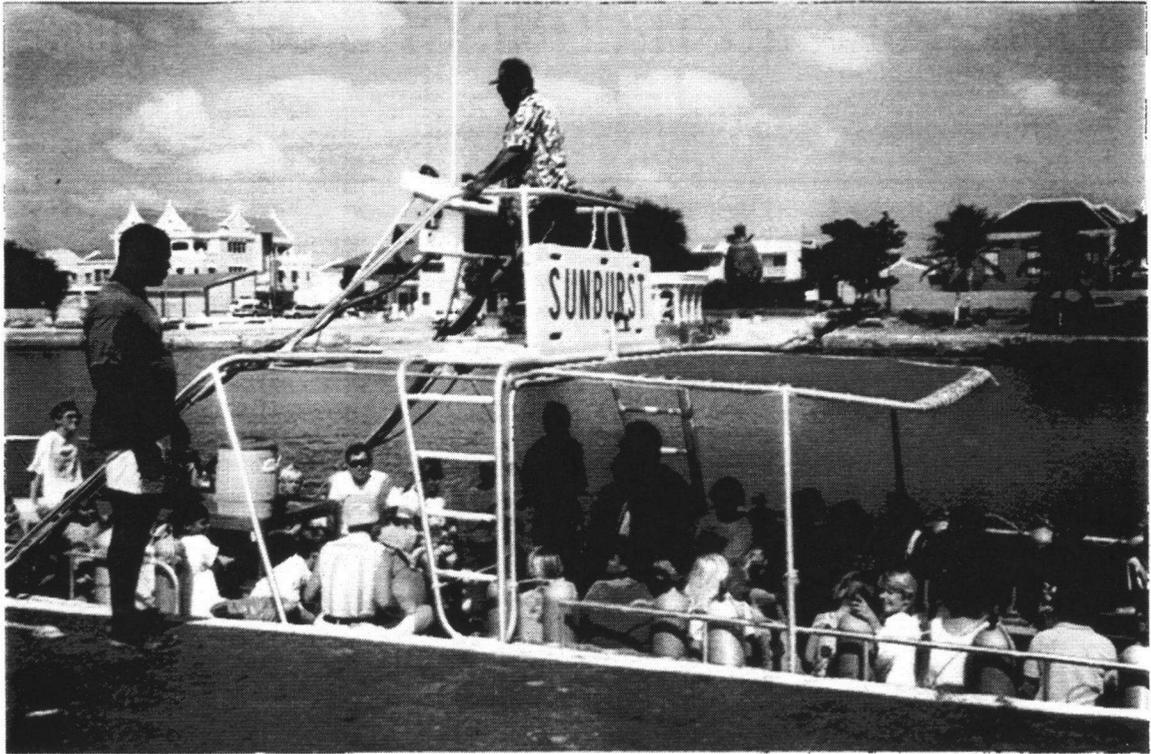
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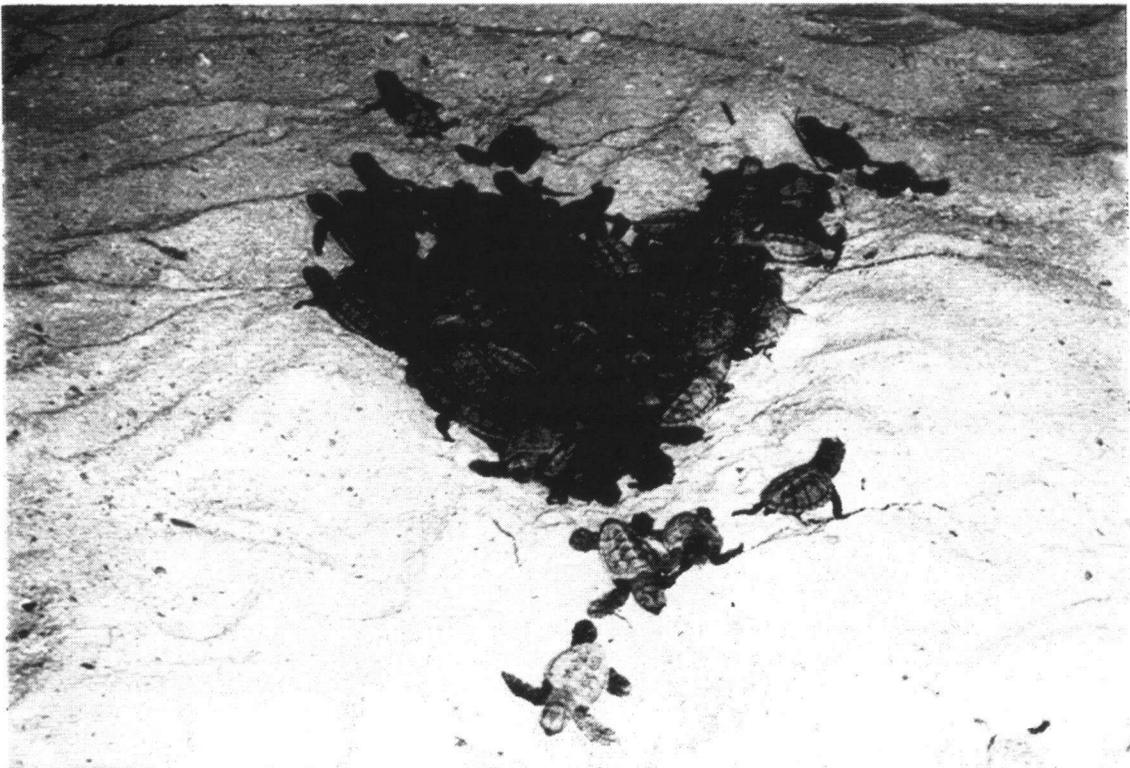
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'Turtuganan di Boneiru'-children heading for a snorkel course (photo: A.L.L.M. van Put).



Loggerhead hatchlings emerging from the nest and heading for the sea (photo: STCB).

Preface

Since the first Sea Turtle Club Bonaire-Project in 1993, it is known that two species of sea turtles are nesting on Bonaire: the hawksbill turtle (*Eretmochelys imbricata*), which is the most endangered sea turtle of the Caribbean region, and the loggerhead turtle (*Caretta caretta*), whose nesting grounds in the Caribbean are scarce. Furthermore, the coastal waters of Bonaire provide an important habitat for juvenile green turtles (*Chelona mydas*) and hawksbill turtles. Over a five year period, the STCB gained better insight in the distribution of the sea turtles on Bonaire.

Since 1995, the STCB provides graduate students in ecology the opportunity to cooperate with the STCB in yearly following up projects. For the STCB 1997 Project, Maarten Schuit and Annemieke van Put were appointed as project assistants in order to execute all activities involved in the project. These activities include research on the nesting and residing sea turtles as well as running a public awareness campaign to inform and involve Bonaireans and tourists. The STCB 1997 Project was initiated in the beginning of June and lasted until mid-December.

We very much enjoyed working on the different aspects of the conservation project. The field surveys provided us with satisfactory results. Together with figures from former and following projects, these will contribute to the knowledge on the status of the turtles on Bonaire as well as on the relation between turtles and their habitat.

The involvement of children in the nature conservation program was very pleasant and rewarding. Every week, local children could attend 'Turtuganan di Boneiru', a nature education program, which is a joint effort between the Bonaire Marine Park and the STCB. This year, a new, extended program on the marine wildlife of Bonaire was developed in cooperation with E. Scholtens, Coordinator Nature and Environmental Education Bonaire. The children were willing to learn about their own natural environment. Because of this great interest, and because of the gratifying cooperation with E. Scholtens, 'Turtuganan di Boneiru' was a very valuable aspect of the project. Moreover, organizing and performing the different (sometimes unexpected) tasks proved to be challenging.

The interest in the conservation work of the STCB was enormous and is increasing. Every year, more divers and snorkelers cooperate in the sighting network and this year, the local dive shops (again) collected a record number of sighting sheets. The weekly slide show presentations were successful as well and the press, the Bonairean government, the local business community and Antillean non-governmental organizations and others showed great interest.

Each STCB-Project is concluded with a report. Such a report contains the results and a description of the pursuits of the project. In this report, M. Schuit wrote the preface, the table of contents, the sections 1.1, 1.2, 1.3, 2.1, 2.5, 3.1, 3.2, IV and was responsible for Appendix 5, 9 and 10. A.L.L.M. van Put wrote the acknowledgements, the sections 2.2, 2.3, 2.4, 3.4 and was responsible for Appendix 1, 2, 3, 4, 6, 7, 8 and 11. M. Schuit and A.L.L.M. van Put wrote the abstract and A.L.L.M. van Put and drs. N.P. Valkering wrote section 3.3.

The report was reviewed by drs. T.J.W. van Eijck and drs. N.P. Valkering as well as by Prof. dr. R.P.M. Bak from the Universiteit van Amsterdam (UvA) and by the Institute of Systematics and

Population Biology, UvA.

The STCB 1997 Project was realized with the support of many enthusiastic sponsors and volunteers on Bonaire as well as in Holland. We thank everyone who contributed to the success of the STCB 1997 Project.

Maarten Schuit
Annemieke van Put

Acknowledgements

The success of the STCB 1997 project was largely due to the support and cooperation we received from many individuals, organizations and institutions.

Firstly, we are grateful to Tom van Eijck. He has been the driving force behind the realization of STCB-projects since 1993. We thank Niels Valkering, the STCB project coordinator, who introduced us to the fascinating world of the Bonairean sea turtles. We also acknowledge Pieter Borkent en Bert Hogenbirk, respectively the chairman and the treasurer of the STCB in Holland. We thank the board of the STCB on Bonaire. The president, Corine Gerharts, and her husband Larry Gerharts were always available for suggestions and advice. Hugo Gerharts, treasurer of the STCB and president of Bonaire Trading Company Ltd. (BTC), sponsored the project in various ways. The two new boardmembers of the STCB, Bart Snelder (secretary) and Imre Esser (fundraising treasurer), introduced us to Bonairean society, gave us practical advice and support when needed.

We thank Prof. dr. Bak of the University of Amsterdam (UvA) for the academic supervision on our research activities and on writing the report. Prof. dr. Wendelaar Bonga from the Catholic University of Nijmegen (KUN), was also supervising one of the Project Assistants at the KUN. We want to thank drs. W. Los, director of the Zoological Museum of the UvA, for his kind collaboration in the publication of the report in the series 'Verslagen en Technische Gegevens'. The Wider Caribbean Sea Turtle Conservation Network (WIDE-CAST) is acknowledged for supporting us as well.

On Bonaire, we thank the Bonaire Marine Park (BMP). We especially acknowledge Kalli de Meyer, manager of BMP, who was our technical supervisor on Bonaire. She, and later also assistant-manager Suzie Westmacott, offered us practical support and advice. We want to mention the BMP-rangers, who provided us with boat-transportation and assisted us on the pilot study at Lac Bay. Furthermore, we thank chairman Hans Rietveld from STINAPA for providing us with easy and gratuitous access to the Washington-Slagbaai National Park. The rangers of the Washington Park are thanked for their assistance in monitoring the turtle activity. We enjoyed working together with Tene Boneiru Limpi (TBL), the Foundation for the Preservation of Klein Bonaire (FPKB), Amigu di Tera and the Servicio di Limpiesa di Boneiru (SELIBON). We appreciated the close cooperation with Enit Scholtens, the education conservation officer, in the 'Turtuganan di Boneiru'-project. We also want to thank Eric Newton of Dienst Ruimtelijke Ordening en Beheer (DROB).

We acknowledge the members of the local and regional press for realizing the publicity for this year's project. Special regards to Boy Antoin (Extra), Aïda Jager (Algemeen Dagblad) and Hubert Linkels (Amigoe) for their coverage of the STCB. Gerry Fokke (Bon FM) is thanked for announcing our final presentation on the radio and for bringing us back with Baka de Laman to Bonaire, whenever we missed our boat on Klein Bonaire.

Without the active cooperation of the dive and tourism industry this project would not have been possible. Thank you all for having the informative Turtle Corners in your shops and for making divers aware of the fact that sea turtles are in need of protection. We especially want to mention Jack Chalk (Habitat), Pascal de Meyer (Buddy dive) and Walt Stark (Dive Inn). We thank Stefan and René Leach and Anna from sailing charter 'The Woodwind'. Stefan passed away this year, which we deeply regret. We are fortunate to have known him.

The STCB thanks the sponsors of the 1997 project: World Wide Fund for Nature-Netherlands, Stichting Doen/Nationale Postcode Loterij, Dierenrampenfonds, Fonds voor Onderzoek ten behoeve van het Natuurbehoud, Stichting ter Bevordering van Natuurwetenschappelijk Onderzoek, Stichting Nijmeegs Universiteits Fonds, Dittmer-fonds, Stichting de Korinthiers, Paul Huf Studios, G. van Lennep Productions and Van Lindonk Special Projects. Finally, we want to thank all other volunteers for showing interest in, and cooperating with the Sea Turtle Club Bonaire 1997 - Project.

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Abstract

The Sea Turtle Club Bonaire (STCB) is a non-governmental, non-profit organization. Its main goal is the conservation of the sea turtles that occur on Bonaire. To reach this goal, annual projects are undertaken, such as research and the promotion of public awareness on sea turtle conservation.

The STCB undertakes research in order to monitor the nesting activity of the two sea turtles species which nest on Bonaire: the hawksbill turtle (*Eretmochelys imbricata*) and the loggerhead turtle (*Caretta caretta*). Regular beach surveys are performed in order to locate and record the crawls. Nests are excavated to determine the number of eggs, the hatching success and to obtain information on the non-hatched eggs.

Turtle nesting activity was observed from late April onward until December. A peak of activity was found in July and August. 54 crawls have been reported, made by an estimated number of eleven turtles. 72.2% of the reported nesting activity was situated on Klein Bonaire and 27.8% on Bonaire main island. Thirteen nests of the total of twenty estimated nests made in 1997 were found: six were nests of hawksbill and seven of loggerhead turtles.

Two new sites were added to the list of potential nesting sites. On both sites, recent turtle activity was reported and on one of them an old nest was found.

Compared to former years, these figures seem quite average. The number of crawls found in 1997 levels those found in 1993 and 1995. The high number of crawls recorded in 1996 (a total of 116) was striking though.

Information on juvenile turtles around Bonaire is gathered by means of a divers' and snorkelers' sighting network. This year, the total number of sightings was 1464. This is an increase of 63.4% compared to last year. The quality of the data is influenced for a large part by the difficulty for divers to identify turtles and the distribution of the divers over the different dive sites. Though, given these two reasons, the network does not deliver imbiased data, the results gathered this year gave us a better insight in the behavior of the juvenile sea turtles.

A photo identification project was started in 1995. Since then, a database has been made to identify individual sea turtles. After three years, some success can be reported. In this report, only preliminary results are shown. Next year's project assistants will work out the precise data.

Research also included two pilot studies, started this year. An effort was made to investigate the foraging ecology of the juvenile green (*Chelona mydas*) and hawksbill turtles in the coastal waters of Bonaire. Areas which are known to be frequently visited by hawksbill and green turtles were monitored. These included areas at the west coast of Bonaire (Andrea I and II, and Margate Bay) and on the north side of Klein Bonaire (Sampler) for the hawksbill turtle, and Lac Bay on the east side of Bonaire for the green turtle.

No clear traces of predation of hawksbill turtles on sponges have been found. Information on feeding behavior of hawksbill turtles obtained through the sighting network did not support other studies in de Caribbean which demonstrated a clear preference for sponges. The expected feeding activity of green turtles in Lac Bay was not recorded either.

It has become clear that in order to gather relevant data on this subject, methods must be adjusted.

In order to educate local children on their natural environment, the STCB has cooperated in the organization of 'Turtuganan di Boneiru' with the Bonaire Marine Park (BMP) and the Tourism Corporation Bonaire (TCB) since 1995.

It used to be a snorkel club for local schoolchildren. However, this year, an extended program on marine wildlife has been set up in cooperation with E. Scholtens, Coordinator Nature and Environmental Education Bonaire. Turtuganan di Boneiru now offers a variety of educational activities next to snorkeling.

Many children attended the Turtuganan di Boneiru on a regular basis. Per afternoon, on average 22 children were present. In total, 82 children took part in the Turtuganan di Boneiru. To reach children throughout Bonaire, the program will be performed at different locations in the future.

Sea turtles need clean beaches as debris may cause turtles to abandon nesting efforts. To improve the nesting habitat on Bonaire, the STCB organizes a coastal cleanup on an annual basis. This year, 150 volunteers gathered 809 bags of trash. Important information on the quantities and kinds of trash was recorded as well. This will be used to support requests to the government for deposits on products such as soda bottles.

Klein Bonaire is an uninhabited islet in front of the West coast of Bonaire. It is the most important nesting habitat for sea turtles on Bonaire. Each year, 70-90% of the total nesting activity takes place on Klein Bonaire. However, it has been threatened with exploitation by the private owners. The STCB, together with other environmental organizations, devotes itself to the conservation of Klein Bonaire. A proposal to turn the 50 meter-zone beyond the shore line of Klein Bonaire into a national park has been presented to the Bonairean government.

Every year, the STCB cooperates with many organizations. Again in this year's project, assistance came from other NGOs and the local business community on Bonaire. However, a conservation project stretches beyond the local boundaries. Regional and international cooperation is necessary. This year, STCB Project Coordinator Niels Valkering met different people in Curaçao in order to discuss the status of the endangered sea turtles. He also attended the 18th International Symposium on Sea Turtle Biology and Conservation in Mexico. To keep the sea turtles from extinction, this kind of contact between organizations is very important. Regular exchange of information is necessary for the optimization of the ongoing conservation program of the STCB.

Samenvatting

De Sea Turtle Club Bonaire (STCB) is een onafhankelijke natuurbeschermingsorganisatie zonder winstoogmerk, met als doel het behoud van de zeeschildpadden rond Bonaire. Om dit doel te bereiken worden elk jaar projecten ondernomen, zoals onderzoek en de promotie van het publieke bewustzijn omtrent de noodzaak van zeeschildpaddenbescherming.

The STCB doet onderzoek naar de nestactiviteit van de twee zeeschildpadsoorten die op Bonaire nesten: de karetschildpad (*Eretmochelys imbricata*) en de dikkopschildpad ofwel onechte karetschildpad (*Caretta caretta*). Om nestsporen te localiseren en registreren worden de stranden op regelmatige basis geïnspecteerd. Nesten worden uitgegraven om de hoeveelheid eieren en het percentage uitgekomen eieren te bepalen en om informatie te verkrijgen over de eieren die niet zijn uitgekomen.

Er is nestactiviteit geconstateerd vanaf eind april tot december, waarbij de grootste nestactiviteit plaatsvond in juli en augustus. Er zijn 54 nestsporen gevonden, gemaakt door een geschat aantal van elf wijfjes. 72.2% van de gerapporteerde nestactiviteit vond plaats op Klein Bonaire en 27.8% op Bonaire zelf. Van de in totaal geschatte twintig nesten die in 1997 zijn gelegd, zijn dertien nesten gevonden: zes waren nesten van karetschildpadden en zeven waren van dikkopschildpadden.

Aan de lijst van potentiële nestplaatsen zijn er twee toegevoegd. Op beide plaatsen was recente schildpadactiviteit gerapporteerd en op een van hen is een oud nest gevonden.

Het aantal nestsporen dat gevonden is in 1997 komt overeen met het aantal gevonden in 1993 en 1995. Opvallend was echter het hoge aantal nestsporen dat gevonden is in 1996 (totaal 116).

Met behulp van een meldingsnetwerk van duikers en snorkelaars wordt informatie verzameld over juveniele schildpadden. Dit jaar is een totaal van 1464 meldingen gemaakt. Ten opzichte van vorige jaar is dat een toename van 63.4%. De waarde van de gegevens wordt voor een groot gedeelte beïnvloed door de moeilijkheid voor duikers om schildpadden te identificeren, alsook door de verdeling van de duikers over de verschillende duiklocaties. Met behulp van de gegevens die dit jaar zijn verzameld is een beter inzicht verkregen in het gedrag van de juveniele zeeschildpadden ondanks dat het meldingsnetwerk onzuivere data levert.

In 1995 is een foto-identificatie project opgezet. Sindsdien is een database opgesteld om individuele schildpadden te identificeren. Na drie jaar zijn enige goede resultaten verkregen. In dit rapport zullen slechts inleidende resultaten weergegeven worden. De gegevens worden in de loop van 1998 uitgewerkt.

Het onderzoek omvatte ook twee pilot studies die dit jaar zijn opgestart. Er is een poging gedaan om de foerageer-ecologie te onderzoeken van de juveniele soep- (*Chelona mydas*) en karetschildpad in de kustwateren van Bonaire. Gebieden waarvan bekend is dat karet- en soepschildpadden er regelmatig verkeren zijn geobserveerd. Dit betreffen gebieden aan de Westkust van Bonaire (Andrea I en II, en Margate Bay) en aan de Noordkant van Klein Bonaire (Sampler) voor de karetschildpad, en Lac Bay aan de Oostkant van Bonaire voor de soepschildpad.

Er zijn geen duidelijke sporen van sponspredatie door karetschildpadden gevonden. Informatie die verkregen is via het meldingsnetwerk ondersteunden niet de andere studies uitgevoerd in de

Cariben die een duidelijke voorkeur voor sponzen aantoonde. Ook de verwachte graasactiviteit van soepschildpadden in Lac Bay is niet geregistreerd.

Het is duidelijk geworden dat de onderzoeksmethoden aangepast dienen te worden om relevante data aangaande dit onderwerp te verkrijgen.

Sinds 1995 werkt de STCB samen met het Bonaire Marine Park (BMP) en de Tourism Corporation Bonaire (TCB) bij het organiseren van 'Turtuganan di Boneiru', een natuureducatieproject voor lokale schoolkinderen.

Dit jaar is een uitgebreid programma opgezet in samenwerking met E. Scholtens, Coördinator Natuur en Milieu Educatie Bonaire. Naast snorkelen biedt Turtuganan di Boneiru nu ook een variatie aan educatieve activiteiten.

Veel kinderen bezochten de Turtuganan di Boneiru op een regelmatige basis. Per middag waren gemiddeld 22 kinderen aanwezig. In totaal hebben 82 kinderen meegedaan aan de Turtuganan di Boneiru. Om kinderen over geheel Bonaire te bereiken zal het programma in de toekomst op verschillende locaties uitgevoerd worden.

Zeeschildpadden hebben schone stranden nodig aangezien het vuil de schildpadden kan doen besluiten om nestpogingen af te breken. Om de nestomgeving op Bonaire te verbeteren organiseert de STCB een jaarlijkse kustschoonmaak. Dit jaar hebben 150 vrijwilligers 809 zakken afval verzameld. Belangrijke informatie over hoeveelheden en soorten afval werd ook geregistreerd. Deze informatie wordt gebruikt ter ondersteuning van verzoeken aan de overheid om statiegeld te heffen op producten als (frisdrank)flessen.

Klein Bonaire is een onbewoond eilandje voor de westkust van Bonaire. Het is het belangrijkste nestgebied voor zeeschildpadden op Bonaire. Elk jaar vindt 70-90% van de totale nestactiviteit plaats op Klein Bonaire. Het wordt echter bedreigd met exploitatie door de prive-bezitters. De STCB, tesamen met andere milieubeschermingsorganisaties, wijdt zich toe aan de bescherming van Klein Bonaire. Er is een voorstel ingediend bij de Bonairiaanse overheid om de 50-meterzone achter de hoogwaterlijn van Klein Bonaire tot een nationaal park te maken.

Elk jaar is er een samenwerkingsverband tussen de STCB en veel andere organisaties. Ook gedurende dit project was er veel medewerking van andere non-gouvernementele organisaties en van de lokale zakenwereld op Bonaire. Een beschermingsproject als dat voor zeeschildpadden reikt echter ook voorbij lokale grenzen. Regionale en internationale samenwerking is nodig. Dit jaar heeft de STCB-project coördinator Niels Valkering onderhoud gehad met verschillende mensen op Curacao om de status van de zeeschildpad te bespreken. Ook woonde hij het 18e Internationale Symposium voor Zeeschildpaddenbiologie en Bescherming bij in Mexico. Om te voorkomen dat zeeschildpadden uitsterven zijn contacten tussen organisaties zeer belangrijk. Regelmatige uitwisseling van informatie is noodzakelijk voor de optimalisering van het doorlopende beschermingsprogramma van de STCB.

I Introduction

1.1 The Sea Turtles of Bonaire

In the waters of the Dutch Antilles, four species of sea turtles are present:

1) The **green turtle** or turtuga blanku (*Chelonia mydas*) is the biggest hard shell sea turtle. Adults normally reach a shell length of 95-125 cm and weigh 200 kg or more. After being omnivorous in their earliest years, they become herbivorous and mainly feed on sea grass (*Thalassia testudinum*). The green turtle is considered to be the most edible of all sea turtles. Fishing on these turtles as well as egg poaching used to be an experienced occupation. Both locally and internationally, they are largely threatened. The green turtle used to nest on Bonaire. However, during the period 1993-1997, no nesting activity has been observed by the STCB. Many juvenile and some sub-adult turtles are present in the coastal waters of Bonaire.

2) The **hawksbill turtle** or turtuga karet (*Eretmochelys imbricata*) is a relatively small sea turtle, reaching 70-95 cm and weighing about 85 kg. Its main diet consists of sponges. This turtle was fished upon for its carapace, which is used as a decoration or to make ornaments of. The species is seriously threatened, but is still nesting on Bonaire and especially on Klein Bonaire, an uninhabited islet on the West coast of Bonaire. Juvenile hawksbill turtles are present as well.

3) The **loggerhead turtle** or turtuga kawama (*Caretta caretta*) is 90-120 cm in shell length, weighs about 200 kg and is carnivorous. It feeds on shellfish and crustaceans. Due to fishery (the turtle was thought to possess magic powers) as well as drowning because of shrimp fishery, the loggerhead is threatened with extinction. However, on Bonaire, the STCB records nesting activity every year. No juveniles have been observed.

4) The **leatherback turtle** or turtuga drikil (*Dermochelys coriacea*) is the largest sea turtle. Its soft, leather-like carapace generally ranges from 130-175 cm, weighing 250-500 kg. Leatherback turtles are believed to feed predominately on jellyfish and other soft-bodied prey. Although the meat of the leatherback is often considered inedible, the eggs are likely to be consumed if found. Because of the soft, leather-like skin, they can easily damage themselves. They avoid coral reefs and are rather uncommon around Bonaire. The leatherback is a threatened species.

For more extended information about the sea turtles which visit Bonaire, see Van Eijck and Eckert, 1994; Valkering *et al.*, 1996; Norde and Van Rossum, 1997.

1.2 History of the Sea Turtle Club Bonaire

1991 - The Sea Turtle Club Bonaire (STCB) was founded by Albert de Soet as a reaction to ongoing catching, slaughtering, selling and consuming of turtles on Bonaire. The STCB, together with local politics, managed to make a law come into force to protect the sea turtles (see Appendix 1).

1992 - By means of a charity dinner on Bonaire, funds were raised for further activities of the STCB. In cooperation with Marcultura (a marine culture company), the STCB realized the reintroduction of some sea turtles from European zoos. Transport was sponsored by KLM.

1993 - The STCB appointed biologist drs Tom van Eijck to coordinate a research and conservation project for turtles on Bonaire (the 'Sea Turtle Survey Bonaire 1993'). The project was based upon a report of the United Nations Environmental Program (UNEP) (Sybesma, 1992) and further developed in cooperation with dr. Karen Eckert of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). An inventory was made of the sea turtle population and a public awareness campaign was started.

1994 - Results of the 1993 project were presented at the International Sea Turtle Symposium in the USA by Tom van Eijck. A report was written and considerable funding was received from the World Wildlife Fund for Nature of the Netherlands and the DOEN foundation.

1995 - Niels Valkering and Paul van Nugteren continued the activities of the STCB as project assistants. More cooperation with Bonairean nature conservation organizations, such as the Bonaire Marine Park (BMP), Stichting Natuurparken Bonaire (STINAPA Bonaire) and Tene Boneiru Limpi (TBL) took place. A cooperation with the Universiteit van Amsterdam (UvA) was set up; Prof. dr. Rolf Bak supervises the research activities of the STCB.

The public awareness campaign was extended by assisting in a snorkel project for Bonairean children ('Turtuganan di Boneiru') and by organizing a coastal clean-up during the World Clean-Up Day.

The STCB was assisted of Corine Gerharts as an active spokesperson.

1996 - Results of the research and the public awareness campaign of the STCB 1995 project were presented at the International Sea Turtle Symposium. The 1995 project report, which also contained a long term proposal, was released in cooperation with the UvA and distributed internationally. The STCB again was supported by above-mentioned organizations supplemented with support of Dierenrampenfonds.

Derk-Jaap Norde and Joris van Rossum were appointed as project assistants to continue the activities of the STCB.

1997 - Pieter Borkent replaced Albert de Soet as chairman while Tom van Eijck became the new secretary. Niels Valkering replaced Tom van Eijck as project coordinator. On Bonaire a new board has been set up as well. Corine Gerharts is chairman, Hugo Gerharts is treasurer, Imre Esser is appointed as fund raiser-treasurer and Bart Snelder is secretary.

Niels Valkering represented the STCB during the International Sea Turtle Symposium in New Mexico (Mazatlán, Mexico). A Caribbean Turtle Meeting was organized at the UvA (Van Eijck, 1997) and the STCB 1996 report was distributed internationally.

This year's project assistants were Maarten Schuit and Annemieke van Put. Next to the usual activities, two pilot studies on the feeding behavior of hawksbill and green turtles were undertaken. Furthermore, in cooperation with Enit Scholtens, Coordinator Nature and Environmental Education Bonaire, the Turtuganan di Boneiru developed from a snorkel club into an activity club. The STCB, with the assistance of the Doen Foundation, provided the Turtuganan di Boneiru with new snorkel sets.

1.3 STCB-Project 1997

In accordance to the previous projects, a six-month work plan was outlined to attain the following objectives during the 1997 project:

- Determine the distribution, abundance and seasonality of sea turtles and their nesting activity on Bonaire;
- Safeguarding nests in order to prevent disturbing or poaching;
- Extending the photo identification study on juvenile green and hawksbill turtles in the coastal waters of Bonaire;
- Obtaining information on the foraging ecology of the juvenile green turtles in the Lac Bay area and the juvenile hawksbill turtles in the coral reefs around Bonaire and Klein Bonaire;
- Intensify the cooperation with local and regional non-governmental organizations (NGOs);
- Solicit the active support of the local business community of Bonaire in sea turtle conservation;
- Promoting public awareness of the importance of sea turtle conservation and legislation on Bonaire;
- Intensify environmental education for children by means of 'Turtuganan di Boneiru'.

II Research

2.1 Research on Land

2.1.1 Introduction

The STCB undertakes research in order to monitor the nesting activity of the sea turtles on Bonaire. The surveys are continued over the years because information on nesting activity is relevant only when nesting seasons have been monitored and recorded over an extended period of time. The information will give more insight in the population dynamics and the habitat characteristics of turtles which occur on Bonaire. With this knowledge, the STCB might be able to contribute to the directives of reef and coastal management. It will be assimilated in the conservation program of the STCB as well in order to execute the protection of sea turtles and their habitat as efficiently as possible. Therefore, a continuation of the monitoring studies of 1993, 1995 and 1996 was required.

2.1.2 Methods

Areas to be monitored

In order to examine the nesting activity of sea turtles on Bonaire, potential nesting beaches have been monitored on a regular basis since 1993 (table 1). Seventeen potential nesting beaches or areas on Bonaire main island are identified as such in former STCB projects. The nesting area on Klein Bonaire has been divided into four sectors: East Of No Name (EONN), No Name (NN), West Of No Name (WONN) and West Klein Bonaire (WKB). A second zonation within each sector is made: EONN is divided in five sectors, NN in three, WONN consists of little beaches numbered beach 25 to 17 and at WKB the numbering continues to descend from beach 16 to beach 1 (Valkering *et al.*, 1996) (see Appendix 2).

Potential nesting beaches which are not identified as such beforehand are added to this list every year. During the 1997 Project, Aquarium and La Machaca are added as potential nesting areas. On Bonaire main island a total of nineteen beaches are considered to be potential nesting beaches (see also Appendix 3).

Frequency

The project assistants have surveyed beaches on Klein Bonaire and on Bonaire main island 4 times each week from July to half October. During the period half October to December, the beaches have been monitored less frequently because low nesting activity is observed during these months (Valkering *et al.*, 1996) (see table 1).

Table 1. Habitat assessments and monitor schedule of potential nesting beaches on Bonaire and nesting activity

Nr.	Beach	Dimensions (l*w)	Monit. Freq.	Dynamics	Debris	Human Act.	Threats	Vegetation	Offshore Sit.	Early Act.	'97 Crawls
1	Playa Chikitu	110 x 20	1 x a week	high	moderate	low	hu, sea	bushes	sa; ro, waves	yes	none
2	Boka Chikitu	12 x 30	1 x a week	moderate	moderate	very low	cr	none	sa; fring; reef	unknown	none
3	Boka Catuna	10 x 4	1 x a week	high	very light	low	hu; cr; sea	none	sa; reef	yes	7, 6 nests
4	Wayaka	8 x 3	1 x a week	moderate	very light	low	hu; liz; sea	none	sa; fring; reef	yes	none
5	Playa Frans	33 x 10	1 x a week	low	light	high (settlement)	hu; do	low grasses	sa; reef	yes	none
6	Aquarium	10 x 4	1 x a week	moderate	moderate	low	hu; sea	none	sa; reef	yes	3, 1 old nest
7	Playa Nukove	10 x 3	1 x a week	low	very light	moderate	hu; cr	none	fring; reef	yes	none
8	Boka Dreifi	40 x 15	1 x a week	low	light	low	hu; cr; liz	bushes; cact.	reef	yes	none
9	La Machaca	3 x 2	1 x a week	low	light	high	hu; sea	none	sa; reef	unknown	2, no nests
10	Playa Lechi	90 x 10	daily update	low	light	high (settlement)	hu; do	none	sa; ro	yes	none
11	Harbour Village	75 x 10 (artificial)	daily update	low	very light	high (settlement)	hu	none	ro	unknown	none
12	Plaza Resort	60 x 8 (artificial)	daily update	low	very light	high (settlement)	hu	none	ro	no	none
13	Playa P. di M.	200 x 8	1 x a week	low	light	high	hu; do; liz	bushes; trees	sa; reef	yes	none
14	Punt Vierkant	20 x 5	1 x a week	low	light	high (settlement)	hu; do	none	sa; reef	yes	none
15	Pink Beach	450 x 7	3 x a week	high	light	high	hu; do; sea	none	sa; reef	yes	3, no nests
16	S.W.P.B.	4-10 x 2-4	3 x a week	moderate	light	low	hu; do; bi	low bushes	sa; reef	yes	none
17	Chogogo	15 x 5	1 x a week	moderate	light	moderate (settl.)	hu; do	none	sa; reef	yes	none
18	Scorbon Area	270 x 5	1 x a week	very low	moderate	high	hu; do	low bushes	sea grass; sa	yes	none
19	Lagun	84 x 10	2 x a week	moderate	heavy	moderate	hu	mangroves	sa; reef	yes	none
20	E.O.N.N.	1500 x 0-5	2-3 x a week	moderate	moderate	low	hu; cr; liz	bushes; trees	sa; reef	yes	26, 5 nests
21	No Name	530 x 7	4 x a week	moderate	light	high	hu; cr; liz; do	grass; bushes	sa; reef	yes	13, 5 nests
22	W.O.N.N.	4-15 x 2-5	1 x a week	high	very light	low	hu; cr; liz; sea	low bushes	sa; fring; reef	yes	none
23	W.K.B.	4-30 x 2-9	1 x a week	moderate	very light	very low	cr; sea	none	sa; reef	yes	none

hu = humans, cr = crabs, liz = lizards, do = dogs, bi = birds, cact = cactae, sa = sand, fring = coral fringe, ro = rocks

Beach Survey Procedure

During beach surveys, project assistants search for signs of turtle nesting activity. These mostly consist of a crawl with or without bodypits and/ or a nest. Usually a nest is quite well camouflaged. A turtle usually makes several bodypits, on Bonaire ranging from one to twelve bodypits during a crawl (Van Eijck and Eckert, 1994; Valkering *et al.*, 1996; Norde and Van Rossum, 1997).

When crawls, bodypits and/or nests are found during a beach survey, these traces of nesting activity are noted on beach survey data sheets (see Appendix 4). Also information on track width, symmetry or asymmetry of the track and whether the nest site has been disturbed or not is noted. From observation of the characteristics of the immediate environment of the crawl site, it is possible to make an assumption concerning the species involved. For example, a hawksbill turtle likes to nest in a bushy area, whereas a loggerhead turtle prefers more open sandy beaches (Pritchard, 1984).

The project assistants mark the crawl site in a way for them to relocate the site more precisely. After that, the nest site is usually disguised by wiping out the traces, in order to reduce the risk of poaching or purposefully damaging a (potential) nest.

When a (potential) nest is in danger of trample-stress, the STCB places fences. These fences are made up out of wire-netting. Sometimes a sign is placed next to it to give information.

Monitoring of Crawl Sites

The crawl sites found before are checked for disturbance during beach surveys as well. Approximately 55 days after a crawl has been found, the site is monitored more closely because hatching on Bonaire usually takes place between the 50th and the 60th day after nesting (Van Eijck and Eckert, 1994). A small incline in a bodypit could mean hatching has occurred and possibly hatchlings can be expected surfacing soon.

Excavation

After a witnessed hatching or when a period of at least 70 day has expired, excavation of the nest site takes place in order to locate and collect information on the eggs. When excavation of nest sites takes place immediately after a witnessed hatching or after a period of approximately ten days post potential hatching, excavation is done by hand. After a period of fifteen days or more has exceeded, excavation is done with the use of spades. At that time, no living hatchlings are present in the nest, so extra caution is not necessary.

During excavation, the precise location of the eggs as well as nest depth (in cm) and the depth of the most upper eggs (in cm) in the nest is recorded. Encountered dead hatchlings are counted. The total number of eggs is determined and the number of hatched eggs. From the non-hatched eggs, the phase during which development has stopped is determined.

The non-hatched eggs are subdivided into four phases: undeveloped eggs, small, mid and full term embryos. In undeveloped eggs no development whatsoever has taken place. The small, mid and full term embryos represent little, more and fully developed embryos respectively. These different developmental stages can be distinguished mainly by size and color. Eggs from which cannot be determined if they are mid or full term embryos (because of the state of decomposition) are noted as undetermined eggs. The non-hatched eggs can provide a decisive answer on species determination, and sometimes they shed more light on the cause of death (Valkering *et al.*, 1996).

When living hatchlings are encountered during excavation, they are placed on the beach for them to reach the sea by themselves. Carr (1986) and Grassman (1993) hypothesized that hatchling turtles imprint upon chemical cues unique to their natal beach. Supposedly, they use this infor-

mation as adults to return to that same beach for nesting and mating. If the hatchlings are not able to crawl to the sea, the hatchlings are taken home for feeding and observation. When they are considered strong enough, they are released on the beach were they were found.

Statistics

Differences in nest figures (such as number of eggs, hatching success, number of eggs in different developmental stages, etc.) between individual nests of different species (interspecific) or between individual nests within a species (intraspecific) were tested for significance by means of analysis of variance (ANOVA) if the condition of this test was fulfilled. I.e., if, according to the test of Bartlett, the variances were homogenous. When the variances were still heterogeneous also after transformation (log, ln, inverse and square), a distribution free Kruskal-Wallis one-way ANOVA was used in order to show significance of differences. For all tests, a cross value of 5% was used.

2.1.3 Results

Temporal Distribution

Turtle nesting activity was found on small scale from late April (week 17) onwards to November (week 44). As in former years, a peak of activity is found in July and August (week 27 to 35). From half September to December (week 38 and further on) nesting activity decreases to nearly zero (as in December) (see figure 1).

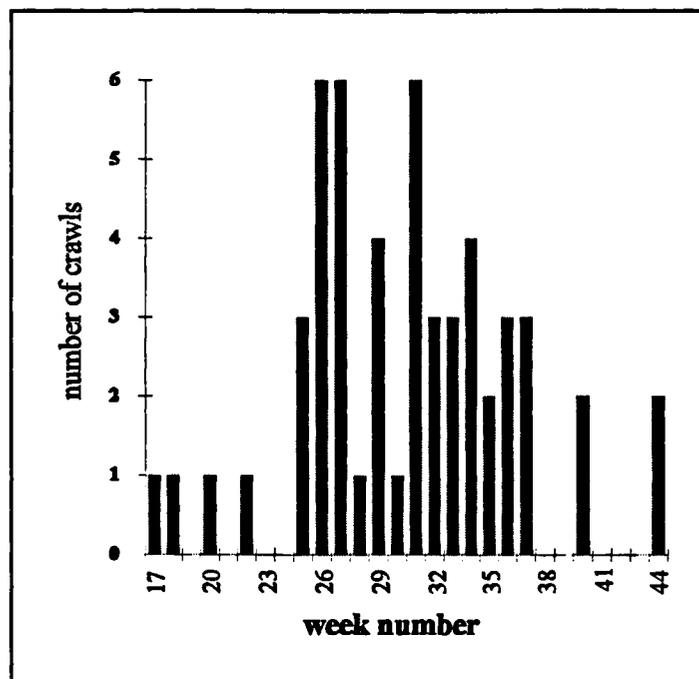


Figure 1. Temporal distribution of crawls in 1997

Number of Crawls and Nests and the Spatial Distribution

From the period April 1997 till December 1997 a total number of 54 crawls has been found

(Appendix 5). Due to time shortage, only 35 of the total of 54 reported crawls have been excavated. The crawls were usually excavated in order of discovery. Of the 35 crawls which have been excavated, 13 contained eggs (37.1% nesting success). Three more nests have been recovered, which were in all probability old nests and not from this year. These are not included in the calculations.

Of the 19 remaining crawls which were not excavated, a number of 7 nests (37.1% of 19) is expected. I.e., when a similar nesting success of 37.1% is assumed as was found for the 35 crawls. This would add up to a total of approximately 20 nests made in 1997.

Figure 2 shows the spatial distribution of the crawls on Bonaire and Klein Bonaire. The left side of the figure depicts the (four) crawl sites on Bonaire main island. The crawl sites (eight) reported on Klein Bonaire were put in the right hand of the figure.

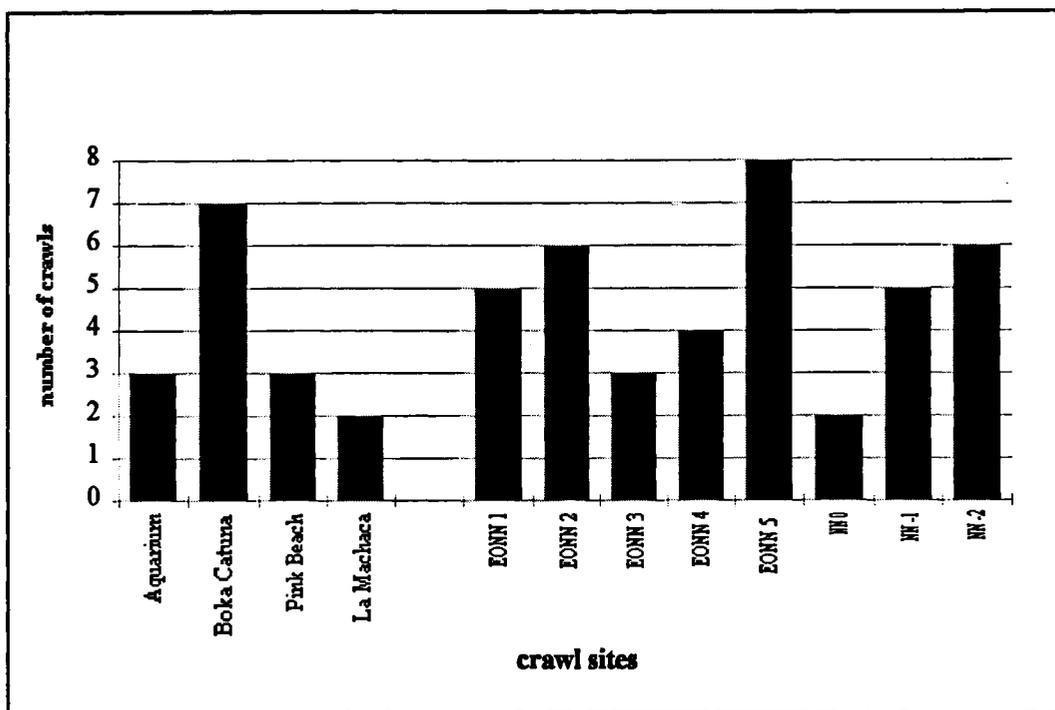


Figure 2. Spatial distribution of crawls in 1997

No signs of turtle activity were found on WONN and WKB at all. Turtle activity on Klein Bonaire was concentrated on EONN (26 crawls) and NN (13 crawls).

Nest Information

Thirteen nests made in 1997 have been excavated. The nesting figures of these nests are shown in table 2. The nests can be divided into seven loggerhead nests and six hawksbill nests. Only six of the total seven loggerhead nests are assimilated in the calculations and graphs because one loggerhead nest was poached and consequently not much information was obtained. Figure 3 and figure 4 show the average reproductive success of the six loggerhead and six hawksbill nests respectively.

Table 2. Excavated nests

EIT=estimated incubation time (days); Und=undeveloped eggs; Small=small term embryos; Mid=mid term embryos;
 Full=full term embryos; Undet.=undetermined mid or full term embryos; H. shells=successfully hatched shells;
 Total=total number of eggs in nest; H%=percentage of eggs that hatched successfully;
 delta S=(hatched shell-dead hatching)/hatched shells; Potentially corrected delta S=emerging success

Nr.	Date	Hatched	Excav.	EIT	Location	Sp.	Und	Small	Mid	Full	Undet.	Dead	Alive	H. shells	Total	H%	delta S	Pot.cor. delta S	Depth	Remarks
1	28-5-97	28/29-7-97	1&3-8-97	61	NN-1	Ei	8	4	2	54	0	3	11	72	140	51,4	49,3%	41,4%	15-48	nesting at noon, trample stress, hatching over couple of nights
2	19-6-97	-	17-8-97	-	Boka Catuna	Cc	-	-	-	-	-	-	-	-	-	-	-	-	-	poached!?, eggs found on nest every survey
3	25-6-97	-	6-9-97	-	EONN 1	Ei	15	0	5	3	2,5	6	0	106	148	71,6	67,6%	67,6%	-	little eggs found, many coral stones
4	28-6-97	-	17-9-97	-	EONN 4	Cc	10	1	1	0	4	16	0	46	62	74,2	48,4%	48,4%	-	little eggs found, many coral stones
5	30-6-97	-	17-9-97	-	Boka Catuna	Cc	9	4	5	-	14	3	0	92	124	74,2	71,8%	71,8%	-	-
6	18-7-97	-	20-25/7-9-97	± 60	Boka Catuna	Cc	9	3	16	40	10	1	1	14	92	15,2	14,1%	13%	-	flooding
7	19-7-97	-	7-10-97	-	EONN 5	Ei	22	3	20	2	59	0	0	53	159	33,3	33,3%	33,3%	15-40	many wind eggs
8	19-7-97	-	23-9-97	± 60	NN 0	Ei	4	0	1	3	2	11	2	141	151	93	86%	84,8%	20-60	nesting from 0:00-1:20h
9	31-7-97	28-9-97	1-10-97	60	NN-1	Ei	4	2	5	0	0	3	0	139	150	92,7	90,7%	90,7%	-	3-11 & 15-11 egg shell on nest, nothing found after re-digging
10	29-7-97	-	7-10-97	55-65	NN-2	Ei	3	0	62	54	19	12	2	14	152	9,2	1,3%	0%	15-52	cause of no success unknown
11	2-8-97	-	5-11-97	-	Boka Catuna	Cc	15	1	9	2	3	7	0	128	158	81	-	-	51	many hatchlings in state of decomposition (#?)
12	9-8-97	-	15-10-97	± 60	Boka Catuna	Cc	0	1	59	0	11	0	0	8	79	0,1	-	-	-	flooding
13	1-11-97	old	1-11-97	-	EONN 3	-	-	-	-	-	3	-	0	143	146	-	-	-	55	old nest, 30cm next to it another chamber
14	1-11-97	old	1-11-97	-	EONN 3	-	-	-	-	-	-	-	0	41	41	-	-	-	35	old nest, 30cm next to it another chamber
15	11-11-97	old	11-11-97	-	Aquarium	-	-	-	-	-	18	-	0	98	116	-	-	-	50	old nest
16	-	16-8-97	17-8-97	-	Boka Catuna	Cc	24	8	5	5	0	5	4	74	121	61,2	57%	53,7%	-	-

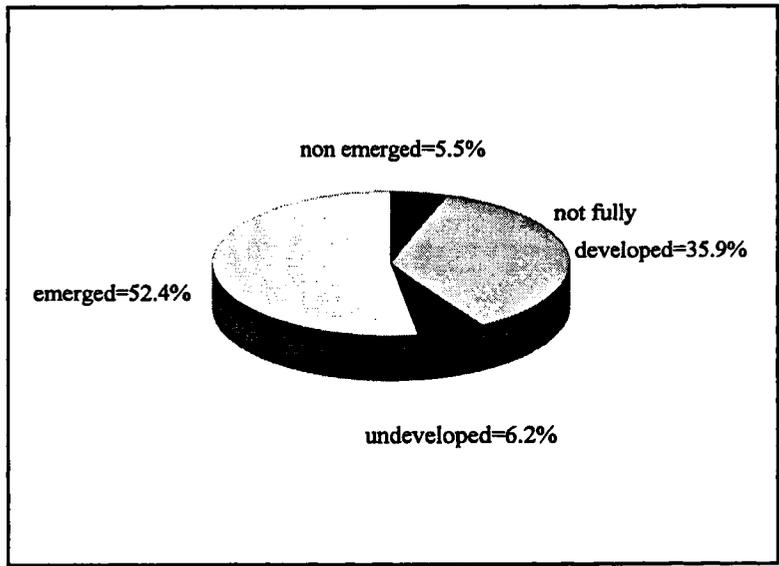


Figure 3. Loggerhead turtle reproductive success (6 nests containing a total of 636 eggs)

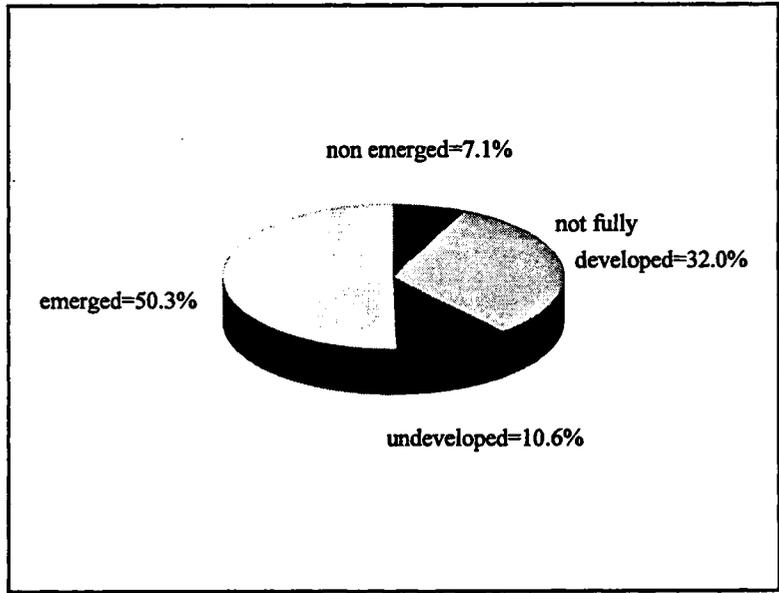


Figure 4. Hawksbill turtle reproductive success (6 nests containing a total of 900 eggs)

The 'not fully developed eggs' from both species take up a large percentage of the total nest figures (see figure 3 and figure 4). Table 3 shows the average number of 'not fully developed eggs' subdivided into: number of small term, mid term and full term embryos and number of undetermined eggs (see section 2.1.2, *Excavation*).

Table 3. Average nest figures of loggerhead (n=6) and hawksbill (n=6) nests. Small, mid and full are increasing embryonic developmental stages. From undetermined embryos it cannot be determined whether they are mid or full term embryos. Total is the number of eggs. H% is the hatching percentage with max. and min. percentages.

species	small	mid	full	undetermined	total	H%	max H%	min H%
loggerhead	3	15,8	7,8	7	106	51%	74%	0%
hawksbill	1,5	15,8	19,3	17,5	150	59%	91%	1%

The number of small term embryos, mid term embryos, full term embryos and undetermined embryos is not significantly different between the two turtle species ($p=0.113$, $p=0.579$, $p=0.634$ and $p=0.553$, respectively). Intraspecific variances in these nests figures are homogenous. Hatching success is no different between species ($p=0.573$). Though, the average total number of eggs does seem to differ interspecifically ($p=0.037$); the average hawksbill nest contains almost 1.5 times as much eggs.

2.1.4 Discussion

Aborted Nesting Attempts

The tracks of aborted nesting attempts are often and erroneously called "false crawls" (Pritchard, 1983). The crawl is real; the nesting attempt was aborted for some reason, albeit usually unknown (Lutz and Musick, 1997). The turtle usually returns to nest the same night or the following night and most return to the same beach (Limpus *et al.*, 1984; Limpus, 1985). The term 'aborted nesting attempt' will be used in this report.

Of the 35 crawls which have been excavated during this year's project, 13 contained eggs. Thus, the ratio aborted nesting attempts is $13:35 = 1:2.7$ (37.1% nesting success). This matches the ratios found in literature (1:1 to 1:3) quite well (Bjorndal *et al.*, 1985; Ryder *et al.*, 1989).

Spatial Distribution

Klein Bonaire is the major nesting area for Bonairean sea turtles. Less disturbance by humans, dogs and cats, no exploitation of the coastal area in the form of hotels, bars or roads and the unspoiled character in general are thought to be reasons for Klein Bonaire being the most important nesting area.

On Bonaire main island, most crawl sites are situated in areas with little prevailing human activity. Boka Catuna in Washington-Slagbaai National Park and Aquarium on the north-west side of Bonaire were this year's relatively undisturbed, suitable nest sites on Bonaire main island.

Surprisingly, a turtle sporadically comes ashore on Bonaire main island on a site that is considered to be less suitable. In 1996, a nest was reported on a beach in front of Harbour Village Resort. This year, two tiny beaches at La Machaca in front of some villa apartments were visited by sea turtles. Unfortunately, the attempts were unsuccessful.

Also on Pink Beach, turtle nesting activity was reported. Although Pink Beach is the most popular beach on Bonaire and regularly visited by many tourists as well as Bonaireans, the project assistants reported three crawls. However, after excavation of the crawl sites it was supposed that none of the crawls were successful. Thus, turtle activity does occur on sites which are characterized by frequent human activity, although attempts usually turn out to be unsuccessful.

Specific Distribution

The nesting activity of turtles of different species tends to be distributed in typical ways. Hawksbill turtles like to nest in or nearby bushes (Ryder *et al.*, 1989) while loggerhead turtles prefer more open sandy beaches (Pritchard and Trebbau, 1984). Consequently, loggerhead turtles are found both on Bonaire main island and Klein Bonaire while hawksbills are found almost exclusively on Klein Bonaire (Van Eijck and Eckert, 1994; Valkering *et al.*, 1996; Norde and Van Rossum, 1997).

Estimating Size of Nesting Population

In order to make an estimation of the size of the nesting population that was active on Bonaire this year, the beach monitoring data is analyzed. Information on the temporal and spatial distribution of crawls, the species (mostly derived from nest remnants) and track characteristics is used to distinguish different individual nesting turtles.

Within each nesting period three to four nests per loggerhead female turtle are made and two to five nests per hawksbill female turtle (Hirth, 1980; Dodd, 1988; Van Buskirk and Crowder, 1994). For loggerhead turtles, there is a period of twelve to sixteen days between each successful nesting attempt (Hughes and Mentis, 1967; Caldwell, 1962). The interesting period for hawksbill turtles varies from thirteen to fifteen days (Witzell, 1983).

On Bonaire, four different crawl sites have been distinguished. These crawl locations were far remote from each other (varying from Pink Beach on the south-west side of Bonaire to Boka Catuna in the far north of Bonaire). Different individual adult female turtles could be assumed.

One of these female turtles is certainly known to be a loggerhead turtle. The other three turtles are thought to be loggerheads too, because during former STCB-projects (Van Eijck and Eckert, 1994; Valkering *et al.*, 1996; Norde and Van Rossum, 1997) on the main island, almost exclusively loggerhead turtle nests have been recorded.

On Klein Bonaire, it is more difficult to determine how many female turtles were active, because the nest sites are less far apart. However, with use of the other information on reproductive behavior of sea turtles (described above), a number of seven individual female turtles is estimated.

On NN, two turtles must have been active. The first crawl on this site was found late May and the last in early November. A nesting season of an individual loggerhead or hawksbill turtle does not extend over five months, which makes the involvement of more than one turtle plausible.

On EONN sector 1, temporal distribution suggests two nesting turtles as well. One crawl was found in late April and the following crawl was reported in late June. The interesting period from a hawksbill or loggerhead turtle usually is not as long as two months. Though it cannot be excluded that nesting attempts were not recorded because no project assistants were present until the beginning of June. The beaches on Klein Bonaire were surveyed by volunteers only once a week in early spring.

On EONN sector 4, one nest is identified as a loggerhead turtle nest by means of hatchlings. Another crawl is thought to be from a hawksbill turtle by having studied the characteristics of the immediate environment. Besides this, a great difference in track width between the crawls was recorded (50 cm for the loggerhead turtle and 75 cm for the hawksbill turtle).

Finally, in sector 5 of EONN, a rather steady interesting period of approximately fourteen days suggests an individual turtle.

An estimation of seven nesting turtles on Klein Bonaire is made. Of these seven nesting turtles, one is known to be a loggerhead turtle and three are identified as hawksbill turtles (by means of nest remnants).

The estimated size of the nesting population on Bonaire is eleven turtles (four on Bonaire main island and seven on Klein Bonaire). During former years, the STCB estimated a number of nesting

females visiting Bonaire per year of five to fourteen.

Comparing Results with Former Years

Number of Crawls

When the number of crawls reported over the years is compared, the high number found in 1996 (Norde and Van Rossum, 1997) is noteworthy (figure 5). It must be stressed, however, that the number of crawls reported in 1993 might not be the actual number, because not all potential nesting areas were identified as such yet. WONN and WKB for example were not monitored, it might be very well possible that no or just a little nesting activity was going on at WONN and WKB in 1993 as was the case in 1996 and 1997 (see table 4).

Furthermore, the importance of low scale monitoring of the beaches during early spring (April and May) has been demonstrated this year through the work of two volunteers, Imre Esser and Bart Snelder. They took over the beach surveys on Klein Bonaire at the end of the STCB Project 1996.

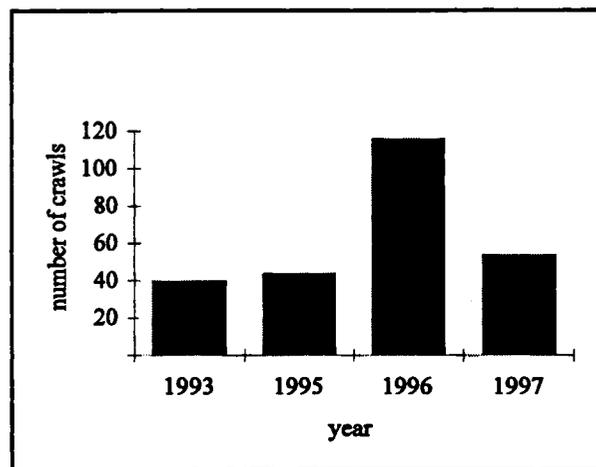


Figure 5. Number of crawls per year

Striking differences in yearly nesting activity are not unusual when dealing with small population sizes (Van Dam, 1997, pers. comm.). Very important in this is the nesting cycle, which is characteristic for sea turtles. The duration of the period between reproductive seasons is defined as the remigration interval (Limpus, 1985). The mean remigration interval of loggerhead and hawksbill turtles is two to three years (Hirt, 1980; Dodd, 1988; Van Buskirk and Crowder, 1994). This makes it impossible to compare one year with the last year or the following year.

Spatial Distribution

Broadly outlined, the spatial distribution of this years crawls is typical for Bonaire; most crawls are made on Klein Bonaire and a smaller part is made on Bonaire main island (table 4). The yearly differences in preference of crawl sites within this distribution is thought to reveal that Bonairean sites are not randomly picked, or judged on their quality each year (Norde and Van Rossum, 1997).

Table 4. Spatial distribution of crawls found over '93, '95, '96 & '97

Distribution	1993	1995	1996	1997
EONN	55%	7%	49%	48%
NN	22.5%	16%	27%	24.2%
WONN+WKB	no data	66%	6%	0%
Bonaire	22.5%	11%	18%	27.8%
nr. of crawls:	40	44	116	54

However, because some crawl sites are highly dynamic (see table 1, section 2.1.2), this idea should be reconsidered. Even more so, four years of research cannot yield enough data to hypothesize on the site fidelity of Bonairean nesting turtles.

Comparing spatial distribution of nesting activity throughout the years is rather complicated. The remigration interval of individual turtles may differ. The remigration period for hawksbill and loggerhead turtles varies from two to five years (Hirth, 1980; Dodd, 1988; Van Buskirk and Crowder, 1994). Therefore, research must focus on the temporal variation in activity at specific sites, rather than comparing the overall figures of Bonairean nesting seasons.

Recorded temporal patterns in spatial distribution of nesting activity becomes more relevant when it is combined with a mark-recapture program, genetic fingerprinting or tagging experiments. This way, individual differences in remigration intervals can be detected and assimilated in a temporal spatial distribution model.

On Bonaire, the STCB has started documenting individual adult sea turtles through a photo identification survey (see section 2.4) in 1995 (Valkering *et al.*, 1996). The preliminary results are promising, and the program is expected to shed more light on site fidelity of nesting turtles in the long run.

Aborted Nesting Attempts

In 1995, an aborted nesting attempts ratio was reported similar to the ratio that was found this year, 1:2.7. Both in 1993 and in 1996, the STCB reported a high ratio, 1:6.7 and 1:7, respectively.

It is tempting to attach conclusions to the similarities found in the years 1993 and 1996 as well as the similarities found 1995 and 1997. Though, lack of knowledge about intraspecific differences in the number of aborted nesting attempts makes conclusions irrelevant. Besides, yet too few years of research have been conducted.

Nest Information

The enormous interspecific differences in the average number of eggs in nests found in 1997 does not seem to be a trend. When looking at other years, no such thing is found (table 5). Nonetheless, the small average number of eggs per nest found for loggerhead nests is curious. It can partially be explained by flooding; eggs have been washed away by the sea.

Table 5. Average number of eggs in loggerhead and hawksbill nest in 1993, 1995, 1996 and 1997
(n=number of nests)

species	1993	1995	1996	1997
Loggerhead	130 (n=3)	144,8 (n=6)	133,3 (n=8)	106 (n=6)
Hawksbill	89 (n=2)	147,8 (n=4)	145 (n=5)	150 (n=6)

Information on the developmental stage of the non-hatched eggs can be very important. When a high percentage of non-hatched eggs in a certain development stage is found, it can elucidate *when* certain unfavorable circumstances have occurred. The disadvantageous conditions might even be determined in this way (Valkering *et al.*, 1996). Thus, with the nest information there is a better chance to explain low hatching successes.

When the average hatching success encountered in 1997 is compared with former years, a similarity with 1995 is notable. In both years, average hatching success was quite low: 56% (n=12) in 1995 and 54.8% (n=12) in 1997, as compared to 82.8% (n=6) and 70% (n=15) in 1993 and 1996 respectively.

The anticipated low percentages of hatched eggs in 1997 turned out to be mainly caused by unfavorable environmental circumstances. For example, a number of loggerhead nests on Boka Catuna has hatched very badly because of flooding by the sea (see section 2.1.3, table 2). Not surprisingly, beaches were subjected to a relatively high level of flooding in 1995 as well (see Valkering *et al.*, 1996).

2.1.5 Recommendations

Excavation of Nest Sites

It is very important that all the crawl sites are excavated. Much valuable information on the nesting population is obtained by means of this procedure. However, it is a very time consuming occupation and after (potential) hatching of the nest, excavation should take place with little delay. This did not pose a problem during former STCB-projects.

However, this year the project assistants did not manage to excavate all crawl sites. The occupations of the project assistants are more and more comprehensive. In order to prevent for crawl sites not being excavated in the future, it might be a good idea that project assistants are assisted on a regular basis. This would mean that volunteers must be gathered and trained by the project assistants in order to be able to excavate crawl sites. When one project assistant is present during crawl sites excavation (they have knowledge on exact crawl site locations), unnecessary damaging of the crawl site can be prevented.

This year especially Imre Esser (now on the board of the STCB) was of great assistance during excavation of crawl sites on Klein Bonaire. Also other people showed interest every now and then and joined the crawl site excavation.

It must be stressed that more precise criteria should be set for the determination of the development stage of embryos. This should make the gathering of nest information by different volunteers or other sea turtle conservation organizations more relevant.

Poaching

Every now and then, the STCB receives signs that poaching of turtles still occurs. The scale on which this harvesting occurs is unknown. It would be interesting and important to assess to which extent turtle poachers are still active. Only then it can be determined what must be undertaken to

try to repel this.

In order to get information on poaching, school children from primary and secondary schools could be questioned. This could be done in the context of a biology class on turtles. At this very moment, an education-kit on sea turtles is being composed by the STCB.

Children could be asked if they have ever eaten turtles or their eggs and if so, how often. This information would certainly not be used to try to catch perpetrators, but it can be used to estimate the level of poaching and to determine whether extra attention must be given to this subject in an educational public awareness campaign.

Areas to be monitored

Every year, potential nesting beaches are discovered and added to the survey schedule. This means that in former years, these sites were not monitored and no nesting information was obtained. In order to collect all the yearly information, a survey along the shore line of Bonaire should be made. It should be done on a yearly basis due to the high dynamics of certain beaches on Bonaire. A combination of boat and car surveys is suggested. The East side might best be monitored by car and on foot because of the roughness of the sea. Beaches which are considered to be suitable for turtle nesting activity should be monitored on a regular basis.

Similarly, since in recent years nesting attempts have been observed on hotel beaches, personnel of hotels with potential nesting beaches should be educated on nesting attempts. They should be taught how to deal with any activity on their beaches.

Lagun should get more attention during beach surveys. During this year's STCB project, only one side of Lagun was monitored. Though polluted, some beaches around Lagun could provide turtles with suitable nesting places. In July 1993, the STCB recorded an aborted nesting attempt of a hawksbill turtle. In November 1995, a juvenile hawksbill turtle was found stranded on Lagun Beach. During this year's project, the project assistants were informed of egg poaching which supposed to have happened at Lagun. This calls for more thorough surveys in the Lagun area.

2.2 Research at Sea: the Sighting Network

2.2.1 Introduction

The research on the population dynamics of the Bonairean juvenile sea turtles is largely performed through a sighting network. This sighting network, which is initiated in 1993 in cooperation with the dive shops, is a great source of information on the resident turtles (van Eijck, 1994; Valkering et al., 1996; Norde and van Rossum, 1997). The accumulation of data over the years increases the understanding of the Bonairean juvenile sea turtles.

2.2.2 Methods

Turtle sightings were reported by dive tourists and dive instructors through filling in a special sea turtle sighting sheet, which is available at every dive shop on Bonaire. Since 1995, so called Turtle Corners are placed in every dive shop in Bonaire. This Turtle Corner consists of a folder rack with a sign on it, that requests the divers to report a sighted turtle by means of the sighting network (Valkering et al., 1996). The folder rack contains the special turtle sighting sheets which comprise questions like the habitat, the species, the whereabouts, size, depth and activity of the turtle (see Appendix 6). The participation of the dive shops and dive instructors on Bonaire is in general very high. Often, the sighting network is mentioned during the dive courses or instruction dives. The STCB provides the dive shops with new sighting sheets by visiting the shops once a week and replacing the completed sheets with new ones.

2.2.3 Results

A total of 1306 sighting sheets was collected in this year's project. The sheets contained 1554 sightings. This means that there were 248 sheets (19%) on which more than one turtle was reported. The project assistants started collecting the sheets in June. Prior to this, there was a period of 6 months, during which no STCB project assistants were present on the island. Still a total of 500 sightings was reported. In this way, information from the whole year was available. Of the 1306 sheets there were 90 sheets of the former year. These data are not included in the 1997 results presented in this report.

Through the sighting network, information about juveniles and adults is collected. In total almost 4% of the sightings (54 sightings) regarded turtles larger than 100 cm, which are believed to be adults and are analysed separately. Figure 6 depicts the size distribution of sea turtles sighted in 1997.

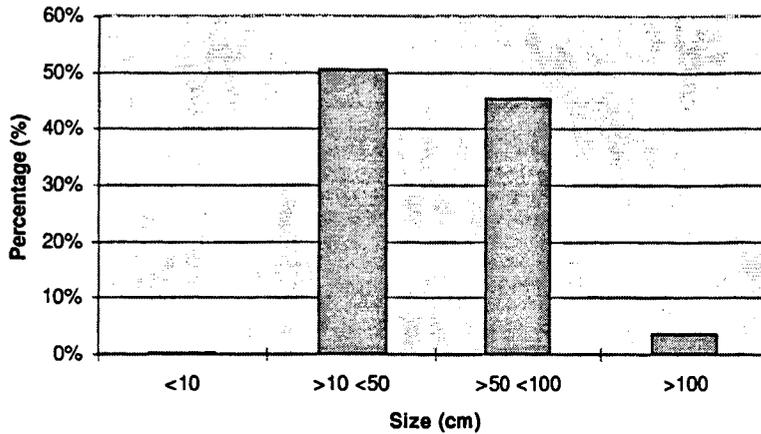


Figure 6. Size distribution of sea turtles sighted in 1997 (n=1464). Sighting network data.

Results Juvenile Sea Turtles

Species Distribution

In total 1410 sightings regard juvenile sea turtles, 59.6% are reported as hawksbill turtles (*Eretmochelys imbricata*), 19.4% as green turtles (*Chelonia mydas*), 2.3% as loggerhead turtles (*Caretta caretta*) and 0.1% as leatherback turtles (*Dermochelys coriacea*). Not identified are 18.6% of all sighted turtles (Unknown) (Figure 7).

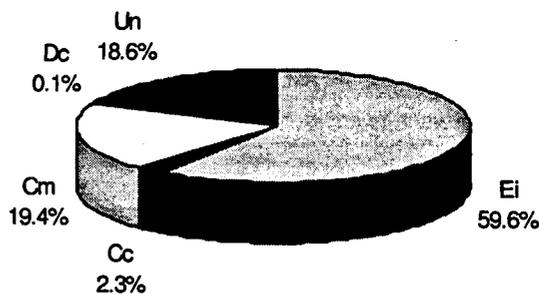
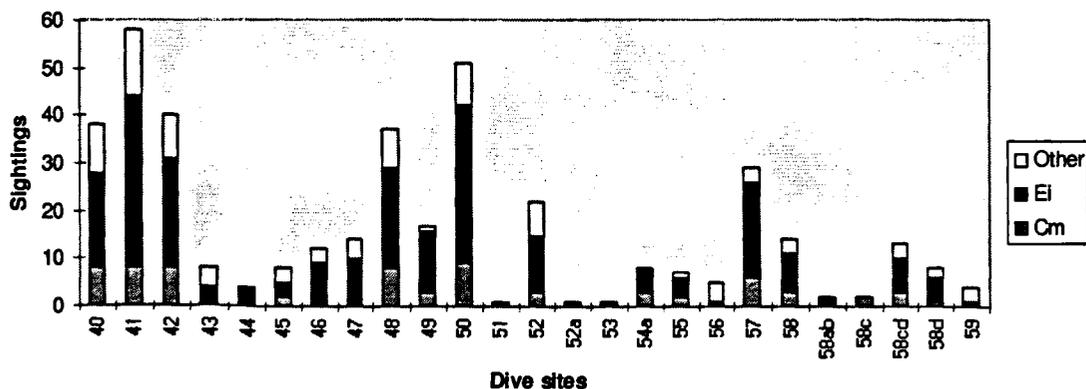
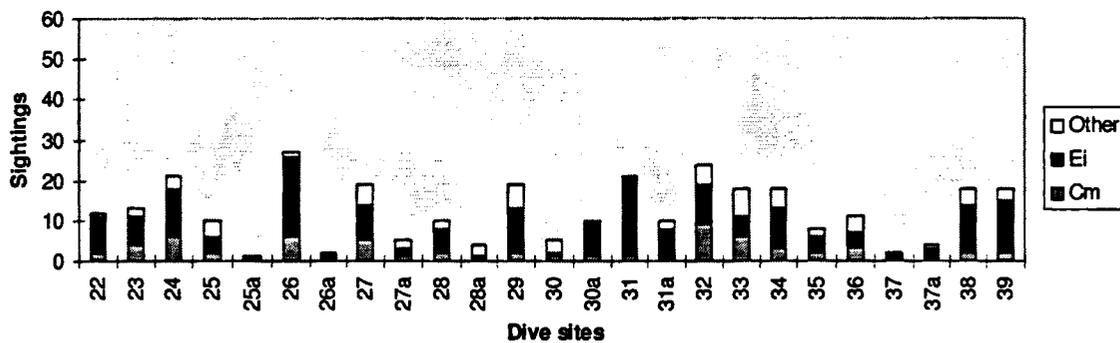
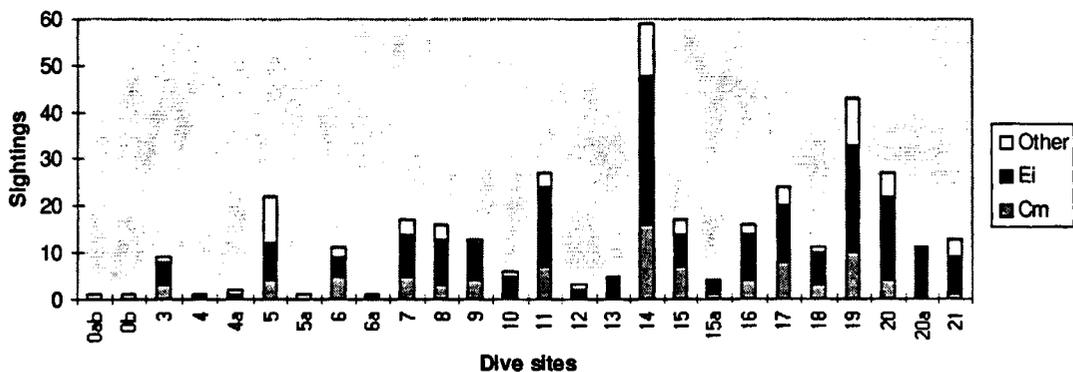


Figure 7. Species distribution of sighted turtles smaller than 100 cm in 1997 (n=1410). Sighting network data.

Spatial Distribution

Since on Bonaire the green and the hawksbill turtle reside as juveniles (Sybesma, 1992; van Eijck and Eckert, 1994), and other species in the juvenile length class (smaller than 100 cm) are observed infrequently (Valkering et al., 1996), the latter are not expected to account for 21% of the total number of sighted turtles. In the following results these sightings are therefore taken together in the group 'other'.

The information gained through the sighting network, especially concerning the spatial distribution of turtles, is influenced by several factors. First of all, the information depends on the distribution of the sea turtles itself. Secondly, the distribution of the divers over the different dive sites is also of main importance (Van Eijck and Eckert, 1994). The information should be corrected with the frequency that dive sites are visited and by the number of divers. Unfortunately, this information is not available so the data cannot be corrected for this bias. Figure 8 represents the spatial distribution of juvenile sea turtles.



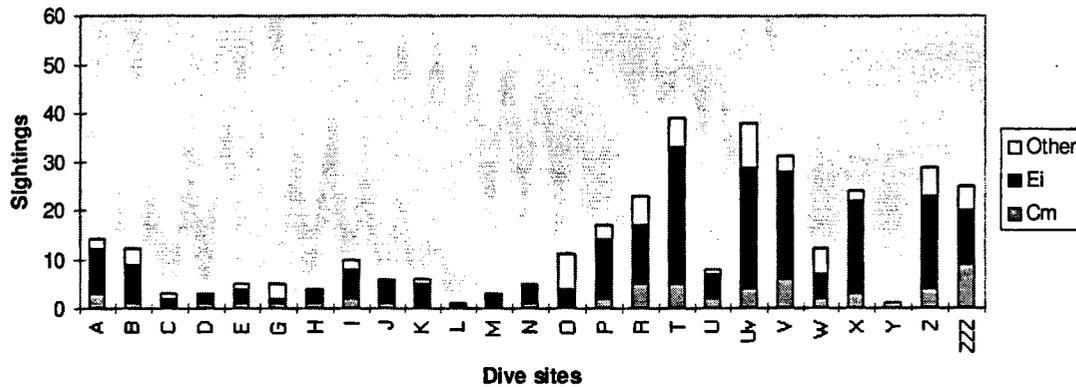


Figure 8. Number of sightings of juvenile turtles per dive site in 1997 (n=1410). Sighting network data.

The dive sites correspond with the numbers in Appendix 7.

The density of the spatial distribution of juvenile sea turtles on Bonaire is the highest on the dive sites 1000 Steps, Angel City and Pink Beach. Around Klein Bonaire, the highest density is on the dive sites Mi Dushi and Yellow Man.

From these data can also be determined if there is a difference in species distribution in relation to geographically distinct areas (Norde and van Rossum, 1997). To make the comparison between the dive sites, these are clustered in 5 different more or less equally sized geographic regions. In these regions, the species distribution is determined. The following areas are distinguished on basis of habitat characteristics (see Appendix 7 for locations of areas):

- 1) Northwest area: Dive site 1-15, high density of head corals, low human impact.
- 2) West area: 15-45, less coral coverage, high coastal development, high diving frequency.
- 3) Southwest area: 45-58, high soft coral density, low coastal development.
- 4) East area: 58-60, sea grass beds, less coral coverage, windward side, high hydrodynamics, low coastal development, low diving activity.
- 5) Klein Bonaire area: A-Z, high coral density and diversity, no coastal development, high diving activity.

(Habitat characteristics based on Van Duyl, 1985).

From the dive sites that are clustered, the total number of hawksbill and green turtles is computed (Table 6). For these species, the ratio is calculated per area but also in total. The other sightings in the areas are considered to be false, because the other species are not considered to be there as juveniles. Although these data are in the table they are not used in this calculation. The column 'others' is represented in the table to clarify the ratio in the different areas between the different species.

Table 6. Numbers of sighted turtle species for different areas (n=1385). Sighting network data.

<i>Area</i>	<i>Ei</i>	<i>Cm</i>	<i>Total</i> <i>(Cm+Ei)</i>	<i>Ei/Cm</i>	<i>Others</i>
<i>Northwest (n=193)</i>	107	48	153	2.23	40
<i>West (n=624)</i>	369	123	492	3.00	132
<i>Southwest (n=213)</i>	131	39	170	3.36	43
<i>East (n=43)</i>	22	10	32	2.20	11
<i>Klein (n=310)</i>	200	45	245	4.44	65
<i>Total (n=1385)</i>	829	265	1094	3.13	291

Obvious from this table is that in every region there are about an equal number of green turtles reported as there are undetermined or other species. Also it becomes clear that not every area has an equal number of sightings reported.

Activity

In figure 9 the activity of the sighted juvenile turtles is represented. Of the sighted turtles, 13.2% was resting, 0.4% was mating, 74.3% was swimming and 12.1% was eating. The six reports of the mating turtles were all on the same day, the same dive site and with the same dive instructor. From this, it can be concluded that each group of divers saw the same two turtles mating. Pictures from this event were taken by the divers.

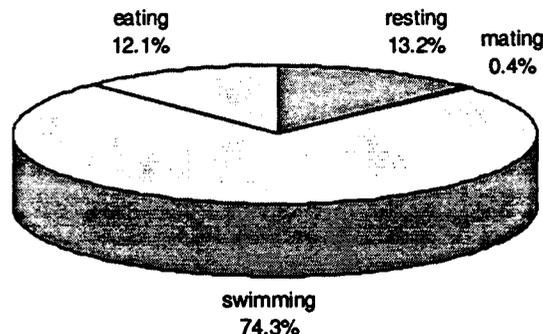


Figure 9. Activity distribution of juvenile sea turtles sighted in 1997 (n=1410). Sighting network data.

From the 189 turtles reported eating, 70.4% were hawksbill turtles and 14.8% were green turtles. The main reported diet of the 133 hawksbill turtles was coral and algae (sometimes reported as algae in or around coral). The 28 green turtles reported eating, mainly ate coral and only 1 was reported as eating seagrass. Juvenile green turtles are omnivorous animals. When the turtles grow older they develop a diet mainly based on sea grass. Figure 10 shows the specific feeding information from the hawksbill and green turtles. During the 1997 project, the STCB has initiated pilot studies on the feeding behaviour of green and hawksbill turtles (see section 2.5).

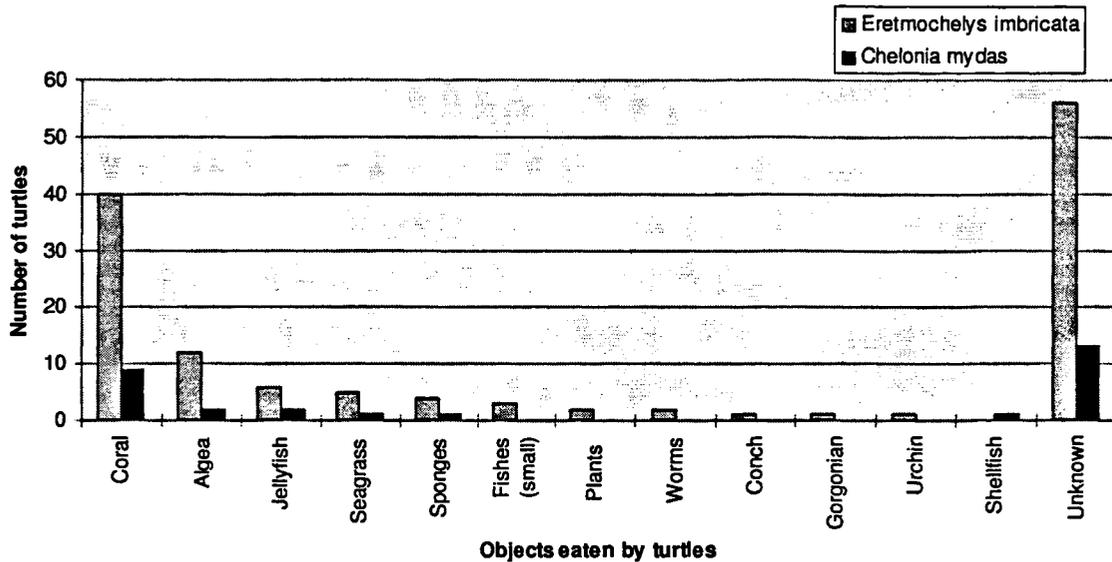


Figure 10. Objects juvenile sea turtles were eating. Sighting network data.

Depth Distribution

The preferred habitat depth is preferably measured on turtles which are resting, mating or eating. Swimming turtles can be either ascending or descending, making the assessment of the depth of occurrence increasingly difficult. As a result, the depth at which turtles are reported, may not be representative for its preferred habitat depth. Therefore only resting, mating or eating are taken as a measurement for the preferred habitat depth. Figure 11 depicts the depth distribution of juvenile sea turtles.

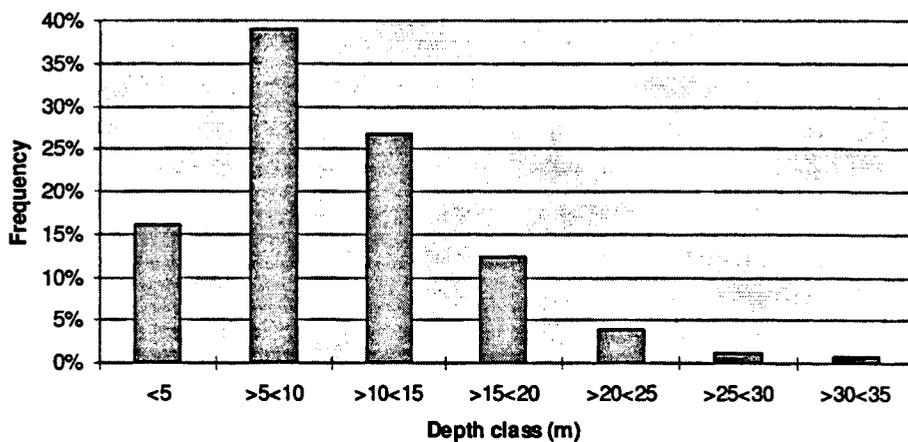


Figure 11. Depth distribution of juvenile sea turtles resting, mating or eating (n=381). Sighting network data.

It appears that the most preferred habitat depth is between 5 meters and 10 meters. A total of 149 (39.1%) sightings regarded turtles in this depth range. The average depth the juvenile turtles prefer

to reside in is about 9,5 meters. When hawksbill (245 sightings) and green turtles (66 sightings) are compared, it appears that from both species most of the turtles prefer to reside between the 5 and 10 meters, respectively 38.0% and 40.9%.

The average depth for the hawksbill turtle is 9,6 meters and for the green turtle 10,6 meters.

Injuries

During the 1997 project, two dead turtles were found, one at Spelonk and one at 1000 steps. One of the turtles seemed to have been entangled and was already in a state of decomposition. The other dead turtle was reported by a volunteer of the STCB. The species of both turtles is not clear because the turtles could not be recovered for further examination.

In total, 36 reports of injured turtles were made. In some occasions turtles were observed at different dive sites. Thus, the sighting sheet network provides the STCB with an additional tool to monitor the dynamics of individual sea turtles in time. Table 7 presents a global survey of the injuries reported. Specific information about dive sites, dates and species is given in Appendix 8.

Table 7. Observed injuries. Sighting network data.

<i>Injury remarks</i>	<i>number of sightings</i>
Right front flipper (mostly) gone	10
Damaged shell	7
Missing part of left flipper	6
Caught in cable or fishing line (+/- hook)	4
Right edge indentation	4
Turtle stuck in coral	1
Almost dead hatchling	1
no comment on injury	3

When the locations of the sightings are compared, a pattern can be found for some turtles.

In total, ten sightings were of turtles with missing a right front flipper. Seven of these sightings are in each other's presence from Larry's Liar to Alice in Wonderland to Angel City. The dates of the sightings are from the 24th of November to December the 29th. All the sightings except one are from hawksbill turtles, which probably means that the one green report is a false identification. It can be assumed that these seven reports regard the same turtle. The other three reports are all at non successive places and, though these reports could also be about the same turtle, it is not made clear enough to state this.

The remark of the damaged shell is harder to interpret, because the actual kind of injury is difficult to notice. The shell can have an indentation, it can be damaged by a propeller or a boat, or the shell can also miss a plate. Assumed that the turtles have the same kind of injury, two hawksbill turtles can be identified. One of the two turtles swims around Klein Bonaire, it has been seen at Captain Don's Reef, Rock Pile and Joanne's Sunchi. Even Jerry's Jam at the other site of Klein Bonaire. The other turtle with the damaged shell is seen twice around Bonaire, at Alice in Wonderland and Salt City. Though the sighting data from both turtles are weeks apart, it can be assumed that these

reports regard two turtles, spotted respective five and two times.

From January on, a turtle with a piece of the left rear flipper missing was reported six times. The first four reports were at the dive sites Pink Beach, Invisibles, Tori's Reef and Vista Blue. Though a time lapse occurs between the first three sightings and the last one, it is quite possible that the same turtle was seen. The identification of the green is assumed to be false one. The other two sightings, one at Buddy's Reef and one at Ol' Blue, are two non successive locations with reports in a very short time limit, that it probably is not the same turtle.

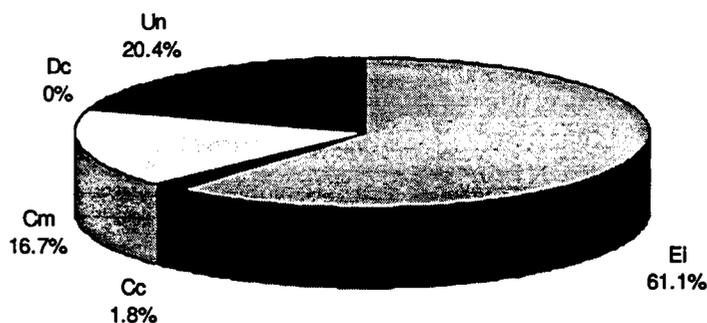
Since a turtle, which is entangled in a line is not swimming, these reports cannot be about the same turtle. Obvious though are the places where the turtles were spotted. Two of them right in front of a hotel, Buddy Dive & Beach Resort and Flamingo Beach Hotel and the other two reports almost next to each other, Andrea II and Oil Slick Leap. The turtles entangled at the hotels could have been stuck in lines of boats. The dive shops should be notified of this fact and maybe find a way to make those lines less dangerous for turtles. The other two reports seem to handle turtles caught in fishing lines. Whether the turtles were caught on purpose or by accident, remains unclear. However, these fishing lines and also old ones which are still stuck in the coral, should be taken away because they hold a potential danger for the turtles.

Results Adult Sea Turtles

Species Distribution

In total 54 sightings regarded adult sea turtles, of which 61.1% are reported as hawksbill turtles (*Eretmochelys imbricata*), 16.7% as green turtles (*Chelonia mydas*), 1.8% as loggerhead turtles (*Caretta caretta*) and 0% as leatherback turtles (*Dermochelys coriacea*). Not identified are 20.4% of all sighted turtles (Unknown) (Figure 12).

Figure 12. Species distribution of sighted turtles larger than 100 cm in 1997 (n=54). Sighting network data.



Spatial Distribution

Since on Bonaire only hawksbill and loggerhead turtles lay their eggs, it is suspected that these species are reported as adults. However only one sighting regarded a loggerhead turtle and, in contrast, 9 sightings regarded green turtles larger than 100 cm. The adult loggerhead was seen at the dive site Ebo's Special at Klein Bonaire.

As stated before, the information gained via the sighting network, especially concerning the spatial distribution of turtles, is influenced by several factors. First of all, the information depends on the distribution of the sea turtles itself. Secondly, the distribution of the divers over the different dive sites is also of main importance (van Eijck and Eckert, 1994). The information should be corrected with the frequency that dive sites are visited and by the number of divers. Unfortunately, this information is not available so the data cannot be corrected for this bias.

In order to be able to compare the data of the adult turtles with the data of the juvenile turtles, figure 13 is subdivided in the same way as figure 8. This means that figure 13 shows the spatial distribution of adult hawksbill and green turtles. The other species and unknown determinations are divided under the group 'others'. The dive sites correspond to the numbers in Appendix 7.

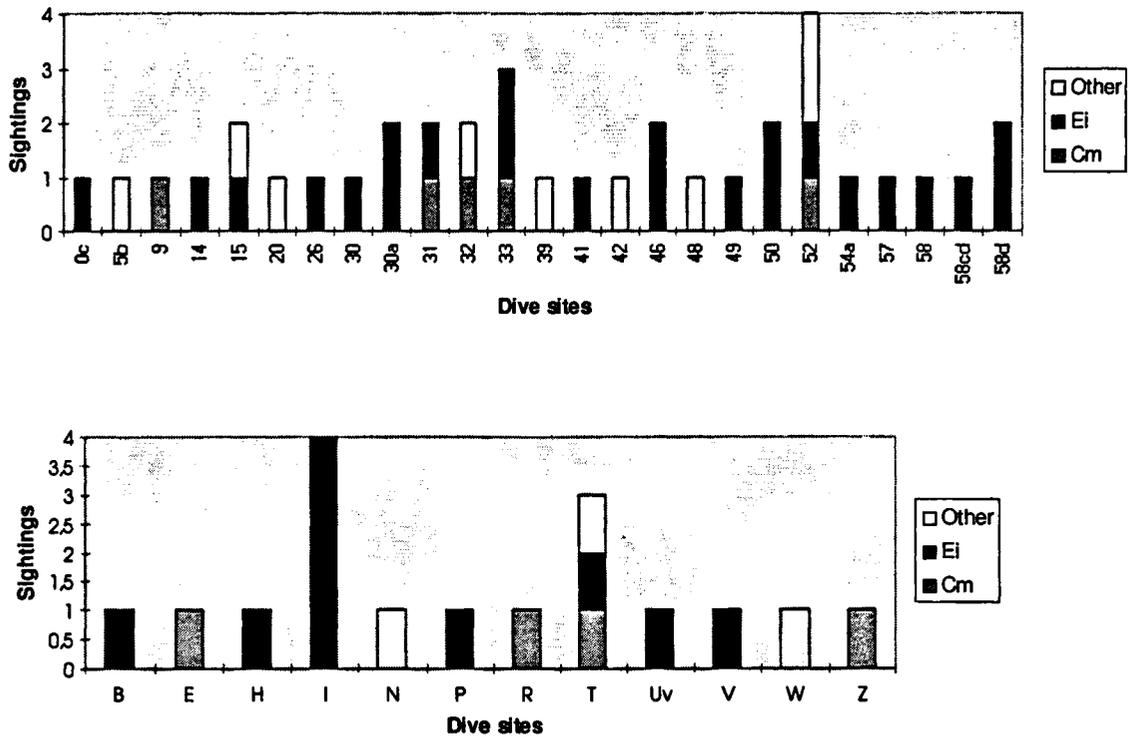


Figure 13. Number of sightings of adult turtles per dive site in 1997 (n=54). Sighting network data.

Activity

In figure 14 the activity of the sighted adult turtles is represented. Of these turtles, 18.3% was resting, 5.0% was mating, 68.3% was swimming and 8.4% was eating. In total there were three reports about mating turtles. These reports were on the same day and at the same dive site as the mating juvenile turtles. From the five turtles reported eating, three reports concerned eating coral and two reports had no remarks about the feeding.

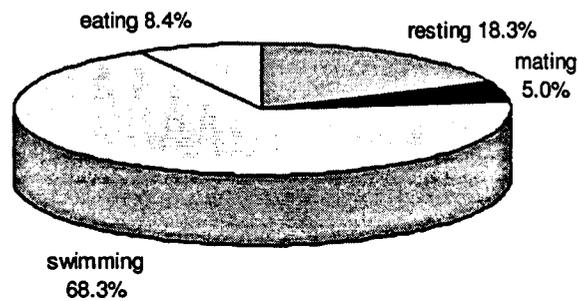


Figure 14. Activity distribution of adult sea turtles sighted in 1997 (n= 18). Sighting network data.

Depth Distribution

As stated before is the preferred habitat depth preferably measured on turtles which are resting, mating or eating. Swimming turtles can be either ascending or descending. As a result, the depth at which turtles are reported, may not be representative for its preferred habitat depth. Therefore only resting, mating or eating are taken as a measurement for the preferred habitat depth. Figure 15 depicts the depth distribution of adult sea turtles.

Although these data are based on only 18 sightings, it seems that 44.4% (8 sightings) of the turtles larger than 100 cm prefers to be in a depth range of 10 meters until 15 meters. The mean average of these sightings is 15.3 meters.

Injuries

There were no reports of injured turtles, larger than 100 cm.

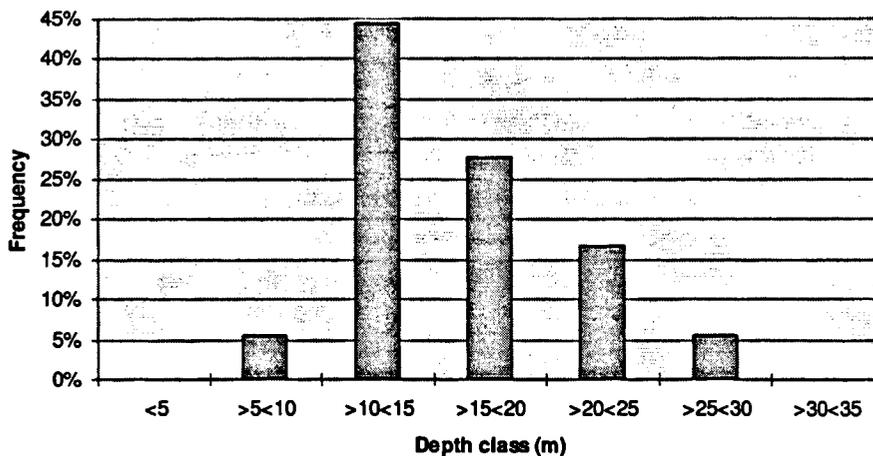


Figure 15. Depth distribution of adult sea turtles resting, mating or eating. (n=18). Sighting network data.

2.2.4 Discussion

Over the years, the sighting network has proved important in collecting extra information about the sea turtles around Bonaire. This year, 1464 sightings were reported, which is again an increase, compared to former years (Figure 16).

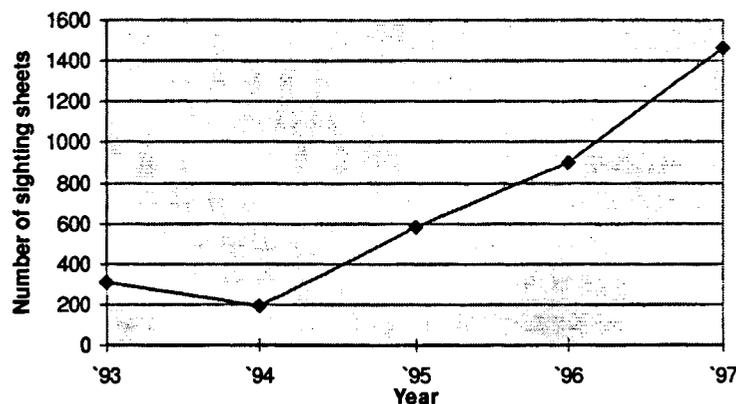


Figure 16. Number of collected sightings per year. Sighting network data.

The participation of the dive shops and divers becomes greater each year resulting in more reported sightings and an increasing interest in sea turtle conservation.

Unfortunately, there are a few difficulties with the interpretation of the information. As stated before, the distribution of reported sea turtles depends on the distribution of the divers at the different dive sites. Moreover, there is a big difference in the frequencies in which the different sites are visited by the divers. As a consequence of this temporal and spatial variation in visits, the sighting network is not sufficient to determine the spatial density distribution of sea turtles. Notwithstanding this bias, some trends in spatial distribution can be extracted from the data of the sighting network, as will be discussed later in this section. More information of past years sightings will be calculated as soon as the dive statistics from the Bonaire Marine Park become available. (Valkering et al., 1996)

Other uncertain factors of the sighting network are the species determination of the sea turtles, since most divers are not trained in species recognition, and the feeding activity of the sea turtles.

However, it is safe to assume that the distribution of species at dive sites is not affected by the fact that some dive sites are more regularly visited than others, since the faults in species identification are supposed to be the same everywhere. Due to this fact, the difference in species distribution in relation to geographically distinct areas can be determined with the data from the sighting network (Norde and van Rossum, 1997). However, one should bear in mind, that although the relative species distribution between the regions can be determined, the derived species ratios may be biased towards a certain species.

With the increasing number of collected sighting sheets, the sighting network gives better and more constant results. As a consequence, a better comparison of the information can be made over the years. For example: last year, 78 (9%) turtles were reported eating, whilst this year 189 (12.1%) turtles were reported eating. The locations of the reported foraging turtles, provide important information for the feeding studies of the hawksbill and green turtle (see section 2.5). With more sighting sheets filled out, more precise information can be obtained.

Although the sighting network is not considered to provide 'scientific' data, it surely is a useful tool to make people aware of the endangered status of the sea turtles. In addition, the sighting network helps to shed more light on several trends of the local sea turtle population dynamics (Valkering et al., 1996), thus proves to be helpful in the development and execution of more specific research programs.

Spatial Distribution

It appears that the spatial distribution of juvenile sea turtles in 1997 is slightly different from former years. In 1993, 1995 and 1996, the dive sites No Name, Karpata, 1000 Steps, Andrea, Pink Beach and Red Slave had a relative high percentage of sightings. In the 1997 project, relatively more sighting sheets were collected from the dive sites 1000 Steps, Angel City, Pink Beach, Mi Dushi and Yellow Man. The spatial distribution seems to have shifted a little bit.

Although this can also be a consequence of the spatial distribution of the divers, perhaps of the fact that these dive sites were more favourable this year. Since these dive sites are often visited by divers, this does not prove that more turtles are also more present at these sites.

When the different areas on Bonaire (table 6) are compared, it seems that the most turtles are present on the west side of Bonaire and around Klein Bonaire. This could be explained by the fact that on the west side area the most dive sites occur, and that less divers dive at the east side, because of the 'rougher' water. Also obvious from this table is that much more hawksbills are sighted than greens. Apparently they are larger in number, less shy or people don't dive at the sites where greens can be found.

When this table is compared with last years figures (see Norde and van Rossum, 1997) it appears that overall the ratio E_i/C_m is higher. Northwest has changed from 1.83 to 2.23, the west side has changed from 2.31 to 3.00, the southwest side has changed from 1.79 to 3.36, the east side has changed from 0.14 to 2.20 and Klein Bonaire has changed from 3.13 to 4.44. The total ratio has changed from 1.82 to 3.13. The total different ratios can be a consequence of more sighting sheets. If the correctness of the species determination this year differs from the correctness of the species determination last year, this could explain the difference. It is difficult however to determine which data are the right ones and depict the right ratio of hawksbill and green turtles.

Comparing Juvenile with Adult Turtles

The data of the turtles bigger than 100 cm were presented separately, because it is believed that those turtles are adults. However, these two data sets can be compared in order to make the distinction between juveniles and nesting (adult) turtles more obvious. On Bonaire, the juvenile population consists of hawksbill and green turtles. The nesting population however, consists of the hawksbill and loggerhead turtles. Unfortunately, when compared, this distinction cannot be found in table 8.

Table 8. Proportion of species in juvenile (n=1410) and adult population (n=54).

<i>Species</i>	<i>Juveniles</i>	<i>Adults</i>
<i>Eretmochelys imbricata</i>	59.6%	61.1%
<i>Chelonia mydas</i>	19.4%	16.7%
<i>Caretta caretta</i>	2.3%	1.8%
<i>Dermochelys coriacea</i>	0.1%	0.0%
Unidentified	18.6%	20.4%

The sighting network data show, that the ratios between adult and juvenile turtles are approximately the same. Striking are the 2.3% juvenile loggerheads (32 sightings) and 1.8% adult loggerhead (1 sighting) reports. The reports of the juvenile loggerhead turtles are somewhat strange because juvenile loggerheads are not expected in the waters around Bonaire. However, since some of these reports are from successive dive sites on more or less following dates, it could indicate that the reports are indeed justified and loggerheads are seen. An example; five juvenile sea turtle reports from Hilma Hooker to Salt City from March until November and ten juvenile sea turtle reports from South West Corner to Ebo's Special from May until November (for the location of the dives sites see Appendix 7). A possibility is that the reports were not from juveniles but adults, so the length estimation on the reports is false, because expected are adult loggerhead turtles, since they make nests on Bonaire.

The reason for the similar ratios can also be found in the following factors. First of all it is proven difficult to determine the species and estimate the size of a (moving) turtle (Valkering et al., 1996). The species of a turtle is hard to determine, because divers are not very familiar with the specific distinction between the species. Since turtles are also moving, it is sometimes hard to get a good look at the turtle. The size estimation is difficult, also because the turtles are moving around and sometimes too far away to make a clear estimation. Secondly it could also be that not nesting adult turtles "visit" Bonaire. Although it is not very likely, it would mean that a new population resides around Bonaire.

The difference in activity between the smaller and larger turtles consists out of less mobile adults, 18.3% is resting and only 68.3% is swimming, compared to juveniles, 13.2% is resting and 74.3% is swimming.

The reason for this could be, that nesting turtles are indeed believed to be less mobile (Norde and van Rossum, 1997). However, another reason could be that the larger turtles are not as shy as juvenile turtles and are easier to spot. Turtles are often spotted because they get disturbed by divers and then swim away out of their camouflage. If the larger turtles are less shy, they are not so easily disturbed by divers, which would mean that they are not spotted.

When the foraging activity is compared it seems that the juvenile turtles (12.1% reported eating) are more active than the adult turtles (8.4% reported eating). The fact that foraging behaviour of the (adult) nesting turtles is not as active as the juvenile turtles (Anderes and Uchida, 1994) is already known for some while. It is even believed that nesting turtles almost do not forage at all and can, at the same time, be spotted in an active condition in the open sea. The percentage reported eating (nesting) adult turtles would even be very high if you take in consideration that the nesting female turtles almost don't eat at all (Anderes and Uchida, 1994).

There were several reports of mating turtles this year. All reports were at the same dive site, on the same day and at the same time. Obviously all the divers saw the same two turtles mating. Strange is the fact that the turtles were reported as juveniles, which could clearly be a false estimation of the size of the turtles. Adult, mating hawksbill or loggerhead turtles are overall larger than 100 cm (Lutz and Musick, 1997). Probably the divers made a distinction in length between the female and the male, the latter being the largest turtle. Again it is evident that the estimation of the length of the turtle is hard to make for divers.

A comparison between the frequency distribution in depth of juvenile and adult turtles can also be made. Figure 17 shows the depth class distribution of the juvenile turtles and adult turtles.

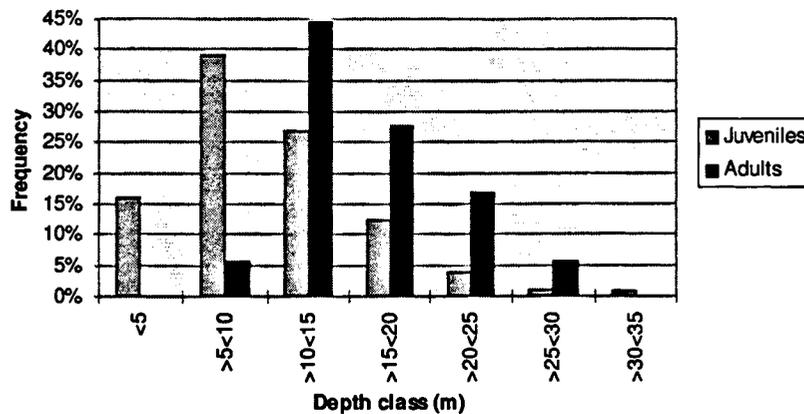


Figure 17. Depth class distribution at which juvenile (n=381) and adult (n=18) rest, mate or eat. Sighting network data.

Juvenile sea turtles have a habitat preference around 9.5 meters mean depth, compared to 15.3 meters for adult sea turtles. From these data and the figure, it can be concluded that juvenile sea turtles prefer more shallow water than adult turtles. Reason for this preference could be some sort of gradient whereby larger turtles reside at greater depths (Lutz and Musick, 1997). The opinion of divers is of course subjective and meters of depth can be estimated false. Adventitiously, less divers dive at a depth of 30 meters than around 10 meters, resulting in less reportings from that depth range.

From the comparison between these two data sets, it can be concluded that some of the examined qualities can be a valid criterion to determine the specifics of juvenile and adult turtles. However, it is difficult to justify the results when only 54 adult turtles are reported and more than 1400 juveniles. From this year's results it can be concluded that the adult turtles are larger, less mobile and eat less. Furthermore, adult turtles prefer deeper water, as compared to juveniles.

2.2.5 Recommendations

Divers on a boat dive are easy to reach through the dive instructors or dive masters who are present on the boat. More difficult are the shore divers, who often do see turtles but forget to fill in the sighting sheets, because they are not reminded to do so by dive instructors or dive masters. Therefore, it is important that the turtle corners are easy visible and accessible in the different dive shops at the same time people will be reminded of the endangered status of the sea turtles and also that filling out the sighting sheets helps to preserve these creatures. Consequently, more sighting sheets for more precise research can be collected.

Difficult for the divers is the identification of the species. It would be helpful if an enlarged determination table could be present at the turtle corners. This would make it easier to recognize the species.

Further, attendance on the slide shows would make the divers more aware of the endangered status of the sea turtle and the fact that something needs to be done. During the slide shows, divers are asked to fill out the sighting sheets when they see a turtle, the difference between the species is outlined and they also hear about the photo identification project (see section 2.4). This would probably lead to more documented sightings and more photo and video material for the identification project.

2.3 Research at Sea: STCB and Woodwind Snorkel Surveys

2.3.1 Introduction

Apart from the data collected through the sighting network, the STCB project assistants collect additional data by undertaking regular snorkel surveys. These snorkel surveys take place around Bonaire and Klein Bonaire at least once a week. As a result, less biased data is obtained, because the project assistants have more knowledge about sea turtles in general as well as some individual turtles. Furthermore, it can give a somewhat more complete picture about for instance the behaviour of the sea turtles.

2.3.2 Methods

The project assistants held their surveys between East of No Name (EONN) and Leonora's Reef, a distance of approximately 1400 meters around Klein Bonaire. Also areas at the west side of Bonaire, Andrea and Margate Bay, were monitored and occasional surveys at Lac Bay. (for location of dive sites, see Appendix 7).

Since 1993, the crew of charterboat "the Woodwind" has cooperated intensively with the STCB. Not only does the Woodwind provide the STCB with weekly transportation to Klein Bonaire, the crew further accounts for a considerable part of the yearly sea turtle sightings.

The Woodwind collected data at roughly the same locations. The frequency of the Woodwind surveys is high; at least five times a week the Klein Bonaire region (between EONN and Leonora's) was covered, and more irregularly about three times a week, the area of Andrea.

2.3.3 Results

In 1997, the crew of the Woodwind reported 118 sightings, whilst 41 turtles were sighted by the project assistants. Some turtles that were sighted could be identified as individuals, due to the fact that these turtles have resided around Bonaire for a few years now. In total, 89 sightings of the Woodwind could be identified and only seven sightings of the project assistants could be identified.

The best example of an individual turtle that has been observed over the years is Fuzzy. This is a hawksbill turtle with a carapace length of approximately 35 cm. In total, this turtle has been sighted 28 times in 1997; three sightings at East of No Name, twice at Small Wall and 23 sightings at No Name. This year the first and last sighting of Fuzzy were both at No Name; March 26th and December 9th, respectively. This turtle is called Fuzzy due to the fuzzy appearance of the back end of its carapace. Fuzzy has been reported in Bonairean coastal waters since the beginning of the STCB 1995 project (Valkering et al., 1996).

Another hawksbill turtle which has been identified since 1995 is Little One. The name is representative for the turtle, having a carapace length of about 20 cm. Little One is observed to migrate between three sites; Andrea (9 sightings), Small Wall (13 sightings) and No Name (11 sightings). This year it was seen regularly from March (19th, at No Name) until December (9th, at Andrea) with the exception of September.

This year, four new turtles with special marks or special behaviour were identified. One of the new hawksbill turtles was first seen in company of Fuzzy, which was the motive for the name Fuzzy's Mate. Fuzzy's Mate is seen from March 24th on at Andrea (8 sightings) and Small Wall (8 sightings). The last sighting was at Small Wall on December the fifth. Its shell has about the same

length as Fuzzy, which is 35 cm, and also a fuzzy carapace.

Dot is a new reported hawksbill turtle with a carapace length of approximately 25 cm. This juvenile turtle was first seen on May 25th. The shell has on the lower edge of the carapace three dots. The precise places of the dots are not clear though. Dot is seen at No Name (7 sightings), East of No Name (1 sighting) and also once at Sampler. The last sighting was at No Name on the first of December.

On November 27th, another juvenile hawksbill turtle, not encountered before, was sighted. The length of the turtles shell is about 20 cm and it is named Tiny. This turtle is reported 3 times at the dive site Andrea, on November 27th, November 29th, and the first of December.

At the dive site Leonora's Reef a new hawksbill turtle is reported as well. This turtle, Ugly, is reported only once, December the first, when it has been identified. Its carapace length is about 25 cm. and the turtle misses the second plate in the middle of his shell.

2.3.4 Discussion

Due to unfortunate circumstances, one of the project assistants was unable to undertake snorkel surveys during most of the project. As a result, fewer surveys were performed and therefore less turtles were identified by the project assistants. Though with the assistance of the Woodwind, more sightings of turtles were recorded and even more turtles could be identified, compared to last year.

Due to insufficient data, it is still very difficult to ascertain the exact range of movement of the identified turtles. To record the dynamics of a turtle in time, a permanent tracking method would be necessary. Still, to shed more light on this matter the results from former years with this year are compared. The identification of the juvenile turtles obviously continues.

Fuzzy was sighted 28 times at East of No Name, Small Wall and No Name. Compared with last year and two years ago; respectively seen at East of No Name (6), No Name (17), Sampler and Leonora's Reef (both once) and two years ago spotted several times along the north coast of Klein Bonaire, between Leonora's Reef and Ebo's Reef, it seems that Fuzzy resides in the same area for three years now. The data from Fuzzy tends to confirm the hypothesis that juvenile hawksbills show a limited home range area and appear resident at the feeding grounds for several years (van Dam, 1997).

In 1995 Little One was seen between Leonora's Reef and Ebo's Reef. Last year Little One was seen at the dive sites East of No Name, No Name and Leonora's. This year the turtle was seen several times at Andrea, Small Wall and No Name. It seems that Little One has enlarged its home range since former years.

Next year more knowledge can be attained for the recent identified turtles. Following the turtles over a period of several years should provide useful data about the population dynamics of the juvenile sea turtles around Bonaire.

Injuries and Strandings

On the 18th of August, a turtle was found entangled in a fishing line at Karpata, a dive site at the west coast of Bonaire (see section 3.1.7). It is still unclear whether the turtle got entangled in the fishing line by accident or was purposefully caught. The fishing line was long enough to allow the turtle to surface for air and seemed to be tied to a coral head. The turtle has been released again.

During the 1997 project, one stranding occurred near Marcultura. A juvenile hawksbill turtle washed ashore on December the sixth. The shell length of the turtle was 43 cm. The turtle did not have any external injuries. Every year at least one stranding occurs. Recommended would be to do an autopsy with a veterinarian, because additional information about the cause of death might be determined this way. Unfortunately, this could not be done this year.

2.3.5 Recommendations

For the project assistants it proves difficult to identify the different sea turtles in the first few months, since they don't know which turtle has which marks. That is why it would be very helpful if the identified turtles could be recorded and studied before future project assistants start the project.

Moreover, a permanent tracking method would be useful to identify turtles more specific. Since this cannot be done by the project assistants alone, assistance from volunteers diving the surveys would be recommended. A suggestion is to survey the dive sites which are certain to have special turtles more regularly, for instance once a week. Other dive sites should be visited irregularly in order to identify new individuals. A permanent tracking method would also help determine the accurate home range of the turtles.

Tagging juvenile turtles should be considered in the future, so that the individual turtles can be recognized by diving tourists as well.

2.4 Photo Identification

2.4.1 Introduction

The objective of the photo identification project is to identify individual sea turtles by means of taking photos and slides of juvenile sea turtles at fixed locations throughout the project. Individuals are characterized by scars, injuries, algal growth, barnacles, distinct color patterns, etc. In order to find out if the same turtles reside around Bonaire for several years and in order to obtain a more accurate estimation on the number of turtles present in Bonairean waters, the information with the photos, slides and videos can be compared over different years. If the same turtles are present over several years (which is, at least for some turtles the case), a relatively stable aggregation of turtles can be assumed.

2.4.2 Methods

The project assistants were equipped with a Nikonos 5 underwater camera. During the surveys also recreational underwater cameras (Kodak Fun Saver Weekend 35) were used at a max. depth of 4 meter. The surveys were held along the drop-off as well as on the flat bottom of the reef terrace. Dive sites where the snorkel surveys were held were; Margate Bay, Andrea I and II, Marcultura, Cai, Small Wall Sharon's Serenity, No Name and Sampler (see Appendix 7). Pictures were made whenever a turtle was seen, preferably as close to the turtle as possible. Because the circumstances were sometimes far from optimal, both snorkelling and diving were tried for results. A recreational underwater camera was also given to the crew of the Woodwind.

Very often, pictures are taken and videos are made by divers on their dive trips. Since those pictures of turtles can also be very helpful, divers were asked if the pictures, slides or videos could be copied for the database of the Bonairean sea turtles.

2.4.3 Preliminary Results

In total, the project assistants made 19 photos of turtles with the Nikonos 5 underwater camera and 22 photos of turtles with the recreational underwater cameras. The crew from the Woodwind provided us with 9 pictures. The quality of the pictures, both from the Nikonos as the recreational underwater cameras, was not always very good. Often, the approached turtle swam away quickly, the camera was moved or the turtle was too far away so nothing special could be seen on the carapace.

In total 38 pictures and slides were collected through the sighting network. Even videos were sent; one of a nesting turtle, one given by Julie Morgan (a local dive instructor) and one about different sea turtles on different dive sites on Bonaire.

The project assistants of the 1998-project will work out the details of the gathered material.

2.4.4 Discussion

During the project in 1995, 133 slides were taken by the project assistants themselves and 30 pictures and 6 slides were received via the sighting sheet network. In the 1996 project 60 slides of green turtles were taken at Lac Bay.

There was no record of the collected photos gained through the sighting network. This year less photos and slides were taken by the project assistants, partly due to the fact that only one assistant

was able to snorkel.

The number of photos gained through the sighting network is about the same number as two years ago. A problem with these photos is that they have to be developed on Bonaire and also copied. Often there isn't enough time to do this before the divers go back home again.

2.4.5 Recommendations

The making of pictures of which a successful identification can be made is very hard when never having handled an underwater camera before. Therefore, some exercise in camera handling, maybe even with a professional diver, could be useful. In this way, pictures of a bad quality can be prevented.

In order to identify the different turtles, tagging could be a possibility. Unfortunately, it is an expensive operation and very stressful for the turtles. So, for the identification of turtles around Bonaire, visual information is probably the best solution.

It is however possible to extend the general photo identification project. Divers are willing to help and often pictures, slides or video material can be copied. A difficulty arises when the divers don't have their films developed on Bonaire. There should be a folder, which could be handed out, with the explicit addresses on Bonaire and in Holland where people could send their items to.

2.5 Pilot Studies

There are four species of turtles that visit Bonaire. Two of these are supposed to be residential: the green turtle and the hawksbill turtle are staying in the coastal water of the island throughout the year. The residential sea turtles are mainly juvenile turtles, although sub-adult green turtles are regularly encountered along the east coast of Bonaire. To find out more about the relation between turtles and their marine environment, two pilot studies on the feeding behavior of the turtles have been set up. One concerns hawksbill turtles feeding on sponges, and the other pilot study deals with green turtles feeding on seagrass.

2.5.1 Predation of Hawksbill Turtles on Sponges

Introduction

The hawksbill turtle, together with the green turtle, is the most common turtle on Bonaire (Van Eijck and Eckert, 1994). The hawksbill turtle is omnivorous; its diet mainly consists of marine invertebrates. In the Caribbean, they are specialized on a diet of sponges (Meylan, 1984; Anderes Alvarez and Uchida, 1994). In regions such as Mona Island, Monito Islands, etc., the hawksbill turtle is known to feed mainly on the following sponges (Van Dam, pers. comm.), all present on the list of the ten highest-ranking prey sponges of hawksbills (see Meylan, 1988) :

- Chondrilla nucula*
- Geodia sp.*
- Chondrosia sp.*
- Tethya sp.*

A first survey was undertaken in order to make a first identification of the species of sponges hawksbill turtles prefer in the coastal water of Bonaire.

Material and Methods

From the end of June until the end of December, surveys were undertaken in order to identify prey sponges of hawksbill turtles on Bonaire. Three areas which are known to be frequently visited by hawksbill turtles were monitored. The areas are chosen by comparing the figures of the STCB reports of 1995 and 1996 (Valkering *et al.*, 1996; Norde and Van Rossum, 1997) and the information obtained through the 'Woodwind', a local charterboat. The places which were monitored were situated on the west coast of Bonaire (Andrea I and II, and Margate Bay) and on the north side of Klein Bonaire (Sampler) (see Appendix 7). The pilot study has involved snorkel- and SCUBA dive surveys at the selected locations. In this way, the areas could be monitored roughly for damage on sponges.

After the rough monitoring, in one area another method has been applied in order to get a more thorough view on the origin of the damage on sponges. This should lead to more information about sponge preference of hawksbill turtles. A dive was made at Andrea I on the 28th of October. Monitoring took place at respectively 20, 15, 10 and 6 meter depth. Observed damage on sponges was recorded.

When feeding signs were found, pictures with a Nikonos V underwater camera were taken (when available) and the predated sponges were identified.

Results

Table 9 gives an overview of the damaged sponges found during the more thorough monitoring dive at Andrea I. The damaged sponges are recorded irrespective of the cause of the damage. All damaged tube sponges missed sponge parts at the top of the tubes.

Table 9. Number of damaged sponges at different depths found at dive site Andrea I (Bonaire)

Depth (m)	Number of damaged sponges	Species	Remarks
6	none		sponge abundance very low
10	1	<i>Ircinia strobilina</i>	sponge abundance very low
15	2 4	- <i>Aplysia fisturalis</i> - <i>Aplysia archeri</i>	one <i>A. fisturalis</i> was predated by fishes
20	3	<i>Aplysia archeri</i>	

Information on feeding activity of hawksbill turtles obtained by means of the sighting network showed that only a small number of turtles were feeding on sponges. Of the 133 eating hawksbill turtles that were sighted in 1997, only four were reported feeding on sponges. The largest number of identified nourishment concerned corals (in 40 cases) and algae (12 sightings) (see figure 10, section 2.2.3).

Discussion

During the SCUBA-dive examination at Andrea I, only 10 damaged sponges were observed. It is unclear whether the lesions are caused by turtles or not. Several species of teleost fishes are known to feed extensively on sponges in the Caribbean as well (Randall and Hartman, 1968; Wulff, 1994). However, in general, feeding signs on sponges produced by turtles can be distinguished from traces of predation by fishes through examination of the size of the feeding sign. Fishes take smaller bites and have a more extensive diet; they eat less and from more different species of sponges. Furthermore, the hawksbill feeds on species of sponge which can be toxic to fishes, resulting in the presence of one type of bite-marks on these particular sponges (Van Dam, pers. comm.). Lesions on sponges may however have other causes such as impact from divers or (stone) anchors.

If the damage was caused by turtles, then it seems that tube sponges are preferred over the other (smaller) species. Notable is that none of the expected sponges were found predated by hawksbills. However, another study on the feeding behavior of sea turtles revealed that hawksbill turtles frequently remove individuals of the species *Geodia neptuni* entirely (Diez and Van Dam, in press). This might partly explain why none of the expected sponges were found damaged. It might also partly account for the low number of damaged sponges that was encountered at Andrea I.

Information on feeding behavior of hawksbill turtles obtained through the sighting network did not show the expected preference for sponges in the diet of this turtle species. Based upon this

source of information, coral and algae appeared to be preferred over sponges. However, when a turtle is sighted feeding on corals, it is unclear whether or not the turtle is actually feeding on coral or if it is feeding on little sponges living inside (dead) coral. The same holds for algae. While the information of the sighting network is collected mostly by diving recreants, the degree of expertise of the informants is unknown. Algae might as well be mistaken for (encrusting) sponges.

A continuation of the study on feeding behavior of hawksbill turtles on Bonaire is desirable. Data on hawksbill turtle diet composition and feeding behavior presented by Van Dam (1997) suggests that turtles may influence sponge species diversity.

Recommendations

Before continuing the sponge predation survey, future project assistants must be educated on sponge identification. First, the project assistants must have general knowledge about which sponges are predated by which species of fishes. Furthermore, one must know which sponges are toxic for fishes and not for turtles. Finally, differences between turtle feeding marks on sponges and fish feeding marks must be clarified.

On most reefs on Bonaire, one finds a low abundance of sponges. Monitoring for predated sponges should be performed at a depth of ten to fifteen meters. At this survey depth, most sponges were encountered.

When hawksbills are spotted eating during the regular snorkel surveys, a picture of the predated sponge should be taken as well as a sample. Recreational divers should be addressed through the sighting network to make a picture of a predated item as well.

Because of the relatively low abundance of hawksbills on Bonaire, all of these methods apart will not give much information on the preference of hawksbills concerning sponges, but when applied all together, more information can be obtained.

The methods to be used to get information on hawksbill preference for sponges are very time-consuming. The assistance of a group of volunteers is very much desired. Therefore, cooperation with the Bonaire Marine Park and the local dive industry seems to be a favorable option.

2.5.2 Predation of Green Turtles on Seagrass

Introduction

Seagrass ecosystems, found in relatively shallow waters worldwide, are among the most productive in the world (McRoy and McMillan, 1977). On Bonaire, important seagrass areas are Lac Bay and Lagun, both bays situated on the east side of the island. The Lac Bay area is thought to be a foraging area for sea turtles (Valkering *et al.*, 1996).

From literature it is known that in the Caribbean, the seagrass *Thalassia testudinum* is the primary diet species for the green turtle (Bjorndal, 1980 and Bjorndal, 1982). They usually feed on young, short leaves of the seagrass. These contain more nitrogen (an important nutrient) and less lignin than old leaves. Lignin is a plant constituent that is indigestible and lowers the digestibility of other structural elements in the plants (Bjorndal, 1980).

Green turtles establish and maintain grazing plots, recropping plots of *T. testudinum* that they previously grazed (Bjorndal, 1980). *Thalassia* comprised 87% of the dry mass of contents from 202 stomachs of green turtles captured in foraging areas off the Caribbean coast of Nicaragua. Van Eijck (1994) suggested that during the night, green turtles swim into Lac Bay and feed on the seagrass. In the morning, they swim out again and reside on the reef nearby during the rest of the day. It is found more often that the tidal cycle is more important in determining foraging times than is the diurnal cycle (Balazs, *et al.*, 1987). Lac Bay has been frequently visited to determine

in which areas of the bay feeding activity of green turtles takes place.

As far as the quantity of seagrass intake, Bjorndal (1980) and Williams (1988) both found a mean intake of 24 to 218 g dry mass day⁻¹ turtle⁻¹ of green turtles with a weight ranging from 7 to 68 kg. Those are the results of experiments with green turtles feeding on *T. testudinum* in the Greater Caribbean. An attempt was made to get information on the quantity of seagrass that is predated in Lac Bay during a certain time unit as well.

Material and Methods

Lac Bay was visited during half September throughout November on a weekly basis. Information on bottom vegetation of Lac Bay available on maps from the Bonaire Marine Park was checked on correctness. The check was done by snorkeling at several random spots throughout Lac Bay while making an estimation of the covering of the bottom. A ranger from the BMP provided for boat transportation.

In order to determine if feeding activity takes place in Lac Bay, one of the project assistants undertook snorkel trips and surveyed for feeding signs. The surveys were done in areas which are known to have a high density of seagrass (such as Boca di Pos, in between Boca di Coco and Boca Fogon, Boca di Pedro, in front of Boca Djukfes and at Binnenklip [see Appendix 9 and 10]).

After the observational snorkel trips two wire-netting cages were placed under water at the location Boca di Pedro (see Appendix 9). The size of the cages was 60 x 60 x 120 cm. The bottom was left open in order to place the cages without damaging the seagrass. The cages were held on the bottom by 6 dive weights per cage. A buoy was attached to the cages in order to relocate the cages.

The top of the cages was closed with chicken wire-netting as well, in order to make a rough quantity-determination of the sea grass eaten by the green turtles. The average length of the seagrass was measured before the cages were placed. After 3 weeks, the average length of the seagrass was to be measured again outside the cages as well as inside the cages. If green turtles were feeding in that particular area, a difference in average length of seagrass could be determined.

Results

The cover of the ground of Lac Bay agreed with the map of the BMP, no striking differences were found (see Appendix 10). During the surveys for feeding signs, no explicit traces of grazing by green turtles were observed. Patches of short, fresh seagrass were recorded though (for example at location Boca di Pedro).

No relevant results were acquired on the experiment with the cages. Because of rusting of the chicken wire-netting, the cages were not held on their location by the dive weights throughout the experiment and they had washed away.

Discussion

Because so little information was obtained during this pilot study, not much can be said about the feeding behavior of green turtles in Lac Bay. Patches of seagrass with short, green leaves were encountered. This could suggest selective recropping feeding behavior which was found in other studies in the Caribbean (Bjorndal, 1980). However, no fundamental data was recorded to support this for Lac Bay.

Thus, it is still unknown whether or not these turtles display the same feeding behavior as green turtles from other regions in the Caribbean. To make a tribute to the study of foraging ecology of sea turtles, the pilot study should be carried out more thoroughly again.

Recommendations

It is important to get a better understanding of the role of green turtles in their ecosystems. As pointed out by Lutz and Musick (1997), 'much research is needed to elucidate the relationships between the foraging ecology of sea turtles and their role in marine ecosystems (..). Quantitative studies are needed that address diet selectivity in sea turtles by relating relative abundance of potential food items in the environment to the food items that are ingested (..). Furthermore, understanding feeding behavior is critical for assessing habitat quality. Grounded on these kind of researches, difficult decisions on wildlife managing are made.'

Lac Bay is being exploited in several ways. Traditionally, much fishing activity has been performed. The tourism industry uses the area for recreational purposes such as swimming, snorkeling, wind surfing and guided kayaking through the mangroves.

The exploitation of Lac Bay must bring along as less disturbance as possible for the green turtles and their habitat. However, the pressure from exploitation probably will be even greater in the future. Studies on foraging behavior (or any aspect of the population biology) of green turtles must be conducted on a very short term, because turtle distribution might decline with increasing exploitation. By gathering more knowledge on green turtles, the importance of the conservation of Lac Bay and its seagrass beds can be supported.

In the continuation of the pilot study, determining the exact location of graze plots within the seagrass beds should get the highest priority. Snorkeltrips should be performed by project assistants or volunteers who have been trained on recognizing grazing traces. When the grazing plots are located, possibilities for quantitative studies should be considered.

III Public Awareness

3.1 Public Awareness Campaign

3.1.1 Introduction

Next to research, a very important part in conservation programs consists of increasing the public awareness. Very often, people are not aware of the endangered status of certain species or habitats. When extra attention is given to the status of the species or area, people are often found willing to contribute to its conservation.

Finally, creating public awareness is also very important in acquiring the necessary funding to carry out a conservation program.

On Bonaire, the conservation program of the STCB comprises a very extensive public awareness campaign. It is necessary because fishing on turtles as well as egg poaching used to be an experienced occupation. Although the Bonaire Marine Environment Ordinance has been amended since 1991 (see Appendix 1), not all people are yet aware of the necessity of protecting the sea turtles and their nesting grounds.

Therefore, various activities are undertaken by the STCB, especially focused on children. Children are not yet familiar with the consumption of turtle meat or eggs and because they are the future population of Bonaire, they can assist in conserving the Bonairean sea turtles and their environment.

The tourism industry is addressed as well. Tourism, being the major source of income for Bonaire, has a great impact on the marine environment on Bonaire. Tourists need to realize that while diving, snorkeling or sunbathing, they are enjoying a very special and fragile part of nature. Very good care must be taken of the marine and terrestrial environment. This is of vital importance, for the sea turtles as well as for the tourist industry.

3.1.2 Turtuganan di Boneiru

General

To educate children on turtles and marine life in general, the STCB is involved in a nature educational program for children called 'Turtuganan di Boneiru' (Turtles of Bonaire). Since 1995, the STCB has cooperated in the organization of this project with the Bonaire Marine Park (BMP) and the Tourism Corporation Bonaire (TCB).

Turtuganan di Boneiru is a snorkel club for children between six and fourteen years old. Since the foundation of this club, 200 children were certified after having successfully passed through the snorkel course. Subsequently, children were invited to join snorkeltrips to Klein Bonaire (Valkering *et al.*, 1996).

This year, the Turtuganan di Boneiru evolved into an environmental club for children. In cooperation with Enit Scholtens, Coordinator Nature and Environmental Education Bonaire, the STCB developed an extended program on the marine wildlife of Bonaire. Beach assignments, slide show presentations and educational games about (marine) wildlife alternated snorkeltrips on a weekly basis.

Most of the exercises and slide shows took place in a youth center called 'Jong Bonaire' (situated

in Kralendijk), which was the meeting point as well.

Turtuganan di Boneiru during the STCB Project 1997

During nineteen weeks, children in possession of a snorkel certificate could attend the activities on Fridays. Snorkeling took place at several snorkel and dive sites on Bonaire as well as on Klein Bonaire. Various dive shops offered their assistance in the transportation of the children to Klein Bonaire. The STCB provided the Turtuganan di Boneiru with new sets of fins, snorkels and masks. This was very much needed because most of the old gear was either too small or broken. In total 120 pair of fins and 150 snorkel sets were donated by the STCB.

By means of exercises, games and presentations, the children were taught about marine life and during the snorkel sessions they could witness the things they had learned in practice. Before every snorkeltrip, one of the rangers of the BMP made sure the children remembered what they were taught during the snorkel program. This included not to touch marine life, to pick up the garbage they encounter, to stay close to the group and listen to the person accompanying them, etc.

Persons accompanying the children were the STCB project assistants, Enit Scholtens, the BMP-rangers and volunteers such as the Queen Angels (an adult snorkeling group). No more than two to four children were accompanied in the water per volunteer.

Per marine subject, a snorkeltrip was first undertaken as a general introduction. The next Turtuganan-afternoon, educational games and exercises about the subject were carried out. Subsequently, interactive slide shows were held in order to test the knowledge of the children. Certain subjects also required beach assignments. In between the dry sessions and in order to close a subject, snorkeltrips were undertaken again.

Obviously, the children were also informed about sea turtles. The life cycle of turtles and their threats were outlined through a slide show. Other educational materials included: prepared hatchlings, a prepared turtle and samples of their nourishment. The children were further instructed how to act when a turtle or tracks of a turtle were encountered. In repetition, the children were to work on an educational picture about the life cycle of sea turtles.

The Turtuganan di Boneiru children were also actively involved in the annual World Clean-up Day. First of all, they participated in the 'sushi-monster'-contest organized by Tene Boneiru Limpi. In groups, the children made a huge monster of sushi, or: garbage, with which they could win prizes.

Furthermore, big posters were produced in groups, about marine environment and the conservation of it. The posters were displaced for over a week in the Cultimara, a large supermarket in Kralendijk. A video of BMP was presented about the legislation for recreants and fishermen in the coastal waters of Bonaire. After that a true/false game was performed about the reef and the rules concerning this fragile part of nature.

Finally, the Turtuganan-children were very active in cleaning up Lagun beach (on the east coast of Bonaire) during the coastal clean-up day (see also section 3.1.8).

During one afternoon on the beach as well as during one snorkel session, a film crew of a children program called 'the Cartoon Express' was present. They interviewed the children about nature, the importance of conservation and about the Turtuganan di Boneiru in general. This was broadcast on the 14th of September at a television show on the occasion of the 35th anniversary of WWF-Holland (see also section 3.1.7).

Future

The method used for providing information about marine life through games, exercises, slide shows, etc. and bringing it in practice during the snorkel sessions proved to be a good approach. Many children attended the Turtuganan di Boneiru on a regular basis. Per afternoon, on the average 22 children were present (the group varied in number from 15 to 35). In total, 82 children took part in the Turtuganan di Boneiru.

Because the dry sessions as well as the gathering for snorkel sessions took place at youth center 'Jong Bonaire' which is situated in Kralendijk, children from more remote parts of Bonaire who lack means of transportation were not able to attend Turtuganan di Boneiru afternoons. In order to be able to reach children from different areas of Bonaire in the future, the purchase of a bus to pick up children is recommended.

However, until the club can afford such a vehicle, the Turtuganan di Boneiru could change location itself. A program could then run for a couple of months in a certain area (for example Rincon). When such a program finishes, the Turtuganan di Boneiru club would move to another place. This way, other children will get the chance to participate in these nature educational afternoons.

The various youth centers throughout the island seem ideal locations for the Turtuganan di Boneiru. A closer cooperation with these 'barrios' is then required

3.1.3 Slide Show Presentation

From the period of August till half October, slide show presentations were held on a weekly basis at the bar of Buddy's Dive and Beach Resort and at the conference room of Captain Don's Habitat. After half October, slide shows were held at Buddy's Dive and Beach Resort only, because too few people came to see the slide shows at Captain Don's Habitat. When held at the Deco Stop bar at Captain Don's Habitat, the slide show presentation was always attended by a lot of people, during former STCB projects.

The slide show consists of four parts, in which important aspects of sea turtles and their present status is explained. In the first two parts an introduction of the sea turtles of Bonaire is given and the life cycle is explained. In the second half of the presentation, threats for sea turtles are pointed out and attention is given to conservation work on sea turtles.

A slide show presentation lasts for about 45 minutes and afterwards questions can be asked. The slide show presentations were highly appreciated by the attendants and usually extra information was asked. At the end of a slide show presentation, handout brochures were available. Of course, the donation box was brought to everyone's attention as well. Also, the STCB-poster was offered for sale for \$3.- or Nafl.5.-. All the funds which are derived from donations and poster sale are used for the financing of the project.

3.1.4 Education

Other actions that have been undertaken to increase awareness about sea turtle conservation, include the following:

Since 1995, The Turtle Corners are situated at every dive shop (Valkering *et al.*, 1996). These consist of a sign, urging divers to fill in STCB sighting forms. Attached to this is a folder which contains sighting sheets, mini posters -with on the back side an identification key of the sea turtles of Bonaire- brochures of the STCB, as well as a brochure about turtles of Curaçao. Finally, little handouts are present requesting tourists to take their used batteries home, and have them recycled

in their home country since Bonaire lacks the possibility to recycle batteries.

On Sunday 28-9-1997, on the Reina Beatrix School (a primary school) information stands about nature education were set up by Enit Scholtens. The STCB took part in this and information on turtles was presented. Educational materials such as 'Nos Mundu di Turtuga', a little book in Papiamentu written by Tom van Eijck and produced by the 'ÈXTRA' in 1993 (Van Eijck and Eckert, 1994) were shown. Furthermore, brochures and mini posters could be taken home by the children. Former STCB reports were present on approval and also some prepared hatchlings and embryos were on view.

At the invitation of the Rotary Club on Bonaire, a slideshow was given. The volunteers of the BMP were presented a slide show on invitation as well.

In November, the Tourism Cooperation Bonaire (TCB) organized various activities in connection with the 'Month of Tourism'. The STCB was involved in one of these activities concerning wildlife. On Saturday 22-11-1997, the project assistants provided the visitors (mainly Bonairean children) with information about the STCB and sea turtle conservation. After a short talk, brochures, mini posters and the booklet on turtles 'Nos Mundu di Turtuga' were handed out to the children.

3.1.5 Press Releases

To increase the involvement of people regarding sea turtle conservation, press messages are released regularly. These are updates on the status of the sea turtles and the activities of the STCB. In 1995, at least 35 articles have been published and in 1996 at least 20. These are minimum numbers, because not all published material which is dealing with the STCB is in possession of the STCB.

This year the STCB recorded that the largest Papiamentu newspaper 'ÈXTRA' has published four articles on the STCB, The Dutch Antilles 'Algemeen Dagblad' five articles, and both the 'Amigoe' (Dutch written newspaper) and the 'PORT CALL', a weekly newspaper featuring waterfront activities on Bonaire, have published two articles. The PORT CALL also announced the weekly slide shows. Finally, the tourist's magazine 'Bonaire Affair' placed an article from last years project assistant J. van Rossum. Thus, considerable attention is paid to the activities of the STCB.

In Holland, the STCB has also featured in some magazines. The 'Panda' is a paper from World Wide Fund for Nature-Holland (WWF-Holland) which is distributed quarterly. This time it concerned the 35th anniversary of WWF-Holland. The Panda paid much attention to the STCB project on Bonaire.

The STCB was also represented in a magazine called 'Islands', which dealt with nature conservation in the Dutch Caribbean. It is a joint initiative of local organizations supported by the WWF. 'Grasduinen', a magazine about nature, travelling and leisure time, dealt with Bonaire and the STCB as well.

Over the years, the recorded number of press releases concerning the STCB have been 25, 35, 20 and 14 in 1993, 1995, 1996 and 1997 respectively. This is a minimum number, because not all articles come into possession of the STCB.

3.1.6 STCB Newsletter

Since 1995, the STCB produces yearly STCB newsletters (see Appendix 11). The newsletter summarizes the project activities and contains preliminary results of turtle research. The newsletter serves as a feedback-medium for all supporters of the STCB. The newsletter is also important for maintaining contact and exchanging information with other NGOs, on a local, regional and international scale.

Distribution of newsletters takes place by means of the Turtle Corners from the sighting network, during slide presentations, by ways of the BMP office and of course in case of distant organizations with an interest in sea turtle conservation, newsletters are sent by mail.

Another way for residents of Bonaire to obtain the newsletter is for example through a distribution point (a Turtle Corner) in a supermarket in Kralendijk. On the 'Scholen Gemeenschap Bonaire' (SGB, a secondary school) the biology teacher hands over newsletters. Enit Scholtens distributes the newsletter through nature education programs on primary schools.

Distribution in Holland takes place as well.

3.1.7 WWF-Holland

The World Wide Fund for Nature was founded to raise funds in order to sponsor nature conservation groups or programs. To celebrate the 35th anniversary of WWF-Holland, several television programs on nature were broadcast on Saturday 13 and Sunday 14 September 1997. The television programs highlighted the Antilles and Aruba and especially projects sponsored by WWF-Holland, such as the STCB-project.

Therefore, several press groups visited Bonaire, among who two film crews for WWF-Holland and a group of reporters from several newspapers in Holland. Meetings with each film crew were coordinated by the BMP.

The first film crew arrived on the 14th of August and stayed for ten days. The crew filmed for a program called the 'Cartoon Express'. This is a children's program on nature issues.

Turtuganan di Boneiru was filmed as well; an afternoon of snorkeling and an afternoon with beach assignments. Also, the project assistants were interviewed at Lac Bay and Klein Bonaire about the activities of the STCB. During these interviews the necessity of conserving important turtle habitats such as Lac Bay and Klein Bonaire was pointed out.

Finally, the project assistants allowed the film crew to record the release of a juvenile hawksbill. The turtle was found entangled in a fishing line by the owner of a local dive shop. The turtle was cut loose and taken home because of its light injuries. The STCB was contacted and after some hours of observation, the turtle was considered well enough to be released in the sea again.

The broadcast of the program took place on the 14th of September 1997.

The second film crew filmed for both a special broadcast of a program called the 'Parodie Parade' and for a special WWF-broadcast entitled 'Ursul Goes Wildlife'. The crew spent five days filming on Bonaire; from the 16th of August onwards and at the end of August (25th/26th).

The STCB project assistants were interviewed by the second film crew to elucidate the need for conservation of sea turtles and protection of their nesting and feeding grounds.

During the program, it was shown how WWF-Holland will cooperate in the conservation of nature on the Dutch Antilles and Aruba. The program was broadcast by RTL 4 on Saturday the 13th of September.

In connection with the 35th anniversary of WWF-Holland, a group of reporters arrived on Bonaire on the 29th of August and stayed for three days. It concerned reporters from the 'Telegraaf', 'Wegener' and 'GPD' together with some reporters from the Antillean papers: 'Amigoe', 'Algemeen Dagblad Antillen' and 'Beurs en Nieuwsberichten'. A meeting was organized with environmental conservation organizations which are supported by WWF-Holland. For the STCB, the president attended the meeting.

The STCB project assistants gave an update about the STCB, sea turtle conservation work and the present status of the sea turtles on Bonaire on the 29th of August. The next day, information was provided on the importance of Lac Bay as a forage area for green turtles.

3.1.8 Coastal Clean-Up

Every year, the people of Bonaire are very active in cleaning-up their island during the World Clean-up Day. This year, the clean-up took place on the 13th and the 14th of September. The clean-up on Bonaire is coordinated by several organizations. Tene Boneiru Limpi organizes the land clean-up, the underwater clean-up is led by Council of Underwater Resort Operators (CURO), and the coastal clean-up is organized by the STCB.

During the clean-up, people gather trash in bags, especially distributed for this occasion. Participants in the coastal clean-up organized by the STCB are asked not only to clean the coastal areas on Klein Bonaire and Bonaire main island, but they are also asked to keep record of the quantities and types of trash which are found.

On Klein Bonaire (the major nesting area for turtles), many bottles, cans and caps are found. Approximately 60% of all items found concerned these packing materials for beverage (table 10). The remaining 40% of trash collected during the coastal clean-up varied from pieces of plastic bags to fishing nets and fluorescent light tubes.

Table 10. Some figures of the coastal clean-up 1997

packing material for beverage	number
glass bottles	2,444
plastic bottles	8,011
metal cans	1,048
plastic caps or lips	622
metal caps	400

Figures such as these are send to the Center for Marine Conservation (CMC). With these figures, requests to the government for deposits on products such as soda bottles can be supported. For each bag delivered at one of the supervisors, two tickets were given. One ticket could be exchanged for a guilder and with the other one some prizes could be won at the end of the clean-up.

This year, the coastal clean-up year was focussed on the North East side of Klein Bonaire, Lagun, Sorobon, Windsock, Chachacha, 1000 steps, Karpata and at some beaches in the Washington-Slagbaai National Park (Playa Chikitu, Playa Grandi and Slagbaai) (see Appendix 7). About 150 people volunteered for the coastal clean-up amongst who children of Turtuganan di Boneiru coordinated by Enit Scholtens, the always loyal Cruisers, Samur Charters, Chess Club of the SGB and many other enthusiastic people such as Al Catafumo and Navimar Statie. The trash from Klein Bonaire was transported to the Bonaire main island by a pontoon boat from Sunset Beach Dive Center. At Sunset Beach Hotel, a free lunch and happy hour was offered to the participants. In total 150 participants gathered 809 bags of trash. Compared to last year's figures (509 bags collected by 219 persons) this was a great success; less people brought together more bags. The trash was taken away by 'SELIBON', the garbage company on Bonaire. The President of the CMC, Roger E. McManus, awarded the organizers and participants of the coastal clean-up for their outstanding and dedicated service to the 1997 International Coastal Clean-Up and for their profound commitment to the marine environment.

3.1.9 Final Presentation

The annual final presentation of the STCB 1997 project was on the 11th of December. During the final presentation, an overview was given on the activities of the project. Preliminary results were shown, special happenings were highlighted, and other things concerning turtles or turtle conservation were presented. This was meant to be as feedback for all the supporters of the STCB and other interested people.

Many people involved were invited for the final presentation. Quite a few companies were found willing to donate beverages and snacks. Those were Consales, J.C. Herrera N.V., Bon Awa, Sunset Beach Hotel, Buddy Dive Center, Creolita and Cultimara. Also, the conference room at Flamingo Beach Hotel was put at the disposal of the final presentation. A stand with information about the STCB and its activities was set up next to a stand for food and beverage. Available at the information stand were, amongst others, the 1997 newsletters that were just printed.

People were welcome from 19:00 hours and the presentation lasted until approximately 21:00 hours. The final presentation started with an introduction from Corine Gerharts, the President of the STCB, which included the history of the STCB, the agenda of the evening and the thanking of the sponsors. Two new board members of the STCB were introduced as well, Imre Esser as treasurer and fund raiser, and Bart Snelder as secretary. They have been active and very much involved as volunteers in the past.

After that, a summarized version of the slide show was presented by the project assistants. Preliminary results on nesting activity, the sighting network, the pilot studies, and the photo identification project were given by means of a PowerPoint presentation. A computer projector was borrowed from Tjin Productions N.V.. After a break, the project assistants continued with information on the slide shows, Turtuganan di Boneiru, the coastal clean-up, the press contacts and the special events of the STCB Project 1997.

Then, a video presentation was introduced by the board members Imre Esser and Bart Snelder. It was a compilation of WWF-film material and various other STCB and Bonaire footage. The compilation gave an overview of nature conservation activities on Bonaire. It was produced by Jerry Schnabel with the assistance of the project assistants, Bart Snelder, Imre Esser, Hendrik Wuyts and Corine Gerharts. The equipment to show the video came from Captain Don's Habitat. Further, acknowledgements were given by the project assistants and finally Corine Gerharts closed the evening with the issue of CMC-awards. The possibility to become part of the STCB as a

member or volunteer was pointed out and interested people could sign up for it afterwards. Also, an announcement was made of the donation of 100 full color, big sized posters of a green turtle (by Dos Winkel) to be sold by the STCB.

For the final presentation a total of 81 people showed up, among who the deputy of Environmental Affairs, Robbie Beukenboom.

3.1.10 Recommendations

Obviously, creating public awareness is very important for the STCB in trying to reach the main goal of the conservation of sea turtles and their habitat on Bonaire. Therefore, it is of great importance that the public awareness campaign continues and that the campaign will be extended.

A way to create more public awareness can be the selling of STCB-products. By selling turtle t-shirts, caps, and for example postcards (maybe even turtle stamps could be produced) with the STCB logo, the STCB will even be better known throughout Bonaire and other areas in the Caribbean. The increased interest in the STCB should result in generally increased attention for the conservation of sea turtles.

Another way to increase public awareness is the presentation of slide shows at different locations on Bonaire. The slide shows at hotels usually attract tourists, but to reach the Bonairean people is more important. This has been done in youth centers several times, but much more promotion is needed for this.

Best would be if Bonairean audience would be addressed to in their own language, Papiamentu. In this respect, native speaking volunteers should be invited to join in these presentations.

Finally, a decrease in the number of press releases is recorded throughout the years (see section 3.1.5). As press releases are very important in getting people interested and involved, more coverage by the press is needed. Therefore, own written press releases should be produced more often.

3.2 Klein Bonaire

3.2.1 Introduction

Klein Bonaire is a small, uninhabited island off the west coast of Bonaire (some 750 m west of Kralendijk, the capital). The islet has a maximum length of approximately 4,000 m and in width it is maximum approximately 2,500 m (see Appendix 7 and Appendix 2).

The shoreline consists mainly of coral rock and coral dikes alternated with several sandy beaches and dunes. On the north side, a long stretch of beach called No Name Beach is present with dunes land inward. On the west and east side numerous small beaches can be found. The southern shoreline consists of coral rubble. Land inward Klein Bonaire is flat and overgrown with a variety of low bushes, trees and cacti.

Klein Bonaire accounts for the major part of the nesting attempts of Bonaire. Each year, 70-90% of the total nesting activity takes place on its sandy beaches. The vivid coral reefs which surround Klein Bonaire, are among the best developed in the Caribbean Sea. Populations of juvenile green turtles and hawksbill turtles can be found offshore throughout the year. The coral reef also offers many high-quality dive sites.

Klein Bonaire is privately owned by a consortium with the exception of the first 50 m from the coast, which is government ground. Plans for tourist development have been under consideration. When realized, these plans would be disastrous for the natural environment such as the reefs and nesting beaches. When individuals, the STCB and other NGOs became aware of these plans and the consequences of it, action was undertaken.

3.2.2 The Future of Klein Bonaire

For some time now, plans have been in existence for the construction of a mooring pier on No Name Beach, Klein Bonaire's main sandy beach. Research by the Bonaire Marine Park has revealed that this, or any other construction, will lead to massive reef avalanches in front of this beach, since this region is very unstable. The STCB urges the Bonairean, Antillean and Dutch government to take appropriate action on this point.

In 1996, a new NGO was founded, the Foundation of the Preservation of Klein Bonaire (FPKB), with its main goal to prevent Klein Bonaire from being developed and to turn it into a national park. The FPKB produced a video documentary regarding the threatened status of Klein Bonaire. A separate part of the film depicts the special role Klein Bonaire plays for Bonairean sea turtles. In this part, assistants of the 1996 STCB project were interviewed.

Also, much attention was given to Klein Bonaire during the 35th anniversary of WWF-Holland (see section 3.1.7). WWF-Holland helped to raise money for the purchase of Klein Bonaire. Negotiations with the owners of Klein Bonaire were in progress, but unfortunately came to a deadlock.

Now that negotiations have been stopped, another idea has been proposed. The first 50 m of the coast (high water line) of Klein Bonaire is government property. The government has already agreed to prohibit the construction of a mooring pier at the shore line. To turn the first 50 m into a national park would exclude any tourist development on Klein Bonaire. A proposal for this has recently been presented to the government.

3.2.3 Recreational Activities

Another problem on Klein Bonaire is the increasing exploitation of No Name Beach and its dunes. An increasing number of tourists and local people come over to Klein Bonaire for recreation. Especially on Saturdays or Sundays, more than 40 people can be found sunbathing, snorkeling and swimming in the vicinity of No Name Beach, on average.

Recreation is not only restricted to the daytime. Also during the night people stay on Klein Bonaire. These nightly visits can cause turtles to abort nesting attempts (Mann, 1978) or even to deter nesting (Witherington, 1992).

For years, one wooden hut was situated in the dunes. A few years ago a second hut was built on the beach, accompanied by some small shelters scattered in the dunes. The result was intensive walking through the dunes. When turtle nests situated in the dunes are trampled, the possibility exists to damage buried eggs and harm pre-emergent hatchlings (Mann, 1978). Besides that, little by little parts of the dunes degenerated. With this degeneration, part of the nesting habitat for - Bonairean sea turtles is lost.

This year, a new hut was made on a more remote part of Klein Bonaire; in EONN sector 4 (see Appendix 2). The hut was built by a group of teenagers. They had checked the area and it was thought to be free of turtle activity. The STCB however, has reported turtle nesting activity in that specific area several times in the past few years. Only a couple of meters away from the hut a nest was reported by the STCB. Also, five fireplaces were made adjacent to the hut. The STCB contacted the persons involved and their parents and agreed on removing the hut.

Also this year again without permission three wooden huts were placed in the dunes behind No Name Beach. Now six huts were present, scattered over more than 450 m of the dunes behind No Name Beach. Already after a couple weeks, traces of degradation of the dunes in the direct neighborhood of the new huts were visible. The No Name Beach-area is a turtle nesting ground; the STCB recorded a maximum of 32 crawls of turtles per year in this particular area in the last couple of years. Two of the newly placed huts were situated just behind turtle nests which were found during the STCB 1996 Project.

In 1995, a big barbecue-pit of concrete was made on No Name Beach by a group of people with tourist interests together with local recreants. This was done in order to ban little fire places. Two KLIKO-trash bins were placed near to the barbecue-pit as well.

The barbecue-pit, however, was not so much used to prepare food, as it was in use as a fire place. Next to deterring sea turtles from nesting (Witherington, 1992) which was mentioned before, lighted beaches can also produce high hatchling mortality. Hatchlings move to 'artificial' light sources rather than the sea, and succumb to exhaustion, dehydration, and predation (Mann, 1978; Peters and Verhoeven, 1994; Salmon and Witherington, 1995).

Finally, more than once the project assistants witnessed the combustion of trash bags from the KLIKO-bins on the big barbecue-pit. In just a short period of time, the sand in the proximity of the pit turned dark of all the charcoal and burned trash. Soda and beer cans, plastic and pieces of glass could be found in abundance.

Debris and other obstacles encountered during a nesting attempt may cause female turtles to change direction or even to abandon the effort (Lutz and Musick, 1997). Hatchling have more difficulties reaching the sea and are more likely to be predated, to get exhausted or dehydrated. NGOs such as the STCB, the FPKB, the BMP and TBL, but also individuals were alarmed by the state Klein Bonaire and No Name Beach were in and DROB (Dienst Ruimtelijke Ordening en

Beheer¹) was addressed. The project assistants from the STCB were asked to inform DROB about the importance of Klein Bonaire (and especially No Name Beach) for the nesting turtles of Bonaire. The project assistants also gave information on the possible effects of a growing number of huts in the dunes for this important turtle nesting area.

In consultation with the BMP and the people who placed the huts, DROB decided to remove the huts from the dunes. Three huts were allowed in a certain area of No Name Beach where the dunes had already disappeared. The big barbecue-place had to be removed as well.

The FPKB, together with some other people removed most of the huts from Klein Bonaire as well as the barbecue-pit. With the latter, the STCB was also involved.

Another initiative undertaken to conserve Klein Bonaire is the annual coastal clean-up, organized by the STCB and TBL (see section 3.1.8).

3.2.4 Conclusion

Keeping Klein Bonaire free from exploitation and debris is of vital importance for the survival of the Bonairean sea turtles. The consequence of the conservation of Klein Bonaire is not only the security of the main nesting area for sea turtles in Bonaire. The rich reefs surrounding Klein Bonaire which serve as an important resident for sea turtles are secured as well.

In order to preserve Klein Bonaire's unspoiled status, the STCB supports NGOs such as FPKB and BMP in their effort to turn this islet into a National Park. The STCB urges not only the Bonairean and Antillean Government to take appropriate action on this point, the Dutch Government is also informed about the precarious situation Klein Bonaire is in.

¹DROB is a government institute for spatial planning and management

3.3 Local and International Cooperation

3.3.1 Non Governmental Organisations

During the 1997 project, the STCB cooperated intensively with other non-governmental organisations. First of all, the Bonaire Marine Park (BMP) offered boat transport to Klein Bonaire once a week as well as the use of an underwater photo-camera. Furthermore Kalli de Meyer, the manager of the BMP provided the STCB with advice and assistance when needed and acted as the local supervisor to the project assistants.

STINAPA offered us free entrance to the Washington-Slagbaai National Park. Before every weekly visit, the rangers of the park informed the project assistants about the beaches and their observations of the week.

Turtuganan di Boneiru was also a cooperation between BMP and STCB. The project assistants assisted every Friday afternoon Enit Scholtens, Coordinator Nature and Environmental Education Bonaire, with scientific issues and guidance of children during beach assignments and snorkel trips.

Every year Bonaire takes part in the World Clean-Up day. The clean-up is divided in the land clean-up, the coastal clean-up and the underwater clean-up, all organised by Tene Boneiru Limpi, STCB and Council of Underwater Resort Operators (CURO), respectively. Much trash was gathered this year, 150 participants collected a total of 809 bags of trash. Compared to former years, 1996: 509 bags collected by 219 participants and 1995: 225 bags collected by 160 participants, more bags were filled.

The Foundation for the Preservation of Klein Bonaire (FPKB) is an organisation founded two years ago. During these two years much progress has been made. This year, the STCB was again invited to join the monthly meetings and actions when possible.

3.3.2 The Business Community

The STCB is supported by the local business community. Bonaire Trading Company, the main sponsor of the STCB on Bonaire, offers the project assistants the opportunity to make use of the computer, fax and copy machine. Sunset Beach Hotel offers housing for the project assistants every year for a reduced price. Bonleasing supported the STCB with the use of a mini-van, also for a reduced price.

The active cooperation of the dive industry on Bonaire helps the STCB in collecting valuable information about the turtles around Bonaire. Besides collecting information, several dive shops also provide the project assistants with regular transport to Klein Bonaire. The sailing charter vessel 'Woodwind' also transports the project assistants to Klein Bonaire once a week. Since snorkel trips are regularly undertaken by the crew, they provide much useful information about the turtles around Klein Bonaire (see section 2.3).

Furthermore, slide-shows were presented, in the conference room at Captain Don's Habitat and at the pool bar at Buddy Dive Resort.

For the final presentation on December 11th, a video was produced regarding the highlights of this

years project. The video was made with Jerry Schnabel from Phototours who donated his time and equipment. Slides were duplicated by Sand Dollar Dive & Photo.

For the final presentation, Divi Flamingo Beach Resort offered the conference room and Tjin N.V. let us use its equipment to make the presentation a success. Other sponsors of the final presentation were: Consales, Cultimara, Bon Awa and Criolita. The STCB 1997 newsletter was made with the cooperation of Flamingo Communications and Bonaire Affair and presented at the final presentation.

3.3.3 Regional Cooperation

The project assistants met with Tom Barmes (LVV Aruba) on Bonaire, whereby information was exchanged. Also, contact was made with Karen Eckert from WIDECAST (Wider Caribbean Sea Turtle Conservation Network) and Paul Hoetjes in the Seaquarium in Curaçao regarding the last captive green sea turtle (see section 3.4).

At the start of the 1997 Project, the STCB Project Coordinator, Niels Valkering, travelled to Curaçao for a working visit. During the visit, meetings were arranged with various people and organizations in order to inform them on the STCB 1997 Project, and to exchange information about the various projects concerning nature conservation on the Netherlands Antilles.

A meeting with Mr. J. Sybesma (former WIDECAST Executive Coordinator for the Netherlands Antilles) from the Department of Public Health and Environment (VOMIL) provided interesting information on governmental issues concerning nature and environment. Future plans were discussed, whereby Sybesma advised to produce a document regarding the recent reorganizations within the STCB.

The project coordinator also met with Dr. D. Debrot (representative of STINAPA) from the Caribbean Marine Biological Institute (CARMABI). In addition to the sea turtle research programs on Bonaire, past research on Curaçao and the contemporary conservation of Curaçao nesting beaches were discussed.

The meeting with drs. L. Pors (Curaçao Marine Park Manager, CARMABI) again revealed the mutual wish to intensify the cooperation between the STCB and CARMABI. First, Pors offered his assistance in the production of a STCB/Bonaire Marine Park video. Second, the Curaçao Marine Park would readily cooperate with the STCB in the set up and execution of a sea turtle conservation program on Curaçao. Future initiatives could include: (1) monitoring nest activity on Curaçao, (2) education on sea turtle biology at the various potential nesting beaches in populated areas and (3) research on the populations dynamics of juveniles sea turtles around the bays along the north coast. The STCB has offered to provide students and a project proposal, albeit when the logistics and finances allow it.

Finally, the project coordinator met with drs. G. van Buurt (National Fisheries Officer) to inform him of our progress on Bonaire and in order to share thoughts about environmental issues on the Netherlands Antilles.

3.3.4 International Cooperation

From the third until the seventh of March 1998, the STCB Project Coordinator visited Mazatlan, Mexico, in order to attend the 18th annual sea turtle symposium.

By attending the Symposium regularly (Van Eijck: '91, '92, '93; Van Nugteren: '96, Valkering: '98), the STCB can rely upon a strong regional and international network.

The international nature of the annual sea turtle symposia offers the STCB an excellent chance to intensify and extend its contacts and exchange information with other sea turtle conservation organisations in the world. Not only do we learn from others and thus benefit sea turtle biology among the Netherlands Antilles, the STCB also makes an important contribution to the Symposium. The success of our initiatives in awakening awareness tells us that our efforts could certainly act as supporting ideas for other conservation groups.

In 1998, Project Coordinator drs. Niels P. Valkering was invited to give a paper presentation about the activities of the STCB in creating more local awareness concerning sea turtles and their environment. This paper was entitled: 'The Sea Turtle Club Bonaire: ideas for creating awareness' (Valkering and Van Eijck, 1998).

The presentation was attended with great interest by the approximately 700 participants. Through discussions about the STCB presentation and other oral and poster presentations with a wide variety of established colleagues, the project coordinator attained much of new information and contacts, that will benefit the STCB in its future work.

Of particular importance were conversations with representatives of the Sea Turtle Protection Society of Greece, MEDASSET, Barbados and the Nehru Foundation for Development. All these colleagues showed sincere interest in the STCB and its public awareness activities. Cooperation with their organizations is expected by means of exchange of information and educative materials.

Also, interesting discussions were held with colleagues about population dynamics of juvenile turtles. Valuable ideas were especially brought up by K. Bjorndal concerning the grazing behavior of green turtles, and R. van Dam, with whom sponge predation research was evaluated.

A promising conversation with H. Guada (Venezuelan WIDECASST representative) led to the intention to cooperate in a more intensive and practical manner. Interesting thoughts were shared concerning the possibility of a shared green turtle stock, and future joint research programs. Especially sea grass fields along the Venezuelan coastline - most adjacent to Bonaire- require monitoring of the population dynamics of the juvenile greens, as well as of the poaching that still prevails in those areas.

3.4 Special Events

During each STCB project, some unexpected events occur. The special events from this year include:

3.4.1 Noon Turtle

On May 28 at noon a hawksbill turtle came ashore on No Name Beach to lay her eggs. The turtle was discovered by the owner of Baka di Laman, a watertaxi. Normally, turtles make their nest during the night when it is quiet and cool. The STCB was informed about the turtle and the project assistants went to No Name beach to make sure that she could lay her eggs without interruption. Directly after this event, the nest was protected by placing a sign on front of it, which was already on No Name beach. The sign was originally placed to make people aware of the fact that Klein Bonaire is a nesting area for sea turtles. It warns people not to walk in the dunes, in order to avoid trampling of nests.

The whole event was recorded on video and slides, which were taken by Jack and Karen Chalk of Captain Don's Habitat. These materials were donated to the STCB. This is greatly appreciated, since the STCB will use this material for educational and scientific purposes.

The project assistants monitored the nest as the incubation time passed. When the time came for the nest to hatch, nestwatching nights were organised by the STCB. After 62 days, the hatchlings, emerged from the sand, made it safely to the sea.

3.4.2 The laying of the Eggs by a Hawksbill Turtle

On the 29th of July, while nestwatching at the nest mentioned above, another hawksbill turtle was found in the dunes searching for a suitable place to nest. It took at least three hours before the female turtle had laid the eggs.

Of course, this nest was closely monitored by the project assistants, and as the sixtiest day approached, the nestwatching began. Unfortunately, the hatching success of this nest was very low (9,2%). From the 152 eggs, only 14 hatchlings came out of the nest. Most of the embryos in the eggs were in the full term stage. The cause of the low hatching success could be the very hot period during incubation. The fact that it was a shallow nest would support this.

3.4.3 The Release of the Last Captive Turtle on Bonaire

In 1991, the Bonaire Marine Environment Ordinance (A.B. 1984, no. 21) was changed to include the total protection of all sea turtle species on Bonaire. Since then, it was prohibited to disturb or destroy sea turtle nests or to remove eggs from the nest. Any kind of trade of eggs, sea turtles, sea turtle meat or products of sea turtles is forbidden. Also killing, catching or possessing sea turtles is prohibited (see Appendix 1).

However, two turtles still lived in captivity on Bonaire, since turtles which lived in captivity before June 27th 1991 could still be held in captivity. The two captive turtles were living in an aquarium in Den Laman, a local sea food restaurant. Max Reina, the owner of the restaurant, contacted the STCB and Plaza Resort to find a solution for one of the two turtles because he wanted to release it. One (Caribbean) turtle was already released by the owner of the restaurant. The other turtle was from the Pacific and thus could not be released. Together with the Bonaire Marine Park it was decided that Plaza Resort would provide the turtle with half-way housing. It would stay there

for 4-6 weeks until it could be transferred to the Seaquarium Curaçao, where sufficient knowledge and materials are present to provide the turtle with a suitable home.

The conditions at Plaza Resort were not optimal, but it was the best that could be done in such short notice.

A part of a lagoon of 28 meters of length and in the middle 13.5 meters width (it was V-shaped, from 35.5 meters to 2 meters) was blocked with a steel fence. The depth of the basin varied between 2.7 and 3.2 meters. The water was troubled; the visibility was sometimes less than one meter. Moreover, there wasn't any waterflow in the basin.

After 6 weeks, the turtle was transported to the Seaquarium Curaçao on the 'Insulinde', a sailing ship.

3.4.4 A New STCB Board in Bonaire

During the STCB 1997 project, a new board was formed on Bonaire. Two new boardmembers joined the president, Corine Gerharts and the treasurer, Hugo Gerharts. Bart Snelder has been appointed as the secretary and Imre Esser as the fundraising treasurer. Bart en Imre are well known in the Turtle Club because they were already involved as volunteers. Among their first tasks is to install a committee to support the board and also to assist in the set-up of a volunteer network. With the assistance of committee members and volunteers, the STCB will enter a new period with a more continuous character.

3.4.5 Fences on Pink Beach and on Klein Bonaire

Also new in this year's project was the placement of fences with a sign on Pink Beach and No Name Beach. On Pink Beach, the fences were constructed by the STCB after project assistants had found crawls and bodypits on this popular beach. Whether the bodypits also contained nests was not clear at that moment, though potential nests would be trampled on when unprotected. The owner of Pink Beach, Cargill, was willing to cooperate. In 1993 and 1995, there was no evidence of nesting at all on Pink Beach (van Eijck and Eckert, 1994, Valkering et al., 1996). In 1996, one hawksbill nest was made on Pink Beach (Norde and Van Rossum, 1997). Striking was the large number of dead hatchlings in this nest (35 dead hatchlings were found on a total of 149 eggs).

Therefore, to protect possible nests from trampling, dogs and donkeys on Pink Beach, fences were placed around the bodypits. After 70 days, no signs of hatching were found on Pink Beach and the project assistants excavated the bodypits. Unfortunately, no nest was found. The fences, placed both on Pink Beach and on No Name, were not damaged in any way. After excavation it became clear that there was no nest in this fence as well.

The fencing of some bodypits on Pink Beach and Klein Bonaire was an interesting attempt to examine if fences would be tampered with or if the nests would be poached. The absence of such activities indicates that placement of fences around potential nests may be considered on Bonairean beaches, when the possibility of trampling on nests is reasonable. Furthermore, there was a great interest from the visitors of the beaches for the fences. Questions were asked about the purpose of the fences and simultaneously about sea turtles. This indicates that the fences helped increasing the public awareness about the conservation of sea turtles.

IV Literature

- Anderes Alvarez, B.L. and Uchida, I., 1994. Study of the hawksbill turtle stomach contents in Cuban waters. In: Study of the hawksbill turtle in Cuba (I). Ministry of Fishing Industry, Cuba. pp.27-40.
- Balazs, G.H., Forsyth, R.G., and Kam, A.K.H., 1987. Preliminary assessment of habitat utilization by Hawaiian green turtles in their resident foraging pastures. NOAA Tech. Memo. NOAA-TM-NMFS-SWFC-71. Honolulu, HI.
- Bjorndal, K.A., 1980. Nutrition and grazing behavior of the green turtle, *Chelonia mydas*. Mar. Biol., 56: 147.
- Bjorndal, K.A., 1982. The consequences of herbivory for the life history pattern of the Caribbean green turtle. In: Biology and Conservation of Sea Turtles. Bjorndal, K. A., Ed., Smithsonian Institution Press, Washington, D.C. 111.
- Bjorndal, K.A., Carr, A., Meylan, A.B., and Mortimer, J.A., 1985. Reproductive biology of the hawksbill *Eretmochelys imbricata*, at Tortugero, Costa Rica, with notes on the ecology of the species in the Caribbean. Biol. Conserv., Vol. 34: pp.353-368.
- Caldwell, D., 1962. Comments on the nesting behavior of Atlantic loggerhead sea turtles, based primarily on tagging returns. Q. J. Fla. Acad. Sci., 25: 287.
- Carr, A., 1986. The sea turtle: so excellent a fish. University of Texas Press, Austin.
- Diez, C.E. and Van Dam, R.P., in press. Proceedings of the Eighth International Coral Reef Symposium. June 24-29, 1996, Panamá.
- Dodd, C.K., Jr., 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). U.S. Fish Wildl. Serv. Biol. Rep., 88: 110.
- Grassman, M., 1993. Chemosensory orientation behavior in juvenile sea turtles. Brain Behav. Evol., 143: 184.
- Hirth, H.F., 1980. Some aspects of the nesting behavior and reproductive biology of sea turtles. Am. Zool., 20: 507.
- Hughes, G.R. and Mentis, A., 1967. Further studies on marine turtles in Tongaland. 2. Lammergeyer, 3: 55.
- Limpus, C.J., Fleay, A., and Baker, V., 1984. The flatback turtle *Chelonia depressa*, in Queensland: reproductive periodicity, philopatry and recruitment. Aust. Wildl. Res., 11: 579.

- Limpus, C.J., 1985. A study of the loggerhead sea turtle, *Caretta caretta*, in Eastern Australia. PhD dissertation, University of Queensland, St Lucia, Australia.
- Lutz, P.L. and Musick, J.A., 1997. The biology of sea turtles. CRC Marine Science Series. ISBN 0-8493-8422-2.
- Mann, T.M., 1978. Impact of developed coastline on nesting and hatchling sea turtles in Southeastern Florida. Fla. Mar. Res. Publ., 33, 53.
- McRoy, C.P. and McMillan, C., 1977. Production ecology and physiology of seagrasses in seagrass ecosystems: a scientific perspective. McRoy C. P. and Helfferich, C., Eds., Marcel Dekker, New York, 53.
- Meylan, A.B., 1984. Feeding ecology of the hawksbill turtle (*Eretmochelys imbricata*): spongivory as a feeding niche in the coral reef community, Dissertation, University of Florida, Gainesville, FL.
- Meylan, A., 1988. Spongivory in hawksbill turtles: a diet of glass. Science. 239, 293.
- Norde, D.J., Van Eijck, T.J.W., and Van Rossum, J.P., 1997. Sea Turtle Club Bonaire 1996 Project Report: sea turtle conservation on Bonaire. Sea Turtle Club Bonaire, Amsterdam, The Netherlands. 55p.
- Peters, A. and Verhoeven, K.J.F., 1994. Impact of artificial lighting on the seaward orientation of hatchling loggerhead turtles. J. Herpetol., 28, 112.
- Pritchard, P.C.H., and Trebbau, P., 1984. The turtles of Venezuela. Contrib. Herpetol. 2, Society for the Study of Amphibians and Reptiles. Fundacion de Internados Rurales, Caracas. 402p.
- Randall, P.J. and Hartman, W.D., 1968. Sponge-feeding fish of the West Indies. Mar. Biol. 1: pp.216-225.
- Ryder, C., Richardson, J.I., Corliss, L.A., and Bell, R., 1989. Habitat preference and beach management for nesting hawksbills, Jumby Bay, Antigua, West Indies. In: Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology. Scott A. Eckert, Karen L. Eckert, Thelma H. Richardson (compilers). NOAA Tech. Mem. NMFS-SEFC-232. pp.263-266.
- Salmon, M. and Witherington, B.E., 1995. Artificial lighting and seafinding by loggerhead hatchlings: evidence for lunar modulation. Copeia, 1995, 931.
- Sybesma, J., 1992. WIDECASST Sea Turtle Recovery Action Plan for the Netherlands Antilles (K.L. Eckert, ed.). CEP Technical Report No. 11, UNEP Caribbean Environment Programme, Kingston, Jamaica. 63p.

- Valkering, N.P., Van Nugteren, and Van Eijck, T.J.W. (ed.), 1996. The Sea Turtle Club Bonaire Project: progres report and long term proposal. STCB, Amsterdam, The Netherlands. 105p.
- Van Buskirk, J. and Crowder, L.B., 1994. Life-history variation in marine turtles. *Copeia* 1994, 66.
- Van Dam, R.P., 1997. Ecology of hawksbill turtles on feeding grounds at Mona and Monito Islands, Puerto Rico. Academic thesis, faculty of biology, University of Amsterdam (UvA), the Netherlands.
- Van Duyl, F., 1985. Atlas of the living reefs of Curaçao and Bonaire (Netherlands Antilles). Foundation for Scientific Research in Surinam and the Netherlands Antilles. Utrecht. No. 117, ISSN 0300-5534.
- Van Eijck, T.J.W. and Eckert, K.L., 1994. Sea Turtles in Bonaire: 1993 survey results and conservation recommendations. Sea Turtle Club Bonaire, Amsterdam, The Netherlands. 89p.
- Van Eijck, T.J.W., 1997. Verslag van de Caraïbische turtle meeting op 2 oktober 1997 (Borkent, P.K., ed.). Biotopic Technical Report No. 6.
- Williams, S.L., 1988. *Thalassia testudium* productivity and grazing by green turtles in a highly disturbed seagrass bed. *Mar. Biol.*, 98: 447.
- Witherington, B.E., 1992. Behavioral responses of nesting sea turtles to artificial lighting. *Herpetologica*, 48, 31
- Witzell, W.N., 1983. Synopsis of biological data on the hawksbill turtle, *Eretmochelys imbricata* (Linnaeus, 1766). FOA Fish. Synop., 137, 78.
- Wulff, J.L., 1994. Sponge feeding by Caribbean angelfishes, trunkfishes, and filefishes. In: Sponges in time and space (van Soest, van Kempen, Braekman, eds). Balkema, Rotterdam. pp.265-271.

APPENDIX 1

Bonaire Marine Environment Ordinance, as amended in 1991

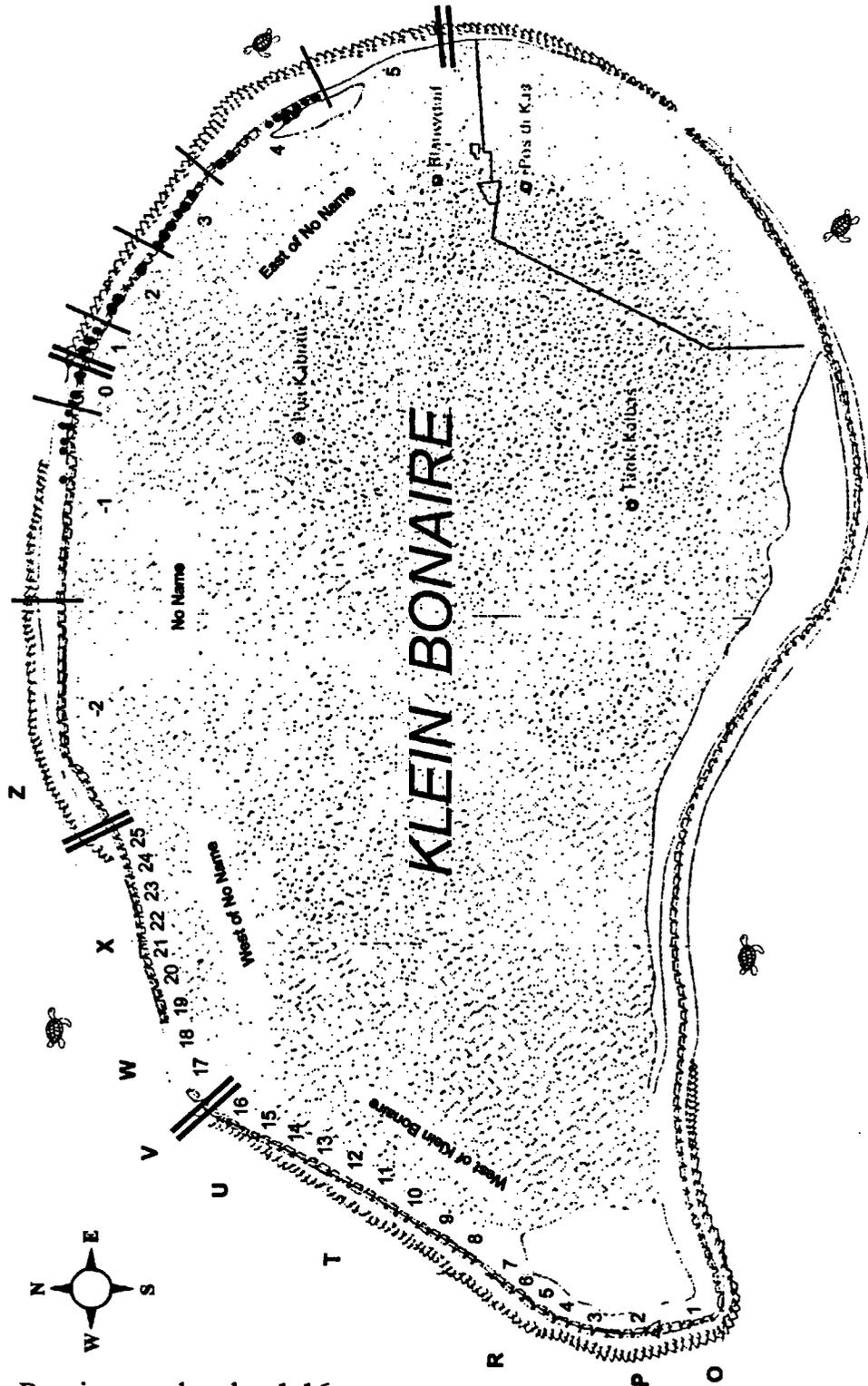
On 27 June 1991, the Island Council of Bonaire amended the Marine Environment Ordinance (A.B. 1984, no 21) to include the total protection of all sea turtle species. Article 14 reads:

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 (tortugu 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 2

Klein Bonaire: Nesting Beaches and Dive Sites

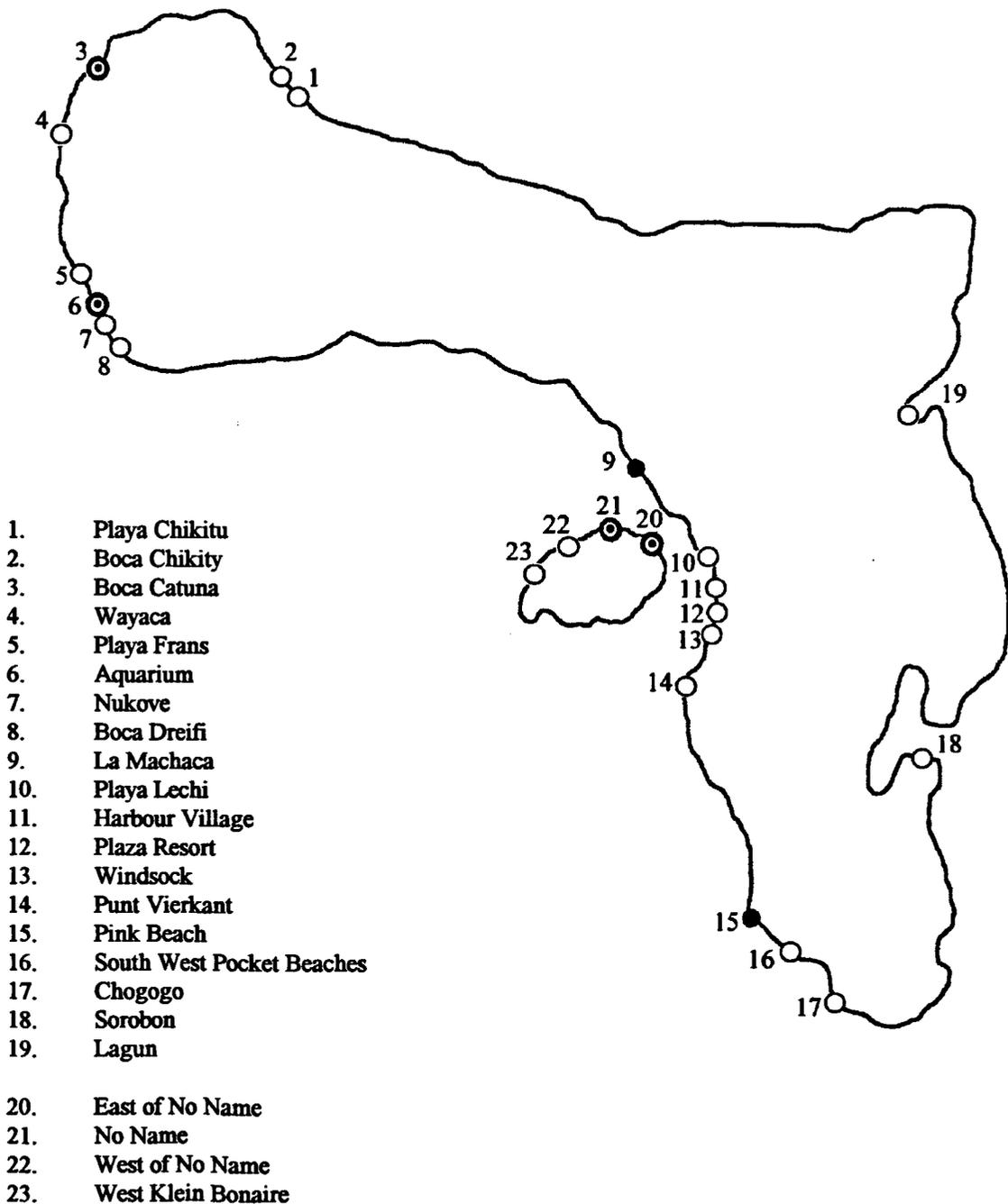


- | | |
|----------------------|---------------|
| West Klein Bonaire : | beaches 1-16 |
| West of No Name : | beaches 17-25 |
| No Name : | sector -2 - 0 |
| East of No Name : | sector 1 - 5 |

APPENDIX 3

Sea Turtle Nesting Beaches on Bonaire

- Potential nesting beaches
- Crawls in 1997
- ⊙ Nest(s) excavated in 1997



APPENDIX 4

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 5

1997 Crawls ordered on data

S/B=sector or beach number; TW=track width;
O/F=crawl old or fresh (fresh=from previous night);
BP=number of body pits.

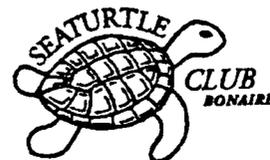
nr	Location	S/B	Date	Time	Act.	Sp.	TW	O/F	BP	Remarks
1	EONN	1	26-04-97	10:30	bp			o	1	in dunes, no eggs found
2	NN	-2	4-05-97	11:15	cr, bp		80	f	3	in dunes, no eggs found
3	EONN	2	12-05-97	11:45	bp			o	2	in dunes, no eggs found, already marked
4	NN	-1	28-05-97	11:00	cr, ne	Ei		f	1	on beach, eggs found, nest made at noon
5	NN	-2	early June		bp, cr	Ei	70		6	behind stone beach, no eggs found
6	Boka Catuna		early June		cr, ne	Cc				on beach, observed last hatching group
7	NN	0	16-06-97	8:30	cr			f	0	on beach, no bodypit, tide up iguana nearby
8	La Machaca		17-06-97	23:00	cr			f	0	on tiny beach, turtle scared away by humans
9	Boka Catuna		19-06-97	15:33	cr, bp, ne	Cc	70	f	2	on beach, poached!? same turtles as #6?
10	EONN	1	25-06-97	9:00	cr, bp, ne	Ei	84	f	5	in dunes, eggs found
11	EONN	5	25-06-97	9:00	cr, bp	Ei	79	o	6	in dunes, no eggs found
12	EONN	4	25-06-97	9:00	cr	Ei	75	o	0	in bush area, vague crawl, no eggs found
13	EONN	4	28-06-97	8:30	bp			f	1	in dunes, vague bp, no tracks, no eggs found
14	EONN	4	28-06-97	8:30	cr, bp, ne	Cc	50	f	11	in bush area, many stones and dead hatchlings
15	Boka Catuna		30-06-97	pm	bp, ne	Cc		f	2	on beach, eggs found, same turtles as #6?
16	EONN	2	1-07-97	8:30	cr		65	f	0	in dunes
17	EONN	2	1-07-97	8:30	cr, bp	Ei?	75	f	4	in dunes, track route unclear, no eggs found
18	NN	-2	1-07-97	8:30	bp, cr		90	f	4	in dunes, no eggs found
19	EONN	3	1-07-97	8:30	bp				1	in bush area, no eggs found
20	NN	-1	5-07-97	9:30	bp			o	4	in dunes, no track
21	NN	-2	12-07-97	9:00	cr, bp	Ei?	80	f	5	in dunes, labyrinth track through bushes
22	Pink Beach		14-07-97	13:00	bp, cr	Cc?	68	f	4	on beach, 2 bp fenced, no eggs found
23	Boka Catuna		18-07-97	9:30	cr, bp	Cc	70	f	3	on beach, eggs found, same turtles as #6?
24	EONN	5	19-07-97	9:00	cr, bp	Ei		o	3	in bushes, long track (190 steps), eggs found
25	NN	0	19-07-97	9:00	bp	Ei		f	1	in bushes, step stress, eggs found
26	EONN	3	26-07-97	11:00	bp	Ei?		o	8	in bushes, vague bp
27	NN	-2	28/29 Jul	0:30-3:30	cr, bp, ne	Ei	75	f	12	in dunes, eggs found, nesting filmed
28	EONN	1	31-07-97	10:00	cr, bp, ne	Ei	73	f	4	in dunes, eggs found
29	EONN	1	31-07-97	10:00	cr, bp		70	f	11	in dunes, near to 1995 bp, no eggs
30	EONN	2	31-07-97	10:00	cr, bp			f	6	in bush area, near to sea, much broken glass
31	Aquarium		1-08-97	16:30	cr, bp		65	o	3	on beach, no eggs found
32	Boka Catuna		2-08-97	8:30	cr, bp, ne	Cc	70	f	4	on beach, eggs found, flooding, turtle #6?
33	EONN	5	5-08-97	9:00	cr, bp		66	o	2	in bushes/beach
34	Pink Beach		8-08-97	10:30	cr, bp	Cc?	68	f	3	on beach near coral dike, no eggs found
35	Boka Catuna		9-08-97	11:00	cr, bp	Cc	68	o	2	on beach, eggs found, same turtles as #6?
36	EONN	4	11-08-97	8:45	bp			o	1	in dunes, probably old nest
37	NN	-1	11-08-97	9:00	bp			o	2	in bushes, no eggs found
38	Boka Catuna		17-08-97	23:00	bp	Cc	69	f	1	on beach, no eggs found, same turtles as #6?
39	EONN	1	18-08-97	8:45	cr, bp		66	f	3	in front of bushes near to sea, no eggs found
40	EONN	2	21-08-97	9:15	cr, bp		60	f	1	in bush area, aborted attempt? no eggs found
41	EONN	3	21-08-97	9:15	cr, bp	Ei		f	4	in bushes, no eggs found
42	EONN	5	21-08-97	9:15	cr, bp		70	f	11	in bush area, no eggs found, already marked
43	NN	-2	25-08-97	8:45	bp			o	1	in dunes, near to #27, no track
44	Pink Beach		25-08-97	9:30	bp	Cc?		f	2	on beach near to coral dike, no eggs found
45	EONN	5	1-09-97	8:45	cr, bp	Ei?	66	f	7	in bush area, probably the same turtle as #33
46	Aquarium		5-09-97	9:15	cr, bp			o	4	on beach, vague track

Continuation Appendix 5

nr	Location	S/B	Date	Time	Act.	Sp.	TW	O/F	BP	Remarks
47	EONN	2	6-09-97	am	cr, bp		57	f	2	in dunes
48	EONN	5	10-09-97	9:00	cr, bp		71	f	4	on sandy place behind bush sites
49	EONN	5	10-09-97	9:00	cr, bp	Ei?	60	f	2	in bush area, partly over #42
50	EONN	5	10-09-97	9:00	cr, bp	Ei?	70	o	4	in bush area, near to #42, no eggs found
51	Aquarium		30-09-97	10:00	cr, bp		63	f	2	on beach near coral dike and overhanging rock
52	NN	-1	2-10-97		cr, bp			f	1	in dunes, probably aborted attempt
53	La Machaca		late Oct		cr			f	0	on tiny beach in front of apartment nr 9
54	NN	-1	early Nov		cr, bp			f	1	in dunes

APPENDIX 6a

Front of the STCB Sighting Sheet



Sea Turtle Sighting Sheet

Thank you very much for your willingness to participate in this survey! Sea turtles are highly endangered throughout the Caribbean and research is one way of implementing effective conservation and management programs. You can help the sea turtles by filling out this form. *Thank you!*

Name: _____ Date: day ___ month ___ year ___

Location / Dive site: _____ Time: _____

Dive Shop / Dive Master: _____

Water depth: ___ feet metres. Was the turtle seen: on the surface
 in the mid-column
 at the bottom

Was the turtle: alive injured dead

If injured, how was the turtle injured?: _____

What was the turtle doing? Was it: resting mating swimming eating

If eating, what was it eating?: _____

What was the turtle's shell length? Was the length: less than 4 inches (<10 cm)
 between 4 and 20 inches (10-50 cm)
 between 20 and 40 inches (50-100 cm)
 more than 40 inches (>100 cm)

If the shell was longer than 40 inches, did the turtle's tail extend more than 6 inches (>15 cm) beyond the shell?:
 Yes No I don't know

Could you determine the species of the turtle?: Yes No

If yes, was the turtle a: Green turtle
 Hawksbill turtle
 Loggerhead turtle
 Leatherback turtle

What was the immediate environment? Was it: sand sea grass meadow coral reef
 rocks other (cave, wreck, etc)

Did you notice anything else (special marks like scars, barnacles, spots, etc.): _____

Did you make a picture slide video of the turtle?: Yes No

If so, could you provide us a copy along with this sighting sheet? These can be used for scientific and/or educational purposes. Thank you very much!!!

Sea Turtle Club Bonaire c/o BTC, Kaya L.D. Gerharts 22, Postbus 333, Kralendijk, Bonaire N.Antilles
Tel.: (599 7) 8300,

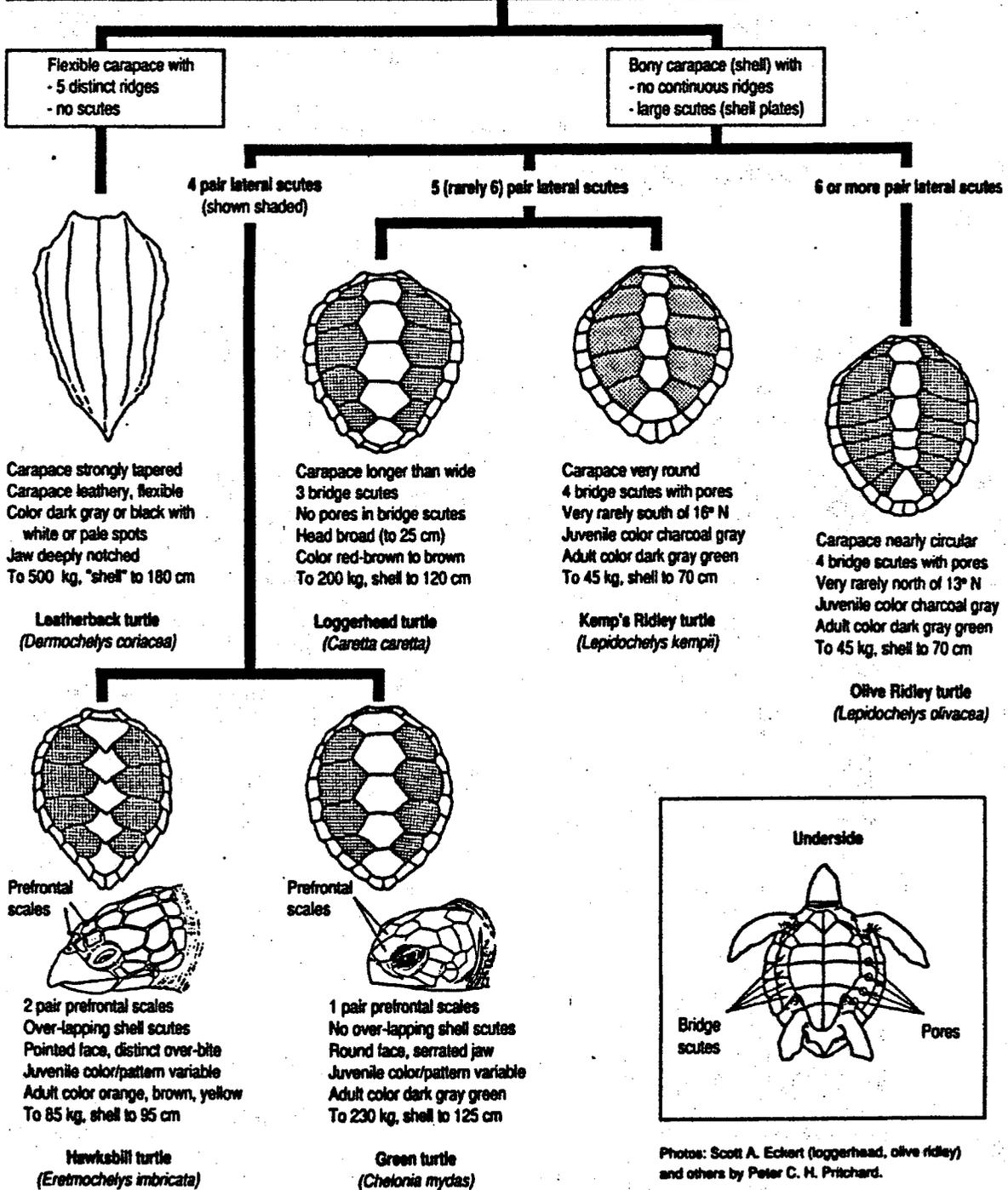
Sea Turtle Club Bonaire Madurastraat 126 hs, 1094 GW Amsterdam, The Netherlands, Tel: (3120) 6684782.

APPENDIX 6b

Reverse side of the STCB Sighting Sheet

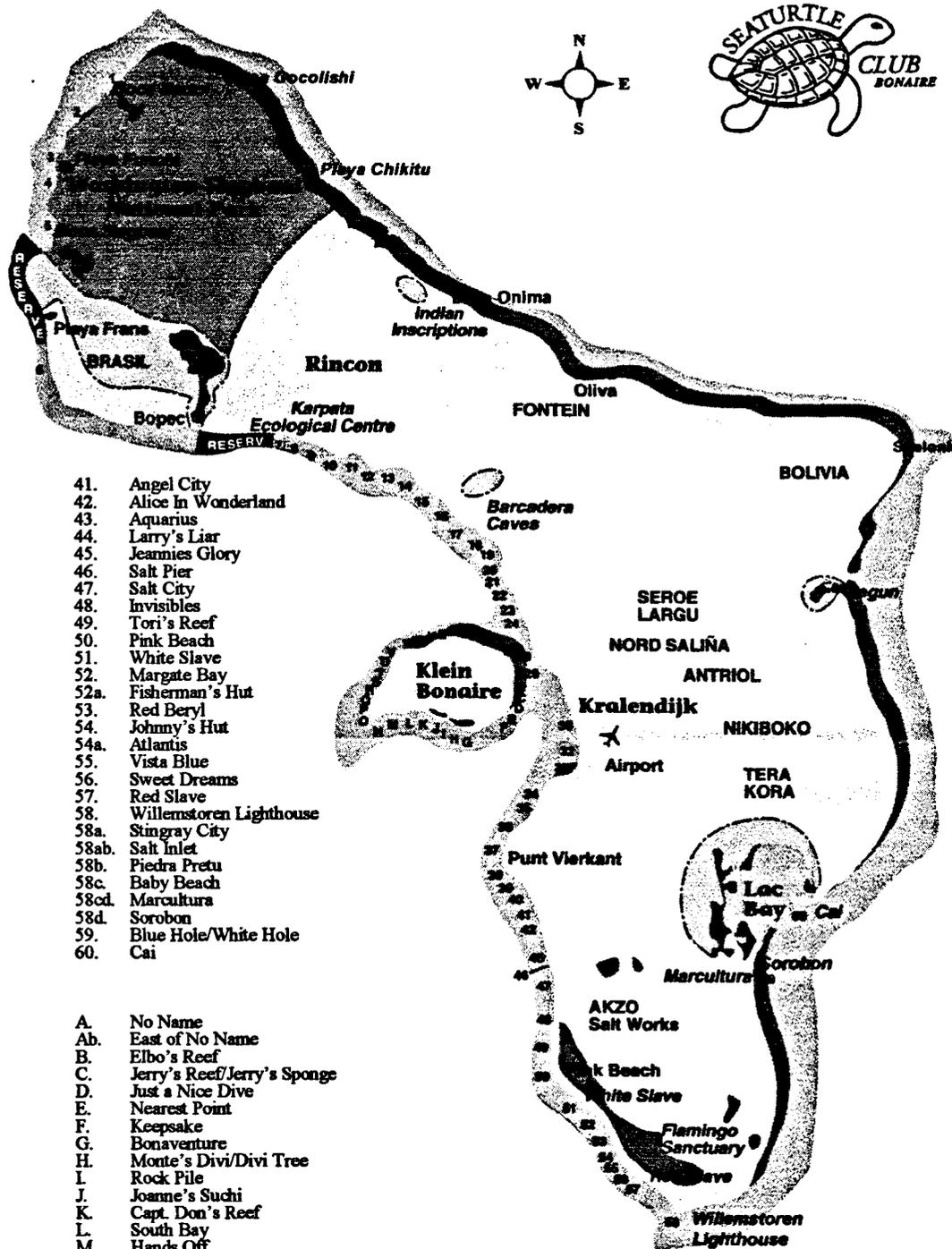
Wider Caribbean Sea Turtles

IDENTIFICATION KEY



APPENDIX 7

Dive Locations of the Bonaire Marine Park



- 0a. Lagun
- 0ab. Spelonk
- 0b. Boca Onima
- 0c. Boca Bartol
- 1. Boca Catuna
- 2. Playa Bengé
- 3. Playa Funchi
- 4. Bise Morto
- 4a. Wayaca
- 5. Boca Slagbaai
- 5a. Playa Frans
- 5b. Boca Dreifi
- 6. Nukove
- 6a. Windjammer
- 7. Karpata
- 8. La Dania's Leap
- 9. Rappel
- 10. Bloodlet
- 11. Ol' Blue (Tolo)
- 12. Country Garden/
Mushroom City
- 13. Bon Bini Na Cas
- 14. 1000 Steps
- 15. Webbers Joy
- 15a. Witches Hut
- 16. Jeff Davis Memorial
- 17. Oil Slick Leap
- 18. Barcadera
- 19. Andrea II
- 20. Andrea I
- 20a. Black Durgon
- 21. Petries Pillar
- 22. Small Wall
- 23. Cliff
- 24. La Machaca
- 25. Habitat
- 25a. Reef Scientifico
- 25b. Coral Regency
- 26. Buddy's Reef
- 27. Bari Reef
- 27a. Sunset Beach
- 28. Front Porch
- 28a. Harbour Village
- 29. Something Special
- 30. Town Pier
- 30a. Chachacha
- 31. Calabas Reef
- 31a. Carab Inn
- 32. Eighteenth Palm
- 33. Windsock/
Playa Palu di Mangel
- 34. North Beinem/Corporal Meiss
- 35. Bachelors Beach
- 36. Chez Hines/Dick's Place
- 37. Lighthouse Point/BL Resort
- 37a. Bonaire Beach Bungalows
- 38. Punt Vierkant
- 39. The Lake
- 40. Hilma Hooker

- 41. Angel City
- 42. Alice In Wonderland
- 43. Aquarius
- 44. Larry's Liar
- 45. Jeannies Glory
- 46. Salt Pier
- 47. Salt City
- 48. Invisibles
- 49. Tori's Reef
- 50. Pink Beach
- 51. White Slave
- 52. Margate Bay
- 52a. Fisherman's Hut
- 53. Red Beryl
- 54. Johnny's Hut
- 54a. Atlantis
- 55. Vista Blue
- 56. Sweet Dreams
- 57. Red Slave
- 58. Willemstoren Lighthouse
- 58a. Stingray City
- 58ab. Salt Inlet
- 58b. Piedra Pretu
- 58c. Baby Beach
- 58cd. Marcultura
- 58d. Sorobon
- 59. Blue Hole/White Hole
- 60. Cai

- A. No Name
- Ab. East of No Name
- B. Elbo's Reef
- C. Jerry's Reef/Jerry's Sponge
- D. Just a Nice Dive
- E. Nearest Point
- F. Keepsake
- G. Bonaventure
- H. Monte's Divi/Divi Tree
- I. Rock Pile
- J. Joanne's Suchi
- K. Capt. Don's Reef
- L. South Bay
- M. Hands Off
- N. Forest
- O. South West Corner
- P. Munk's Heaven
- Q. Twixt
- R. Sharon's Serenity
- S. Valerie's Hill
- T. Mi Dushi
- U. Carl's Hill Annex
- Uv. Yellow Man
- V. Carl's Hill
- W. Ebo's Special/Jerry's Jam
- X. Leonora's Reef
- Y. Knife
- Z. Sampler

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

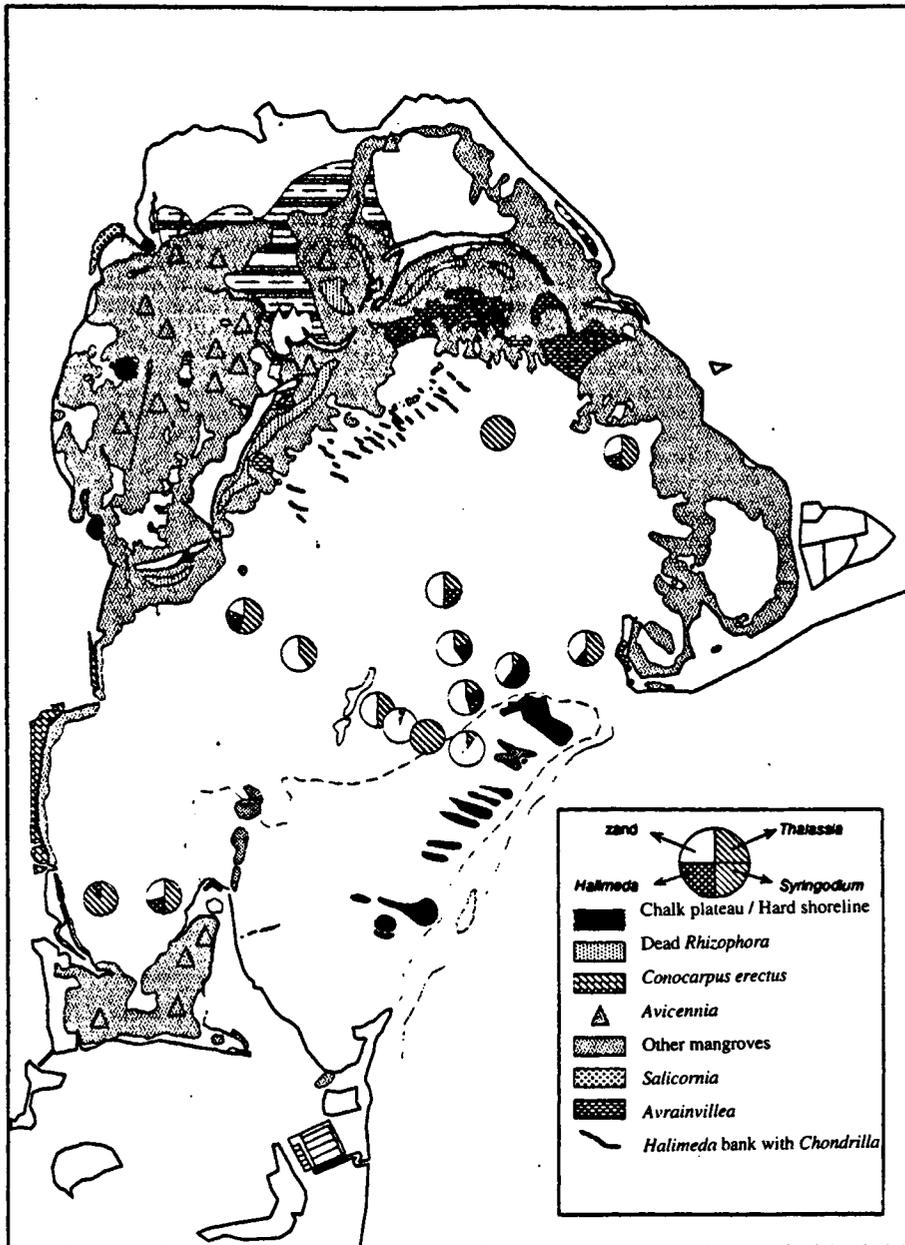
APPENDIX 8

Reported injuries on juvenile sea turtles

<i>Date</i>	<i>Location</i>	<i>Location nr.</i>	<i>Species</i>	<i>Remarks</i>
01-06-97	Sampler	Z	Ei	Right front flipper missing.
19-06-97	Karpata	7	Ei	Right front flipper missing.
08-07-97	1000 steps	14	Ei	Right front flipper missing.
24-11-97	Larry's Lair	44	Ei	Right front flipper missing.
01-12-97	Alice in Wonderland	42	Cm	Right front flipper missing.
08-12-97	Angel City	41	Ei	Right front flipper missing.
09-12-97	Angel City	41	Ei	Right front flipper missing.
11-12-97	Angel City	41	Ei	Right front flipper missing.
11-12-97	Angel City	41	Ei	Right front flipper missing.
29-12-97	Angel City	41	Ei	Right front flipper missing.
04-01-97	Alice in Wonderland	42	Ei	Shell was damaged at the back.
20-01-97	Capt. Don's Reef	K	Ei	Shell was damaged at the back.
16-05-97	Salt City	47	Ei	Shell was damaged at the back.
24-05-97	Capt. Don's Reef	K	Ei	Shell was damaged at the back.
14-08-97	Rock Pile	I	Ei	Shell was damaged at the back.
18-08-97	Joanne's Sunchi	J	Ei	Shell was damaged at the back.
16-09-97	Jerry's Jam	W	Ei	Shell was damaged at the back.
21-01-97	Pink Beach	50	Ei	Piece of the left rear flipper missing.
17-03-97	Invisibles	48	Unknown	Piece of the left rear flipper missing.
27-03-97	Tori's Reef	49	Ei	Piece of the left rear flipper missing.
14-09-97	Vista Blue	55	Cm	Piece of the left rear flipper missing.
05-10-97	Buddy's Reef	26	Cm	Piece of the left rear flipper missing.
21-10-97	Ol' Blue	11	Ei	Piece of the left rear flipper missing.
16-05-97	Andrea II	19	Ei	Turtle entangled in a line.
09-06-97	Buddy's Reef	26	Ei	Turtle entangled in a line.
18-08-97	Oil Slick Leap	17	Ei	Turtle entangled in a line.
30-11-97	Calabas Reef	31	Ei	Turtle entangled in a line.
	Barcadera	18	Ei	The shell had an indentation on the right edge.
09-09-97	Leonora's Reef	X	Cm	The shell had an indentation on the right edge.
13-11-97	Andrea II	19	Ei	The shell had an indentation on the right edge.
28-11-97	Atlantis	54a	Ei	The shell had an indentation on the right edge.
18-01-97	Sharon's Serenity	R	Unknown	Turtle stuck in coral.
15-09-97	No Name	A	Ei	It was a dying hawksbill hatchling, and it lay next to a crab's hole.
11-07-97	La Machaca	24	Ei	
22-03-97	Ebo's special	W	Cc	
15-09-97	Hilma Hooker	40	Ei	

APPENDIX 10

Vegetation of Lac Bay



News Letter

News from the Sea Turtle Club Bonaire

December 1997

SEA TURTLE CLUB BONAIRE 1997-PROJECT PUTS ON WEIGHT!

The Sea Turtle Club Bonaire (STCB), better known as the 'Turtle Club', once again had the opportunity to boost their yearly activities by sending two project assistants to Bonaire. This year, the assistants were Maarten Schuit from the Vrije Universiteit of Amsterdam (VU) and Annemiek van Put from the Katholieke Universiteit Nijmegen (KUN). They continued and reinforced the biological research and the public awareness campaign for the conservation of Bonaire's sea turtles, which has been started by Tom van Eijck in 1993. Like in former years, the biological

research was executed under the supervision of Prof. Dr. R.P.M. Bak from the University of Amsterdam (UVA). In the beginning of the project, the assistants were trained by Niels Valkering, the STCB project coordinator. During the entire project, the assistants were supervised by Kalli de Meyer, manager of the Bonaire Marine Park (BMP), and Corine Gerharts, who is the Chairman of the STCB.

Most of the public awareness activities, such as the Turtuganan di Bonairu-project and the World Cleanup day, were undertaken in close cooperation with

other local organizations, such as the Bonaire Marine Park (BMP) and Tene Boneiru Limpi. Another important contribution to the project was made by Bonaire's diving industry. Most of the diveshops participated in the STCB Sighting Network, thereby acting as the 'underwater eyes and ears' of the STCB. This year, over a 1300 sighting sheets have been filled in compared to 896 last year. The information which came in through the network proved to be a very valuable tool for the research on the juvenile and adult sea turtles that reside in Bonairian waters.

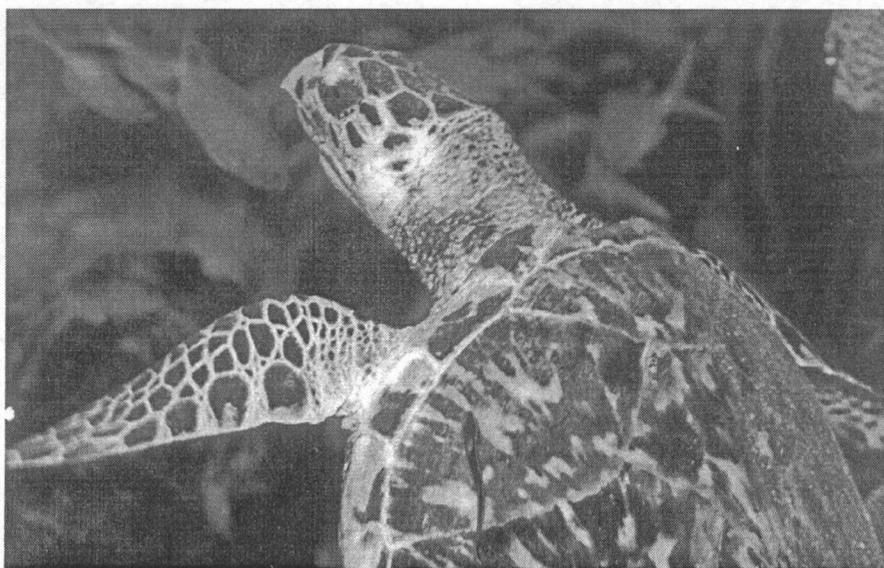


PHOTO: SILL LIPSCOMB

Juvenile Hawksbill photo received via the sighting sheet network

Bonaire's Nesting Turtles

It would be fair to say that turtle activity has been considerable this year. So far, 49 crawls have been reported, of which 80% have been documented on Klein Bonaire. A total number of twelve nests have been excavated to date. However, the near future could reveal more of this year's attempts to have been successful. Klein Bonaire provides nesting grounds for loggerhead and hawksbill turtles, while on Bonaire itself mainly loggerhead nests are found. Previously, it was assumed that the nesting season on Bonaire roughly coincided with the period from the middle of May to the beginning of December, with a peak of activity during July and August. This year, thanks to the voluntary work of Bart Snelder and Imre Esser during the period

from January to June, more detailed information was gathered. Consequently, low-level nesting activity was revealed from April onward. The months of July and August again represented the peak period of activity.

In order to obtain more information about each nest, the assistants dug up the remains after a 70 day period had elapsed - turtle nests hatch between 55 and 65 days. Specific details about the hatching success, development of the embryos and the turtle species were uncovered in this process. It is a practise which must be handled with care as there is a rare chance of discovering live hatchlings which could not surface on their own because of late hatching or a poor hatching rate in the nest.

KLEIN BONAIRE

Klein Bonaire is an uninhabited island off the West Coast of Bonaire and is one of the most important nesting grounds for sea turtles in the Antilles, especially for the highly endangered hawksbill turtle. However, with the exception of the first 50 metres from the coast (high water line) which is government land, it is privately owned by a consortium which has touristical development plans for the islet. For the nesting sea turtle population, these plans will be absolutely disastrous. At this moment, Klein Bonaire and its surrounding reef are still quite pristine. The beaches offer nesting grounds for sea turtles and the coral reef surrounding Klein Bonaire is home to a vast amount of fishes and other beautiful reef creatures. Any large-scale exploitation of Klein Bonaire will have a negative and devastating effect on this environment. The effects would also be felt on Bonaire itself, as the two are intricately connected. Bonaire's main source of income is tourism - dive tourism - which would be tremendously threatened by the exploitation of Klein Bonaire. That in itself should be reason enough for the local government, authorities and people of Bonaire to take a stand and actively preserve Klein Bonaire.

There is a group which has done exactly that. The Foundation for the Preservation of Klein Bonaire (FPKB) was formed because a group of individuals understood the need to protect and preserve Klein Bonaire as it is today. The STCB has become a partner to the FPKB and fully supports the joint goal to keep Klein Bonaire completely undeveloped with the final aim to turn it into a reserve or national park.



Saw A Turtle? Fill Out A Sighting Sheet!

A lot of information on Bonairian sea turtles is received via the help of dive shops and their divers. In 1993 a sighting sheet network was set up by the STCB and in 1995 turtle corners were placed in every dive shop. These turtle corners contain brochures of the STCB, information on turtles and of course the sighting sheets. Divers, snorkelers and other people who sighted a turtle are asked to fill out a sighting sheet. Every year the amount of sighting sheets which is collected is increasing (graph 1).

'Turtuganan di Boneiru' a Big Success

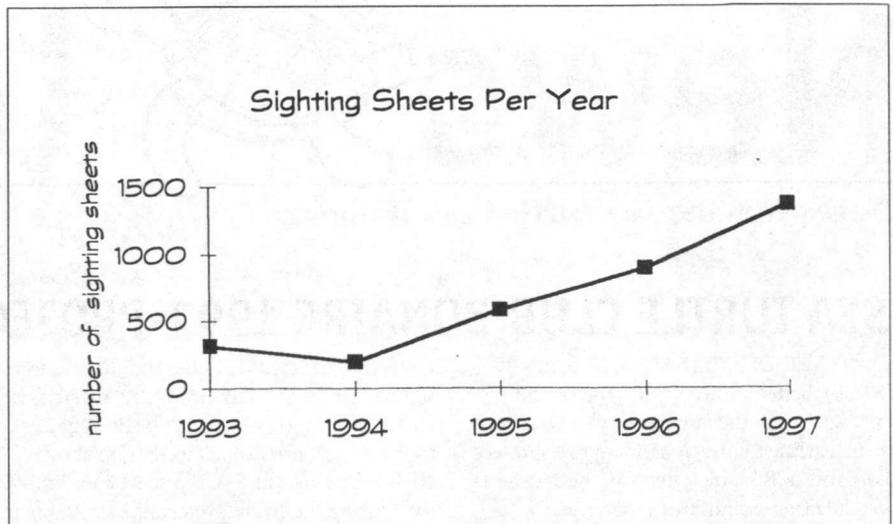
Turtuganan di Boneiru (Turtles of Bonaire) is a children's snorkel program, sponsored by Stichting DOEN and jointly operated through the STCB and BMP. It is important for the Bonairian children to know more about the environment in which they live in. The message of preservation and conservation of nature is that much clearer for them if they understand and learn to enjoy the world around them. In the past, Turtuganan di Boneiru organised snorkel lessons for the local children of Bonaire and subsequently invited them for snorkeltrips to Klein Bonaire. In cooperation with Enit Scholtens, the Education Conservation Officer on Bonaire, Turtuganan di Boneiru evolved into a more extensive program. Apart from the snorkel activities, there are indoor nature educational programs. Several marine life programs have been developed and set up in such a way that the children can take an interest and learn more about the fishes, turtles, reef creatures and the reef itself. The programs consist of educational games, slide presentations, and assignments on the beach.

In view of the bad state the contemporary snorkelsets of the Turtuganan di Boneiru club are in, the STCB recently purchased new snorkelsets, which will be used by the children during the lessons and snorkeltrips. Furthermore, the STCB offers snorkelgear for sale. These sets can be bought for a low price by 'Turtuganan'-certified children, enabling them to undertake snorkeltrips out of Turtuganan Club-hours.

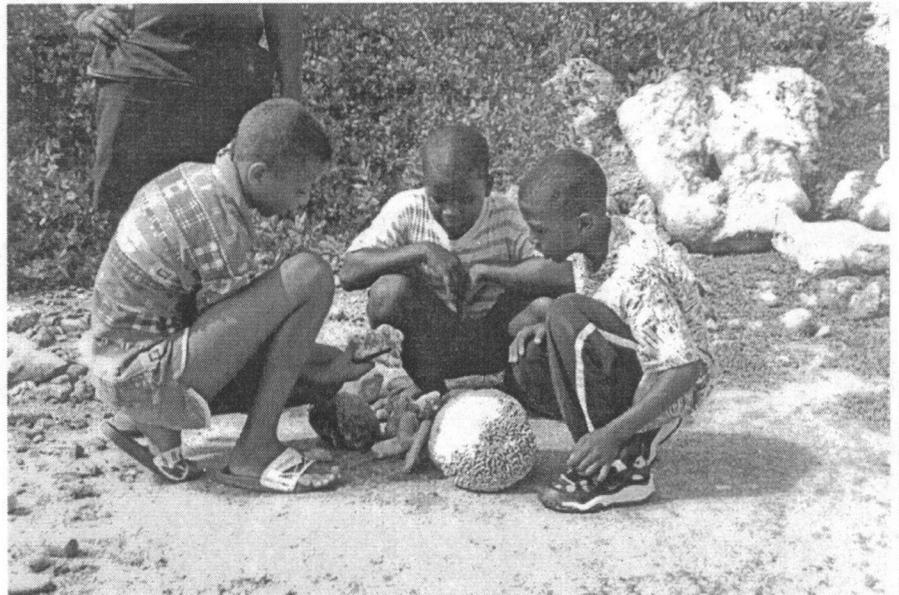
For more information, call Enit Scholtens at the Bonaire Marine Park at 8444.

United Nations Cleans-Up Coast Of Bonaire

This year, the World Cleanup event was held on September 13 & 14 and for the third consecutive year, the STCB co-ordinated the coastal cleanup. The inland and underwater cleanups were organised by Tene Boneiru Limpi and CURO, respectively. The coastal areas consisted of Lagoon, Washington Park



Graph 1



'Turtuganan di Boneiru' children during an assignment on the beach.

beaches and the entire island of Klein Bonaire. We had 150 participants in which 17 different nationalities were represented! From Argentina, Austria, Belgium, Canada, Channel Islands, England, France, Germany, Holland, Israel, Malta, Netherlands Antilles, Norway, Sweden, United States, Venezuela all the way to Wales! A true united nations event and effort. The amount of trash bags collected totalled a mammoth quantity of 809, which when compared to last year's figures, 219 participants / 509 bags, we clearly had less people but managed to fill many more bags! The underwater cleanup was also a big success with 113 participants filling 1 1/2 containers plus 25 bags (approx. 3000lbs of trash). The coastal cleanup differs from the other cleanups because participants are asked to fill in data sheets so as to identify and quantify the type of marine debris collected. The STCB then reports the findings to the Center for Marine Conservation (CMC), Washington D.C. and the results are published in their annual report. Bonaire receives global recognition by

appearing in the CMC's end of year results. More importantly, these official results will help in creating stronger cases in the fight against pollution of Bonairian coastal waters. Many people and organisations help make this event a success every year. For our part, we have many to thank and would like to take this opportunity to mention those that have been with us from the beginning: *Sunset Beach Dive Center*, for the generous use of their pontoon through out the entire weekend. *Samur Charters*, for their invaluable assistance on Klein Bonaire. *Sunset Beach Hotel*, for their complimentary lunches and happy hours what a treat! *SELIBON*, for removing the trash on time and efficiently. *Cruisers*, for always turning out in droves and having the biggest positive impact on Klein Bonaire. *Al Catafumo & Navimar Statie*, for always going where nobody has ever wanted to go before! *SGB Chess Club* for their commitment to cleaning Lagoon and, of course, to our friends at *Tene Boneiru Limpi* without whom none of this would be possible.

AWARENESS ACTIVITIES OF THE STCB

Sea Grass Beds Are Food!

Lac Bay, a lagoon situated on the east coast of Bonaire, is a very important foraging area for green turtles. It provides them with their main diet, sea grass. They graze upon the sea grass beds during the night, whilst in the morning they leave the bay to reside along the east coast of Bonaire. The sea grass beds are very sensitive to trampling, making public recreation in the bay a potential threat which needs to be monitored very closely. The STCB cooperates with the Bonaire Marine Park (BMP) in monitoring the sea grass beds for abnormalities like stranding scars in the sea grass, caused by boats or windsurf-boards. Concurrently, the beds are surveyed for grazing plots by green turtles, in order to detect foraging behavior of these animals in Lac Bay. The BMP has set up a project to divide Lac Bay into sectors. Certain areas are water sport restrictive thus allowing a better protection of Lac Bay's fragile environment. The area is also checked for possible poaching activities (i.e.; the mass width of fishing nets are checked and reported).

In 1991 legislation was put in place, forbidding the sale, trade or donation of any kind of turtle product. On Bonaire restaurants do not serve turtle soup or meat, shops do not carry turtle products and there are no sea turtles in captivity. Much progress has been made in 6 years, but still the poaching continues to exist on a low level. Education on turtles and their endangered status is necessary to bring the public to a better understanding of these sea creatures. Most important is the younger generation, the children, who should receive the message of conservation and protection as early as possible.

Pink Beach Increasingly Popular!

Pink Beach is thought to be an unsuitable nesting habitat for sea turtles - mainly caused by a small layer of sand on a hard surface and the dynamic character of the beach. The traditionally low-level of nesting activity in this area could be the result of these poor conditions, although the high intensity of recreational activities are also expected to contribute to lack of nesting activity at this site. Noteworthy is that the number of sighting sheets reporting turtles in the vicinity of Pink Beach is amongst the highest of all dive sites. However, these sightings almost exclusively represent juvenile turtles.

The STCB's research, from 1993-95, showed no evidence of nesting on Pink Beach. Surprisingly, the 1996 surveys revealed one hawksbill nest, with a large number of dead hatchlings - 149 eggs comprising 35 dead hatchlings. These disturbing figures are most likely due to

continuous trampling of the nest, a well-known threat to nests on heavily visited beaches. This year, from July onward, the STCB has again observed tracks of turtles, that had landed on Pink Beach in an attempt to lay their eggs. Cargill, the owner of Pink Beach, gave permission to fence the body pits of interest (the STCB prefers not to search for the eggs, due to the risk of damaging them in that act) and to place a sign explaining the reason for the fences. The body pits were closely observed but no eggs were found. Although this is indicative of unsuccessful nesting attempts, the possibility also exists that the eggs were washed away by the sea (due to a flood during the incubation period).

Poaching in Washington Park!

In the Washington-Slagbaai National Park, flooding of nests constitutes an everlasting problem. Both the rough seas and the characteristic small dynamic beaches can account for this threat. During the 1997 Project, the STCB discovered nesting activity at Boka Catuna. Of the various attempts, merely one resulted in a nest which was located safely behind the shoreline. Ironically, this particular nest suffered a poaching. When the nest was dug up there were no signs of hatching found and only very little eggs were inside the nest. Given the fact that this nest was at quite an advanced stage - the embryos were almost fully developed - it is strange that the eggs were poached. Although a lot of progress has been made since 1991, this incident reaffirms the need for continued educational/public awareness activities.

A Turtle is Saved

In August the STCB was contacted by Patrick's Divers, a local dive shop, and informed that a turtle had been found entangled in fishing line. Whether the turtle entangled itself or had been purposefully caught, remains unclear. The fishing line seemed to be fastened to the coral and was long enough to enable the turtle to surface for air. After the turtle was freed, it was kept under observation for some hours until it was considered well enough to be released in the open sea again. A World Wild Life Fund film crew happened to be on island and were permitted to document the release which was broadcasted throughout Holland, last September.

Better Late Than Never

On May 28, at noontime, something very unusual took place. The owner of Baka di Laman, a local water taxi, discovered a hawksbill turtle making a nest on No Name Beach. Usually, turtles make nests during the night when it is cooler and quieter. The

HISTORY OF THE STCB

The Sea Turtle Club Bonaire, founded in 1991 by Albert de Soet, is a Bonairian-Dutch non-profit organization of which the main goal is to save from extinction the sea turtles that visit Bonaire. The first comprehensive sea turtle conservation project of the STCB was executed by Tom van Eijck in 1993, using recommendations made by the Wider Caribbean Sea Turtle Conservation Network (WIDECAST).

WIDECAST, an international organization sponsored by the United Nations, published Sea Turtle Recovery Action Plan for the Netherlands Antilles in 1992 (STRAP; Sybesma, 1992). The STRAP is a guide for project development and the implementation of field conservation priorities. The beach monitoring results, as well as sighting reports from the dive school network established by the STCB, indicated that Bonaire was still visited by juvenile, sub-adult and adult turtles of several species. The results were made available to the public, including policy makers, educators and the media. Apart from the monitoring and sightings database, an extensive public awareness campaign was undertaken; targeting schools, law enforcement agencies and the general public (Van Eijck & eckers, 1994).

In 1995, a first follow-up project was organized and two project assistants, were sent to Bonaire. The research activities of the project assistants were supervised by the UvA. The project was sponsored by the World Wild Life Fund for Nature-Netherlands and the Dutch National Postcode Lottery, and activities were organized in cooperation with a consortium of local nature conservancy organizations, including the *Bonaire Marine Park* and *Tene Boneiru Limpí*. Although the number of nests documented did not differ appreciably from 1993, new nesting beaches were identified. Moreover, a promising pilot project on photo identification of juvenile green and hawksbill turtles was initiated. Apart from the research, the STCB focused once again on public awareness.

The 1993 Project had revealed a large demand for educational materials suitable for local schools; thus, the 1995 campaign held as a priority the development and distribution of such materials.

Much progress has been made on Bonaire since 1991, but although the turtle fishery (including egg collection) have been forbidden by law on Bonaire since 1991, a small quantity of sea turtles is still harvested illegally. The hunting is pursued by a small group of fishermen who have traditionally hunted sea turtles for their meat. The hunt threatens remaining populations, but the major concern is not this clandestine market, but rather the continuing development of the tourism industry.

STCB was immediately informed and went to No Name to witness the event and to ascertain that the turtle was not disturbed in any way during the nesting procedure. When the time came for the nest to hatch, the project assistants, along with some interested parties, went over during the evening hours to nest watch. On day 62, the nest hatched.

It was pure joy to watch those little hatchlings make their way to sea and swim away. The hatching percentage was only 49.3%, and not considered good ratio. A successful hatching event, would ensure a percentage between 65%-100%. Again, trampling is accounted for the failure of the nest. Nevertheless, a total of 69 hatchlings made it to sea. Jack and Karen Chalk from Captain Don's Habitat were very kind to provide us with a copy of their video and slides of the nesting turtle at No Name Beach. This is greatly appreciated by us, since the material can and will be used in our educational campaign.

WWF Holland Celebrates 35 Years

This year, WWF Holland celebrated its 35th anniversary and on the occasion of this special event, the Netherlands Antilles and Aruba were chosen to be featured in a unique Dutch television broadcast. Television film crews from 'Cartoon express', 'Ursel Goes Wildlife' and 'Parodie Parade', along with several journalists from various major Dutch newspapers came to interview and film the non-governmental organisations (NGO) of Bonaire. Their objective was to give the Dutch public an insight into the nature and conservation activities being conducted in this area. The STCB was asked to make a presentation on the status of Bonairian sea turtles as well as present our club's activities and objectives. As well, our interest in preserving Klein Bonaire, being the most important nesting ground of the Netherlands Antilles, was stressed as a main concern for the future of sea turtle populations and other marine life forms. During the month of September,

special WWF Holland programs were aired throughout Holland including the Bonaire segments. In addition, the STCB was invited to join in the festivity at castle Kerckebosch in Zeist, the Netherlands, alongside guest of honour H.R.H. Prince Bernhard.

The Turtle Club Needs YOU!

The work of volunteers is a very important one on which the STCB relies heavily. Without the help of the dive shops, divers and snorkelers it would have been impossible to collect as much information, on turtles residing in the coastal waters of Bonaire, as has been done. Also of great importance is to continue the STCB effort on the long term. The monitoring of beaches for signs of turtle activity, the public awareness campaign and the popular Tortuganan di Boneiru club all need to continue throughout the year. Many people have expressed an interest in the work the STCB commits itself to and have offered to assist us because they believe in this mission. For this reason, the STCB has set up a volunteer network that will enable the continuation of the work and the collection of vital data through the involvement of the caring community of Bonaire. The volunteers will be taught to conduct snorkel surveys, monitor beaches and the sighting sheet network as well as help extend a photo identification project and much, much more! If you are interested in joining the STCB Volunteer Network, please contact Corine Gerharts at 8399.

The Board Not Bored!

The entire STCB board operates on a volunteer basis, both in Bonaire and in Holland. Recently, two new persons were added to our board in Bonaire. Bart Snelder has been appointed Secretary and Imre Esser is our Fund Raising Treasurer. They will join the President, Corine Gerharts and the Treasurer, Hugo Gerharts who have been on the board for two and six years, respectively. They are all well known to the community and tremendously motivated individuals.

They will be responsible for setting-up the new committee members and the volunteer network. We are very glad to have this group as our board and wish them well in their efforts to keep the work of the Sea Turtle Club of Bonaire active and significant.

SPONSORS OF THE STCB:

World Wild Life Fund for Nature (the Netherlands); Stichting Doen/Nationale Postcode loterij; WIDECAST; Dierenrampenfonds; Bonaire Trading Company; KLM; Paul Huf Studios; G. van Lennep Productions; Villapark Ooghduyne; Sunset Beach Hotel; Van Lindonk Special Projects B.V.; Buddy Dive Centre; Captain Don's Habitat; Sunset Dive Centre; Woodwind; Great Adventures Bonaire; Buddy Beach & Dive Resort; Extra.

SUPPORTERS OF THE STCB:

Tene Boneiru Limpi; Bonaire Marine Park; Sunset Sailing. We would like to thank some people who without their help, the 1997 Project would not have been as rewarding: Corine Gerharts, Bart Snelder, Imre Esser, Kalli de Meyer, Enit Scholtens, Niels Valkering, Jerry Schnabel, Hendrik Wuyts, Renee Leach.

PUBLICATIONS OF THE STCB:

1993 STCB Folder, STCB Poster
1994 STCB 1993 Report
Nos mundi di Tortuga
1995 1st STCB Newsletter
1996 STCB 1995 Report
STCB/WIDECAST
miniposter
2nd STCB Newsletter
1997 STCB 1996 Report
STCB Folder (full color)

TO BE EXPECTED SOON:

STCB Video

FINALLY, WHAT CAN YOU DO TO HELP THE TURTLES?

You can do your share of turtle protection as well. If you happen to see a sea turtle, don't harass or ride it, and if you are lucky to see one coming on land, please don't shine lights or make noise, and keep good distance: the turtles are very shy when planning to nest. Please report any sightings to the nearest dive shop. If you are at a beach such as Klein Bonaire, which is frequently nested upon, beware where you walk. Trampling or sitting on a nest will make the sand on top too dense, preventing oxygen from reaching the eggs, and killing the growing hatchlings. Protect feeding areas by keeping the sea clean of plastic or other

waste. A plastic bag ingested by a turtle will be lethal for the animal. If you notice any illegal activity, such as the capture of turtles, destruction of nests, or the sale of turtle eggs, please report this to Bonaire Marine Park (8444) or the police (8000). To continue our work, both your financial and practical support will be highly appreciated. Send your donations to the Sea Turtle Club Bonaire.

Maduro & Curiel's Bank: acc.nr 10106273,
Kralendijk, Bonaire, Neth. Antilles
ABN-AMRO Bank: acc.nr. 550391150
Hilversum, The Netherlands.

Also contributions of pictures of Bonairian sea turtles are very welcome. Volunteers willing to devote time and effort to monitoring activities are certainly welcome, especially for the period of December to June, when no project assistants are available on the island.

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