PROCEEDINGS OF THE FIRST MEDITERRANEAN CONFERENCE ON MARINE TURTLES

Rome, 24-28 October 2001

Editors:
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ICRAM
Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare

IUCN/SSC Marine Turtle Specialist Group
Mediterranean Region

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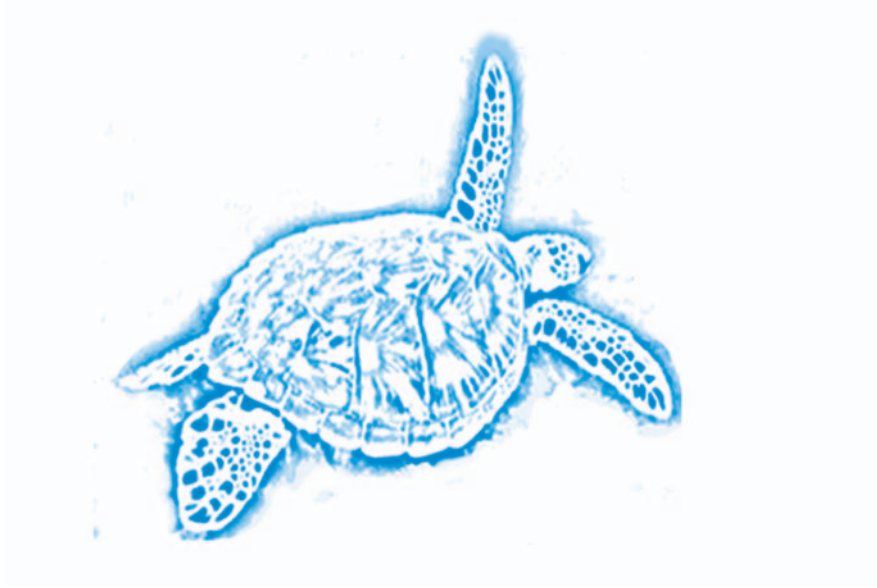

Barcelona Convention - Bern Convention - Bonn Convention (CMS)

Nicosia, Cyprus, December 2003

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This publication should be cited as follows:

Margaritoulis, D. and A. Demetropoulos (editors). 2003. Proceedings of the First Mediterranean Conference on Marine Turtles. Barcelona Convention – Bern Convention – Bonn Convention (CMS). Nicosia, Cyprus. 270 pp.

Copies of this volume can be freely downloaded from:

http://www.medturtleconf.net
http://www.seaturtle.org
http://www.cms.int
http://www.coe.int/T/E/Cultural_Co-operation/Environment/

ISBN 9963 8928 0 9

PREFACE

During the last few years, discussions have taken place in various fora regarding the possibility of organizing a pan-Mediterranean marine turtle conference that would allow the Mediterranean scientific and conservation community to express its views and knowledge on these threatened species with the final aim of improving the conservation-minded approach already endorsed by wildlife conservation instruments such as the Barcelona, Bern and Bonn Conventions.

At the RAC/SPA meeting for the revision of the Action Plan for the Conservation of Mediterranean Marine Turtles (Arta, October 1998) a specific proposal for the organisation of a Mediterranean conference on marine turtles was made by Douglas Hykle of the Secretariat of the Bonn Convention or CMS (Convention on Migratory Species). The RAC/SPA Director, Mr Mohamed Hentati, brought the subject to the Meeting of Experts for Priority Actions for the above mentioned Action Plan (Tunis, February 1999) which responded very favourably. Further, the proposal was adopted formally by the Fourth Meeting of the National Focal Points for SPAs in the context of the Barcelona Convention (Tunis, April 1999). Eladio Fernandez-Galiano, at the Secretariat of the Bern Convention, was also very enthusiastic on the proposal and eventually the above three supra-national Conventions (Barcelona, Bern, Bonn) proceeded in funding and organizing the First Mediterranean Conference on Marine Turtles. The venue was chosen to be in Rome with ICRAM acting as the host organization. The Organizing Committee comprised by representatives of the three conventions (Marco Barbieri from the CMS, Eladio Fernandez-Galiano from the Bern Convention, Atef Ouerghi from RAC/SPA), supplemented by Giulia Mo of ICRAM and Dimitris Margaritoulis from IUCN's Marine Turtle Specialist Group (MTSG).

The Conference took place at the Jolly Hotel Leonardo da Vinci, Rome, from 24 to 28 October 2001 and gathered 173 registered participants from 18 countries. The programme was organized around four main topics, which comprised the four conference sessions:

- Population dynamics and genetics
- Identification and conservation of critical habitats
- Interaction with fisheries
- Biology, ecology, etc.

In addition, three workshops were organized with the following themes:

- Reducing mortality at sea through education of fishermen
- Standardization of methodologies for monitoring nesting beaches
- Mitigation of tourist development impacts on nesting beaches

Key-note presentations were made at the opening of the conference and at the beginning of each thematic session. Each thematic session was followed by a round table discussion where all questions were brought after some grouping by the respective Session Chair and Rapporteur.

The present volume contains all contributions made during the conference, as submitted at a specific deadline after the conference. The volume is divided in the following sections: Introductory notes, key-note presentations, oral and poster contributions (not separated). Within each section abstracts are listed in alphabetical order, by author. Round table discussions led to the drafting of the Conference Highlights, which were adopted by the Conference. These are presented at the end of the volume, before the Index of Authors.

We feel privileged to have undertaken the edition of the Proceedings. Our editing has been minimal and has concentrated more on the appearance than on the content of the contributions. So, the responsibility for the content falls with the authors, whom we thank for their cooperation and patience. We also thank Michael Coyne for kindly hosting the pdf file at www.seaturtle.org and Alan Rees for editorial assistance.

Dimitris MARGARITOULIS and Andreas DEMETROPOULOS
The Proceedings Editors

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ABOUT THE CONFERENCE

The **First Mediterranean Conference on Marine Turtles** has been a joint initiative by the Secretariats of the following Conventions:

- Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention, 1976)
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979)
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982)

The event was organized with the support of the IUCN's Marine Turtle Specialist Group (IUCN/MTSG) and the Istituto Centrale Ricerca Applicata al Mare (ICRAM).

ORGANISING COMMITTEE
- Marco BARBIERI (Bonn Convention)
- Eladio FERNANDEZ-GALIANO (Bern Convention)
- Dimitris MARGARITOULIS (Regional Chair of the IUCN's MTSG)
- Giulia MO (Istituto Centrale Ricerca Applicata al Mare)
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- Andreas DEMETROPOULOS
- Jean LESCURE
- Sedat YERLI

The Organizing Committee would like to thank all conference participants and particularly the Programme Committee, the Invited Speakers (Josette Beer-Gabel, Thomas Dellinger, Andreas Demetropoulos, Graeme Hays, Jean Lescure, Max Kasparek, Dimitris Margaritoulis, also Nat Frazer for sending his key-note presentation to be read at the conference), the Session Chairs and Rapporteurs (Mohamed N. Bradai, Paolo Casale, Myroula Hadjichristophorou, Abdulmaula Hamza, Fiona Glen, Bojan Lazar, Giulia Mo, Jesús Tomás, Oguz Turkozan) and the Workshop Organizers (Dimitrios Dimopoulos, Guido Gerosa, Brendan Godley). Last but not least our greatest thanks to the conference's local host ICRAM and its then president Giuseppe Notarbartolo di Sciara.

THE ACTION PLAN FOR THE CONSERVATION OF THE MEDITERRANEAN MARINE TURTLES ADOPTED WITHIN THE FRAMEWORK OF THE MEDITERRANEAN ACTION PLAN

Barcelona Convention Secretariat

Several international conventions applicable to the Mediterranean region contain provisions for the protection of marine turtles. The Barcelona Convention is the only one to which all riparian Mediterranean nations are signatories. The significance of the Barcelona Convention, as far as marine turtles are concerned, is reflected not only in the Protocol concerning specially protected areas and biological diversity in the Mediterranean but also in the elaboration of an Action Plan for the Conservation of the Mediterranean Marine Turtles in 1989 and its recent revision in 1999.

The Revised Action Plan takes a holistic approach to processes threatening Mediterranean turtle populations. Its main objectives are to enhance the population of marine turtles, conserve their critical habitats in the Mediterranean region and to improve scientific knowledge about these species.

An important feature of the Revised Action Plan is its emphasis on addressing interactions of marine turtles with Mediterranean fisheries. The Plan emphasises that appropriate legal measures are essential to successfully carry out the priorities and implementation measures.

The Annex to the Revised Action Plan lists concrete actions for individual States, many of which concern the adopting or strengthening of legal protection for turtles and critical habitats. These actions are to be taken forthwith and are not contingent on further research. In addition, the Plan provides for ongoing research into turtle status, biology and behaviour and recognises that readjustments may be needed when further information becomes available.

Lastly, the Revised Action Plan emphasises the importance of developing public awareness, information and education measures to meet the needs of different target groups.

Within the framework of the Action Plan, RAC/SPA has carried out and continues to carry out many concrete field actions, inter alia: assessment of the marine turtle nesting activity, annual organisation of a training session on marine turtle conservation techniques at the Lara station, elaboration of guidelines for legal frameworks for conservation and management of Mediterranean marine turtles, a training/awareness module to educate fishermen in the need to release incidentally-caught turtles.

BERN CONVENTION ACTIVITIES ON MARINE TURTLES IN THE MEDITERRANEAN

Eladio FERNANDEZ-GALIANO

Head of the Natural Heritage Division, Council of Europe, Strasbourg, France

The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979) counts 45 Contracting Parties, 13 of which are riparian states of the Mediterranean (Albania, Croatia, Cyprus, France, Greece, Italy, Malta, Monaco, Morocco, Slovenia, Spain, Tunisia, Turkey). Its main objective is to conserve wild flora and fauna and natural habitats. The Convention provides for full protection to all marine turtles, their nesting beaches and their wintering areas. In the past 15 years the Bern Convention has delivered substantial work on marine turtles in the Mediterranean, mainly through the action of its Group of experts on Marine Turtles (from 1985 to 1987) and its Group of experts on the conservation of Amphibians and Reptiles and by the opening of file-cases on problem sites.

The Standing Committee to the Convention, which is the body responsible for its monitoring and implementation, examines every year possible breaches. When the Committee is informed of a difficulty in the Convention's implementation, it may open a case file and recommend appropriate action to governments. In the case of marine turtles, the conflict between tourism and the preservation of nesting beaches has been the source of an important number of these files being opened at the Convention. The purpose of these files is to find satisfactory solutions and monitor as effectively as possible the means chosen to solve the problems encountered. Many marine turtle files have been the object of recommendations by the Committee since 1989, including the main nesting beaches; Zakynthos and Kaminia in Greece, Dalyan, Akyatan, Belek, Dalaman, Anamur and Patara in Turkey, and those in the Akamas Peninsula in Cyprus.

On-the-spot appraisals on some of the beaches have been carried out and negotiation meetings have been held with the governments of these three Mediterranean States, the general result being an improvement of government measures and the formal protection of many important sites that were not previously protected.

THE ROLE OF THE CONVENTION ON MIGRATORY SPECIES (CMS) IN THE CONSERVATION OF MARINE TURTLES

UNEP/CMS Secretariat

UNEP/CMS Secretariat, United Nations Premises in Bonn, Martin-Luther-King Str. 8, D-53175 Bonn, Germany

The Convention on Migratory Species (CMS or Bonn Convention) contains strict measures for the protection of marine turtles. CMS Parties that are Range States for marine turtles are to endeavour to conserve their habitat, to counteract factors impeding their migration, and to control other factors that might endanger them. Above all, Parties are obliged to prohibit the taking of animals of these species, with few exceptions.

CMS also encourages regional co-operation through specialized Agreements. These may range from legally-binding treaties to less formal memoranda of understanding. The Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia was concluded in July 2000. The contents of a detailed Conservation and Management Plan to accompany the Memorandum were agreed in Manila in June 2001. Nine States have signed the Memorandum thus far.

A comparable instrument for Africa - the Memorandum of Understanding concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa - was concluded in Abidjan in May 1999. Twelve Range States have signed that instrument. A meeting is scheduled in Nigeria in November 2001 to finalize a Conservation Plan. Efforts to conserve marine turtles in Africa received a further boost in 2001 with CMS' release of the report Biogeography and Conservation of Marine Turtles of the Atlantic Coast of Africa, authored by Jacques Fretey.

The Convention on Migratory Species also promotes co-operation through sponsorship of research (e.g. surveys of nesting beaches, genetic studies to help elucidate migration patterns), production of information materials (e.g. identification posters, and a prototype GIS mapping facility for nesting beaches of the Indian Ocean) and capacity building (e.g. regional training/policy workshops, conservation techniques manual).

Starting at a regional level and focusing in particular on developing countries, CMS is working towards an interlinked, global framework for the conservation of marine turtles. Mediterranean initiatives that make use of appropriate instruments and tools are best seen in this wider context.

UN REGIME JURIDIQUE POUR LES TORTUES DE MER EN MEDITERRANEE

Josette BEER-GABEL

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Les tortues de mer ont ceci de particulier qu'elle sont prises en compte dans un vaste ensemble de traités internationaux. Ceux-ci intègrent en pratique deux générations de textes. La première, développée à partir des années soixante-dix, correspond aux grands accords protégeant la faune et la flore sauvages dans son ensemble, tels que les conventions de Berne et de Bonn ou la CITES. De ce premier groupe de textes, relèvent encore trois accords conclus dans le cadre du Programme des Nations Unies pour l'Environnement, dont l'un concerne la Méditerranée. Á la seconde génération d'instruments, élaborés à partir des années quatre-vingt-dix, correspond une approche distincte, exclusivement axée sur la protection des tortues marines. Cette démarche a d'ores et déjà donné lieu à la conclusion de trois traités. On a affaire ici à des accords de portée régionale visant: - le continent américain, -l'Amérique centrale, - la côte Ouest de l'Afrique.

Peu d'espèces font l'objet d'une telle sollicitude et de fait, l'on se trouve à la tête d'un impressionnant appareil de protection comportant neuf instruments conventionnels; seuls les cétacés peuvent y être comparés, et dans une moindre mesure les oiseaux et les phoques (Beer-Gabel et Labat 1999). Toutefois, il n'existe pas à l'heure actuelle d'accord international spécifique, pour les tortues de la région méditerranéenne; leur protection relève en conséquence des quatre régimes généraux protégeant la vie sauvage. Il m'est alors apparu intéressant de chercher à définir en quoi consistent les mécanismes juridiques actuellement applicables aux tortues de mer en Méditerranée (I), et de tenter d'imaginer ensuite, ce que pourrait être, un instrument, envisageant un régime juridique propre à la région (II).

I. LA PROTECTION DES TORTUES DE MER, OBJET DE REGIMES GENERAUX

A. LA PROTECTION DES TORTUES DE MER PAR LA CONVENTION SUR LA CONSERVATION DES ESPECES MIGRATRICES APPARTENANT A LA FAUNE SAUVAGE (BONN, 23 JUIN 1979)

Il ne fait guère de doute que cet instrument, constitue aux côtés de la CITES, de la Convention de Berne et de la Convention de Rio sur la diversité biologique, l'un des piliers fondamentaux sur lesquels repose la protection conventionnelle de la faune et de la flore sauvages. Le texte, entré en vigueur en 1983 et qui vise toutes les tortues de mer, rassemblait au 1er janvier 2000, soixante-dix-sept États Parties issus de toutes les régions du monde à l'exception il est vrai de l'Amérique du Nord puisque ni les États-Unis, ni le Canada n'ont signé la Convention. Il est intéressant de noter que l'on compte au nombre des parties à la Convention de Bonn, 11 États riverains de la Méditerranée, Chypre, l'Égypte, la France, la Grèce, l'Italie, l'Espagne, Israël, la Tunisie, le Maroc, Monaco, le Royaume-Uni. Ensuite, la Convention de Bonn distingue en fonction de leur état de conservation, deux catégories d'espèces auxquelles s'appliquent deux régimes juridiques distincts. Pour les espèces menacées en danger d'extinction qui figurent à l'Annexe I, c'est dans la Convention elle-même que se trouvent fixées les dispositions relatives au régime juridique qui leur est applicable ; celui-ci repose notamment sur la mise en œuvre d'interdictions du prélèvement de ces animaux (art. 3.5), et d'engagements relatifs à la restauration de l'habitat (art. 3). Les espèces dont l'état de conservation est considéré comme «défavorable» et qui sont énumérées à l'Annexe II, bénéficient d'un régime de protection original, dans la mesure où il n'est pas déterminé dans le texte même de la Convention, mais où il repose sur l'action que les parties doivent entreprendre. En vertu de l'article 4.3, les Etats doivent en effet, s'efforcer de conclure des accords internationaux, relatifs à la conservation des espèces visées, en vue de permettre leur rétablissement, dans un état de conservation favorable. Bien que non contraignante, cette voie a été largement suivie par les Etats puisque plusieurs accords ont déjà été conclus: l'Accord sur la conservation des phoques de la mer de Wadden (1990), l'Accord sur la conservation des petits cétacés de la Baltique et de la mer du Nord, également désigné par l'abréviation ASCOBANS (1992) et l'Accord sur la conservation des chauves-souris en Europe, EUROBATS (1993), ACCOBAMS.

Les tortues de mer ont été considérées par la Convention de Bonn, à la fois comme des espèces menacées et comme des espèces dont l'état de conservation est défavorable; elles sont donc inscrites à ce titre aux annexes I et II, et dès lors, elles relèvent des deux régimes de protection définis.

B. LES TORTUES DE MER ET LA CITES

La Convention sur le commerce international des espèces de faune et de flore menacées

d'extinction a été signée à Washington le 3 mars 1973; elle réunit aujourd'hui environ 150 Etats, ce qui témoigne de la préoccupation éprouvée par la communauté internationale quant au danger qu'engendrent pour certaines espèces, les bénéfices tirés de leur exploitation. Comme l'indique son intitulé en effet, c'est par le biais d'une activité particulière - la réglementation du commerce - qu'est organisé le mécanisme de la protection.

La CITES pose comme principe que tout commerce (exportation, réexportation, importation et introduction en provenance de la mer) de spécimens inscrits dans des listes figurant en annexe à la Convention, doit satisfaire à des réglementations qu'elle définit de façon extrêmement précise dans ses articles 3, 4 et 5. Ces réglementations reposent principalement sur la délivrance et la présentation préalable de permis ou de certificats, qui doivent être conformes aux dispositions de l'article 6. Les conditions très strictes qui entourent l'exportation et l'importation d'espèces protégées, sont fonction de leur état de conservation; à cet égard, la CITES distingue trois niveaux au sein du vaste ensemble des espèces visées, auxquels correspondent autant d'annexes à la Convention : - l'Annexe I, énumère les espèces menacées d'extinction; - l'Annexe II, les espèces susceptibles de le devenir; - l'Annexe III, celles qui sont soumises par les parties à une réglementation.

Dans cet immense répertoire de la faune et de la flore mondiale que constituent les annexes à la CITES, lesquelles comportent des milliers d'espèces, les tortues marines ont été considérées comme menacées d'extinction; elles figurent de ce fait à l'Annexe I et font donc l'objet d'une protection maximale.

C. LES TORTUES DE MER ET LA CONVENTION DE BERNE RELATIVE á LA CONSERVATION DE LA VIE SAUVAGE ET DU MILIEU NATUREL DE L'EUROPE (19 SEPTEMBRE 1979)

La plupart des espèces de tortues de mer figurent à l'Annexe II de cet instrument, et s'inscrivent à ce titre, d'emblée, dans la logique d'un régime de protection stricte. Les États sont tenus de par le système de Berne, de remplir des obligations générales et des obligations spécifiques. Les obligations générales sont énoncées aux articles 2 à 4 du texte, et aux articles 10 et 11. Il s'agit ici pour les Etats, de prendre des mesures nécessaires pour maintenir ou adapter la population de la flore et de la faune sauvages, à un niveau satisfaisant. Les tortues de mer bénéficient aussi en tant qu'espèces de l'Annexe II, de devoirs spécifiques qui s'imposent aux États (article 6). Le régime de protection stricte élaboré ici, repose sur une série d'interdictions visant les captures, la détention et la mise à mort intentionnelle des spécimens (a), mais aussi la détérioration ou la destruction intentionnelle des sites de reproduction et des aires de repos (b); les interdictions s'appliquent aussi à la perturbation de la faune, notamment durant la période de reproduction (c), à la destruction, au ramassage et à la détention des œufs (d); elles visent enfin la détention et le commerce interne des animaux vivants ou morts, y compris naturalisés (e).

D. LA PROTECTION DES TORTUES DE MER DANS LE CADRE DES CONVENTIONS DU PNUE SUR LES MER REGIONALES: LE PROTOCOLE DE BARCELONE SUR LES ASPIM

Si l'on se tourne à présent vers le Protocole de Barcelone sur les aires spécialement protégées et la diversité biologique de la Méditerranée de 1995, il est certain que l'on se trouve en présence d'un instrument juridique ayant pour objet spécifique la protection de la nature en Méditerranée; il ne se préoccupe pas des tortues marines à titre exclusif mais celles-ci figurent en bonne place au nombre des espèces visées. Le Protocole de Barcelone appartient à la famille des conventions du PNUE, qui a visé à partir des années 70, à mettre sur pied, des régimes juridiques, propres à protéger l'environnement de régions géographiques, ayant des traits comparables. Ce texte s'appuie pratiquement sur deux catégories de mesures: certaines sont classiques, et déterminent des règles qu'il faut respecter dans le domaine de la protection des espèces animales et végétales en danger ou menacées; les autres prévoient la création d'aires spécialement protégées dans lesquelles une action d'ensemble pourra être menée et c'est ce qui va nous intéresser tout particulièrement ici.

1. POUR CE QUI CONCERNE LES ESPECES?

Les tortues de mer ont été considérées par le Protocole de Barcelone, comme nécessitant une protection particulière; à ce titre elles figurent dans l'Annexe II, qui énumère les espèces en danger ou menacées et qui sont totalement protégées. Le régime juridique qu'établit le Protocole de Barcelone à leur endroit, repose sur un ensemble de devoirs parfaitement contraignants pour les États, et se décline d'une part, en mesures nationales, et d'autre part, en mesures pour lesquelles, les Etats doivent se concerter.

- Aux termes de l'article 11 tout d'abord, qui énumère les mesures nationales, les Etats sont tenus d'identifier les espèces en danger ou menacées et de leur accorder le statut d'espèces protégées (11.2); ils doivent aussi adopter des mesures qui visent à contrôler, ou interdire la capture, la détention, la mise à mort, le commerce de ces espèces; ils doivent enfin interdire toute perturbation de la faune sauvage, particulièrement au cours des périodes de reproduction, d'incubation ou de migration.

- En tant qu'espèces en danger ou menacées, les tortues de mer relèvent aussi, des dispositions de l'article 12 qui demande ici aux Etats qu'ils adoptent des mesures «en concertation» avec les autres parties au Protocole afin de parvenir à mettre sur pied une protection maximale et à garantir la restauration des espèces visées (12.5).

2. LE PROTOCOLE DE BARCELONE NE SE LIMITE PAS

à traiter de la protection d'une espèce jugée vulnérable, il comporte aussi un second volet, qui vise à prendre en compte l'environnement d'une région dans son ensemble, avec ses écosystèmes rares et fragiles, et ses ressources naturelles. Il est ainsi déclaré dans le Préambule, qu'il importe de protéger et d'améliorer l'état du patrimoine naturel et culturel de la Méditerranée, en particulier par la création d'aires spécialement protégées. Il est

précisé que ces aires peuvent concerner selon les cas, aussi bien les eaux côtières des États ou encore les zones humides que la haute mer.

a) LES AIRES SPECIALEMENT PROTEGEES

Pour les premières, chaque partie peut créer dans les zones marines et côtières relevant de sa juridiction (art. 5), des aires protégées qui ont pour objectif, de permettre la sauvegarde des écosystèmes marins et côtiers représentatifs, et des habitats particulièrement importants (art. 4). Les Etats sont tenus d'appliquer dans les zones ainsi définies, des mesures de protection; ainsi, entre autres mesures, ils doivent y renforcer l'application des autres protocoles de la famille de Barcelone relatifs à la lutte contre la pollution; le rejet des déchets y est interdit; le passage des navires doit être réglementé.

b) LES ASPIM

L'originalité du Protocole s'exprime ensuite dans la mise au point du mécanisme de la Liste des aires spécialement protégées d'importance méditerranéenne (art. 8 et 9), ou Liste des ASPIM. Les ASPIM sont des sites importants au regard de la diversité biologique ou qui renferment par exemple des écosystèmes spécifiques à la région méditerranéenne. Elles peuvent être instituées par un ou plusieurs États, dans les zones marines et côtières soumises à leur souveraineté ou juridiction, mais également et c'est plus intéressant, en haute mer, et dans ce cas la demande doit être présentée par les parties voisines concernées. Le grand intérêt d'une aire de ce type, est qu'elle ne relève pas uniquement de la juridiction du ou des États qui l'ont instituée et qui en ont demandé l'inscription sur la Liste des ASPIM. En réalité, à partir du moment où une ASPIM existe, et qu'elle a été inscrite, tous les Etats parties au Protocole sont liés et doivent se conformer aux mesures qui y sont applicables, et ce, où que soit située cette Aspim, dans des zones sous juridiction nationale, ou en haute mer. On comprend qu'en vertu de ce mécanisme, de telles aires une fois établies, vont devoir être respectées par tous les États parties, étendant largement le nombre des États concernés au départ. Il faut faire observer à ce titre, que le Protocole de 1995 qui compte 6 parties contractantes - les Communautés européennes, l'Italie, Malte, l'Espagne, la Tunisie, Monaco - a vocation à réunir les 21 Etats méditerranéens parties à la Convention de Barcelone (tous les pays du pourtour de la Méditerranée). Aussi, si la France et l'Italie décident d'instituer une ASPIM au large de leurs côtes, ce sont 6 puis peut-être 21 États qui seront obligés de respecter les réglementations que les deux pays auront établies.

On précisera enfin, que cette inclusion de la haute mer dans le champ d'application du Protocole, - espace pourtant traditionnellement libre - a été jugée nécessaire car, à la différence de ce qui se passe pour d'autres mers ou océans, les riverains de la Méditerranée n'ont pas proclamé de zones économiques exclusives. De fait, leur juridiction s'arrête à la limite des douze milles marins au large de leurs côtes, ce qui aurait laissé, si la haute mer

n'avait pas été visée par le Protocole, un espace immense en dehors de la réglementation mise en place» (Beer-Gabel 2000). Le choix opéré ici devrait donc permettre d'organiser la protection de certaines espèces migratrices comme les tortues de mer.

II. VERS UN INSTRUMENT SPECIFIQUE POUR LA PROTECTION DES TORTUES DE MER EN MEDITERRANEE

On peut se demander aujourd'hui s'il n'existerait pas une autre voie pour protéger les tortues en Méditerranée, qui serait centrée cette fois-ci, de manière spécifique, à la fois sur ces espèces et sur cette région géographique. À la différence d'autres continents en effet, il n'existe pas à l'heure actuelle, d'instrument juridique exclusivement consacré, à la protection des tortues de mer en Méditerranée. S'il s'avérait nécessaire, pour mieux prendre en compte la situation de ces animaux, de s'orienter en ce sens, deux voies pourraient être empruntées: l'on pourrait imaginer d'une part, que les États intéressés, répondant à l'invitation de la Convention de Bonn sur les espèces migratrices, et se glissant en quelque sorte dans le modèle dessiné à cet effet, élaborent un traité international consacré aux tortues en Méditerranée; mais de la même manière, le Protocole sur les ASPIM, semble offrir, un cadre d'accueil idéal pour un corps de réglementation spécifiques.

A. LA CONCLUSION D'UN TRAITE INTERNATIONAL

On se souvient que la Convention de Bonn distingue en fonction de leur état de conservation, deux catégories d'espèces auxquelles s'appliquent deux régimes juridiques distincts, et que les tortues de mer relèvent de l'une comme de l'autre hypothèse. Les États étant donc engagés par le texte de la Convention de Bonn à conclure un accord en vue de leur conservation, il est loisible, d'envisager ce que pourrait être le contenu d'un futur traité, sur la protection des tortues de mer de la Méditerranée. Emprunter une telle démarche permettrait sans doute, de réunir en un seul accord, le véritable socle normatif qui s'est constitué au fil du temps, au travers des instruments conventionnels, généraux ou spécifiquement consacrés aux tortues marines, pour assurer leur protection. Il apparaît ainsi que le maintien et la restauration de ces populations, met en jeu cinq catégories de dispositions qu'il conviendrait de retrouver dans le nouveau traité et qui concernent:

a) L'interdiction de toute capture intentionnelle des tortues marines, de leurs œufs ou de leurs produits, et l'interdiction de toute mise à mort.

b) La soumission aux dispositions de la CITES, de tout commerce international des tortues, de leurs œufs ou de leurs produits.

c) La mise en œuvre de mesures de restrictions concernant les activités risquant d'affecter les tortues, particulièrement au cours des périodes de reproduction, d'incubation et de migration. À cet égard, le nouveau texte pourrait requérir de ses Etats parties qu'ils réglementent l'utilisation et l'accès aux sites de ponte, la

construction de futurs immeubles, l'usage d'éclairages artificiels, le passage des navires; qu'ils restaurent les sites détériorés, et qu'ils subordonnent l'exécution de tout projet industriel à la réalisation d'une étude d'impact préalable.

d) Parmi les mesures de protection, qu'il importerait de prendre en compte dans le nouvel accord, la réglementation des équipements utilisés pour les activités de pêche, et la question de la réduction des prises accidentelles de tortues devraient retenir l'attention. Les «prises accidentelles» ou «prises accessoires» d'animaux parallèlement à une espèce chassée ou pêchée, atteignent pour certaines espèces comme les albatros ou les dauphins, un niveau qui a conduit des institutions comme la CCAMLAR (Commission pour la conservation de la faune de la flore de l'Antarctique) et l'IATTC (Commission interaméricaine pour le thon tropical) à élargir considérablement leur champ d'action; l'IATTC commission de pêche se préoccupant du thon tropical, a ainsi décidé de mettre en œuvre un véritable Programme multilatéral de protection des dauphins (Beer-Gabel et Lestang à paraître). Un traité relatif aux tortues, pourrait ainsi requérir de ses parties contractantes, comme l'a fait de façon extrêmement détaillée la Convention interaméricaine sur la protection des tortues de mer, qu'elles imposent à leurs nationaux, l'usage, au cours des campagnes de pêche, de «dispositifs d'exclusion des tortues» (turtle excluder devices ou TEDs) composés d'équipements et filets permettant à celles-ci de s'échapper.

e) À ces quatre mesures, doivent s'ajouter des dispositions destinées à garantir en quelque sorte, leur exécution par les Etats. Face à des comportements perturbants des habitats, tels que la pratique du cheval sur les plages de ponte, l'usage de bulldozers sur les dunes, l'absence de démolition des constructions illégales ou encore l'usage de bateaux à moteurs rapides, un accord devrait pouvoir requérir de ses parties, qu'elles adoptent des réglementations sanctionnant ces comportements. De telles dispositions ne sont pas inconnues du droit international et pour citer un exemple proche de celui qui nous préoccupe, celui des commissions de pêche, il est des statuts tels que celui de l'Organisation pour la conservation du saumon de l'Atlantique Nord (NASCO) qui disposent que les États sont tenus de prendre des mesures établissant des pénalités en cas d'infraction à l'accord, commises par leurs ressortissants. Ensuite, il faut prendre en compte la procédure bien connue du droit de l'environnement, que l'on désigne couramment par l'expression anglaise de «reporting system». On demande ici aux Etats de présenter à la Réunion des parties contractantes, un rapport périodique sur les mesures qu'ils ont adoptées pour donner effet au traité. Ce mécanisme est considéré comme efficace pour plusieurs raisons:

- il est difficile à un État qui s'est lié par un traité, de reconnaître dans le cadre de

son rapport qu'il n'a rien accompli pour en assurer l'exécution;
- ensuite la mise au point d'un tel document suppose des enquêtes, des contacts entre administrations, qui attirent l'attention des acteurs intéressés sur les actions effectivement engagée par l'État;
- enfin, l'examen du rapport par l'ensemble des parties contractantes, leur offre l'opportunité de comparer les efforts accomplis et d'identifier les Etats dont l'action est défaillante.

B. LA CREATION D'UN CHAPELET D'ASPIM

La négociation formelle d'un nouveau traité n'est peut-être pas le passage obligé pour instituer un régime propre aux tortues de mer en Méditerranée. En effet, Le Protocole de Barcelone de 1995, fondé tout entier sur l'impératif de protection et d'amélioration de l'état du patrimoine naturel et culturel de la Méditerranée, semble constituer le cadre d'accueil idéal d'un tel régime. C'est ici le système des aires spécialement protégées d'importance méditerranéenne ou ASPIM qui retient l'attention. Dans le système du Protocole, on s'en souvient, les aires protégées d'une région et leurs réglementations, lient tous les États parties. Par ailleurs, on s'en souvient aussi, le Protocole donne à ses Etats membres la possibilité de demander l'inscription sur la Liste des ASPIM, de zones marines et côtières relevant de leur juridiction, ou couvrant des zones de haute mer, auxquelles elles veulent voir appliqué, un régime de protection renforcée. Ce champ d'application élargi, permet aux zones établies de répondre aux deux caractéristiques des tortues de mer: espèces migratrices qui parcourent de longues distances en mer, et espèces qui viennent au moment de la ponte, investir certaines plages situées dans des zones relevant de la juridiction des Etats. Il importe de bien comprendre, qu'en mettant en œuvre une telle solution, le Protocole de Barcelone innove largement par rapport au droit de la mer traditionnel. Celui-ci admet certes, que les Etats puissent exercer leur juridiction sur les eaux internationales; mais celle-ci s'exerce par le biais de réglementations applicables aux navires battant leur pavillon qui eux exécutent dans ces eaux, les mesures arrêtées par les Etats dont ils relèvent.

Les difficultés liées à l'intervention en haute mer se profilent lorsque des Etats ou des institutions ayant adopté des mesures de conservation et de gestion, entendent les faire valoir à l'égard d'Etats étrangers, et en demander le respect. Dans ce cas en effet, ce sont bien des atteintes à la liberté de la haute mer, qui vont leur être imposées. Le droit international n'admet aujourd'hui, aucune intervention de ce type.

Le Protocole de 1995 opère un saut qualitatif par rapport aux solutions traditionnelles, car cet instrument passe en pratique, de l'application de mesures de conservation par l'État du pavillon à ses navires en haute mer, à la réalisation d'une emprise sur ces eaux internationales. En effet, nous sommes non seulement en présence d'un texte qui déclare

que certaines zones de protection pourront s'étendre à la haute mer, mais encore, en vertu de l'article 28.2, il est demandé aux Etats, de prendre des mesures appropriées en vue d'assurer que nul - les parties et les tiers - n'entreprenne des activités contraires aux principes du Protocole. En pratique, les parties contractantes se trouvent contraintes d'empêcher les tiers, d'entreprendre dans toutes les Aspim, des activités contraires au Protocole. Ce mécanisme confère, on le comprend, un degré d'effectivité supplémentaire, à l'emprise réalisée sur la haute mer, ce qui contribue à la matérialiser, un peu à la manière d'une barrière qui serait érigée dans la région considérée.

Il paraît difficile d'achever cette réflexion sur les tortues de mer, sans évoquer un évènement qui touche à un domaine proche de celui qui nous occupe. Le 25 novembre 1999, était conclu ici à Rome, un accord sur la création d'un sanctuaire pour les mammifères marins en Méditerranée, réunissant la France, l'Italie et Monaco. Ce traité vise ni plus ni moins à créer une ASPIM en mer de Ligurie, puisqu'il prévoit dans son article 16, qu'aussitôt le Protocole de Barcelone en vigueur, le sanctuaire sera présenté à la Conférence des parties, en vue d'une inscription sur la Liste des ASPIM. La France et Monaco ont ratifié le texte de l'Accord de Rome, l'Italie s'apprête à le faire; dans ces conditions, la demande d'inscription devrait pouvoir être présentée lors d'une prochaine réunion des parties au Protocole de Barcelone. L'aire spécialement protégée d'importance méditerranéenne que constituera le sanctuaire, couvre une superficie gigantesque puisque le quadrilatère dans lequel un régime de protection totale pour 8 espèces de mammifères marins est instauré et qui relie les côtes françaises et monégasques, la Sardaigne, et l'Italie, s'étend sur 96,000 km^2. Pourquoi dès lors, ne pas imaginer que puisse se constituer au fil des années en Méditerranée, - non pas un sanctuaire aussi vaste que celui des mammifères marins - mais peut-être un chapelet d'ASPIM, accompagnant les tortues de mer le long de leurs parcours migratoires jusqu'à leurs sites de ponte.

ACCORDS INTERNATIONAUX TRAITANT DES TORTUES DE MER

- Convention de Washington du 3 mars 1973, CITES.
- Convention de Bonn du 23 juin 1979 relative à la conservation des espèces migratrices appartenant à la faune sauvage.
- Convention de Berne du 19 septembre 1979 relative à la conservation de la vie sauvage et du milieu naturel de l'Europe.
- Protocole de Nairobi du 21 juin 1985 relatif aux zones protégées ainsi qu'à la faune et à la flore sauvages dans la région de l'Afrique orientale.
- Protocole de Kingston du 18 janvier 1990 sur les aires spécialement protégées et la vie sauvage dans les Caraïbes.
- Protocole de Barcelone du 10 juin 1995 sur les aires spécialement protégées d'importance méditerranéenne et la diversité biologique (ASPIM).

- Convention interaméricaine du 5 septembre 1996 pour la protection et la conservation des tortues de mer.
- Accord tripartite du 8 mai 1998 pour la conservation des tortues de mer le long de la côte Caraïbe du Costa Rica, du Nicaragua et du Panama.
- Mémorandum d'Accord du 29 mai 1999 relatif aux mesures de conservation applicables aux tortues de mer de la côte atlantique de l'Afrique, y compris la Macaronésie.

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IMPACT OF TOURISM DEVELOPMENT ON MARINE TURTLE NESTING: STRATEGIES AND ACTIONS TO MINIMISE IMPACT - A SUMMARY*

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1. INTRODUCTION

Loggerhead turtles are endangered and Green turtles in the Mediterranean are now classed as critically endangered. They are endangered because of past overexploitation. This has been aggravated by incidental catches in fishing gear. Regulatory measures and awareness have reduced intentional catches and consumption, though losses due to incidental catches are large and ongoing and are probably increasing in direct relation to fishing effort.

In the last two or three decades, tourism development on or near turtle nesting beaches has added serious new threats to turtles. The Mediterranean is now the world's leading tourist destination, accounting for 30% of international tourism. Its tourism is basically coastal tourism, which is strongly seasonal and which is increasing rapidly. Tourism is currently the first foreign currency source in the Mediterranean region. The growth of tourism in Greece is indicative, increasing from about 2.8 million international arrivals in 1975 to about 12 million in 2000. It contributes 7% to the country's GDP and employs 10% of its manpower (GNTO 2000). In Cyprus, 2.7 million tourists now leave an income of $1.9 billion and contribute over 20% to the GDP. The nature of tourism is such that there can be no reliable predictions for the future. Predictions of the growth of tourism, in the Mediterranean, are from 135 million visits in 1990 to well over 300 million in 2025. The Blue Plan predicts even higher numbers. (Grenon and Batisse 1989)

Effective protection and conservation management of turtle nesting beaches is now a pressing need. The problems faced in preventing or mitigating the problems of tourism development near nesting beaches, bear witness to the fact that this is no easy task. Strategies and actions to mitigate escalating problems need to take into account not only the complex biology of turtle reproduction but also socio-economic factors and political interests. But turtle biology is given, and provides little, if any flexibility on the choice of beach. The tourism sector has the potential of being able to choose the segments of coastal

** The present paper is a summary of a paper commissioned by the Bern Convention of the Council of Europe.*

land it develops from a range of options. Turtles have no such choice.

2. ON TURTLE BIOLOGY

There is no need to elaborate on turtle biology here, but it is essential to underline some aspects of it that are vital to conservation and essential in political decision making. There is by now enough evidence to dispel any doubts that turtles imprint and nest on the beaches they were laid on. The earth's magnetic field, wave direction and chemicals in the sand and adjacent water, are some of the factors that are being researched into as cues in imprinting and in navigation in turtles. There is evidence that all these cues are, to some degree, involved in imprinting. This imprinting and the fidelity of turtles to their natal beaches, have significant conservation implications, as they result in demographically distinct populations (Bowen et al. 1992). The implications are that each rookery, obviously, has to be protected individually and separately and that such protection will not help other rookeries.

It also needs to be noted, that the beaches the turtles "choose" to lay their eggs on, are the result of the suitability of these beaches, as nesting grounds. It makes good biological sense, from an evolutionary point of view, to nest on a beach that proved good for the parent. In other words it is the result of a kind of "natural selection" that has approved suitable beaches and rejected unsuitable ones. Many factors play a role in this - one of them is temperature. Nesting beaches have the right temperature regime - otherwise they would not sustain populations. Of course it is not so simple. Coarse sand beaches have higher incubation temperatures than fine sand beaches in the same geographical area. So, some beaches have a tendency to produce more females and others more males. But a rookery as a whole has beaches with the right temperature regimes for sustaining a population. The Mediterranean is on the northern limit of turtle nesting and it is assumed that nesting temperatures determine this limit. Incubation temperatures in the eastern Mediterranean, are high and suggest a female dominated population. This may of course not be so, if the pivotal temperature, which is still to be determined, is higher for Mediterranean turtles. Otherwise, there would be nesting in the cooler western Mediterranean.

The effects of lights on nesting turtles and on hatchlings are well known and need to be kept in mind at all times, with Green turtles being more sensitive to lights and movement. Preventive and/or mitigating measures for light-pollution are needed. Much work has been done in Florida on beachfront lighting. (Witherington and Martin 1996, BPSM 2000). A word of warning however: Inevitably much of this work is geared to the situation in the State of Florida and the USA, which in terms of enforcement of ordinances and management, differ significantly from the more special and often ineffective, if not "anarchic", situation in the Mediterranean.

3. TOURISM PERSPECTIVES

The trend of unchecked and chaotic development and expansion of coastal tourism is likely to continue, in spite of any issues of sustainability and indications are that the Mediterranean may not continue to be competitive enough in the global context (WTO 1997). Findings show that destination areas undergo a "life cycle" of development, enjoying popularity for some years and then decline (Coccosis 1996).

What is important to realise is that tourism development gains a momentum of its own that is often beyond the powers, or willingness, of governments to control. As in the case of over-investment in fishing fleets - where, for a variety of reasons, investments, often State subsidized, continued, well after it was clear that gross overfishing was already taking place and fish catches were often pathetic - so, in the case of tourism development, over-investment in infrastructure seems to continue even when it is amply clear that what is happening is to the detriment of what made that particular destination attractive in the first place. In the quest for quick but transient gains - on the state level, at least - the threat of tourist preferences switching to other destinations, is seen as far in the future - if at all - as are spirals of decline. The value given to environmental capital, in political decision-making is, often, clearly debatable, and does not act as a constraint in the willingness of entrepreneurs to squander the environmental capital of coastal regions.

In mitigating the impacts of tourism, note should be taken of the synergy that exists between mass tourism and other kinds of tourism, such as domestic tourism and holiday/weekend home development. Holiday (and retirement) homes, "with a view to the sea", is now what is, increasingly, being offered by land developers in Cyprus. Increased interest in ecotourism, which though supposedly environmentally friendly, is already causing problems to the environment, including to turtle nesting and can lead to mass tourism. Adventure tourism can also cause problems. An example of this and of a combination of the two (ecotourism - adventure tourism) is the fast development in Cyprus of the so called "Safari" day excursions, where convoys of 20 or so four-wheel drive vehicles invade the countryside - wilderness areas, forests - approaching nesting beaches for a glimpse of a turtle nest on a beach.

4. IMPACTS OF TOURISM DEVELOPMENT ON MARINE TURTLE NESTING

Turtles need nesting beaches and notwithstanding the success of any other conservation measure, such as reducing incidental catches, any programme aimed at conserving turtles, is doomed to failure if turtles no longer have beaches to nest on.

Tourism is of course having its impact on the main turtle nesting areas in the Mediterranean, in Greece, Turkey and Cyprus and many turtle nesting areas have already

become tourist resorts. Many causes can disturb nesting or make beaches unsuitable for successful nesting:

- Stationary lights (street lights, hotels, etc.), moving lights (cars etc.) - and movement on, or near, the beaches, at night, will scare away nesting turtles
- Lights will disorientate hatchlings, leading to increased predation, loss of energy and death from overheating if they stay on land until the following day.
- Sun-beds and umbrellas interfere with nesting and incubation temperatures.
- Physical alteration of nesting beaches, from structures on land (hotels, etc.) and at sea (breakwaters), impacting sand dynamics and modify sand characteristics of beaches. Large numbers of visitors have similar effects. Mechanical beach cleaning will hide tracks and nests and may destroy nests.
- Boats and water sports, near nesting beaches will scare away or injure turtles.
- Driving on beaches can destroy nests and compact the sand, making nesting and hatchling emergence difficult or impossible. Tire grooves can make the descent of the hatchlings to the sea difficult or impossible.
- Large numbers of holidaymakers on beaches will damage nests directly, (collapsed chambers, etc), they may also change the chemical cues of the beach (sun tan oils).
- Interest by holiday-makers in watching turtles nest may "make" their holiday, but may stop nesting, they may disturb nests, dig up eggs, turning them and causing death to the embryo, or change the structure of the egg chamber reducing hatching success.

Some of these threats can only be addressed through appropriate land use (spatial) planning. Others need to be dealt with through legislation that foresees the protection and management of nesting beaches, through, inter alia, the setting up of protected areas. This includes the control of the public on, or near, these beaches. Mitigating measures can address problems outside protected areas, others can be addressed through raising public awareness.

5. STRATEGIES AND ACTIONS TO MINIMISE IMPACTS

5.1. SETTING UP PROTECTED AREAS AND MITIGATION MEASURES

Setting up protected areas is a primary target in this part of the world, where tourism is quickly invading and taking over much of the coastal zone. Experience has shown that the balance that can be reached in defining the extent of protected areas is often the product of "bargaining" sessions - with compromises often wanted and expected within the areas selected, on scientific grounds, for their ecological (nesting) value, without looking at the wider picture. Land acquisition and adequate funding and compensation are critical in setting up protected areas and in resolving conflict. The basic aims of Protected Areas are to safeguard that there is no tourist or other physical development in the protected area and that the area is managed in such a way as to avoid human interference with turtle reproduction.

Spatial planning legislation, such as Town and Country Planning laws, need to foresee that no development in the area takes place. Creating tourist zones in the vicinity of nesting beaches is obviously a formula for failure and for generating and perpetuating conflict. The actual extent of the area, towards the hinterland, will depend on several factors (keeping in mind the needs of turtles), such as the nature of the hinterland, existing development, ownership (government-private) etc. The protected area should extend far enough into the hinterland to prevent any development that will lead to future pressures on the beaches. The biology of turtles is such that leaves little leeway in the selection process for beaches and also predetermines, to a large degree, the extent of the area needed and the management measures themselves.

It is obvious that not all nesting beaches can be declared and managed as protected areas. On very extensive beaches with sparse nesting other measures need to be taken. Still other measures are needed for nesting beaches with tourism development. These are measures intended at mitigating the effects of tourism and recreation activities. Inevitably their effectiveness will depend on many factors.

5.2. INSTITUTIONAL ASPECTS

Management and other measures need to be backed by legislation, which should foresee also adequate penalties. The legislation should be clear as to what it covers in terms of spatial cover, the period of the year during which it is applicable and, of course, the measures themselves. Legislative/administrative gaps often exist, as marine species have to be protected on land. To catalyse effective law enforcement, it is desirable that the management and the law enforcement duties are carried out by the same agency, or at least, foresee for their close cooperation. Inevitably wardens/rangers cannot be employed on a year round basis to protect turtles and their nesting beaches, as these are seasonal activities. To a degree, this has catalysed the use of volunteers, to take over the duties of government wardens/rangers - and has absolved governments from taking a stronger stand on turtle conservation issues.

5.3. MANAGEMENT OF NESTING BEACHES AND ADJACENT AREAS

5.3.1. MANAGEMENT OF NESTING BEACHES IN PROTECTED AREAS

In protected areas, in addition to spatial planning regulations governing development, seasonal beach management measures are also needed - some measures (like prohibiting driving on beaches) are needed throughout the year. These measures should include the adjacent sea area. The following recommendations are broadly based on the management measures already implemented, from the 1 June to the end of September each year, at the Lara/Toxeftra Reserve in Cyprus, where there is no development (Demetropoulos and Hadjichristophorou 1995):

- The public should not be allowed on the beaches or near the beaches at night - aiming at a zone which will result in the minimum disturbance to nesting turtles and emerging hatchlings. (From the use of lights, cars, bonfires etc).
- Driving of vehicles on the beaches should be forbidden.
- Sunbeds, umbrellas etc. should be forbidden on the beaches.
- Boats and fishing should be banned from the sea area adjoining the beaches to a specified depth (20-30m. isobath) or to a set distance from the shore.

Infrastructure in protected areas should include notices and where appropriate, information centres and demarcated access paths, with provisions for the protection of sand dunes. Walkways over sand dunes may be needed.

Some of the measures foreseen under the section that follows may also be applicable to protected areas - and especially to any adjacent territory.

5.3.2. MANAGEMENT OF NESTING BEACHES OUTSIDE PROTECTED AREAS

The measures to be taken here are, of necessity, mainly mitigatory (with varying degrees of success) - and what realistically can be implemented will depend on the nature and degree of development. Such mitigating measures may help in the case of Loggerhead turtles, but are less likely to be effective with Green turtles, which are more sensitive to movement and even to stationary lights. Some of the management measures mentioned for Protected Areas may be applicable here also. The following may be considered:

- Introducing spatial planning measures to minimise impacts, including setting a minimum distance between any new buildings and the beach. The distance will inevitably vary depending on such factors as the morphology of the area, the height of the buildings etc.
- Restricting the operation of isolated restaurants, etc. to daylight hours of work
- Adopting regulations regarding photopollution. Shading and control of lights by various methods is possible. Much work was done in Florida on this. (What happens there, however, should not be accepted at face value as justification in applications for obtaining permits for development in or near sensitive areas. The level of administrative control and law enforcement in the Mediterranean implies caution in relying on such measures.)
- Restricting traffic at night on roads which have a direct eye-contact with the beaches or by taking measures to hide the lights from cars, e.g. by setting up fences, hedges etc.
- Restricting the presence of people on the beaches at night during the nesting season.
- Regulating the hours of any mechanical beach cleaning, so that time can be given for the location, protection or relocation of nests.
- A hatchery may be needed. This will depend on the degree of development, threats etc. and each case needs to be assessed on its own merits. Care should be taken that

this does not provide an excuse for further development or for downgrading more significant turtle conservation activities (protection of nesting females or in situ protection of nests).

5.3.3. MANAGEMENT OF EXTENSIVE BEACHES WITH SPARSE NESTING

This is the case in areas where very extensive beaches, tens of kilometers long, support sparse nesting. Sparse nesting may well be the result of overexploitation, heavy predation or of sprawling tourist or other development - though this is not always the case, especially at the margins of the current nesting distribution. In other words sparse nesting may be natural. With appropriate turtle conservation and recovery programmes, nesting could increase, in places at least, that supported dense nesting in the past. Stretches of such beaches need to be protected to provide future nesting grounds for turtles from a possible recovery of turtle stocks. In such cases, selecting adequate stretches, with the densest nesting, is indicated. The rest can be covered as much as possible by management measures (no driving on beaches, control of mechanical beach cleaning etc), and a hatchery programme, aiming at concentrating future nesting in the protected areas. This is the current strategy in Israel and the one most likely to be effective also in similar areas with sparse nesting. Other measures mentioned already may also be applied here, depending on circumstances.

6. PUBLIC AWARENESS AND EDUCATION

Turtle conservation ultimately depends largely on awareness of the issues by the public. By itself, it cannot guarantee conservation, but it goes a long way in setting up the scene for political decisions to be taken, or, at least, for making the taking of the wrong political decisions difficult. This is critical when dealing with powerful development actors and economic forces that can influence decision makers. Raising public awareness falls on the shoulders of NGOs - with meager resources to carry it out. Public awareness will also help in getting public cooperation in implementing management measures.

Access to Internet is now widespread in the countries of origin of most tourists to the Mediterranean. Accessing the Internet for information on destination areas is now standard practice in many countries. Searching for information on turtles and protected areas, at tourist destinations, implies interest and awareness of the subject. So as “not to preach to the converted” Web pages with destination information need to be used to inform or lead “the uninitiated” to appropriate information on turtles.

7. MEDITERRANEAN REALITIES AND SOCIO-ECONOMIC HURDLES

There can be little doubt that the complete protection of nesting beaches will yield the best results. The degree of protection that can be given to a nesting beach, however, is, as

can be evidenced by the existing conflicts, certainly not a simple matter in many cases. There are beaches with varying degrees of "development" ranging from "pristine" to fairly well developed touristically, with varying degrees of impact on turtle nesting. Economic and political considerations often enter the picture and in some cases are paramount. Turtle conservation in the Mediterranean in particular, finds itself in competition with powerful actors and forces (the tourist economy). To curb these forces decisive and strong legal and administrative measures need to be taken. These may not be easy to carry through on the level of political decision making, considering the inherent dynamic of tourism development and the apparent, at least, advantages that national, and other, economies are already reaping, or are anticipating for the future, from tourism development (Demetropoulos 2000). The existing conflicts in Zakynthos and Akamas and elsewhere and the related government indecisions and deliberations on the fate of these, are evidence of this.

International Conventions, signed and ratified by most Mediterranean countries, often provide a counterweight for powerful local development actors and forces. That the issue of Zakynthos and Akamas and several other turtle nesting habitat issues, in Greece and Turkey, are, in front of the Standing Committee of the Bern Convention, is indicative of support being solicited by local interest groups. Such calls for help are usually from NGOs, pushing for conservation, and frustrated at the lack of any progress at the national level. Governments in this area, and probably elsewhere, need to show their interest in the environment; at the same time they are trying to give themselves ample leeway and flexibility in what they actually do in tangible terms. Political decisions are often taken on balance of the forces that act on governments and administrations at various levels and are not infrequently responding to particularistic interests, in disregard of the common good.

In "virgin" territories it is obviously simpler to provide protection, though the matter is not always simple, even here. Aspirations in development circles and local communities for their development may well exist - as in the case of Akamas.

It must also be born in mind that simply monitoring the advance of tourism development and keeping an eye on the impact so as to gauge the carrying capacity of nesting beaches will inevitably result in a post-mortem examination of the situation. The built-in inertia of any government machinery in decision making, especially when so much is at stake, and the built-in momentum of tourism development, are such as to guarantee that any measures decided upon, at that stage, will simply be unenforceable and lead to further confrontations - and the effective loss of nesting beaches. Inevitably compromises have to be made, in at least some cases. Time is valuable and it is best to take whatever steps can realistically be taken immediately and

enforce them adequately, provided they can bring about practical and tangible results - and provided of course that this does not jeopardize the outcome of any "negotiations" on more vital issues.

8. KEY POINTS

- Tourism is adding new threats to turtle survival, as it competes with turtles for their nesting beaches. Coastal tourism in the Mediterranean is set to continue increasing, in the immediate future at least, irrespective of any issues of unsustainability. This will increase pressures and conflicts.
- The root issues lie with governments/local authorities, not with the tourists. Adequate funding for land acquisition and compensation is critical for effective conservation and in resolving conflict, as are informed policies on government level on spatial planning and tourism development.
- Important nesting beaches in undeveloped areas should be protected from development, by declaring and managing them and their environs, as protected areas, preferably before there is pressure for development.
- Appropriate management (mitigating) and spatial planning measures urgently need to be implemented in nesting beaches where there is development.
- Notwithstanding the success of any other conservation measure, such as the protection from incidental catches, any conservation programme, is doomed to failure if turtles have no beaches to nest on.
- Turtles need to return to the same beaches they themselves hatched on, to lay their own eggs, when they mature. This imprinting and the fidelity of turtles to their natal beaches leads to demographically distinct and independent populations. The implications are that conserving turtles in one rookery will not save turtles in another rookery. If a rookery is to survive, it needs to be protected individually.
- Public awareness and education, both in the countries with nesting beaches and in the countries of origin of tourists are key issues in shaping and implementing policies on conserving turtles and their nesting beaches.

It is vital to understand the needs and implications of turtle nesting and reproduction, if their conservation is to be appropriately and rationally addressed. The arguments often used in political debate - if there is any - are not always based on scientific facts or conservation principles. As a consequence, such debates often arrive at compromises that are to the detriment of turtles. If turtles are to continue surviving in the Mediterranean, political decisions need to be based on a sound knowledge of the biology and needs of turtles. We, therefore, have the responsibility for getting clear and sound messages across to decision makers.

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LES TORTUES MARINES: BIOLOGIE ET STATUT

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Les Tortues marines, sont des espèces migratrices à répartition mondiale. On n'en dénombre que sept ou huit espèces: *Caretta caretta,* la Tortue Caouanne, *Chelonia mydas,* la Tortue verte et peut-être *Chelonia agassizii,* la Tortue d'Agassiz, *Eretmochelys imbricata,* La Tortue Caret ou Tortue imbriquée, *Lepidochelys kempii,* la Tortue de Kemp, *Lepidochelys olivacea,* la Tortue olivâtre, *Natator depressa,* la Tortue plate et *Dermochelys coriacea,* la Tortue luth.

Les Tortues marines sont des Reptiles, qui se sont adaptées à la vie marine. Les femelles, seulement, reviennent périodiquement à terre pour pondre dans le sable des plages. Il y a un effet de la température d'incubation sur la différenciation du sexe chez toutes les espèces: au-dessus de la température pivot (28-30°C), on a 100 % de femelles, en-dessous 100 % de mâles. Après une soixantaine de jours d'incubation, une durée variant avec la température du sol, les nouveau-nés éclosent, émergent du sable et courent vers la mer.

Les nouveau-nés s'éloignent rapidement des côtes, mènent une vie pélagique, dispersée et cachée des prédateurs, souvent sous la surface de l'eau. Après plusieurs années, les grands juvéniles, que j'appelle jeunes, migrent vers des aires d'alimentation côtières. Ces jeunes, qui proviennent de différentes zones de ponte et appartiennent donc à des unités populationnelles distinctes, se côtoient sur une même aire d'alimentation, appelée aire de croissance. Tous les jeunes d'un lieu de ponte ne vont pas dans la même aire de croissance. Jeunes, subadultes et adultes procèdent parfois à des migrations saisonnières nord-sud et sud-nord pour rester actifs dans des eaux à température compatible avec une vie active. Ils vont donc d'une aire d'alimentation estivale à une aire d'alimentation hivernale. Les Tortues marines hibernent-elles? C'est possible mais on ne connaît que deux cas et c'est plus rare qu'on ne l'a pensé à un moment.

Les Tortues marines sont des espèces longévives à maturité tardive. L'âge à la maturité varie avec les espèces et même entre les populations d'une même espèce: la Tortue imbriquée serait adulte entre 20 et 40 ans, 20-30 ans dans les Caraïbes, 30 à Aldabra, 30-40 en Australie (Meylan et Donnelly 1999). Il y a normalement une migration des mâles et des femelles, des aires d'alimentation vers les aires de reproduction. Un aspect paradoxal de cette migration est que, selon de récents travaux (Limpus et al. 1992), des Tortues marines migrent pour se reproduire sur des plages à des milliers de kilomètres alors que

des plages tout aussi propices sont proches de leurs aires d'alimentation. C'est contraire au principe de l'économie d'énergie.

Les accouplements ont lieu au large des plages de ponte. Males et femelles sont-ils fidèles à leur clan d'origine? Les mâles sont plus infidèles et copulent parfois avec des femelles de populations adjacentes dans des zones de contact (FitzSimmons et al. 2000). Une femelle peut être fécondée par plusieurs mâles (multiparenté). Dans une saison, les femelles pondent plusieurs fois dans une même zone. Elles sont habituellement fidèles à leur zone de ponte et y reviennent périodiquement tous les deux ou trois ans, parfois après une année. Il n'y a pas d'imprégnation à la plage de ponte natale, comme le Crapaud *Bufo bufo* à sa mare natale. Dans une région comme la Guyane française, où les plages sont instables à cause des bancs de boue de l'Amazone, j'ai vu des Tortues Luth, des Tortues vertes et des Tortues olivâtres pondre sur une plage, qui avait 2-3 ans d'existence et donc ne pouvait pas être la plage de leur naissance. Dans une même zone de 200-300 km (Guyane française-Surinam), des femelles de Luth changent de plage de ponte dans une même saison et d'une saison à l'autre. Les premières pontes ont plus d'oeufs que les dernières. Je crois que le nombre de pontes et d'oeufs par saison ainsi que l'intervalle annuel de ponte varient avec l'âge des femelles mais il n'y a pas de sénescence progressive chez les Reptiles comme chez les Mammifères. D'après White (2000), à Mounda (Grèce), les primipares pondent une seule fois, les multipares 2 ou 3 fois.

Par extrapolation avec les autres Tortues, on pense que les Tortues marines vivent longtemps et que malgré leur maturité tardive, elles se reproduisent longtemps et souvent, assurant ainsi le renouvellement des générations. Les résultats des premières études démographiques sur certaines populations contrediraient ce modèle. Une des données fondamentales pour évaluer la dynamique d'une population de Tortues marines est d'arriver à bien calculer le taux de survie des femelles. Si, pour différentes raisons, captures accidentelles par les pêcheries par exemple, les femelles ne vivent qu'une dizaine d'années comme adulte, elles ne se reproduisent que 4-5 fois en moyenne. Cela suffit-il pour remonter une population et même pour renouveler simplement les générations actuelles?

NATATOR DEPRESSA (GARMAN, 1880)

Endémique du plateau continental australien, cette Tortue marine bien particulière a une dossière très plate, une carapace mesurant 80-88 cm et un poids d'environ 70 kg. Les nouveau-nés, un peu plus grands que ceux des autres Cheloniidés mais aussi grands que ceux de Tortue Luth (57-62 mm), s'éloignent des plages mais ne font pas de migration océanique, ils vivent dans la colonne d'eau et se nourrissent près de son sommet. Il n'y a donc pas de stade pélagique, des juvéniles plus grands (les jeunes) ont été capturés par des chaluts de fond, le long de la Grande Barrière et de la côte septentrionale de l'Australie.

Les subadultes et adultes vivent apparemment côte à côte, semblent éviter les récifs et fréquentent plutôt des eaux côtières troubles et peu profondes (Musick et Limpus 1997).

Natator depressa, vivant dans des régions peu fréquentées et bien surveillées, est la Tortue marine la moins menacée mais elle est vulnérable à cause de son aire de répartition restreinte et des prises accidentelles par les crevettiers.

LEPIDOCHELYS KEMPII (GARMAN, 1880) ET *LEPIDOCHELYS OLIVACEA* (ESCHSCHOLTZ, 1829)

Après les études de Pritchard (1969) et Brongersma (1968, 1972), tout le monde reconnaît que *Lepidochelys kempii* et *Lepidochelys olivacea* sont deux espèces distinctes, qui ont divergé depuis 3-6 MA (Bowen et al. 1991) mais sont aujourd'hui allopatriques. *L. kempii* est cantonnée à l'hémisphère nord et *L. olivacea* à l'hémisphère sud mais *L. kempii* n'est que dans l'Océan Atlantique tandis que *L. olivacea* est aussi bien dans l'Atlantique que dans le Pacifique et l'Océan Indien. Il y a apparemment quelques zones de sympatrie, où elles sont très rares: nord des Grandes Antilles (Cuba, Jamaïque, Iles Caicos), nord de L'Amérique du Sud (Venezuela, Colombie, Panama) (Fretey 1999) et peut-être Mauritanie-Cap-Vert-Sénégal (Arvy et al. 1996, Fretey 2001). Les rares *Lepidochelys* des Petites Antilles sont des *L. olivacea* (Fretey et Lescure 1999). Aucun cas d'hybridation n'a été observé dans la nature (Marquez 1994), alors que celle-ci est biologiquement possible.

Les mentions anciennes de *Lepidochelys* sur du matériel de collection ou dans la littérature scientifique doivent être maniées avec précaution et analysées avec rigueur. Des confusions entre les deux espèces ont été faites dans le passé et des *Lepidochelys* de Musée ont été déterminées comme des *Caretta caretta*. Parker (1939) a parlé de "Mexican Loggerhead" en Europe. Brongersma (1972) a clarifié un certain nombre de cas. Tout le monde se souvient aussi de la longue controverse entre Brongersma et Carr (1983) sur l'identification d'un spécimen du Musée de Mdina à Malte: une *Lepidochelys kempii* juvénile de 28.9 cm, qui est toujours le seul record de cette espèce pour la Méditerranée (Lescure 1997).

Les *Lepidochelys* sont les plus petites des Tortues marines: *L. kempii* mesure 60-70 cm de carapace et pèse dans les 45 kg, *L. olivacea* 55-76 cm et 35-55 kg. Les dossières sont olivâtres, cordiformes, surtout chez les jeunes, avec des costales allongées, le plastron est jaune. La distinction la plus visible entre les deux espèces est dans le nombre des costales: 5 symétriques, très rarement 6, chez *L. kempii,* 5,6,7,8 et même 9 disposées souvent asymétriquement et en nombre différent de chaque côté chez *L. olivacea*. Les deux espèces se nourrissent principalement de crabes et de crevettes.

L. kempii est inféodée au Golfe du Mexique et sa seule grande plage de ponte est celle de Rancho Nuevo au Mexique, où on voyait les arrivées massives de plusieurs milliers de

femelles, les fameuses "arribadas" (40,000 en 1947!). Les nouveau-nés se dispersent, disparaissent en mer et on les revoit dans la zone néritique côtière quand ils atteignent une longueur de 20-25 cm (vers 2 ans). Pendant leur stade pélagique, ils doivent se faire porter par les courants et on en a vu dans des masses de végétation flottante, se nourrissant de petits mollusques. Certains vont vers le nord du Golfe du Mexique et y restent, d'autres vont vers le sud, empruntent le courant de Loop, celui de Floride et basculent dans le Gulf Stream. La plupart d'entre eux vont alors vers le nord, y croissent suffisamment pour atteindre le stade jeune à vie benthique, se nourrissent principalement de crabes, longent la côte nord des Etats-Unis jusqu'à la Nouvelle Angleterre et retournent probablement comme subadultes ou adultes vers le Golfe du Mexique. Quelques uns sont déportés vers l'est et, par la Dérive nord-atlantique, atteignent les côtes européennes ou nord-africaines. On observe régulièrement de jeunes Tortues de Kemp, le long des côtes atlantiques françaises (5 de 23-31 cm en 2000; Duguy et al. 2001). On en a vu jusqu'au Pays-Bas, Irlande et Grande-Bretagne (Brongersma 1972). On craint qu'ils deviennent des individus "perdus" car ils n'auront probablement pas la capacité de revenir dans le Golfe du Mexique pour s'y reproduire.

L. kempii est la Tortue marine la plus menacée et celle qui a les effectifs les plus faibles. A cause de la pêche à la crevette et surtout des collectes massives d'oeufs, les arribadas étaient passées de 5,000 en 1965 à quelques centaines dans les années 80. Les programmes de protection, les opérations de "head starting" ont contribué à une légère remontée du cheptel (Pritchard 1997). Le sort de cette Tortue dépend des mesures de conservation mais est toujours en danger critique.

Les principaux sites de ponte de *L. olivacea* sont sur la côte pacifique du Mexique (état d'Oaxaca), Costa-Rica (province de Guanacaste), Nicaragua (Masachapa-Pochomil) et Panama, au Surinam (en fort déclin, de 3,000 en 1968 à 500 actuellement), Guinée, Ghana, Côte d'Ivoire, Sao Tomé, Congo Brazzaville et Angola (Fretey 2001), dans l'état d'Orissa (Inde), au Sri-Lanka et Thailande. On a observé des "arribadas" sur les sites d'Amérique Centrale et d'Orissa. Sur les petits sites de ponte, les femelles sont craintives, s'arrêtent au moindre bruit, légères, elles ne rampent pas mais soulèvent leur corps et marchent allègrement.

Rien n'est connu des stades juvéniles et jeunes de *L. olivacea*. Les juvéniles sont probablement pélagiques, des subadultes et des adultes vivent sur le plateau continental au nord de l'Australie, les adultes sont dans des aires d'alimentation côtières ou océaniques (Musick et Limpus 1997).

L. olivacea est sans doute la moins menacée des Tortues marines mais elle paie un lourd tribut aux captures intentionnelles ou accidentelles sur les côtes pacifiques de l'Amérique Centrale et en Asie. On constate un grave déclin du nombre de pontes sur les principaux sites de nidification. Elle est classée en danger par l'UICN.

ERETMOCHELYS IMBRICATA (LINNAEUS, 1766)

Eretmochelys imbricata est la plus tropicale des Tortues marines et la plus inféodée aux récifs coralliens. Elle mesure de 80 à 90 cm de carapace et pèse de 60 à 80 kg, très rarement plus de 100 kg. Elle est surtout caractérisée par son bec crochu et ses larges et belles écailles imbriquées (d'où son nom), brun orangé avec des stries et des mouchetures plus foncées. Sa viande peut être toxique, il y a eu récemment des cas d'intoxication mortelle, voisin de la ciguatera, à Tahiti.

La plupart des populations d'*E. imbricata* sont en déclin ou éteintes, celles qui subsistent sont très dispersées et ne constituent plus q'une part minime des populations qui existaient auparavant. Seulement, cinq ou six populations dans le monde ont plus de 1,000 femelles se reproduisant chaque année (une aux Seychelles, au Mexique, en Indonésie et peut-être à Cuba, deux en Australie) (Meylan et Donnelly 1999).

On disait volontiers, qu'*E. imbricata* était plus sédentaire que les autres Tortues marines et que les nouveau-nés ne s'éloignaient pas trop et se cachaient dans les fentes des récifs coralliens (Witzell 1983). On a des preuves q'il y a des individus pélagiques de 5 à 21 cm en association avec des sargasses (Carr 1987). En Atlantique, les habitats récifaux de croissance recrutent à une taille plus petite (20-25 cm) donc à un plus jeune âge (1-3 ans) que chez les autres Tortues marines (Boulon 1994). Dans la région indo-pacifique, le recrutement s'opère à une taille plus grande (35 cm). Les habitats récifaux et les mangroves d'estuaire, où abondent les éponges, la principale nourriture de cette espèce, sont aussi bien des aires d'alimentation pour les jeunes que pour les adultes. Un fait nouveau : dans l'Atlantique, une proportion non négligeable de juvéniles et de jeunes voyagent et des adultes migrent d'une aire d'alimentation à une aire de reproduction et vice-versa (Bass 1999, Diaz-Fernandez et al. 1999). *E. imbricata* est plus sédentaire en Australie (Limpus 1992). La présence de l'espèce dans les eaux européennes de l'Atlantique (2 records) et en Méditerranée (7) est exceptionnelle et le fait de quelques jeunes individus erratiques (Laurent et Lescure 1991).

A cause de son écaille, *E. imbricata* est la Tortue marine qui a subi le plus de prélèvements depuis des siècles. Le Japon en a importé 1,177,000 adultes et jeunes, entre 1970 et 1986 (Milliken et Tokunaga 1987). Elle a été déclarée espèce gravement en danger d'extinction sur la base d'un déclin d'au moins 80 % depuis 3 générations, c'est-à-dire 105 ans, et ce déclin est suspecté continuer pour les trois générations à venir (Meylan et Donnelly 1999). Selon Anne Meylan (in litt.), le commerce international de l'écaille demeure toujours la menace la plus sérieuse sur le statut de la Tortue imbriquée. D'autre part, ces Tortues sont liées aux massifs coralliens, un écosystème très fragile et menacé dans le monde, beaucoup de plages ont été dégradées ou aménagées pour le tourisme et ne peuvent plus être fréquentées par les Tortues marines.

DERMOCHELYS CORIACEA (VANDELLI, 1761)

La Tortue Luth est la plus grande de toutes les Tortues, jusqu'à 2.20 m de longueur totale (195 cm de carapace) et un poids de 800-900 kg, habituellement autour de 300 kg. Elle n'a pas d'écailles mais une fausse carapace de cuir, vit en haute mer, se nourrit principalement de méduses, peut plonger à plus de 1,000 m et fréquenter les eaux froides, grâce à un début de régulation thermique. A croissance très rapide, comme les autres très grands animaux, à cause de la présence de cartilage vascularisé dans les épiphyses de ses os longs (Rhodin 1985), elle peut atteindre sa maturité sexuelle entre 8 (135 cm) et 14 ans (147 cm) (Zug et Parham 1996).

La Tortue Luth est le Reptile qui a la plus vaste répartition mondiale, des eaux de la Nouvelle-Zélande et du sud du Chili à l'Islande et la mer de Barents. Cependant, les sites de reproduction se situent dans les zones tropicales et équatoriales, dont les principaux sont ceux de Guyane française-Surinam, Trinidad, Gabon-Congo, Costa-Rica, côte pacifique du Mexique, Iran Jaya (Indonésie). Ils sont sujets à de fortes fluctuations, des années faibles succèdent à des années fortes. Les Tortues Luths changent volontiers de plage de ponte dans une même saison sur quelques dizaines ou centaines de kilomètres et d'une saison à l'autre sur plusieurs centaines voire plusieurs milliers de kilomètres. Dans les Guyanes, c'est une adaptation à l'instabilité des plages. Une Luth marquée pendant sa ponte en Guyane française a pondu une autre année à Trinidad. On aurait donc une même métapopulation reproductrice de Trinidad à la Guyane française. On est passé ainsi en Guyane-Surinam de 7,000 femelles/an vers 1980 à 10,000 vers 1990 et de nouveau 7,000 en 2,000, en Guyana de 200 en 1994 à 3,000 et à Trinidad de 200-300 en 1970-95 à plusieurs milliers, peut-être 7,000 actuellement.

Dermochelys coriacea est la plus pélagique des Tortues marines. Les nouveau-nés s'éloignent des côtes et nagent presque sans se reposer pendant les sept premières semaines (Bels et al. 1988). On ne les revoit pas, les juvéniles sont en mer, peut-être dans la zone équatoriale. Fretey (2001) vient de signaler la capture de 3 juvéniles de 17-21 cm (1-2 ans) au large de Principe, une observation exceptionnelle. On doit rappeler qu' un juvénile de 50-60 cm a été capturé près de Sidi-Ferruch (Algérie) au siècle dernier (Lallemant 1867). Actuellement, on redécouvre des subadultes de 110 cm à côté des adultes dans les aires d'alimentation du nord-ouest de l'Atlantique.

Les Luths font d'énormes migrations: des femelles baguées en Guyane ont été revues au Canada, Terre Neuve, côtes atlantique des Etats-Unis, Floride, Cuba, Açores, Espagne, France, Ghana. Une Luth marquée en 1993 en Guyane française, revenue y pondre en 1997, a été trouvée échouée au sud de Bordeaux (France), le 22 décembre 1999. Une femelle, munie d'une balise Argos sur sa plage de ponte en Guyane française, est allée à 80

km au large entre les pontes et à séjourné ensuite autour des îles du Cap Vert, sans doute son aire d'alimentation, une autre est allée au large des Antilles et ensuite près de la Floride (Ferraroli et al. 2002). Une Luth marquée par une équipe canadienne est allée directement de Terre Neuve au Cap Vert, ce qui remet en question les dérives des Tortues marines par les courants, tout au moins pour les adultes.

Les adultes s'approchent des côtes pour trouver les bancs de méduses. Des Tortues Luths sont vues régulièrement dans les eaux européennes occidentales, particulièrement en été le long des côtes atlantiques françaises (environ 150/an). Elles pénètrent aussi en Méditerranée par le Détroit de Gibraltar et en sortent. Elles n'y pondent plus mais quelques pontes ont été signalées dans le passé, au sud de la Sicile (Lescure et al. 1989).

Il y a eu une controverse récente entre Spotila et al. (1996) et Pritchard (1996) sur le statut mondial de *Dermochelys coriacea*. La Tortue Luth est-elle vraiment menacée d'extinction? On est passé des premières estimations mondiales de 29,000 femelles dans les années 70 à 115,000 en 1982 avec les découvertes des grands sites de ponte de Guyane française et de la côte pacifique du Mexique (75,000!) (Pritchard 1982). L'estimation du Mexique a été surévaluée et on a assisté en outre à un déclin grave de cette population (75,000 ou plutôt 40-50,000 en 1982, 20-30,000 vers 1990 à 600-900 en 1996). La population mondiale serait descendue à 35,400 selon Spotila et al. (1996). Nous pensons qu'à cause des grosses fluctuations, que nous constatons dans les populations étudiées depuis 20-30 ans, la population mondiale de Tortue Luth n'est pas aussi faible qu'on ne l'a dit. On assiste à des montées spectaculaires en Guyana et à Trinidad et on vient de découvrir que le site du Gabon-Congo est en ce moment un des premiers du monde avec 4,222-7,096 femelles (Billes et al. 2000). La Tortue Luth est moins exploitée et moins menacée que les autres Tortues marines, elle est en danger mais pas en voie d'extinction. Elle est menacée surtout par les captures accidentelles de la pêche, qui vont en s'intensifiant et... les sacs plastiques.

CHELONIA MYDAS (LINNAEUS, 1758)

Certains et non des moindres comme Pritchard (1997) pensent que la Tortue verte du Pacifique oriental, très foncée, est une espèce distincte, *Chelonia agassizii* Bocourt, 1868, mais Bowen et Karl (1997), d'après leurs travaux de génétique, ne la considèrent que comme une sous-espèce de *Chelonia mydas*.

Les Tortues vertes mesurent 100-125 cm de carapace et pèsent de 130 à 250 kg. Si les jeunes sont omnivores, les adultes ont la particularité d'être herbivore. C'est une espèce des mers tropicales mais vivant aussi dans des eaux tempérées chaudes, moins cependant que *Caretta caretta, Dermochelys coriacea* et même *Lepidochelys kempii*.

Les principaux sites de reproduction sont moins nombreux sur les continents (Tortuguero au Costa-Rica, Surinam, Inde) que sur des îles souvent éloignées (Ascension, Archipel de Bijagos (Guinée-Bissau), Bioko (Guinée Equatoriale), Sao Tomé, Aldabra, Europa, Tromelin, Atoll das Rocas au Brésil, Galapagos, Hawaï, Récif d'Encastreaux en Nouvelle Calédonie et même la Grande Barrière de Corail en Australie). Pourquoi ces grandes migrations pour pondre sur des îles? Pourquoi de telles dépenses d'énergie? Deux hypothèses sont possibles: soit les populations à reproduction continentale ont été éliminées par les collectes effrénées de l'Homme depuis des siècles, soit leur stratégie de reproduction les ont conduits à pondre sur des petites îles n'abritant pas de prédateurs. Cependant, pourquoi les autres espèces ne les ont pas accompagnées dans cette stratégie? D'autre part, il y a quelques prédateurs sur ces îles désertes: Frégates comme à Europa, Crabes, Pagures. Les Tortues vertes des Galapagos *(Chelonia agassizii)* resteraient autour des îles. Est-ce le caractère de certaines populations insulaires quand les ressources alimentaires y sont suffisantes pour tous les stades? Est-ce le cas à Chypre?

Les nouveau-nés partent en mer pour un stade pélagique, ils évitent les bois flottants et vivraient plus en plein océan. Ceux de Floride iraient dans le Gulf Stream, prendraient la Dérive nord-atlantique et reviendraient dans les Caraïbes et la Floride par le courant nord-équatorial. On a vu quelques juvéniles de Floride dans les Açores et Madère mais beaucoup moins que les Caouannes. On en voit plus aux Canaries et exceptionnellement le long des côtes atlantiques européennes. Le recrutement dans les aires de croissance côtiers se fait de toute façon à une taille plus petite (20-25 cm en Atlantique ouest, 35 cm en Australie et Hawaii) donc à un plus jeune âge que les Caouannes (50-70 cm). Les jeunes deviennent herbivores et sont souvent résidents dans leurs aires d'alimentation (herbiers, récifs couverts d'algues), surtout dans les eaux tropicales toujours chaudes. Ils deviendraient matures sexuellement vers 20-30 ans et retourneraient périodiquement vers leur île ou leur continent d'origine pour se reproduire.

Depuis des siècles, la Tortue verte a été exploitée à cause de sa viande excellente et ses oeufs. Les bateaux déroutaient pour aller sur les îles désertes faire le plein de Tortues au moment des pontes. C'était le meilleur remède contre le scorbut. On montait aussi des expéditions particulières dans ce but. C'est à partir du cartilage, qu'on faisait la fameuse soupe de Tortue, servie encore au début du XXe siècle à la table royale d'Angleterre. Cette exploitation et ce commerce international intensifs ont été la cause du déclin grave de cette espèce et de la quasi-destruction de plusieurs populations, qui ne s'en relèvent pas comme celle de Méditerranée orientale.

Aujourd'hui, le commerce international est arrêté mais en beaucoup de pays (par ex. Costa-Rica, Panama, Colombie, Indonésie, Guinée Equatoriale, Gabon, Surinam avec

contrebande d'oeufs en Guyane française), la collecte et le commerce local des oeufs et de la viande augmentent dangereusement, sous la pression de l'augmentation de la population. Dans quelques pays, les mesures prises enrayent la chute, comme en Floride et à Rancho Nuevo (Mexique), elles arrivent peut-être trop tard en Martinique et les autres îles des Petites Antilles, dont l'île Aves (Venezuela), et à Tahiti, où les habitants se rabattent faute de mieux sur *E. imbricata* et encourent parfois des intoxications graves, voire mortelles. Tout ceci justifie amplement que cette espèce soit classée en danger critique par l'UICN.

CARETTA CARETTA (LINNAEUS, 1758)

La Caouanne est un peu moins grande et pèse moins que la Tortue verte: 90-100 cm de carapace (?max: 114) et 60 à 160 kg. Carnivore, elle a un régime alimentaire varié et se nourrit principalement de Mollusques (dont Céphalopodes) et Crustacés (dont Cirripèdes) mais aussi de Limules, Eponges, Poissons, Algues. Elle ne vit pas dans les eaux équatoriales mais fréquente et se reproduit dans les zones intertropicales et tempérées chaudes, de sorte qu'il y a un hiatus entre les populations reproductrices de l'hémisphère nord et celles de l'hémisphère sud, beaucoup moins nombreuses et plus fragmentées. Ses principaux sites de reproduction sont sur l'île de Masirah (Oman), le long des côtes des Etat-Unis (principalement en Floride), en Lybie, Grèce (Zakynthos), aux îles du Cap Vert et en Australie orientale. Elle pond aussi mais en petit nombre dans le Golfe du Mexique, au Brésil, en Afrique du Sud (Tongaland) et au Japon.

Les nouveau-nés sont pélagiques. Ceux du Japon et d'Australie iraient jusqu'en Californie. On connaît assez bien l'itinéraire de ceux du littoral atlantique américain. Les intuitions de Carr (1986) se sont révélées exactes: les petits juvéniles voguent et se cachent dans la Mer des Sargasses, sont d'ailleurs attirés par les objets flottants, un comportement persistant à l'état adulte. Ils empruntent le Gulf Stream, passent par les Açores et y séjournent. La plupart continuent dans ce système giratoire, dérivent vers le sud, passent à Madère, frôlent les Canaries, retournent vers l'ouest par le courant nord équatorial et rejoignent les aires de croissance des côtes américaines à 25-35 cm (2-4 ans) et même plus tard (40-50 cm). Quelques unes empruntent la Dérive nord atlantique et s'égarent (?) le long des côtes atlantiques européennes, d'autres continuent vers l'ouest et pénètrent en Méditerranée en nombre appréciable, parfois en groupe (Lanteri 1982), longent les côtes d'Espagne, où beaucoup se font capturer accidentellement (22-24,000 selon Aguilar et al. 1995), atteignent une taille de 31-51 cm, séjournent en Méditerranée occidentale, ne s'y reproduisent pas et repartent. Retournent-elles au stade jeune ou subadulte vers les plages américaines pour s'y reproduire ou s'égarent-elles dans l'Atlantique pour devenir aussi des individus perdus pour les générations futures (Laurent et Lescure 1995)? Nous l'ignorons.

Le long des côtes américaines, les aires de croissance recrutent aussi bien à 25-30 cm et même à 50 cm et plus (7-10 ans). Il y a des migrations nord-sud pour aller dans des eaux plus chaudes l'hiver. Les jeunes et les adultes paraissent fidèles à leurs aires d'alimentation et y reviennent après leur reproduction, qui commence vers 20-25 ans.

Caretta caretta est moins menacée mondialement que *Chelonia mydas, E. imbricata* et *L. kempii*. La Caouanne a été moins pêchée historiquement parce que sa chair était beaucoup moins appréciée que celle de la Tortue verte et même méprisée. Cependant, des nouvelles menaces surgissent, la Caouanne vit dans des eaux très pêchées, le nombre de morts accidentelles croît dangereusement, et elle pond sur des plages très fréquentées aujourd'hui par les touristes. Si la petite population d'Afrique du Sud et celle plus importante de la Floride au sud du Cap Canaveral semble augmenter, celle au nord du Cap Canaveral et celle du Queensland en Australie déclinent à cause des captures accidentelles (Pritchard 1997).

CONCLUSION

La vie dans plusieurs milieux, la maturité tardive, la venue à terre sans pouvoir s'y défendre et l'abandon de la progéniture rendent les Tortues marines extrêmement vulnérables aux prédateurs et particulièrement au plus grand d'entre eux, l'Homme.

Après plusieurs siècles d'exploitation, particulièrement effrénée pendant le dernier siècle, le déclin des Tortues marines est général. Plusieurs populations ont été détruites et il est impossible de les reconstituer, d'autres populations s'éteignent sous nos yeux. Quelques unes se stabilisent actuellement, quelques autres sont en légère augmentation. Cela justifie le souci particulier des Conventions internationales à leur égard, les mesures prises pour leur conservation et tous nos efforts pour mieux les connaître et mieux les protéger.

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THE STATUS OF MARINE TURTLES IN THE MEDITERRANEAN

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INTRODUCTION

Three species of marine turtles, namely the Loggerhead *Caretta caretta,* the Green Turtle *Chelonia mydas* and the Leatherback *Dermochelys coriacea,* are encountered regularly in the Mediterranean. The Loggerhead and the Green Turtle have established local populations whereas the Leatherback, with a less common occurrence, is a visitor from the Atlantic.

Genetic studies reveal that the regionally established loggerhead and green turtle populations originate from western Atlantic stocks which colonized Mediterranean about 12,000 years ago at the end of the last glacial period (Bowen et al. 1993, Encalada et al. 1996).

NESTING POPULATIONS

The main nesting concentrations of *Caretta caretta* in the Mediterranean are found in Greece, Turkey and Cyprus. Substantial nesting was also discovered in Libya (Laurent et al. 1997) but the nesting effort there needs to be quantified. Few nests are made each season in Egypt, Israel, Italy, Syria, Lebanon, Tunisia, and occasional nests in Spain (Tomás et al. 2002b, Margaritoulis et al. 2003). Monitoring of nesting areas in Cyprus, Greece, Israel, Tunisia and Turkey, range the total nesting effort in these countries from 3,375 to 7,085 nests per season (Margaritoulis et al. 2003). However, these numbers are considered minimum figures as they do not include nests outside the monitored areas or in countries where regular monitoring has not yet been initiated (e.g. Libya).

Nesting loggerheads in the Mediterranean are significantly smaller that those in other parts of the world. Moreover, there are body size differences within Mediterranean (Margaritoulis et al. 2003). Mitochondrial DNA analyses have shown that although loggerheads nesting in Greece and Cyprus share common haplotypes with those nesting in the western Atlantic they seem to have diverged genetically as a result of reduced gene flow (Bowen et al. 1993); this genetic isolation becomes more prominent in nesting areas of Turkey (Laurent et al. 1998). Further, it seems that there exists further genetic

differentiation among nesting areas of Turkey (Schroth et al. 1996) indicating the occurrence of sub-populations (Kaska 2000).

Nesting of *Chelonia mydas* occurs exclusively at the easternmost part of the Mediterranean, with the great majority of nests made in Turkey and Cyprus; few nests appear in Egypt, Israel and Lebanon. The total nesting effort of green turtles in the Mediterranean ranges from 350 to 1,750 nests per season (Kasparek et al. 2001). A genetic analysis of green turtles in Cyprus has revealed endemic haplotypes rendering an almost isolated green turtle population in the eastern Mediterranean (Encalada 1996).

INTERCHANGE BETWEEN MEDITERRANEAN AND THE ATLANTIC

The relatively large number of juvenile loggerheads caught incidentally in the western Mediterranean invoked the question as to their origin. Argano and Baldari (1983) suggested that they were derived mostly from populations nesting in the eastern Mediterranean and, in part, from the Atlantic. Further, Carr (1987) indicated that loggerheads originating from beaches in the western Atlantic seem to follow a transatlantic developmental migration with some of them entering Mediterranean. This hypothesis was confirmed by tag recoveries (e.g. Bolten et al. 1992) and, also, by genetic studies in which it was found that about half of the pelagic loggerheads originate from Mediterranean populations and the other half from the western Atlantic (Laurent et al. 1998).

TURTLE MOVEMENTS WITHIN MEDITERRANEAN

Existing data for turtle movements in the Mediterranean concern mainly *Caretta caretta* and have been accumulated mostly through long term tagging projects. Long-range recoveries of loggerheads tagged in Greece show a post-nesting wide dispersion in the Mediterranean with preference areas the Gulf of Gabés and the Adriatic Sea (Margaritoulis 1988b, Lazar et al. 2000). In Italy, a total of 1,047 loggerheads, mostly juveniles, were tagged after their capture in fishing gear. Of these, 4.8% have been recovered at both the eastern and western Mediterranean basins; the ones in the eastern basin exhibiting, more or less, the same preference areas as the post-nesting females from Greece (Argano et al. 1992). Further, juvenile loggerheads in the western Mediterranean seem to conduct seasonal migrations (Camiñas and de la Serna 1995).

The venturing of green turtles in the western Mediterranean is an exceptional event; probably a result of unfavourable temperature regimes. In the eastern Mediterranean, satellite tracking of green turtles from Cyprus have shown a post-nesting migration to Egypt and Libya (Godley et al. 2002). Although, juvenile green turtles seem to have a restricted dispersal, in comparison to loggerheads (Baran and Kasparek 1989), the discovery of green turtle developmental habitats in southern Greece (Margaritoulis and

Teneketzis 2003) and western Turkey (Türkozan and Durmus 2000) advocates more investigation to this matter.

The use of satellite telemetry, already undertaken on a small scale in the Mediterranean (Hays et al. 1991, Bentivegna 2002, Godley et al. 2002), is expected to assess important aspects on the behavioural ecology of marine turtles in the Mediterranean.

MARINE HABITATS

Sea turtle marine habitats in the Mediterranean have been suggested as a result of concentrated tag recoveries or/and incidental captures in fisheries. Two major areas have been suggested: Gulf of Gabés and northern Adriatic Sea. These very extensive shallow areas seem to host benthic habitats for adult and juvenile loggerheads (Margaritoulis 1988b, Argano et al. 1992, Laurent and Lescure 1994, Lazar et al. 2000). Other benthic habitats of loggerhead and green turtles, indicated by the relatively high number of incidental captures in bottom trawlers, are found in the Nile delta (Laurent et al. 1996), the Bay of Iskenderun (Oruç 2001) and Lakonikos Bay (Margaritoulis et al. 1992). Turtle captures in pelagic fisheries as well as recoveries of tagged juveniles (Argano et al. 1992) suggest that both Mediterranean basins are exploited by pelagic loggerheads (Laurent et al. 1998).

THREATS ON NESTING AREAS

The Mediterranean is a major destination of millions of tourists during the summer, which coincides with the nesting season. Several nesting areas in the Mediterranean are severely threatened by tourist development. Tourist installations impact directly reproductive procedures and either inhibit females from nesting or increase mortality of eggs and hatchlings. Deployment of beach furniture takes up vital space from emerging turtles and disrupts natural incubation of eggs. Vehicular traffic on beaches may destroy incubating clutches and hatchlings about to emerge. Bright lights disorient hatchlings which, instead of going to the sea, are attracted landwards where they succumb to dehydration and predation. Other issues of concern are sand mining, alteration of nesting habitat for agriculture, coastal industries and constructions meant to protect the beach from erosion (sea walls, etc.).

Special attention should be given to the threats, described by Kasparek et al. (2001), on the few major green turtle nesting areas in Turkey and Cyprus, hosting about 78% of the total nesting population in the Mediterranean.

The documented threats and the reduction of favourable nesting habitats have triggered management programmes to address the seemingly natural loss due to nest predation and inundation by the sea. Nest predation, notably by foxes, affects most nesting beaches in the Mediterranean, with the exception of some areas (e.g. Zakynthos) where

foxes are absent. Concerning loggerheads about 48.8% of nests at Kyparissia Bay were disturbed by predators in 1987 (Margaritoulis 1988a), 44.8% in Libya during 1995 (Laurent et al. 1997), 36.0% in Cyprus during 1994 (Broderick and Godley 1996) and 65-70% in Dalyan (Erk'akan 1993). Similar predation rates have been documented on green turtle beaches.

MORTALITIES AT SEA

1. Past and Present Exploitation

Sea turtles in the Mediterranean have suffered human exploitation for a long time. According to Sella (1982) it is estimated that from about 1915 until the middle 1930s at least 30,000 turtles, of both species, were caught offshore of today's Israel coast. A similar situation developed later at Mersin Bay and Iskenderun Bay where it is estimated that from 1952 until 1965 up to 15,000 specimens were taken from the shores of Mersin alone. The turtle-fishery stopped in 1965 after depletion of the local *Chelonia* population. In Italy, Di Palma (1978) notes that a specialized fishery operated north of Sicily, catching 500-600 turtles annually. Turtles were also sold until recently in Algeria and Morocco (Laurent 1990), Malta (Gramentz 1989), Spain (Mayol and Castello Mas 1983), and Tunisia (Laurent et al. 1990). The most recent case of turtle use concerns Egypt where, despite an enforcement of prohibition of turtle sales in fish markets, this seems to continue behind the scenes (Nada 2001).

2. Incidental Catch and Mortality in Fisheries

Today there is a substantial incidental catch of sea turtles in Mediterranean fisheries. An estimated 20,000 juvenile loggerheads are caught annually by the Spanish longline fishery (Aguilar et al. 1995) and 2,000-2,500 turtles per year are caught in Tunisian trawlers in the Gulf of Gabés (Bradai 1992). Incidental captures of turtles in various fishing gear occur practically in all Mediterranean countries. Recently a cooperative project assessed turtle bycatch in the European Mediterranean trawl and drifting longline fisheries (Laurent et al. 2001). Turtle captures seem to be also high in "less industrialized" fisheries, as set gill nets. However, quantification of turtle captures in these widely spread fisheries is very difficult to assess.

Mortality following incidental capture has not been fully documented. Although turtles hooked in drifting long-lines are usually released by cutting the branch line, the effect of hooks left on turtles are not actually known. While turtles caught in trawler nets may suffocate and die, mortalities attributed to this reason appear generally low in the Mediterranean (Margaritoulis et al. 1992, Laurent et al. 2001, Oruç 2001). On the contrary, mortalities caused by set gill nets seem to be very high, e.g. 94.4% in Corsica (Delaugerre 1987). Further, a number of incidentally captured turtles, especially in set gill

nets, seem to be killed or mutilated deliberately by fishermen (Kopsida et al. 2002).

3. Boat Strike, Oil Pollution, Marine Debris

Other reasons of turtle mortality at sea are boat strikes, oil pollution and ingestion of debris. Sea turtles spend a proportion of their time on the surface to breathe and rest between dives. At this time they are vulnerable to boat strikes, particularly from speedboats. The effect of boat strikes is of great concern in turtle frequented waters with dense tourist activities.

The effects of oil pollution are not known in detail, although small size specimens can be immobilized and exhausted by heavy oil pollution. Twenty out of 99 loggerheads, examined in the Maltese islands, were found contaminated, mostly with crude oil (Gramentz 1988).

Marine debris has been identified as harmful to sea turtles. Unattended or discarded nets, nylon bags, various buoyant plastics have been of main concern. Special attention should be given to floating plastics and tar balls, which are frequently mistaken by turtles for food items. This seems to be a major problem for pelagic juveniles in convergence zones where floating debris concentrates (Tomás et al. 2002a).

CONSERVATION AND MANAGEMENT

1. Legal and Formal Aspects

The World Conservation Union (IUCN) has recognized the vulnerability of marine turtles and according to the new criteria for Red List Categories has listed all three species, found in the Mediterranean, as "Endangered". Further, the IUCN's Marine Turtle Specialist Group (MTSG) produced a Global Strategy for the Conservation of Marine Turtles, which addresses research, management and conservation issues.

There are several international conventions containing provisions for the protection of marine turtles in the Mediterranean region. The most important are:

a. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which prohibits trade of all species of marine turtles.
b. The Convention on the Conservation of European Wildlife and Natural Habitats (also known as the Bern Convention), which includes sea turtles in the "strictly protected" list.
c. The Convention for the Protection of the Mediterranean Sea against Pollution (known as Barcelona Convention) and its associated protocols, which includes marine turtles in the List of Endangered and Threatened Species.
d. The Convention on the Conservation of Migratory Species of Wild Animals (CMS), also known as the Bonn Convention, provides valuable tools for

international co-operation with respect to conservation and management of migratory species, including marine turtles.

These conventions have a varying degree of application in the Mediterranean countries with the exception of Barcelona Convention to which all Mediterranean countries are signatories. The significance of Barcelona Convention, as far as marine turtles are concerned, is reflected (1) in the adoption of an Action Plan for the Conservation of Marine Turtles, and (2) in the establishment of a coordinating mechanism, known as RAC/SPA (Regional Activity Centre for Specially Protected Areas). Also the Bern Convention, an initiative of the Council of Europe, has taken a leading role, with an effective administrative structure, in establishing conservation recommendations for countries hosting important habitats for marine turtles.

Besides international and regional obligations, most Mediterranean countries have developed national legislation in protecting sea turtles. Furthermore, some countries have done steps in introducing site-specific protective legislation for nesting habitats. The very important nesting areas on Zakynthos have been recently incorporated in new legislation establishing a National Marine Park. In Turkey, the nesting beaches of Dalyan, Fethiye, Patara, Belek and Göksu Delta were designated a SPA status with Akyatan, the most important green turtle nesting area, being a Wildlife Reserve. In Cyprus, the Fisheries Law contains provisions for protecting the nesting beaches of Lara (Demetropoulos and Hadjichristophorou 1988).

2. Protection and Management of Habitats and Populations

In general, protection and management measures aim in reducing disturbing factors. However, mechanisms for applying active management on nesting beaches are generally lacking. In some countries, state departments undertake this role, in other countries this is mostly done by NGOs and Universities.

Management of marine habitats is at an early stage. Management for these habitats, needing international cooperation, should be effected by securing appropriate bodies and mechanisms to enforce maritime legislation and fisheries regulations.

The high degree of public sensitization, noted the last years, requires the development of appropriate infrastructure to rehabilitate injured turtles. In the Mediterranean this is done either in existing aquaria (Bentivegna et al. 1993) or in facilities specifically established for this reason (Kallonas et al. 1998, Pont and Alegre 2000). However, hospitalizing sea turtles should not be considered as compensating incidental and intentional mortalities at sea.

3. Public Awareness, Education, Capacity Building

At a regional level, RAC/SPA produces or supports production of various informative material, reports and manuals. Further, RAC/SPA promotes capacity building on sea turtle conservation and management techniques by organizing or supporting training courses.

At a national level, public awareness projects, either aiming at specific target groups (e.g., fishermen) or at the general public, are conducted in several Mediterranean countries. It is of paramount importance that local stakeholders be incorporated in conservation plans; management techniques be explained to local people; involvement of local communities in conservation and management is a must, so that they comprehend the value of sea turtles and collaborate for their protection. Visitors at nesting areas should be sensitized and encouraged to participate in conservation efforts. Children comprise another important target group. Presentations by charismatic educators, especially designed traveling kits to be deployed by teachers, guided visits to nesting areas or rescue centres are activities enhancing public participation in conservation practices. The problem of incidental catch and subsequent mortality can be partly eased through appropriate awareness of fishermen. Awareness of fishermen is done in several countries; sometimes combined with assessment of turtle bycatch. The importance of the Italian project with fishermen was not only the collection of valuable data but also the successful sensitization of fishermen. A similar small-scale project gives fruit in Lakonikos Bay, where fishermen kill no more captured turtles, as they did by tradition (Margaritoulis et al. 1992).

REGIONAL COOPERATION

Marine turtles are migratory species, to the extent that conservation efforts in one country could be undermined by harmful practices in another. Therefore, international co-operation and cooperative efforts are urgently needed to adequately study and protect marine turtles in the Mediterranean. Further, late maturity and longevity of marine turtles render the results of management to be evident only after many years, probably too long for any corrections. So, the precautionary principle should dominate conservation and management plans.

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EPIBIONT FAUNA OF *CARETTA CARETTA* IN THE SPANISH MEDITERRANEAN

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INTRODUCTION

The loggerhead sea turtle (*Caretta caretta*) is known to be colonized by the largest and most diverse communities of epibiont fauna among all 7 species of marine turtles (Frick et al. 2000). From the point of view of epizoit-host interaction, we can divide the epibiont fauna into 3 categories:

- True parasites, as hirudineans of the genus *Ozobranchus* (Davies and Chapman 1974), the copepod *Balaenophilus umimegacolus* (Ogawa et al. 1997) or amphipods as *Podocerus chelonophilus* (Davenport 1994).

- Commensal species, typically barnacles of families Lepadidae, Balanidae and Coronulidae. Within this group, there are some harmful species due to its mode of attachment, as *Tubicinella* spp. (Monroe and Limpus 1979). The remaining species are harmless except, perhaps, when they occur in high numbers.

- Symbiotic species, as the crabs of genus *Planes* (Grapsidae), which seems to have developed a cleaning association with sea turtles (Davenport 1994).

A large group of epizoites (about 70 species from the Porifera, Cnidaria, Mollusca, Platyhelmintha, Annelida, Arthropoda, Bryozoa and Chordata) are just free-living organisms that colonise both inanimate and living substrates (see Caine 1986, Frick et al. 1998). A second group includes taxa that have developed specific associations with turtles and other marine vertebrates, i.e., barnacles of the family Coronulidae (Newman and Ross 1976), leeches of the genus *Ozobranchus* (Davies and Chapman 1974), and some copepods, amphipods and tanaidaceans (see, e.g., Chevreux and de Guerne 1888, Yamato 1992, Ogawa et al. 1997). This group is likely the most important from an ecological and evolutionary viewpoint.

The most detailed information about epizoites of loggerheads comes from studies in the USA (e.g., Frazier et al. 1985, 1991, 1992, Caine 1986, Frick et al. 1998) and Australia (Monroe and Limpus 1979). In the Mediterranean Sea, reports on epizoites are sparse and scattered in the literature; we are aware of just a single comprehensive study of epizoite

communities that was carried out in the central Mediterranean (Gramentz 1988). In this study, we present preliminary information about the epizoites of loggerheads from the western Mediterranean, comparing our data with Gramentz's.

METHODS

We examined the epibiont fauna of 13 juvenile loggerheads (range of CCL: 45.0-66.0 cm) stranded along the coasts of the Valencian Community, Spain (from 40° 31'N, 0°31'E to 37° 51'N, 0°46'W). We attempted a complete collection of epizoites. Specimens were removed from the turtles and the specific site of occurrence was recorded. All specimens were fixed and preserved in ethanol 70%. They were later identified to the lowest taxonomic level possible and counted. In the case of species of Lepadidae, we dissected and mounted some specimens to reveal specific taxonomic features. Ecological concepts follow Bush et al. (1997).

RESULTS AND DISCUSSION

Thirteen crustacean species and 1 polychaete species were found in the 13 turtles examined (Tab. 1). The most frequent species were the barnacles *Platylepas hexastylos*, *Lepas hillii*, *L. pectinata*, *L. anatifera*, *Conchoderma virgatum*, Tanaidacea sp., *Caprella* sp. and Amphipoda sp. 1. The remaining species appeared only in single turtles: *Balaenophilus* sp. (1 specimen), *Planes* sp. (1 specimen), Amphipoda sp. 2 (8 specimens), Amphipoda sp. 3 (1 specimen), Isopoda sp. (1 specimen), and Nereididae sp. (1 specimen) (Tab. 1). We have recently collected additional material from 22 turtles still to be processed and identified. During the collection process, we were able to identify several hundred specimens of *Balaenophilus* sp. and some specimens of

Species	No. turtles	Mean intensity±SD	Median
Crustacea			
Cirripedia			
Family Lepadidae			
Lepas hillii	10	156.5 ± 267.4	51
Lepas pectinata	5	35.6 ± 70.7	5
Lepas anatifera	2	77.5 ± 99.7	77.5
Conchoderma virgatum	10	49.0 ± 58.6	20
Family Coronulidae			
Platylepas hexastylos	11	10.4 ± 7.5	10
Malacostraca			
Tanaidacea			
Tanaidacea sp.	8	7.2 ± 12.8	2
Amphipoda			
Caprella sp.	6	21.0 ± 33.8	2
Amphipoda sp. 1	6	7.3 ± 2.3	6
Amphipoda sp. 2	1	8	8
Amphipoda sp. 3	1	1	1
Isopoda			
Isopoda sp.	1	1	1
Decapoda			
Planes sp.	1	1	1
Copepoda			
Balenophilus sp.	1	1	1
Annelida			
Nereididae sp.	1	1	1

Tab. 1. List of species found in Mediterranean Valencian waters in this study with some descriptive statistics.

Present work (Number of turtles = 13)	Gramentz (1988) (Number of turtles = 107)
Annelida	Annelida
Nereididae sp.	-
-	*Pomatoceros triqueter*
-	*Hydroceros elegans*
Cirripedia	Cirripedia
Lepas anatifera	*Lepas anatifera*
Lepas hillii	*Lepas hillii*
Lepas pectinata	-
Conchoderma virgatum	*Conchoderma virgatum*
-	*Chelonibia testudinaria*
-	*Chelonibia caretta*
Platylepas hexastylos	*Platylepas hexastylos*
-	*Platylepas coriacea*
Decapoda	Decapoda
Planes sp.	*Planes minutus*
Tanaidacea	Tanaidacea
Tanaidacea sp.	*Hexapleomera robusta*
Amphipoda	Amphipoda
Caprella sp.	*Caprella andreae*
-	*Hyale grimaldi*
Amphipoda sp.1	-
Amphipoda sp.2	-
Amphipoda sp.3	-
Isopoda	
Isopoda sp.	-
Copepoda	
Balaenophilus sp.	-
Total: 14 spp	**Total: 13 spp**

Tab. 2. Epibiont fauna comparison between this study and Gramentz's (1988).

Chelonibia sp., in single turtles. All identified species had previously been reported from *C. caretta*. Most taxa found in the present study were also present in turtles from the central Mediterranean (Tab. 2). It is noticeable that the total number of taxa are similar in both studies, despite the different turtle sample size.

Balaenophilus sp. represents the first report of a species from this genus in wild turtles. Ogawa et al. (1997) described *B. umigamecolus* from a single juvenile of *C. caretta* in a Japanese aquarium. Therefore, our finding confirms that a species of *Balaenophilus* is naturally associated with loggerheads, which has interesting implications from an evolutionary viewpoint: the only additional species of *Balaenophilus* hitherto described occur on the baleen plates of whales. *B. umigamecolus* was reported from the skin of the neck, apparently scraping the skin for food. Our specimens were found only after a carefully washing of turtles and, therefore, we do not know where they came from.

The habitat of specimens from other taxa does not substantially differ from descriptions made in other studies (Davenport 1994, Gramentz 1988), except for Tanaidacea sp.

Although some of these crustaceans were associated with algae, the species was typically found inside the inter-plate spaces and in small holes on the carapace. Apparently, holes need to have a minimum size to be colonised. Gramentz (1988) found the tanaidacean species *Hexapleomera robusta* in Mediterranean loggerheads, but it was intimately associated with algae.

ACKNOWLEDGEMENTS

This study has been made thanks to the whole team of the Marine Zoology Unit, from the Cavanilles Institute of Biodiversity and Evolutionary Biology of the University of Valencia. Thanks, also, to the Consellería de Medio Ambiente of the Generalitat Valenciana, for the economic and logistic support, and to the NGO Alnitak, for his kindly supply of biological and photographic material. Finally, we are grateful to all the institutions and people implicated in the stranding network.

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CONSERVATION AND RESEARCH ASPECTS OF HATCHERY PRACTICES

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INTRODUCTION

Hatcheries are popular tools for sea turtle conservation. Both beach hatcheries and artificial hatcheries have proven useful for protecting sea turtle nests from predators and natural catastrophes. Another technique (transplantation) has recently been tested, with promising results. A thorough discussion of the advantages and disadvantages of hatchery and transplantation techniques is presented by Stancyk et al. (1980).

Despite criticisms, the relocation of sea turtle nests to protected corrals remains a commonly used strategy around the world (e.g., Blanck and Sawyer 1981, Wyneken et al. 1988). Eggs are removed from the natural nest either during or shortly after oviposition, placed in buckets or bags, and transported to a protected corral on the beach for incubation (Wyneken et al. 1988). Transplantation of nests to sites, which are less conspicuous to predators is another commonly used method of nest protection (Stancyk et al. 1980). Hatchlings are released soon after emergence at a variety of locations along the beach so as not to attract an excess of predators to one area. Many nesting beaches have extremely high rates of egg mortality (Stancyk et al. 1980, Erk'akan 1993). On certain beaches the level of egg mortality may even reach 100% (Blanck and Sawyer 1981).

Dalyan, one of the most important nesting areas for *C. caretta*, was declared as the first Specially Protected Area in Turkey in 1988. Predator removal; use of deterrents: chemical repellents or aversion conditioning, and nest protection were considered against heavy predation but not removal of eggs to other natural sites or hatcheries. Dalyan beach is a 4.6 km long, curved sand dune connected to the mainland at its eastern extreme. The western side of the beach consists of sparsely vegetated sand dunes, behind which the Dalyan river estuary forms a large wetland lake system. Heavy fox predation was reported in the last decade on the sea turtle nests (i.e., Erk'akan 1993, Yerli et al. 1997).

In this work we attempted to set up a hatchery design for the nests under risk of predation or inundation at Dalyan Beach.

MATERIALS AND METHODS

Eggs were collected on the night of laying (within 24 hours) from the nests. Eggs were

handled with care so that they are kept in an upright position at all times so as to minimise membrane disruption and resulting embryo death. When all the eggs have been removed from the nest, both the number of eggs removed and the depth of the nest - as distance from the sand surface to base of the egg chamber were recorded. It is important to avoid any damage to eggs whilst transporting them. Eggs were transported in a plastic bucket.

The artificial nest was opened as closely as possible, in terms of depth, diameter, and shape (flask shaped) as the natural nest. The walls of the egg chamber were smooth enough to allow the hatchling easy access to the surface. Two nests were located at least 0.75 m apart to prevent any interaction between adjacent clutches (disease contamination or the transferral of metabolic heat).

Eggs were relocated into the new nest as quickly as possible. Eggs were handled carefully and placed individually in the egg chamber, not dropped into the nest from the surface. In a natural nest the egg chamber will contain little sand. Therefore, we kept the eggs as clean of sand as possible.

The hatchlings were kept in a box around the nest and this box was checked every hour during the night. Hatchlings were released at different places on the beach during the night as soon as possible at the night of emergence during the hourly control of a nest.

The hatchery site was selected in the zone where the majority of the nests would be. The hatchery location was selected so as not to be liable to flooding during the nesting season. In this area a 10x10 m zone was fenced. The design and type of fencing were designed to prevent people walking through the enclosure and disturbing the nests and to prevent the entry of predators. To prevent the burrowing predators, fencing was extended to a depth of about 0.5 m below.

RESULTS

This study was done on Dalyan beach between 26 June 2001 and 15 September 2001. The sea turtle nests are transferred to a fenced area, against predator animals and the risk of inundation. During the breeding season, eggs are collected from the natural nests and transferred to the hatchery site. A total of 2,489 eggs from 37 nests were collected and 2,111 of them hatched from their eggs. 217 eggs were found dead in shells and 161 eggs were unfertilised. The average hatching success was 85% in all these nests. No predation event was detected on the relocated nests.

Five nests after partial predation at the same night, one partly predated nest after 30 days of incubation and another 6 of the nests found very close to the sea, were relocated to the hatchery site. 15 nests from different parts of the beach were relocated.

The average nest depth was 49.8 (min. 43, max. 56) cm. The average incubation period was 48.3 (43-53) days. This was from the day of laying to the first emergence of hatchlings. Hatching was completed 3-5 days later. Some of these results are presented in Fig. 1.

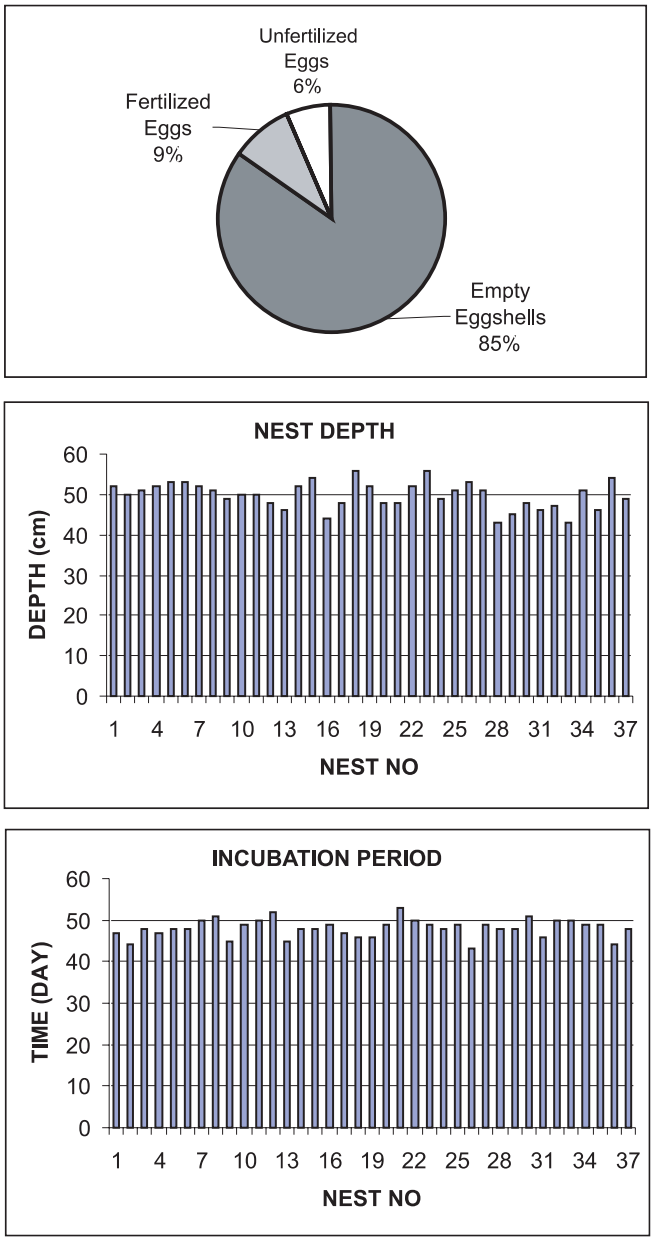

Fig. 1. The hatching success, nest depths and the incubation periods of the relocated nests to a hatchery site on Dalyan Beach during the nesting season of 2000.

DISCUSSION

Fox predation on loggerhead turtles at Dalyan Beach was extremely high (Erk'akan 1993) mesh grids were also used against predation (Yerli et al. 1997). Setting up a hatchery would be a very useful tool (Grand and Beissinger 1997) to increase the hatching success for the nests under risk of predation and inundation.

ACKNOWLEDGEMENTS

Thanks to the Organising Committee and Regional Activity Centre for Specially Protected Areas (RAC/SPA) and Secretariat of the Convention on Conservation of Migratory Species (CMS) for financial support to attend the Conference.

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LOGGERHEAD TURTLE (*CARETTA CARETTA*) IN TYRRHENIAN SEA: TROPHIC ROLE OF THE GULF OF NAPLES

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Of the three turtle species that inhabit the Mediterranean Sea, the *Caretta caretta* is present in higher numbers. Its presence has often been documented in Italian waters in both the Ionian and Adriatic Seas. However, the information regarding the *Caretta caretta* in the Tyrrhenian Sea is scarce and the data available refers to the number of specimens accidentally captured or those stranded on beaches (Argano and Baldari 1983, Argano et al. 1992, Centro Studi Cetacei (CSC) 2000, CSC in press).

This ten-year research study examines the presence of *Caretta caretta* along the Campania coasts. The study set out to understand if environmental factors could have induced a major concentration of animals in one area with respect to another. Indeed, the area involved presents different morphological, hydrological and biological characteristics.

As previous observations led to hypothesise that the coasts of Campania were used by the *Caretta caretta* for trophic purposes (Bentivegna and Paglialonga 2000), the digestive tract contents of 40 carcasses were examined qualitatively and quantitatively. Simultaneously, the local fauna was investigated through a dredging survey to identify the character of potential feeding habitats.

The data concerning turtles' numbers, dimensions and seasonal presence was collated from 1 January 1991 to August 2001.

Thanks to an efficient territorial organisation, involving police, marine authorities, fishermen and citizens, it was possible to opportunely salvage turtles in danger or those stranded on beaches. The animals were then, either subjected to appropriate effective therapies or underwent necropsy following Wolke and George (1981).

The area studied was subdivided into three sectors (A-B-C) taking into consideration hydromorphological and habitat distinctions. The information gathered, after conducting an overall study, was attributed to each of the three sectors in order to compare the presence of the turtles in the different environments (Fig. 1).

The number of the *Caretta caretta* species was 195 including 10 sightings. This number is certainly underestimated as the census and recovery network was not yet fully operative from 1991 to 1994.

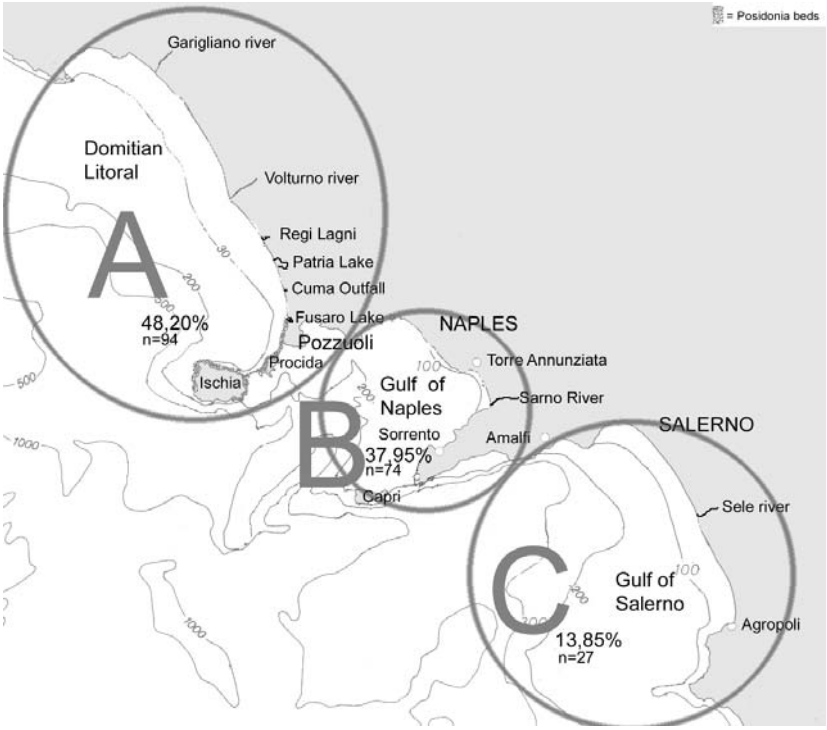

Fig. 1. Geographic distribution of the 195 loggerheads along the Campania coasts.

A steady decrease in animal numbers in the three sectors was recorded from North to South . The highest concentration, i.e. 94 examples comprising 48.20%, was found at lower depths in the sandy stretch extending directly north from the Gulfs of Naples and Pozzuoli to the coasts of Lazio. A slightly lower figure, i.e. 74 turtles, equal to 37.95%, was found in the Gulf of Naples, a large bay with a sandy-rocky bottom but with greater depths (average 200 m) than in the aforementioned area. Twenty-seven specimens, i.e. 13.85%, a significantly inferior number, were found in the last sector, the Gulf of Salerno, a wide and deep bay that is more exposed to the inflow of external Tyrrhenian waters in comparison to the Gulf of Naples.

A more detailed observation of the three areas points out that:

In area A 56.4% (n=53) of the turtles were concentrated in the middle of a sea expanse characterised by coastal fresh water and sewer wastes; 40.4% (n=38) gathered in the Posidonia prairie of the islands of Ischia and Procida and only 3.2% (n=3) beyond the Volturno river, where there is little urban development and there are no fresh water outfalls.

In area B, 85.14% (n=63) were found in the coastal strip distinguished by a significant presence of anthropic installations and at the mouth of Italy's most polluted river, the

Sarno, whereas only 14.86% (n=11) were concentrated in the remaining part not affected by anthropy.

In area C the 27 turtles found were equally distributed throughout the entire area where the phenomenon of urbanisation was much less marked.

A correlation with environmental factors is clearly indicated by such a distribution. In fact, the turtles concentrate in the more anthropic areas, in the proximity of river mouths, urban wastes and on the borders of the Posidonia prairie.

The data regarding the seasonal presence of the turtle has revealed that their numbers rise in spring-summer and decrease in autumn-winter with maximum peaks in August and lows in January (Fig. 2). It must be emphasised that in these periods of the year elevated eutrophic conditions are experienced along the coastal strip and, in particular, in the areas with significant anthropic development and near terrigenous deposits.

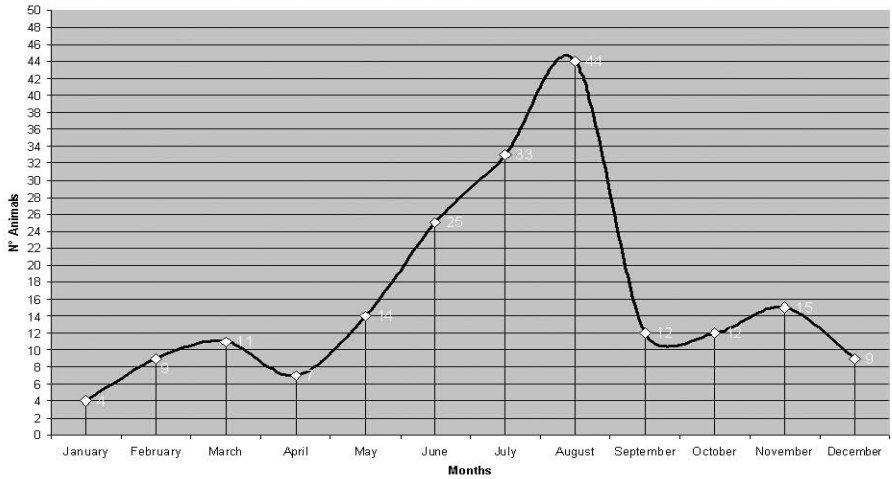

Fig. 2. Temporal distribution of 195 loggerheads stranded along the Campania coasts (1 January 1991 to August 2001).

The contents of the digestive tract (oesophagus, stomach, intestine) of 40 carcasses were rinsed in fresh water by using a 1 mm mesh sieve and then fixed in a 70% alcohol solution. Successively, the material was dried in an oven at 60 degrees for varying lengths of time, depending on the sample, until the same dry weight was obtained. The sample was then weighed and analysed in an attempt to classify each component in the taxonomic scale. 49 species of prey, predominantly fish, crab and molluscs, were present amongst the contents of the digestive tract. For each category of prey the percentage occurrence and dry weight was calculated (Tab. 1). The teleost, *Hippocampus hippocampus* makes a major contribution to the diet of the turtle. In fact, it represents 28% of the dry weight in 70% of the samples. Both crabs and molluscs reveal a slightly higher presence compared to

PREY GROUP	% Dry weight	% Occurrence
Sea horse (*Hippocampus hippocampus)*	69.2	28
Crabs	71.8	26.7
Molluscs	71.8	23.6
Fishes	48.7	4.4
Other*	43.6	2.2
Anthropogenic debris	43.6	1.6
Mantis shrimp (*Squilla mantis)*	28.2	0.8
Tube worms	18	0.5
Other prey	33.3	0.1
Vegetation**	15.4	0.1
Unidentified	48.7	12

* benthic substrate, wood debris, feathers, pumice
** *Posidonia oceanica, Cymodocea nodosa* and unidentified algae

Tab. 1. Percent occurrence and percent dry weight of prey items identified from digestive tract contents of loggerhead sea turtles (n=40).

Hippocampus hippocampus but contribute to the biomass to a lesser degree. Other species of teleosts classified as "fish" are found in almost half of the contents but constitute a considerably lower weight.

The characteristics of almost all the organisms identified are typical for the sandy bottom of the Mediterranean infra-littoral, seaweed free, zone (0 - 25 m). Bibliographic references, supported by the dredging campaign undertaken by the oceanographic boat of the Zoological Station "Anton Dohrn" in the summer of 2001, have confirmed that the typical environments of the main preys recognised are found along the coast in area A and to a limited extent in area B. In fact, these are the areas where the highest concentration of the turtles has been recorded.

A study of the data reveals that in the area examined the *Caretta caretta*:

- is present during the summer months when food is generally more abundant;
- tends to gather in the more productive regions;
- uses coastal areas that are characterised by benthic epifauna of sandy and muddy substrates as feeding grounds.

It is, therefore, evident that within the ambit of the Tyrrhenian Sea, the coasts of Campania are used as feeding grounds by the *Caretta caretta*. Reproductive reasons can be excluded as the population is characterised by young specimens or subadults (Bentivegna and Paglialonga 1998). Monitoring the movements of some specimens has revealed that the turtles move from the Tyrrhenian waters to the eastern Mediterranean in search of warmer waters (Bentivegna and Paglialonga 2000). As pointed out in the routes covered the turtles swim continuously, for long distances, far from the coast. It is probable that

they do not need to feed in these periods as they use the energy previously accumulated in the trophic areas.

On the whole, the Tyrrhenian Sea and its resources, especially in the area examined so far, allows the species to "maintain" this particular itinerant lifestyle.

ACKNOWLEDGEMENTS

Dr. L. Ferretti and Dr. M. Cacciapuoti, Lega Navale Italiana, Corpo Forestale dello Stato, WWF Sezione Gianola Oasi Blu, Servizio Pesca of Stazione Zoologica "A. Dohrn".

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ECOLOGIE DE LA NIDIFICATION DE LA CAOUANNE *CARETTA CARETTA* EN TUNISIE, MEDITERRANEE CENTRALE

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INTRODUCTION

Trois espèces de tortues marines sont observées dans les eaux tunisiennes: la tortue verte *Chelonia mydas* est rare (Laurent et al. 1990), la tortue luth *Dermochelys coriacea* est régulièrement observée (Bradai et El Abed 1998) et la caouanne *Caretta caretta* est très commune et s'y reproduit (Laurent et al. 1990, Bradai 1995, 1996). La nidification de cette dernière espèce a été mise en évidence pour la première fois en 1988 sur la plage située entre Ras Dimas et Mahdia et sur la grande Kuriat (Laurent et al. 1990) ensuite sur la petite Kuriat en 1993 (Bradai 1995) et à la Chebba en 1994 et 1995 (Ellouze 1996). Actuellement, la grande Kuriat qui se trouvent au large de la ville de Monastir à environ 18 km des côtes (35° 48'05''N, 11° 02'05''E) représente le site de ponte le plus important de *Caretta caretta* en Tunisie.

MATERIEL ET METHODES

Les plages des îles Kuriat font l'objet d'un monitoring depuis 1993. Ce monitoring réalisé par l'INSTM (Institut National des Sciences et Technologies de la Mer) et l'APAL (Agence de Protection et d'Aménagement du Littoral) avec la collaboration du CAR/ASP (Centre d'Activités Régionales pour les Aires Spécialement Protégées) a été renforcé depuis 1997 par un campement pour le suivi de la nidification qui prend place chaque année durant les mois de l'été sur la grande Kuriat.

Des prospections nocturnes pour guetter les femelles nidifiantes et matinales pour la recherche des traces sont régulièrement effectuées. Les femelles observées sont mesurées et marquées après la ponte. Après l'émergence des nouveau-nés les nids sont ouverts pour compter les œufs et déterminer ainsi les taux de fertilité, d'éclosion et d'émergence.

Sur le plan de la conservation, les nids sont protégés par des cages métalliques du piétinement et des dérangements des visiteurs et les nouveau-nés sont assistés pour ne pas finir dans les filets des pêcheurs. Les nids déposés dans des endroits jugés risqués

(possibilité d'inondation ou difficulté pour les petits à rejoindre la mer) sont transférés dans des endroits plus sûrs.

RESULTATS

La longueur de la plage propice à la ponte sur la grande Kuriat est de 1,000 m. Toutefois, les dépôts de feuilles mortes de *Posidonia oceanica,* d'importance et d'emplacement variables d'une année à une autre, limitent chaque année la portion de la plage utilisée par les femelles nidifiantes (Bradai 1996).

Le suivi de la nidification sur la grande Kuriat de 1993 à 2000 a permis de situer la période de ponte de *Caretta caretta* principalement aux mois de juin et de juillet de chaque année. Pendant ces huit saisons, nous avons enregistré de 3 à 15 nids avec une moyenne de 8.6 nids/saison. Ce nombre est important une année sur deux. Au total 5 femelles ont été mesurées et marquées. Les longueurs courbes (SCCL) varient de 73 à 85 cm avec une moyenne de 79.2 cm (n=5; Ecartype: 4.71) et les largeurs courbes (CCW) sont comprises entre 63 et 69 cm, la moyenne étant de 67.8 cm (n=5; Ecartype: 2.68). La taille de ponte varie de 49 à 150 avec une moyenne de 91.27 œufs par nid. Ce nombre paraît plus important que celui calculé à Chypre (Broderick 1997) ou en Turquie (Erk'akan 1993) alors qu'il est moins important que celui de la Grèce (Margaritoulis et al. 1994, 1995, 1996, Margaritoulis et Sioris 1997). Les taux moyens d'éclosion et d'émergence qui sont respectivement 76.3% et 74.41% montrent bien que les plages de la grande Kuriat sont propices à la nidification de *Caretta caretta* (Hirth 1980).

Sur la petite Kuriat, la nidification a été mise en évidence pour la première fois en 1993 où 7 traces ont été détectées, ensuite en 1995 (1 nid) et en 1996 (1 nid) (Bradai 1996). Durant notre présence sur la grande Kuriat depuis 1997, aucun nid n'a été détecté sur ce site. La fréquentation abusive de cette île par les baigneurs serait à l'origine de ce déclin de l'activité de nidification et de l'impossibilité de détecter d'éventuelles traces de femelles.

La grande Kuriat représente actuellement le site de ponte de la tortue marine *Caretta caretta* le plus important connu en Tunisie. Toutefois, il faut rappeler que quelques éventuelles sources de nuisances à cette activité de nidification sont enregistrées:

1. Activité pêche et fréquentation humaine

Bien que sous surveillance militaire, la grande Kuriat est très fréquentée par les estivants, les visiteurs du marabout Sidi Saâd et les pêcheurs. Toutefois, il est interdit d'y passer la nuit. Cette fréquentation, souvent abusive, se situe essentiellement aux mois de juillet et août ce qui épargne en partie les sites de ponte au début de la saison de ponte et à la fin de celle de l'émergence des nouveau-nés. Les filets de pêche côtière posés près des côtes forment des barrages pour les nouveau-nés qui se sont trouvés à plusieurs reprises émaillés dans ces filets.

2. Lumière du phare

La lumière du phare n'est "gênante" pour les femelles que pour une petite portion de la plage principale de ponte (Ouest). Pour le reste, le site est soit abrité par les dunes bordières soit qu'il reçoit la lumière rouge du phare (éclairement minima).

3. Banquettes de posidonie

Les banquettes de posidonie déposées sur la plage constituent parfois des barrages infranchissables par les femelles. Toutefois, elles peuvent trouver des issues entre ces banquettes ou des portions de plage où les dépôts de feuilles mortes de posidonie ne sont pas importants. Les nouveau-nés arrivent à franchir les dépôts de phanérogame et atteindre la mer mais ils passent plus de temps à le faire ce qui les expose à la prédation par les oiseaux dans le cas où ils émergent tard la nuit et même parfois la mort par fatigue.

4. Prédation

Les goélands leucophés *Larus cachinans,* présent en grand nombre sur l'île grande Kuriat, engendrent une prédation des nouveau-nés émergeant tôt le matin; plusieurs traces de nouveau-nés s'estompent très vite au voisinage du nid. De même les pêcheurs en témoignent (Laurent et al. 1990). La prédation par les goélands a été mentionnée également en Grèce (Margaritoulis 1985).

REMERCIEMENTS

Nos remerciements les plus sincères vont à tous les responsables de l'INSTM, l'APAL et le CAR/ASP et à tous les volontaires qui nous ont aidé à réaliser ce travail.

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CRITICAL AREAS FOR LOGGERHEAD AND LEATHERBACK MARINE TURTLES IN THE WESTERN MEDITERRANEAN SEA AND THE GIBRALTAR STRAIT REGION

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INTRODUCTION

The western Mediterranean Sea, the Strait of Gibraltar and the contiguous Atlantic region are considered important habitats for both the Mediterranean and the northern Atlantic populations of Loggerhead *(Caretta caretta)* and also for the Leatherback *(Dermochelys coriacea)* turtles (Camiñas 1988, Crespo et al. 1988, Mayol et al. 1988, Laurent 1990, Camiñas and de la Serna 1995, Camiñas 1996, Camiñas 1997a). The presence of Loggerhead turtles from the northern American populations have been recorded on the Atlantic side of Gibraltar but also within the Mediterranean (Brongersma 1972, Carr 1987, Camiñas 1995). Leatherbacks observed in the Mediterranean Sea are of Atlantic origin, whose reproduction beaches are located in Guyana and Suriname (Fretey and Cordeiro 1996, Eckert 1998). The presence of this species in the Mediterranean has been shown all along the year (Camiñas 1997b), but their abundance in the Atlantic region near the Gibraltar Straits is higher than in the Mediterranean (Camiñas and Gonzalez de Vega 1997). The Loggerhead yearly distribution in the study area is a consequence not only of the migratory processes of the species, but also because the Balearic Sea is a concentration foraging area. The critical areas to be considered here should include corridors, foraging habitats and wintering areas. These critical areas should take into account the two mentioned species.

The study area is characterized by some environmental elements that could better explain the presence and abundance of the marine turtles. The Gibraltar Strait is an Atlantic and Mediterranean-connecting region. A powerful surface Atlantic current penetrates the Mediterranean facilitating their eastward migration, and consequently occupying the whole western Mediterranean. Nevertheless, changes in the environmental conditions explain why the area around Balearic islands (which presents higher temperatures in summer that in the Alborán Sea and the connecting Atlantic waters) are important as foraging sites. The western Mediterranean Sea is not an homogeneous environment, but quite the opposite. The distribution of the turtles should be affected by the oceanographic

conditions, not only for the temperature but also by sub regional events. Lopez Jurado et al. (1995) presents a hydrographic conditions model of the Ibiza Channel as follows: when the preceding winter conditions is colder than usual, the formation of stable structures block the flow of the northern current through the Ibiza Channel, deviating the current to the North East of Balearic islands. Contrarily, when the preceding winter conditions are milder, mesoscale structures are not durable and the circulation along the Ibiza Channel is not perturbed. The two different hydrographic situations can play an important role on the concentration of turtles along the Valencia coast and north of Ibiza and Mallorca in the first situation, facilitating the distribution southward (along the Alicante and Murcia coasts) and the pass to the Alboran Sea of the turtles foraging around Balearic islands. The winter presence of Loggerhead in some areas as Columbretes islands (Camiñas and de la Serna 1995) could be interpreted as a consequence of the environmental conditions.

POTENTIAL FISHERIES EFFECTS ON MARINE TURTLES

Fishing exploitation use numerous gears and systems on the littoral to the oceanic regions. In the Gulf of Cadiz, west of Gibraltar Strait, Spanish, Moroccans and Portuguese fisheries can capture marine turtles. Artisanal fisheries are normally deployed near the coast exploiting pelagic and demersal species. Information on the effects of the diversity of small scale fisheries in the marine turtle is not well known in the study area although from personal observations and inquiries to the fishing sector report that incidental captures are uncommon. Bottom trawlers exploit intensively the continental shelf mainly in the Atlantic part of the study area. The Gulf of Cadiz has a broad continental shelf where Spanish and Portuguese fleets fish different target species. According IEO data the mean trawl haul in the region is 3.5 hours; this could be directly related with the numerous leatherbacks that appear stranded in the area (Camiñas and Gonzalez de Vega 1997). Spanish trawlers fishing in the Mediterranean have a low incidence on marine turtles, according inquiries and information from existing Recovery Centres in the region. A Spanish fishery targeting swordfish in the Gibraltar region with surface driftnets was banned in 1990 when a Royal Order prohibits the use of driftnets in waters under Spanish jurisdiction or sovereignty (except in the Mediterranean, which is only subject to restrictions in mesh size and maximum length and the prohibition to catch swordfish *(Xiphias gladius),* albacore *(Thunnus alalunga)* and shortfin mako *(Isurus oxyrinchus))*. The incidental captures of Loggerhead was important before the Order showing a very low mortality (Camiñas and de la Serna 1995). The capture and mortality of Leatherback on the contrary was very low. Actually a Moroccan drift gillnet fleet (more than 300 vessels), fishing near Gibraltar for swordfish and bluefin tuna, based in Tanger (Atlantic), and Mediterranean ports (Nador) fishing from April in the Atlantic (during the swordfish

reproductive migration to the Mediterranean) and in the Mediterranean from August during the migration to the Atlantic are potentially dangerous for the two turtles species (De la Serna 2000). Another important gear in the area of Gibraltar is the traditional almadrabas (traps) for bluefin tuna *(Thunnus thynnus)*; the captures of marine turtles are very low and when these are captured their mortality is near zero. Spanish surface longline fisheries targeting swordfish in Atlantic and Mediterranean waters are very important. A fleet officially composed by 73 licence surface longliners fish for swordfish in the Mediterranean from the coast to the 5° E and eastward (Camiñas and Valeiras 2001). This increase of the fleet during summer due to the entry into the fishery of other vessels (artisanal vessels) is caused by the presence of swordfish and other target species (bluefin and albacore) in the area. The number of Loggerhead turtles incidentally captured with this gear is very important (Camiñas 1988, Aguilar et al 1992, Camiñas et al. 1992, Camiñas and de la Serna 1995, Camiñas 1997b, Camiñas 1997c). The Spanish fleet incidental captures of Loggerhead calculated through a recent EU countries collaborative project showed very important numbers (more than 29,000 in 2000). According to Camiñas and Valeiras (2001), the relative mortality rate is 0.058 loggerhead/1,000 hooks in the bluefin tuna longline fishery during the year 2000.

THE LEATHERBACK SITUATION AND THEIR CRITICAL AREAS

The geographic distribution of Leatherback includes water temperatures between 10° and 20°C. As a result of this, it is the most widely distributed of all sea turtles. The bio-geographical situation of the Gulf of Cadiz, near the Gibraltar Strait is a very interesting site to understand the migration of leatherback to the Mediterranean Sea from the Atlantic. Considering the information based on strandings and at sea observations the Leatherback in the Gulf of Cadiz appears in April with few numbers. Their presence increases with maxima in July and August and continues till December. Camiñas and Gonzalez de Vega (1997) showed that from 1980-1996, no Leatherbacks appeared in January, February and March. The number of dead turtles through fishing gear operations is around 4 % but the highest percentage (42.16 %) corresponds to unknown causes of mortality. A Leatherback tagged in Guyana appeared five months later in the Gulf of Cadiz. That mean the origin of the species is preferentially the South American populations, although we do not dismiss the African origin for the Leatherback present in the area. The occurrence of leatherback turtles in the Mediterranean Sea has been recorded throughout history and records report the presence of leatherbacks in the eastern and western Mediterranean waters throughout the year. Considering the lack of Leatherback reproduction areas in the Mediterranean, the Alboran Sea and Gibraltar Straits are considered the most important for the species within the Mediterranean. The Mediterranean Spanish surface longline fishery interaction with this species is low as

confirmed by the EMTP project (Camiñas and Valeiras 2001). However, the fishery interaction in the Atlantic waters near Gibraltar Straits could be very high. The mentioned increase in the Moroccan driftnets fleet in the Gibraltar Straits together with the Spanish and Portuguese artisanal and trawling fisheries in the Gulf of Cadiz, could in fact explain the increase of leatherback strandings recorded along the Spanish coast. The very important presence of the species (as indicated by strandings and sightings) around Gibraltar Straits confirms the importance of this critical area for the Leatherback conservation.

LOGGERHEAD CRITICAL AREAS

The Gibraltar Straits is known as a common migratory path for Loggerhead (juvenile and adults) sea turtles. Although the Loggerhead can be observed all around the year in the western Mediterranean Sea and Gibraltar Straits in the Alboran Sea, migrant turtle groups have been observed moving from the Atlantic to the Mediterranean during spring and from the Mediterranean to the Atlantic during August. Information from stranding observations in both Atlantic and Mediterranean Gibraltar surrounding areas show that in those regions several causes of mortality exist, such as fisheries, pollution, traffic etc. Strandings and observations at sea (whale watching boats and fisheries vessels) of Loggerhead include sizes from juveniles to adults, both male and female (Camiñas and Valeiras 2001). On board sightings in fishing vessels working in the Gibraltar region showed important numbers during the loggerhead migration periods (entry and exit from the Atlantic) to the Mediterranean (Camiñas 1995). Recent observations from research vessels in the Gibraltar region show the loggerheads distribution near the European (Spain) and the African (Morocco) coasts, but also along the central part of the Strait's channel. Loggerheads can be observed around the year in the Balearic Sea, although the third quarter represents the maximum presence and accidental captures (with surface longline). The main concentration areas, with monthly variations, are the surrounding Balearic islands, northern Balearic Sea and eastern region off Palos Cape. Most of the longline captures around the Balearic islands occur offshore rather than inshore, in more than 500 m depth. Artisanal gears as trammel nets for *Coryphaena* and *Palinurus* also capture unknown numbers of Loggerheads near Balearic islands. With respect to the reproduction areas, these don't exist in the region. Nevertheless, there is information on an egg with an embryo at the Ebro river delta in 1990. During 2001, a successful reproduction of a Loggerhead was reported in the Spanish coast (Vera, Almeria, northward Gata Cape). Newspaper information related with collection of eggs during the sixties at the same beaches can represent a new reproduction area in the Mediterranean. The proposed migratory model of Camiñas and de la Serna (1995) showed the year periods, the Atlantic and Mediterranean origin of the populations and the main

concentration areas for Loggerheads. The previously described critical areas (the surrounding region of Gibraltar and the Balearic islands in a broad sense) represent for Loggerhead and Leatherback, but also for many other marine species as swordfish, bluefin tuna and species of marine mammals, two areas of interest for the conservation and management of the populations. National and international efforts in reducing incidental capture and fishing mortality should be taken into considerations more profoundly in the existing international action plans and agreements. The need to formulate an International Action Plan for the Marine Turtles as expressed by the IUCN during its Amman Congress is a management instrument that could reduce the undesirable capture and mortality of the two marine turtle species considered here.

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MARINE TURTLE RESEARCH IN SPAIN AND COLLABORATIVE PROJECTS WITH THE FISHERIES SECTOR

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Research on fishery interactions with the western Mediterranean marine turtle populations have been carried out from 1982 by scientific staff at the Instituto Español de Oceanografía (Oceanographic Centre of Malaga). Due to the noticeable interaction of fishing activities with marine turtle populations, several activities are developed in collaboration with fishermen. Data on incidental catches are collected by a Fisheries Information and Sampling Network (RIM) managed by IEO experts. Furthermore, onboard observers record additional data on fishery interactions within the framework of several European and Spanish projects thus completing the data record for most of the existing fisheries and fishing grounds. The IEO National Project on fishery effects on marine turtles also includes an educational awareness program based on:

- Meetings and conferences at fishing ports and with fishermen associations.
- Publication of information on specialized fisheries magazines and newspapers.
- Distribution of educational material concerning turtle conservation and fishery interaction.
- Collaboration with rehabilitation centers.

Over the last years, marine turtle tagging has become an important component of collaborative involvement in research and conservation and many fishermen accept the notion that tagging is a useful technique to study marine populations (turtles and fish included). However, fishermen reports on rescues of hooked turtles are still low and very few recaptures of tagged turtles have been reported. The IEO Marine Turtle Research Team's objectives lie on the strong basis that future successful outcomes of marine turtle and fishery investigations need to be based on research efforts involving the scientific and fishery sectors combined.

EPIBIONTIC OCCURRENCE ON LOGGERHEAD TURTLE (*CARETTA CARETTA*) IN THE WESTERN MEDITERRANEAN AND APPLICATIONS ON BIOGEOGRAPHY

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The loggerhead turtle, *Caretta caretta*, is the most frequent marine turtle in western Mediterranean Sea. This species is common in Iberian Peninsula waters from Alboran Sea to Gulf of Lyons. Turtle concentrations occur around Balearic islands in summer season (July - September). Loggerhead population has different origins: some turtles from nesting beaches of eastern Mediterranean and others from Atlantic Ocean mostly from north-western Atlantic nesting beaches.

Biological data of 238 turtles have been compiled from May 1999 to December 2000, by observers onboard Spanish drifting longliners. Samples and data on epibionts came from incidental captures in drifting longline gear targeted at swordfish and tuna, within two European projects (EU-DGXIV). Study projects are carried out for the Spanish Oceanographic Institute (IEO). Results on epibiont composition and occurrence patterns on carapace are presented. The first analyses are indicating a variety of fauna and flora species, including cirripedia (balaniformid and lepariformid), crustacea (decapoda, amphipoda, isopoda, ostracoda), plathelmints, molluscs, green and red algae.

Implications of epibiont biogeography on identification of turtle population's origin are discussed. Identification of Atlantic epibiont species in the area could be a scientific tool to determine the population composition of loggerhead turtles in western Mediterranean Sea.

SPANISH SURFACE LONGLINE GEAR TYPES AND EFFECTS ON MARINE TURTLES IN THE WESTERN MEDITERRANEAN SEA

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INTRODUCTION

Due to its ecology and feeding habits, marine turtle interactions occur often with several fishing gears. The western Mediterranean is an important fishing area for the Spanish drifting longline fleet targeting swordfish and tuna species. The monitoring and assessing of the incidental catches, particularly marine turtles, started in 1986 by the Oceanographic Centre of Málaga (Camiñas 1988, 1997, Camiñas and Valeiras 2001). The European Project co-funded by EU DG XIV 'Assessing marine turtle by-catch in European drifting longlines and trawl fisheries for identifying fishing regulations' was carried out. Research efforts on catch address to the conservation of marine turtle population through appropriate fishing regulations.

METHODS

Studied area includes all the Spanish drifting longline fleet fishing area at western Mediterranean Sea. Data on fisheries incidental catch were collected on board from May 1999 to December 2000. Scientific observers worked onboard 22 longliners targeting swordfish, bluefin tuna and albacore from 5 different base ports (Cartagena, Aguilas, Garrucha, Carboneras and Motril). Data collection and survey strategies have been stratified in two strata by type of fleet and four strata by type of drifting longline gear. Research program was developed monthly along the whole fishing area. Data on 798 fishing sets and 2,127 marine turtles were collected attending the following standardised fishing parameters:

1. Detailed description of types of gear used: swordfish, bluefin tuna and albacore drifting longlines and swordfish semipelagic longline.
2. Fishing strategies, time schedule and fleet dynamics.
3. Technical characteristics of fishing sets, including geographic position, duration, depth, baits, type of setting, etc.
4. Environmental factors and meteorological conditions, including measures of surface temperatures, and fishing depth and temperature by specific sensors attached to gears.
5. Detailed data on commercial and incidental catches of marine species.

RESULTS

Spanish drifting longline fleet is set up by boats from 4 to 22 m length. Fishing grounds include a large area of western Mediterranean between 36° and 44° N latitude and -02° W and 05° E longitude, from Gibraltar Strait to Gulf of Lyon. Longliners target swordfish *(Xiphias gladius),* bluefin tuna *(Thunnus thynnus)* and albacore *(Thunnus alalunga).* Fishing is carried out by four types of gear with differences on components (branch lines, hooks, float distances, main lines), fishing depth and strategy; drifting longline target swordfish (LLSWO), bluefin tuna (LLBFT), albacore (LLALB), and a semipelagic longline target swordfish (LLPB).

The most important fishing effort is carried out at the marine area around Balearic islands and at the Ibiza Channel. The fleet is very dynamic and changes often the fishing methods as well as gear structures depending on the target species. Fishery targeting swordfish operates all around the year, however, several boats target bluefin tuna from May to July. Fishery targeting albacore takes from June to September. The type of gear used depends on season, target species, fishing yields and fishing area. The fishing gear structure is made up by a 19 to 60 km length main line, which drifts off and hangs from plastic floats. The branch lines hang vertically from the main line each few meters. Hooks are baited with several species of fish (mackerel, sardine, sablefish) and shortfin squids (*Illex* spp.). Semipelagic longline is used with several weights that set the branch lines at different depths. Longline for swordfish is usually set at late afternoon to remain during some night hour at sea. Retrieval starts at first hours of the morning and usually is over at daybreak. Time fishing schedules use to include day hours for bluefin tuna and albacore.

1. Incidental captures of marine turtle by gear

A total of 2,127 marine turtles were incidentally caught during 798 observed fishing sets during study period. All marine turtles captured were loggerheads except two leatherbacks, one each year. During 1999, a total of 498 loggerhead turtles *(Caretta caretta)* and 1 leatherback turtle *(Dermochelys coriacea)* were captured in 291 monitored fishing sets. In 2000, a total of 1,627 loggerhead turtles and 1 leatherback turtle were captured incidentally in 507 sets. Tab. 1 presents a summary of the total directly observed captures of marine turtles during the observed period. Most of the loggerheads are hooked by eating the bait. Catch rates (number of turtles by 1,000 hooks) are showed in Tab. 1. Differences on loggerhead catch rates were detected by type of gear: LLALB (albacore gear), LLBFT (bluefin tuna gear), LLPB (semipelagic gear for swordfish) and LLSWO (surface longline for swordfish) (Tab.1). The highest capture rate corresponded to LLALB and LLBFT with values at 3.27 turtles by 1,000 hooks

(C.I. (4.03) in LLALB and 1.74 turtles by 1,000 hooks in the LLBFT (C.I. (0.99). The recently used gear LLPB (semipelagic gear for swordfish) did not captured turtles during the observation period (23 sets distributed in 1999 and 2000). Differences on catch rates by gear are related with fishing depth, fishing season and hook size. Two leatherback turtles were caught both entangled in drifting longline sets targeting swordfish. Captures occurred in August in both years. Catch rate was very low (0.001 and 0.002/1,000 hooks) (Tab. 1).

Gear	Observed fishing effort (x1,000 hooks)	Observed catches	Catch rate (loggerhead by 1,000 hooks)	Observed mortality	Direct mortality rate (dead turtles by 1,000 hooks)
LLSWO99	587.7	205	0.29±0.19	0	
LLBFT99	14.0	0	0	0	
LLALB99	280.3	293	1.05±1.47	4	0.01±0.01
LLSWO00	1,041.3	1,175	1.15±0.73	9	0.01±0.00
LLBFT00	224.5	391	1.74±0.99	13	0.05±0.06
LLALB00	18.7	61	3.27±4.03	1	0.06±0.02
Total 1999-00	2,166.4	2,125		27	

Tab. 1. Loggerhead turtle observed catches and direct mortality in western Mediterranean drifting longline fisheries (1999-2000).

Most of the caught turtles were liberated hooked but alive. Delayed mortality is unknown. A total of 27 loggerhead turtles were boarded dead in 798 fishing sets (3.4% of total turtle catches). Tab. 1 presents the observed loggerhead turtle direct mortality by gear. Highest direct mortality rate was for LLBFT in 2000 (0.058 dead loggerhead turtles by unit effort).

The direct mortality is related to the gear type and the hook position. LLALB and LLBFT produce higher direct mortality than LLSWO. The direct mortality in LLBFT should be associated not only to the gear structure and hook size but also with the fishing depth, that should make difficult reaching the water surface to breathe. A related aspect to direct mortality should be the total catch by set. Higher captures sink the gears affecting turtle mortality by reducing breath possibilities.

2. Annual total incidental catch estimations by gear

Estimations of total loggerhead turtle incidental catch by Spanish drifting longliners at western Mediterranean are shown at Tab. 2. Observed catch rates by gear during 2000 were related to the total fishing effort exerted by the Spanish drifting longline fleet. Estimations on loggerhead incidental capture average 17,789 (C.I.: 3,503-29,562) individuals in 2000. Results indicate a larger incidental catch in LLSWO (2,260-22,786). Estimations on loggerhead direct mortality results in 39-321 turtles per year. Delayed mortality at sea is unknown but it must be exist.

	LLSWO	LLBFT	LLALB	TOTAL 2000
Annual fishing effort (x1,000 hooks)	12,120.3	1,576.5	338.7	14,035.5
Catch rate (loggerhead by 1,000 hooks)	1.15±0.73	1.74±0.99	3.27±4.03	
Mean annual total catch	13,938	2,743	1,108	17,789
Minimum annual total catch	2,260	1,182	61	3,503
Maximum annual total catch	22,786	4,303	2,473	29,562
Direct mortality rate (dead turtles by 1,000 hooks)	0.01±0.00	0.05±0.06	0.06±0.02	
Mean annual direct mortality	121	79	20	220
Minimum annual direct mortality	9	16	14	39
Maximum annual direct mortality	121	173	27	321

Tab. 2. Estimations on annual (year 2000) total incidental catch of loggerhead turtle by Spanish drifting longline fisheries in western Mediterranean.

3. Geographic and temporal distribution of catches

The geographic distribution of loggerhead and leatherback overlap with drifting longline fishing grounds. Depending on fish species occurrence and several factors, fishermen operate along several areas. During 1999 and 2000, LLALB operated mainly north and east of Mallorca island; LLBFT south of Ibiza island; LLPB near the Iberian peninsula coast and LLSWO distributed throughout the western Mediterranean but mainly from the south of the Balearic islands to Gata Cape and north San Antonio Cape (Fig. 1). Geographic location of catches was heterogeneous along studied area, depending on month and type of gear. The most important catch rates have been detected from May to September. The incidental catches diminish during other months, although fishing effort exerted by longliners (mainly LLSWO) remained similar.

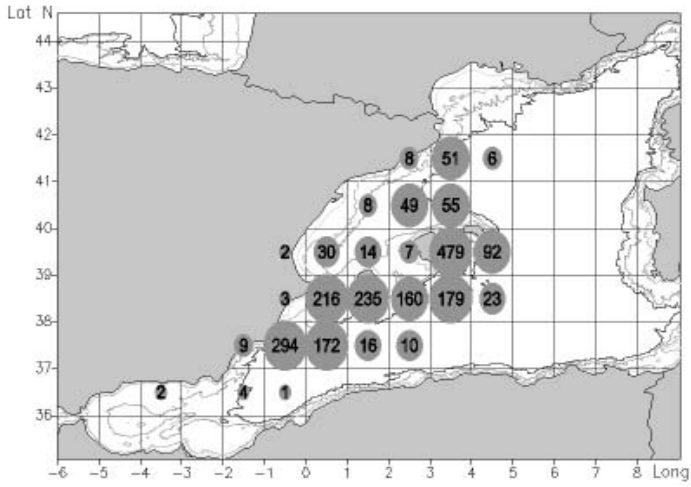

Fig. 1. Geographic distribution of loggerhead turtle catches in drifting longlines in 1999 and 2000.

4. Turtle size distribution by gear

Carapace measures of 676 onboard loggerheads were recorded. Carapace sizes from 17.2 to 72.3 cm Minimum Straight Carapace Length (MSCL) were measured (Tab. 3). Other 455 loggerheads were not boarded but sizes were estimated. Over 13% of estimated sizes (n=61) ranged from 70 to 100 cm MSCL. These large sizes permit to affirm that the

Gear type	Number of measured turtles	Mean	SD	Minimum size (mm)	Maximum size (mm)
LLALB 99	103	330.8	80.3	172	637
LLALB 00	15	334.0	72.3	220	490
LLHB 99	120	491.9	84.7	279	671
LLHB 00	217	494.6	80.4	310	711
LLJAP 00	221	547.9	74.9	361	723
Total	676			172	723

Tab. 3. Loggerhead Minimum Straight Carapace Length (in mm) at western Mediterranean (1999-2000).

loggerhead population at the western Mediterranean is made up of juveniles, subadults and adults. Differences on turtle size caught were detected for the different gear types: gear targeting albacore is built with smaller size hooks; swordfish gear operates deeper than albacore gear, which represents a different availability of baited hooks; bluefin tuna and semipelagic swordfish gears operates deepest due to heavy components and fishing strategy. Regarding loggerhead catch selectivity by size, results showed differences between fishing gears (Fig. 2): the biggest turtles are captured with the LLBFT (mean=548 mm

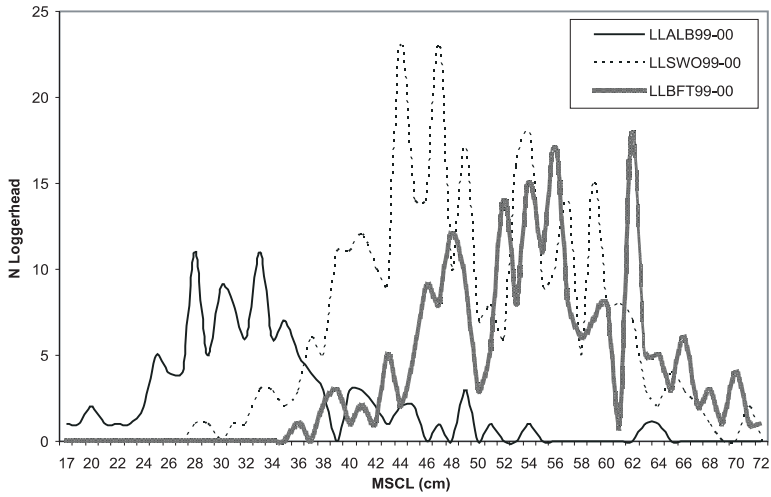

Fig. 2. Loggerhead sizes in western Mediterranean incidental drifting longline fishing catches (1999-2000): Minimum Straight Carapace Length (MSCL) by type of gear.

MSCL); LLSWO capture medium size loggerheads (mean=495 mm MSCL) and LLALB capture the smallest sizes (mean=331 mm MSCL). The most important catch selectivity factors seem to be hook size, fishing depth and fishing schedule.

ACKNOWLEDGEMENTS

This work was partially carried out under the framework of the E.U. PROJECT DG XIV - 98/008: 'Assessing marine turtle by-catch in European drifting longlines and trawl fisheries for identifying fishing regulations'. We are grateful to 'cofradías', fishermen and collaborative people at the Spanish ports. Many thanks to our colleagues of Big Pelagics scientist team of IEO-Málaga and all the Spanish onboard observers working in our projects.

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BELEK: THE MOST IMPORTANT SEA TURTLE NESTING SITE ALONG THE TURKISH MEDITERRANEAN COASTLINE

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INTRODUCTION

Caretta caretta and *Chelonia mydas* nest regularly in the Mediterranean and are listed as "endangered" species by the IUCN (International Union for the Conservation of Nature and Natural Resources). The most important nesting grounds for these species in the Mediterranean are located in Greece, Turkey, Cyprus and Libya (Baran and Kasparek 1989, Groombridge 1990, Laurent et al. 1990, Kasparek 1995, Broderick and Godley 1996, Kuller 1999, Laurent et al. 1999, Margaritoulis 2000, Clarke et al. 2000). Annual adult female population nesting in the Mediterranean is estimated as 300-400 for *C. mydas* and as 2,000 for *C. caretta.*

Baran and Kasparek (1989) have identified 17 nesting grounds in their studies, and have named Belek as one of the 13 most important sea turtle beaches. The first two sea turtle population surveys conducted in the Belek region are by Geldiay et al. (1982) in 1979 and by Geldiay (1984) in 1980-82. The study of Baran and Kasparek (1989) in the region in 1988 did not focus on population determination. In subsequent years, several different studies were conducted in the region (Baran et al. 1992, Yerli and Demirayak 1996, DHKD-WWF 1996, Baran et al. 1996, Baran et al. 1997). As a result of the studies carried out by Yerli and Canbolat (1998a, 1998b) and Yerli et al. (1998) in all nesting sites of Turkey during the nesting seasons in 1996 and 1998, Belek has been declared as a major sea turtle nesting area. This paper includes the research outcomes of 1999 and the year 2000 in the region and compares these results with the outcomes of previous studies.

METHODS

The research area is located within the borders of Serik and Manavgat municipalities in the Antalya City province and stretches 29.5 km between Aksu and Sarisu Rivers. The Belek region contains areas with different protection statuses including "Natural Protection Sites" and "Specially Protected Areas" as well as usage areas such as the "Tourism Development Centre".

Field surveys in the region were carried out by a team of 10 people during June-September 1999 and by a team of 30 people during May-September 2000, regarding the nesting and hatchling emergence seasons. Data collection during these periods were carried out by teams of two people scanning the beaches between 06:00-12:00 in the morning surveys to record all nests individually. Sand on the nest surface was excavated with a diameter of 10 cm by hand until the eggs on the top zone were exposed for identification. The nest was then covered with the same sand in order to avoid any alteration in temperature or moisture. All nests were marked with sticks and pinpong balls (placed inside the nest) showing nest dates and numbers in order to prevent any confusion during the control uncoverings and were mapped via GPS devices. Tracks, which indicated a nest probability but where the nest failed to be located were also marked in the same way and checked frequently for predations and hatchling emergences.

Studies of 1999 in the Belek region started in June. However, nesting dates for unlocated nests that belonged to May have also been estimated regarding subsequent predations and hatchling emergences. Number of non-nesting emergences in May, however, includes approximate values as they have been estimated in accordance with the non-nesting emergence ratios of other months. In the same year, especially in the area between Koprucay and Sarisu Stream, field surveys were sometimes conducted once every two or three days due to the lack of team numbers. However, data collection was successfully carried out as the sand profile of the area helped preserve the turtle tracks unwiped and as there was no intensive beach usage.

RESULTS

According to the evaluation of studies conducted by Yerli and Canbolat (1998a, 1998b) and Yerli et al. (1998) in all sea turtle nesting sites during the nesting seasons in 1996 and 1998, 20.3% of the total *C. caretta* nests in Turkey are located in the Belek region (Fig. 1).

For the beach strip that stretches between Aksu and Sarisu Rivers, a total of 1,316 *Caretta caretta* emergences were determined in 1999. 704 (53.5%) of these emergences did not result with a nest, while 612 (46.5%) of them resulted with nests. For the year 2000, a total of 1,867 *Caretta caretta* emergences were recorded. 1,185 (63.5%) of these emergences did not result with a nest, while 682 (36.5%) of them resulted with nests. Besides these, two nests in 1999 and eight nests in the year 2000 were determined for *Chelonia mydas*. According to the results of two years, nesting density for the entire Belek beach is 22.1 nests/km (20.9 nests/km in 1999 and 23.3 nests/km in the year 2000). The 13.3 km area between Acisu and Sarisu Rivers is within the borders of "Belek Specially Protected Area" (BSPA) and is crucial for the sea turtle population in the region as it contains about 74.7% of the total *C. caretta* nestings in Belek.

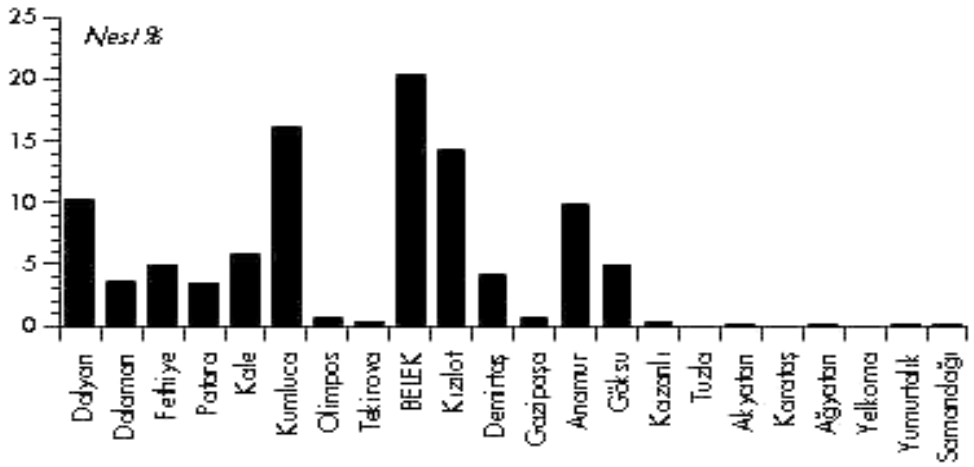

Fig. 1. The regional distribution of *Caretta caretta* nests along the Turkish coastline, adapted from Yerli et al. (1998), and Yerli and Canbolat (1998a, 1998b).

DISCUSSION

When the entire sea turtle population biology studies conducted in all *C. caretta* and *C. mydas* nesting beaches in Turkey (Yerli and Demirayak 1996, Yerli and Canbolat 1998a, 1998b, Yerli et al. 1998) are evaluated; nest numbers determined in the Belek region as 612 in 1999 and 682 in the year 2000 come out to be the highest nesting numbers ever determined for the sea turtle nesting sites in Turkey. Before this study, several studies have been carried out in the sea turtle nesting sites in Turkey except Belek (Geldiay et al. 1982, Geldiay 1984, Baran and Kasparek 1989, Baran et al. 1992, Yerli and Demirayak 1996, Baran et al. 1996, 1997, Canbolat 1997, Yerli and Canbolat 1998a, 1998b, Yerli et al. 1998). Among these studies, the highest nesting number ever given for the sea turtle nesting sites in Turkey is 519 for Akyatan (Yerli and Demirayak 1996). When the results of the most recent studies on *C. caretta* nesting areas in Turkey are evaluated, excluding the research by Geldiay et al. (1982) and Geldiay (1984), it is clearly seen that Belek is a very important nesting site for *C. caretta* in terms of nesting density.

When the nest numbers and beach lengths determined for all nesting sites by Yerli and Demirayak (1996) in 1994 are evaluated, the highest nesting density for *C. caretta* comes out to be in the 8.3 km long Fethiye beach with 158 nests (19.0 nests/km). In the same study, Dalyan beach is estimated to be the second densest nesting site (18.3 nests/km). When regional nesting densities are estimated by evaluating the nest numbers and beach lengths given by Yerli and Canbolat (1998a, 1998b) and Yerli et al. (1998) for all nesting sites in 1996-1998, Dalyan beach comes out to have the highest *C. caretta* nesting density (41.1 nests/km). The same study gives the nesting density for the Belek region as 12.9

nests/km. However, the nesting density determined in Belek for two nesting seasons is 22.1 nests/km. When the nest numbers and beach lengths given for all *C. caretta* nesting sites in Turkey by Yerli and Canbolat (1998a, 1998b) and Yerli et al. (1998) are evaluated, the Belek region comes out to be the second densest nesting site after the Dalyan beach. The highest nesting density ratio ever given for *C. caretta* nesting sites in Turkey is 58.0 nests/km in the Dalyan beach in 1991 (Canbolat 1997).

Although, several sea turtle studies have been carried out in Belek before 1999 and the year 2000 (Geldiay et al. 1982, Geldiay 1984, Baran and Kasparek 1989, Yerli and Demirayak 1996, DHKD-WWF 1996, Baran et al. 1996, 1997, Yerli and Canbolat 1998b, Yerli et al. 1998), the actual importance of the region could only be exposed in the years 1999-2000 due to the distinctions in research periods, beach lengths and the methodologies (Fig. 2). The area between Acisu and Sarisu Rivers (within the borders of the BSPA) has barely been studied before. However, the outcomes of this study shows 75% of the nests in Belek in this area.

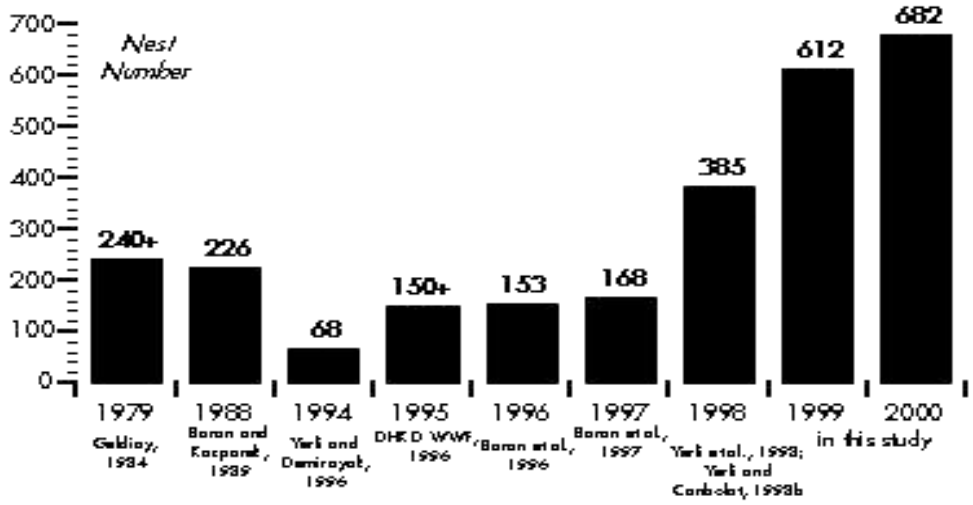

Fig. 2. The comparison of the number of *Caretta caretta* nests determined in the Belek region in 1999 and the year 2000 with the outcomes of previous studies (lengths of the study areas in the studies before 1998 have differences).

Laganas Bay (Zakynthos Island, Greece) is the largest known *C. caretta* nesting site in the Mediterranean with an average of 1,295.8 nests annually over 14 seasons (Margaritoulis 2000). The annual nest number in Kyparissia Bay, which is the second largest nesting site in Greece, is 563.2 (average over 13 seasons) (Margaritoulis 2000). The annual nest number in Belek is 647 (average of two years). Thus, Belek comes out to be the second largest *C.*

caretta nesting site in the entire Mediterranean. However, the possible annual shifts in nest numbers (Laurent et al. 1999) should be considered in long-term studies in a region.

ACKNOWLEDGEMENTS

This study is prepared by utilizing the data produced in the projects of the Belek Tourism Investors Association (BETUYAB)(1999-2000); the Turkish Ministry of Environment, the Authority for Specially Protected Areas (ASPA)(2000); the Earthwatch Institute (July-August, 2000) and the Turkish Ministry of Environment, the General Directorate of Environment Protection (GDEP)(August-September, 2000). I would like to thank all sponsors and the Sea Turtle Research Team (STRT) of Hacettepe University for their contribution and support.

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PROBLEMS FACING SEA TURTLES IN THE BELEK TOURISM DEVELOPMENT AREA (TURKEY) AND RECOMMENDED STRATEGIES FOR THEIR PROTECTION

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INTRODUCTION

Tourism development in recent years has increased risks that may cause the loss of sea turtle nesting habitats in Turkey, Greece and Cyprus, which have the major *C. caretta* nesting grounds in the Mediterranean. Cosijn (1993, 1995) reports that the increasing numbers of tourists cause a serious environmental degradation in these countries. Sea turtle conservation schemes are also affected by this rapid growth in the tourism industry. Zakynthos (Greece), which is the most important *C. caretta* nesting ground in the Mediterranean, was declared a "Marine Park" in 1999 to prevent negative impacts that have already reached a significant level. Margaritoulis (1985, 1990) identifies the problems in the area as intensive human activity, sun beds and parasols, light and noise pollution, traffic on the beach and night visitors. Human activity on nesting beaches may affect sea turtle eggs, hatchlings and adults (Warren and Antonopoulou 1990, Venizelos 1991). These include the destruction of nesting beaches, disturbance of adult females, light and noise pollution, usage of sun beds and parasols that affect the development of eggs, hatchling success and the sex ratio, mortality caused by speedboats (Bentivegna et al. 1993, Venizelos 1993, Dimopoulos 1994) and the usage of vehicles that compress the sand. Tourism facilities, which used to consider sea turtles as a threat against tourism (Yerli and Demirayak 1996), have now started to contribute to the conservation studies in the region. The next step should be the implementation of integrated conservation action plans that both satisfy the interests of tourism industry and ensure the conservation of sea turtles.

METHODS

The study area stretches 29.5 km between Aksu and Sarisu Rivers (from west to east) between Serik and Manavgat towns, within the Antalya City province. The Belek region is divided into 4 natural sections regarding different geographical features and types of

beach usage (Tab. 1). Surveys were conducted during June-September 1999 and May-September 2000, regarding the nesting and hatchling emergence periods. Data collection was carried out at 06:00-12:00 in morning surveys and at 22:00-03:00 in night surveys. All nests were recorded during morning surveys and were marked with sticks showing nest dates and numbers, which were placed both over and under the sand. The distances of nests from the sea were also measured. Tracks that indicated a nest probability but where the nest failed to be located were also marked and checked frequently for predations and hatchling emergences. All predations were recorded in the morning surveys. The "Artificial Light Diagram" (Fig. 1) was used to determine the sections, where artificial lights affected the hatchlings. Examining hatchling tracks on the sand helped determine the directions they oriented towards after emerging from their nests. All hatchlings that failed to go towards the sea were accepted as "affected by the artificial lights".

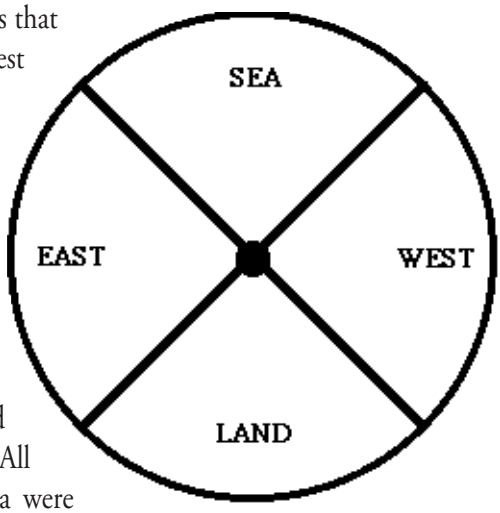

Fig. 1. Artificial Light Diagram.

RESULTS

The Belek region contains areas with various protection statutes including "Natural Protection Sites", "Specially Protected Areas" and "Tourism Development Areas" (Tab. 1). The forest area behind the 4.7 km long Aksu River-Club Asteria section is declared as a "Degree Natural Protection Site". The local people have located beach huts along the 1.2 km beach strip between Aksu and Besgoz Rivers. There is no construction progress in the Besgoz-Club Asteria sub-section.

SECTION	BORDERS	STATUS	BEACH LENGTH
I	Aksu River-Club Asteria	Natural Protection Site	4.7 km
II	Club Asteria-Acisu River	Tourism Development Area	11.3 km
III	Acisu River-Koprucay	Specially Protected Area	6.7 km
IV	Koprucay-Sarisu Stream	Specially Protected Area	6.6 km

Tab. 1. Division of Belek region in sectors.

Belek (11.3 km long area between Club Asteria and Acisu River) was declared as a "Tourism Centre" by a Council of Ministers decree published in the Official Paper (Resmi Gazete) on 21 November 1984 (vol. 18582). The land distribution for potential developers, followed the guidelines stated in "Tourism Encouragement Act, 1982 (Act No: 2634)" and the "Regulation of the Assignment of Public Land to Tourism Investments" published based on the 8th topic of this act. At present, there are 29 major tourism facilities in the region and another 3 are under construction. Most of these facilities are 5 star hotels and 1st class holiday villages and are mainly built in four different locations. The rest of the area contains public beaches, daily visit areas, forests and summerhouses. Approved in 1990 was the construction of 9,000 houses, which are about to be completed, in the forest area behind Asteria-Acisu section. Construction of another 10,000 is in progress within Bogazkent municipality in the Kumtepesi-Siteler section (DHKD-WWF 1996). The 13.3 km long beach strip between Acisu and Sarisu Rivers was designated as "Belek Special Protection Area (BSPA)" by a Council of Ministers decree on the 22 October 1990 (No 90/1117), published in the Resmi Gazete on 21 November 1990 (vol. 20702). However, two areas between Koprucay and Sarisu were excluded from the SPA despite their importance as nesting areas. Construction of another 10,000 summerhouses is in progress within the SPA (Acisu-Koprucay section).

According to the results of 1999 and 2000 seasons, the most important periods for sea turtle nesting in the Belek region are June (52.2%) and July (42.0%). July and August are the most important months for hatchling emergence. These periods overlap with the tourism season in Turkey, which is most intensive during June, July and August.

Fig. 2 shows the regional distribution of 1,294 *C. caretta* nests recorded during two nesting seasons in Belek. According to these results, the densest nesting zone is Section III, (Acisu-Koprucay) (42.6%). 32.1% of the total nestings are located in Section IV (Koprucay-Sarisu) and 14.2% is located in Section II (Asteria-Acisu).

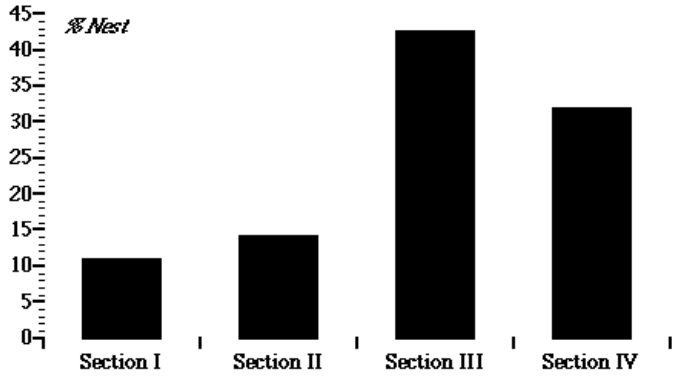

Fig. 2. The regional distribution of *Caretta caretta* nests in the Belek region according to the overall evaluation of data results from 1999 and 2000. Division of Belek region in sectors.

The lowest rate (11.3%) is observed in Section I (Aksu-Asteria). The Belek Special Protection Area (BSPA) therefore is crucial for the sea turtle population in the region as it contains about 74.7% of the total *C. caretta* nestings. The most vulnerable sea turtle nesting area is the 1km long beach strip by the Koprucay River.

98% of the nests in Belek are located within the first 35 m from the sea, especially within the 5-30 m zone. According to the results from 1999 and 2000 seasons, the ratio of nests located within 5-30 m from the sea is 96.3%. This zone is known as the "Egg Laying Zone". There is a strong need for paying more attention to the beach usage activities within this zone as they may have significant impacts on sea turtle nests, eggs and hatchlings.

36.9% of the nests in Belek were completely or partially damaged by the predators (data of two years). Common fox (*Vulpes vulpes*) and dog are the main predators of eggs, while ghost crab (*Ocypoda cursor*) mainly damages hatchlings. The highest predation ratios are observed in Section IV (Koprucay-Sarisu) and in Section I (Aksu-Asteria). Hatchling disorientation studies during 1999 and 2000 were conducted by using over 10,000 hatchlings that had left their nests naturally. The results of these studies showed that 66.5% of the hatchlings headed towards the "Sea", 15.5% towards the "Land", 9.3% towards the "East" and 8.7% towards the "West". Therefore, the ratio of hatchlings that headed towards other directions is 33.5%.

DISCUSSION

Section II, was declared as a "Tourism Development Centre" by a Council of Ministers decree in 1984. Section III is exposed to intensive secondary housing development. Although the area is within the SPA borders, the constructions were planned and approved before the designation of the area as a BSPA. Despite the developments, there are still a considerable number of nests in both areas and certain measures should be implemented for the regulation of artificial lights and beach usage in these areas. In Section II, there are still significant impacts of water sports centres and the usage of sun beds and parasols. There is no intensive beach usage in Section III as there is little construction development. Nevertheless, there will absolutely be an intensive demand for beach usage in the area when the construction activities are completed.

In summary, the "Egg Laying Zone" should be cleared of any activities and be preserved only for sea turtles. It is also necessary to remove all facilities further inland and to take necessary measures (i.e. landscaping, tree plantation and screening of strong lights) in order to prevent the artificial light effect on the beach. Although it seems advantageous to have no construction development in Section IV, the area has been designated as "Tourism Development Zone" and is left out of the SPA borders. In near future, serious problems that may occur in this zone may as well have negative impacts on nesting behaviour, so, it is essential to re-include these areas within the BSPA borders. Beach huts

in Section I should be removed to more suitable areas. Regulations should be made to prevent random beach usage in daily visit areas. In areas with a high risk of predation, nest cages may be used to prevent predations. Finally, all stakeholders should discuss these issues to produce a management plan for the future development activities in Belek. Conservation, tourism, agriculture, industry and all other interests should be included in this process and represented in all decision-making stages.

ACKNOWLEDGEMENTS

This paper is produced regarding the outcomes of the project entitled "Sea Turtles and Tourism in Belek" (1999-2000) funded by Belek Tourism Investors Association (BETUYAB)(1999-2000), the Authority for Specially Protected Areas (ASPA)(2000) and Earthwatch Institute (July-August 2000). We would like to thank all sponsor organisations and also the Sea Turtle Research Team (STRT) of Hacettepe University for their great support and contributions.

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LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) IN ITALIAN WATERS

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Encountering a leatherback turtle is an impressive event and so has a good chance to be reported to authorities, scientists or newspapers. In this way, information about 94 specimens found in the period 1955-2001 were collected, basically in the framework of a tagging and awareness programme (WWF Italia and University of Rome «La Sapienza»; 1981-2000).

Carapace lengths ranged between 120 and 170 cm (n=13), suggesting that the study area is frequented by both adults and subadults.

It is likely that set gill nets and other gears that can be described as 'nets' in the Italian language (drifting nets and trawl nets) are responsible of most of the incidental captures of this species in Italy.

Although leatherback turtles can be found in every sea area around Italy, they frequent mainly, or at least more than loggerhead turtles, the western basin.

LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) RECORDS FROM ITALIAN WATERS

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A total of 3,209 loggerhead turtle records were collected, basically in the period 1981-2000, in the framework of a tagging and awareness programme (WWF Italy and University of Rome «La Sapienza»). Specimens were found stranded, captured by fishing gears, gathered from the sea, or simply sighted, at all marine areas surrounding Italy. Results suggest that: (1) the interaction of sea turtles with the set gill net fishery is very important and comparable to that of other fisheries; (2) the Adriatic Sea is a developing area for small specimens (< 40 cm CCLn-t); (3) either epibiotic crabs quit turtles (or die) when their hosts move from the western basin to the eastern one or turtle movements between the two basins are limited; (4) barnacles occur mainly on turtles frequenting shallow waters and immature turtles move little between areas (or area type); (5) the number of prefrontal scales could easily give useful information on populations if routinely recorded during research activities, and that in the study area at least two populations occur, which are characterized by a different proportion of specimens with four prefrontal scales; (6) among tail measurements, the distance from the posterior margin of carapace to the cloaca (calculated from cloaca-tip of tail and carapace-tip of tail) is the best one to sex turtles of adult size.

INCIDENTAL CAPTURE OF MARINE TURTLES IN THE NORTH ADRIATIC SEA BY ITALIAN TRAWLERS

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In the North Adriatic Sea, where a high interaction of turtles with trawlers was suspected, onboard observations on midwater and bottom trawlers were carried out during 1999 and 2000. The incidental capture of loggerhead turtles (*Caretta caretta*) was directly observed during 415 monitored fishing days, and both biological and fishing parameters were recorded as well. Catch rates were calculated, allowing both to estimate a minimum total turtle catch by the Italian trawl fleet in the area (about 3,600 turtles/year) and to compare catch rates from other fisheries by means of a standardized approach. Interaction of sea turtles with fisheries in the North Adriatic Sea resulted to be important and also greatly different between sub-areas, seasons and time of the day: the highest cacth rates were observed in the eastern part of the study area, during winter, and in the daylight. Physical conditions of turtles resulted to be influenced by haul duration, and fishermen availability to apply recovery procedures seems to be fundamental to prevent post-release mortality. This project was part of an international one (France, Greece, Italy, Spain) co-financed by the European Commission.

STATUS UPDATE AND CONSERVATION PRIORITIES FOR THE GREEN TURTLE (*CHELONIA MYDAS*) IN THE MEDITERRANEAN

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The dire plight of this isolated taxon is compounded by its longevity, long period to maturation, previous exploitation, threatened and fragmented breeding sites, interaction with coastal fisheries. It is the only regional population of the species to have been afforded an IUCN status of Critically Endangered, and is clearly heading toward impending extinction without prompt governmental intervention including habitat conservation measures.

Notwithstanding the difficulty in interpreting survey data, because of differing survey efforts and duration and the characteristic fluctuation in seasonal nesting levels, we conclude that the annual nesting female population is now down to a level of only 250. This should be seen in the context of its previously recorded exploitation during the 1930's and 50's with up to 30,000 individuals taken per season by Turkey and Israel, mainly for luxury food export to the UK and France. The current figures were deduced assuming 3.5 nests per female with an average inter-nesting period of 3 years, a slightly different formula from other published estimates (Kasparek et al. 2001) but nevertheless arriving at a very similar, if dismal, result.

Their known nesting distribution is illustrated by Fig. 1 which is based on mean nesting figures per year and combines adjacent beaches into discrete nesting regions. It has to be noted how few of these remaining breeding sites are yet protected, despite the related agreements and obligations within specific Conventions.

The few Turkish sites for green turtle nesting were clearly identified within WWF's survey (Baran and Kasparek 1989) which concluded the now famous "17 most important marine turtle nesting beaches" from the c.2,000 kilometres of Turkey's Mediterranean coastline. They and the Cypriot nesting sites for this species, together with relevant offshore and over-wintering habitats were accepted for protective measures within Bern Convention Recommendations 7 and 8 (1987), 12 (1988), 24 and 26 (1991), 63 (1997), and 66

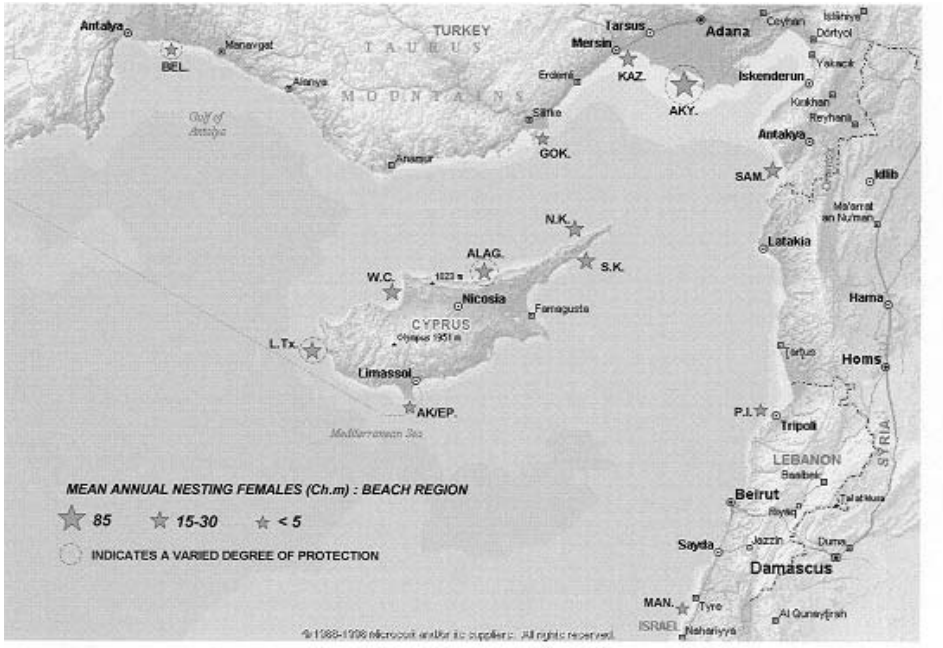

Fig. 1. Main nesting areas of green turtles in the eastern Mediterranean.

(1998). There was also a relevant On-the-Spot Appraisal procedure carried out in the Cyprus peninsula of Akamas in 1997.

The Barcelona Convention has also endeavoured to include marine turtle conservation within its Mediterranean brief, but despite a number of well-intentioned statements over the years on paper, no significant nesting site or offshore conservation has yet been achieved for the Green turtle. It is perhaps also important to note that IUCN at its 2000 World Conservation Congress adopted a strongly worded Recommendation urging the Contracting Parties to this Convention to facilitate more effective implementation of agreed measures.

Whilst the Bonn Convention on Migratory Species could have had a positive influence had it pursued a formal regional Agreement, as achieved for example for cetaceans, we now learn that it proposes to leave Mediterranean marine turtle conservation to the Barcelona Convention!

Tab. 1 presents a comparison across remaining key nesting regions; as such it also includes an assessment of the potential recruitment as deduced from hatching success; this gives a much truer reflection of the conservation status for each nesting population than does the oft published statistics on nest numbers alone.

Taking the Turkish situation first, we find that the main location of Akyatan is conservation designated - but not for its marine turtles for which there are no specific

COUNTRY	BEACH REGION	MEAN NESTS p.a.	NESTING FEMALES p.a.	RECENT HATCHING SUCCESS	PROTECTIVE STATUS
TURKEY	Kazanli	109	30	Low	None
"	Akyatan	297	85	Very Low	Good but .....
"	Samandag	64	18	Low	None
CYPRUS	S. Karpas	64	18	High	None
"	N. Karpas	104	30	High	None
"	Alagadi	68	19	Hign	(SPA)
"	'W. Coast'	55	16	High	None
"	Akamas	75	21	(High)	Threatened

All other remaining "populations" are extremely small, ie.

Turkey:- Belek; Göksu Delta
Lebanon:- Palm Island; Type; Mansouri (further quantitative field survey is required)
Israel:- Hadera/Netanya; Ashgelon

Tab. 1. Nesting and hatching potential of the main green turtle nesting beaches.

management measures. Its adjacent forest habitat is strictly protected with its resident mammalian predators being safeguarded against hunting. Consequently, its jackals, foxes, and wild boar impose an ever-increasing toll on the nests. Recorded nest losses to predation currently range between 64 and 75% in striking contrast to those around 13% at Alagadi in northern Cyprus.

Kazanli had boasted the highest density of green turtle nesting in the Mediterranean but it is still not protected and now exhibits serious deterioration caused by jetty-induced coastal erosion; horticultural use of adjacent sand dunes with extensive plastic waste; local tourist uses; and photo-pollution from adjacent apartments, roads, and a large factory. Whilst the exact effects of two pollution incidents this year from the adjacent Soda-Chrome factory remain unclear, it can surely only be adverse on this turtle sensitive marine eco-system.

Females still return to nest in significant numbers, but their site fidelity is resulting in decreasing recruitment as they endeavour to nest in what is now sub-optimal and often lethal habitat conditions. This season MEDASSET (Demirayak and Titchen 2001) carefully surveyed all other potential beaches 50 km to both the east and west of Kazanli in case there had been a shift of the breeding population caused by the deterioration at Kazanli; no such replacement nesting was found.

The last location of Samandag is also unprotected and is now seriously degraded by municipally sanctioned sand-winning; despite an official announcement stopping this abuse it was found to be continuing even into Summer 2001 with the resultant material left in obvious mounds in the centre of town for municipal road repair! To make matters worse, raw human sewage and dead animals are now openly dumped on the beach further encouraging scavenging, which spills over into nest predation. Lastly, this corner of the Mediterranean shore traps large amounts of plastic and other sea-borne wastes stemming from many other countries and/or their vessels. Although it is well known that its build-up on the Samandag beach front is a serious barrier to marine turtles, and especially to the sea-bound hatchlings, no attempt whatsoever has yet been made to lessen this annual obstruction. Nesting and recruitment continues to decline.

Conservation attention must also be focussed on the high fishing pressures offshore, including Kazanli and Akyatan, and also the over-wintering area of Yumurtalik Bay. It is an unfortunate coincidence indeed that more than 15% of the total Mediterranean trawling fleet is based at the central port of Karatas. A sample (Oruç et al. 1997) of only 12 such boats (from a total exceeding 250) found in winter 1996/97 an accidental capture of 306 green turtle individuals; most were alive but weak or comatose and their fate on release can only be surmised. As with the nesting beaches, no recommended protective measures have been taken for any part of this important marine habitat area.

The situation of the Akamas peninsula on the west coast of Cyprus involves the important nesting area of Lara and Toxeftra, here presently there is a delicate compromise between tourist beach use and nesting zones. However, controversy reigns over future proposals for tourist development and conservation throughout the whole peninsula and which risks increasing pressures on nesting and offshore habitats.

Considerably more green turtle nests are laid along the northern shores of Cyprus (Broderick and Godley 1996). Of these, regional protection has been given to the Alagadi beaches, but as yet there are no relevant designations for those on the north or south of the Karpas peninsula, or for those along the “west coast”.

While the political situation in Cyprus is well known and is impossible to address here, if we are to ensure the survival of the green turtle in the Mediterranean then it is increasingly important that the priority environmental need is recognised. It should then surely be conceivable in the 21st century for some appropriate international recognition/designation to be afforded to these surviving nesting beaches, and which would be independent of past, present, or future administrations. Without such justified international environmental recognition, the very real risk will remain of ever increasing tourist development and use of the coast to the detriment of turtle nesting, and as can be so clearly seen at too many other previous Cypriot nesting beaches.

Without repeating the relevant detail from the marine turtle facets of the Bern and Barcelona Conventions, a number of urgent actions are self-evident and it is hoped that this Conference would therefore endorse the following:

- Protect the key nesting areas of Kazanli, Samandag, and of the Karpas peninsula.
- Prevent the current abuses at Kazanli and Samandag.
- Take immediate measures to reduce the unsustainable nest predation at Akyatan.
- Reduce the seasonal fishing pressures and declare marine nature reserves at relevant offshore areas between Goksu Delta and Yumurtalik Bay.
- Give priority to applied research involving satellite tracking of mature females.

ACKNOWLEDGEMENTS

All credit is due to the diligence and vigilance involved in fieldwork by F. Demirayak in Turkey and to A. Broderick, A. Demetropoulos, B. Godley, and M. Hadjichristophorou in Cyprus, and without whose findings this paper would not have been possible.

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RELIABILITY OF THE SKELETOCHRONOLOGICAL METHOD IN *CARETTA CARETTA* FROM THE ADRIATIC SEA

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INTRODUCTION

The growth of skeletal elements is generally a cyclic phenomenon and is often synchronised with the seasonal changes of the environmental parameters. In the bones of ectothermal vertebrates, the arrest and restart of osteogenesis produce discrete layers that show varying degrees of distinctness depending on the shape, histological organisation (alamellar, pseudolamellar, lamellar) and the growth patterns of the bones themselves. Skeletochronology is a method of age determination in ectothermal vertebrates based on the count of the visible lines of arrested growth (LAGs) in bone sections.The underlying assumptions are similar to those applied for estimating age by counting scute layers/marks (Zug 1991).

The reliability of skeletochronology (number of LAGs = age of the individual) depends on the correct interpretation of the growth marks and of the different osteogenetic processes, such as the periodicity of formation of LAGs and complete endosteal resorption of inner periosteal LAGs (Guarino et al. 1999).

We report the results of a preliminary study of the reliability of the skeletochronological method applied to loggerhead (*Caretta caretta*) from the Adriatic Sea (Italy).

SAMPLES AND TECHNIQUES

We examined bone samples from 12 loggerhead sea turtles (*Caretta caretta*), 3 juveniles and 9 adults, stranded on middle Adriatic beaches between July 1999 and August 2001; some of the specimens were provided by Fondazione Cetacea Onlus (Riccione, Italy). For each specimen, several morphometric measurements were recorded, including carapace length (CL).

Skeletochronological analysis was performed according to Guarino et al. (1998). From each long bone (humeri and phalanxes) a slice 1-2 cm in thickness was cut at mid-diaphyseal level and decalcified in 5% nitric acid for a variable time depending on its size, thickness and porosity. Thin sections were obtained with a cryostat and stained with Erlich's haematoxylin. Osteometric analysis was also performed. LAG counts on thin sections were performed independently by two of us (ADM and FMG) using a light microscope and image analysis techniques. The diameter of the medullary cavity and of the outer periosteal margin were measured on the short axis of each diaphyseal cross-section using a micrometer eyepiece. The humerus and phalanx data from the different individuals were then compared to gain information on the destruction of LAGs due to endosteal resorption.

RESULTS

In both long bones, but especially the humeri, the tissue was highly vascular and phenomena of endosteal resorption were observed near the medullary cavity. However, analysis of the cross-sections showed LAGs in all cases. In many samples, the phalanxes showed well-defined, concentric LAGs in the whole bone section (Fig. 1) that were fully consistent with the number and patterns of the LAGs evidenced in the humeral sections. In our 12 specimens, which measured from 68 cm to 14 cm CL, the number of visible LAGs ranged from two in a specimen 17 cm CL to 15 in a specimen 68 cm CL.

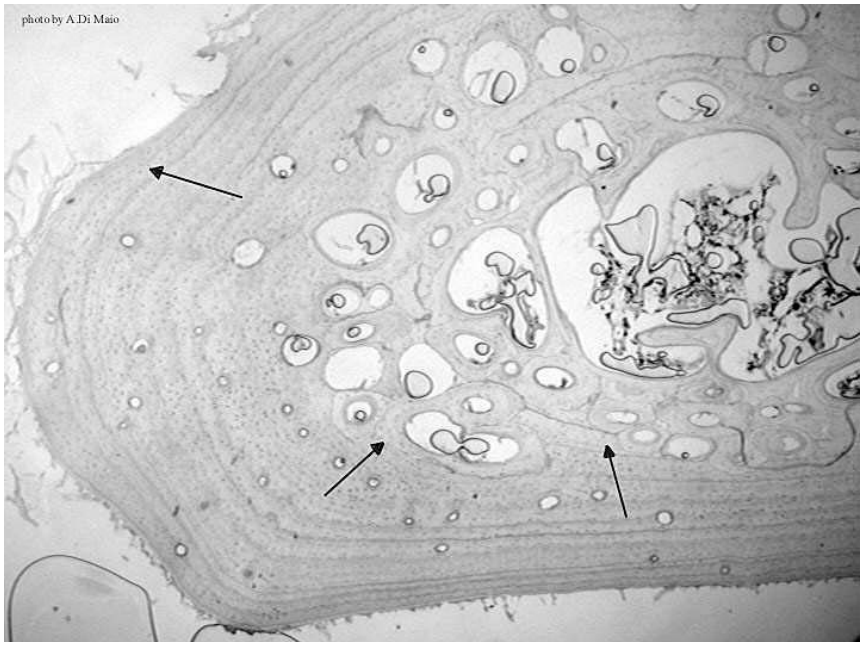

Fig. 1. Phalangeal section from an individual measuring 68 cm (CCL). Arrows show the LAGs, the remodelled bone and the medullar cavity.

PRELIMINARY CONCLUSIONS

Our results provide further evidence of the reliability of skeletochronology applied to *Caretta caretta*. Moreover, in this species the hypothesis of the annual periodicity of the growth layers, first advanced by Zug et al. (1986), has subsequently been verified experimentally in many studies (Klinger and Musick 1992, Coles et al. 2001). Also in our specimens, each growth layer might be considered the product of annual growth.

Bone remodelling was very extensive and constituted the major source of possible counting errors, especially in the adult specimens. The count of the visible LAGs in the sections showed only the minimum age of each specimen. In this regard, comparing the diameter of the bone's outer margin in juveniles to that of the inner LAGs in adults could be useful to estimate reliably the number of LAGs that may be completely destroyed in the adults. Thus, the number of LAGs observed in young specimens could be added to the number of LAGs measured in the adult bone to reliably estimate the age of adult loggerheads.

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CONSERVATION PERSPECTIVES OF THE MAJOR CRITICAL NESTING HABITATS OF *CARETTA CARETTA* IN GREECE

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INTRODUCTION

The loggerhead turtle (*Caretta caretta*) is listed world-wide an endangered species under the recent IUCN criteria. In the Mediterranean the loggerhead turtle has established local populations (Bowen et al. 1993, Laurent et al. 1998) and is the only marine turtle species to nest in Greece (Margaritoulis 1988). There is evidence that loggerhead stocks in the Mediterranean have been depleted due to human exploitation, restriction and degradation of nesting areas and incidental catch. In Greece *Caretta caretta* is protected under various international conventions (Barcelona, Bern, Bonn, CITES) and national legislation (Presidential Decrees 1980 and 1981) as well as through the European Habitats Directive (EEC 92/43).

Sea turtle nesting activity in Greece was first recorded in 1977 on the island of Zakynthos (Margaritoulis 1982). Systematic monitoring projects were initiated in 1982. The Sea Turtle Protection Society of Greece (ARCHELON) was formed in 1983 mainly from the people who worked on the first sea turtle projects (Theodossopoulos 1997). In 1983, an important nesting area was confirmed in the Bay of Kyparissia (Margaritoulis 1988). In 1984, ARCHELON starts working in Lakonikos Bay. During 1989-1992 ARCHELON surveyed about 7,500 km of the coastline of Greece to document existing nesting areas (Margaritoulis et al.1995). As a result areas with high nesting concentration (e.g. Rethymnon on the island of Crete) were identified.

RESULTS AND DISCUSSION

After 18 years of work in Greece, ARCHELON has delimited all known nesting areas and divided them into three categories, according to certain criteria: "major" nesting areas, "moderate" nesting areas and areas of "diffuse" nesting (Margaritoulis 2000). This has been done in order to assess the relative significance of a nesting site and thereby initiate accordingly conservation measures. Total nests estimated annually in Greece fluctuate between 2,335 and 5,287 and nests in the five "major" areas from 1,643 to 3,873

(Margaritoulis 2000). Therefore, the "major" nesting beaches account for an average of 72% of nesting activity in Greece. The beach length and the annual number of nests (minimum and maximum) per "major" nesting site are presented in Tab. 1.

Nesting site	Beach length (km)	Minimum number of nests/season	Maximum number of nests/season
Zakynthos	5.5	857	2,018
Kyparissia Bay	44.0	286	927
Rethymnon (Crete)	10.8	316	516
Lakonikos Bay	23.5	107	220
Bay of Chania (Crete)	13.1	77	192
TOTAL	96.9	1,643	3,873

Tab. 1. Loggerhead nesting effort per "major" nesting area in Greece (from Margaritoulis 2000).

On all "major" nesting sites ARCHELON runs management projects that include monitoring, on-site protection and public awareness (Dimopoulos 1991, Kremezi-Margaritouli 1996, Irvine et al. 1998) in line with the priorities set by the Mediterranean Action Plan for the Conservation of Marine Turtles (Barcelona Convention) and the Global Strategy for the Conservation of Marine Turtles (IUCN/SSC/MTSG).

Monitoring involves daily recording of emergences and nests, tagging and determination of other factors affecting nesting activity. On-site protection involves, amongst other, measures against predation, human trampling, vehicle use and sea inundation; operation of natural hatcheries; beach safeguarding; beach litter removal; and controlling of beach furniture, noise and light pollution. Public awareness is carried out through information stations, slide shows, beach patrols, leaflet distribution, environmental education for schoolchildren, participation in local events, lobbying, and mass media. The results of the projects are communicated to policy makers and government officials and provide the information upon which legal protection measures can be taken. The projects are carried out annually by trained personnel and over 400 international volunteers. All "major" sites have been proposed by the Greek government to be included in the NATURA 2000 network under the European Habitats Directive. For these sites Greece is obliged to introduce specific legislation and implement management schemes. In addition Zakynthos enjoys a specific legal conservation status since 1984 and recently (1999) was declared a National Marine Park with a Management Agency (Dimopoulos 2001). In the context of various European LIFE funded projects, management plans have been drafted by ARCHELON and are currently being implemented on Crete (Irvine et al. 1998) and Lakonikos Bay or are under way (Bay of Kyparissia). The management plans aim at preventing or mitigating the impacts of development (mainly tourism) in the nesting sites

and the adjacent buffer areas. Emphasis is placed on actively involving local communities in sea turtle conservation. This has been achieved in various degrees in all "major" areas.

CONCLUSION

It is important to have the full picture of the nesting activity at a national level. As sea turtles are long lived animals, with late maturation period, long-term monitoring is required to develop the full picture. It is also important to be able to assess the "nesting value" of a site and prioritise management measures. Focusing on the significant critical nesting habitats rather than dispersing conservation efforts may prove to be wiser in terms of achieving survivorship of an endangered species. As sea turtle populations are philopatric to specific nesting beaches it is also wise to ensure that a wide spectrum of individual nesting beaches are protected in order to preserve the genetic diversity of the *Caretta caretta* metapopulation (Schroth et al. 1996).

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THE ROLE OF NGOs IN PROMOTING THE ESTABLISHMENT OF THE NATIONAL MARINE PARK OF ZAKYNTHOS, GREECE

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INTRODUCTION

Laganas Bay on Zakynthos island in Greece hosts an extremely important nesting aggregation of the loggerhead turtle *Caretta caretta* in the Mediterranean (Margaritoulis 2000) and, despite more recent discoveries (Baran and Kasparek 1989, Broderick and Godley 1996, Laurent et al. 1998) the Bay continues to host by far the largest single nesting colony known in the Mediterranean (Groombridge 1990). The nesting habitat comprising of six discrete beaches totals about 5.5 km in length with an annual number of nests ranging from 857 to 2,018 (Margaritoulis 2000). Zakynthos over the past 20 years has experienced a fast growing tourist industry mostly unplanned, which exerts significant pressure on the nesting beaches (Arianoutsou 1988, Katselidis and Dimopoulos 2000).

BACKGROUND

Sea turtle nesting activity on Zakynthos was first recorded in 1977 (Margaritoulis 1982). The first monitoring projects were initiated in 1982. The Sea Turtle Protection Society of Greece (ARCHELON) was formed in 1983 mainly from the people who worked on the above projects (Theodossopoulos 1997). In 1984, legislation was introduced in order to protect the nesting beaches and regulate development in a broader zone. This was amended in 1987. In 1986, the Standing Committee of the Bern Convention opens a file on Zakynthos and urges Greece to take specific protection measures. In 1988, maritime measures were introduced to regulate traffic in a large

portion of the Bay. In 1990, a new Presidential Decree was signed and the nesting beaches were declared Nature Reserves under the national frame law 1650/86. Protection measures though were poorly enforced (Venizelos 1986, Charalambides 1990, Dimopoulos 1991). On the other hand, very little was done to seek sustainable development strategies in the Bay and alleviate affected landowners. This inevitably caused considerable tension in the area. The need for a national park was recommended and accepted by the State (Arapis and Margaritoulis 1994). A Special Environmental Study (SES), as required by law for the establishment of a National Marine Park, was started in October 1991. In 1994, night flights at the Zakynthos international airport were banned as the landing/take-off pathway passes over a nesting beach. In that year, private land behind the most densely nested beach on Zakynthos was acquired by WWF Greece (Charalambides and Katsoupas 1994), in order to be declared the core area of the imminent National Park. In 1994, maritime measures were extended (Dimopoulos 1995) which effectively banned speedboats from the whole Bay. The SES resulted in a draft Presidential Decree that was finalised in 1999. In 1999, MEDASSET filed an official complaint to the EC and Ombudsman (EC). In the same year the Standing Committee of the Bern Convention closed the Zakynthos file as the European Commission announced its decision to take Greece to the European Court of Justice on charges of infringement of the Habitat's Directive (Venizelos 1999). Finally, in December 1999 the enabling Presidential Decree of the National Marine Park of Zakynthos (NMPZ) was signed and in July 2000 its Management Agency was formed by the Ministry of Environment (Dimopoulos 2001). A hearing was held in July 2001 at the European Court of Justice and a decision is pending.

RESULTS AND DISCUSSION

The role of NGOs in nature conservation is very essential. Aspects of the work of NGOs include: collecting on-site data and information (monitoring); raising of public awareness in support of protected areas; formulating and implementing policy and strategies; planning and managing protected areas; effecting on-site protection and wardening; facilitating conservation initiatives; exercising ownership in a protected area; lobbying governments and local authorities; liaising between stakeholders, creating partnerships and mediating between communities and governments; networking to create synergy; building capacity by providing training and voluntary work (IUCN/UNEP/WWF 1991, IUCN Commission on National Parks and Protected Areas 1994, Kelleher and Kenchington 1992, Davey 1998).

Five non-governmental organisations (NGOs) have mainly been active in the Zakynthos issue, each in its own capacity: ARCHELON, the Sea Turtle Protection Society of Greece

(until recently known by its acronym STPS), Greenpeace Greece (founded in 1991), the Mediterranean Association to Save the Sea Turtles (MEDASSET, founded in 1988), WWF Greece (founded in 1990) and the Zakynthian Ecological Movement (ZOK, founded in 1987). The combined efforts of the five NGOs correspond more or less to all the aspects of their role in nature conservation as mentioned above.

ARCHELON has since 1983 been providing policy makers and the government with all the nesting, tagging, and stranding data derived from systematic on-site monitoring (Spyropoulou and Dimopoulos 1999), to prepare legislation and determine management measures in the NMPZ. The main results of monitoring as well as the current conservation status of the nesting area are included in annual technical reports that are also submitted to the European Commission and the Bern Convention (at the Council of Europe). MEDASSET has also effected, since 1985, regular reporting on the state of affairs on Zakynthos to the Greek Government, the EC and Bern Convention and has been instrumental in attracting international pressure on Greece. On-site public awareness has been carried out by ARCHELON since 1986, through information stations, slide shows, daily beach patrols, leaflet distribution, and environmental education. The use of local, national and international mass media by ARCHELON was a very important tool to reach the public and change attitudes. ZOK contributed in this direction especially on a local level, and MEDASSET and WWF Greece at a national and international level. NGO efforts managed to make the sea turtle issue on Zakynthos the most popular endangered animal conservation issue in Greece and a well-known one internationally. AGA a Germany based NGO also contributed to internationalising the Zakynthos issue. Management guidelines prepared jointly by ARCHELON, Greenpeace Greece, WWF Greece and ZOK were taken into consideration by the Ministry of Environment for the planning of the NMPZ. Also, ARCHELON, MEDASSET, WWF Greece and ZOK played a very important role as mediators between the government and local communities as the latter reacted to the principles of the SES and considered proposed protection measures as an obstacle to development. As a result the basic concept of a national park was broadly accepted at a local level. Currently ARCHELON and WWF Greece are jointly represented on the Board of the Management Agency of the NMPZ and actively participate in management decisions for the Park. The two NGOs work closely with MEDASSET and ZOK in order to promote the objectives of the National Park. ARCHELON's participation in a study carried out by the Civil Aviation Service on the impact the airport had on sea turtle nesting and concurrent lobbying resulted in the banning of night flights. Greenpeace Greece took actions in 1992 and 1993 in co-operation with ARCHELON and ZOK, which effectively contributed to the ban of speedboats and thwarted development plans on a nesting site (Marathonissi islet). Despite existing problems, the pressure the five NGOs exerted on the local authorities to enforce

legislation had a positive impact on maintaining the ecological value of the rookery. As wardening by hired personnel from the Prefecture of Zakynthos, prior to the establishment of the NMPZ, was most inefficient ARCHELON conducted safeguarding at certain accesses to the nesting beaches. This resulted in controlling access at night to the beaches and minimising impact on nesting activity. In fact relative increase in nests on one sector of a nesting beach where tourism disturbance at night was high, can be attributed to effective safeguarding by ARCHELON personnel (Dimopoulos 1992). ARCHELON fieldwork was carried out with the involvement of hundreds of volunteers from all over the world. Voluntary work was a totally new concept that entered the Zakynthian society, and is considered now as a vital tool in the operation of the NMPZ. The purchase of land by WWF Greece, following recommendation by ARCHELON and with the support of the government and the EC, was a major breakthrough in sea turtle conservation on Zakynthos. The nesting area under the NMPZ has been declared a zone of strict protection and is off limit to the public.

CONCLUSION

Definitely, ARCHELON, GREENPEACE, MEDASSET, WWF GREECE and ZOK have left their footprints on the nesting beaches of Zakynthos. The National Marine Park of Zakynthos is the end product of their synergy and their continuing co-operation is fundamental in the successful operation of the Park and the conservation of the most important loggerhead rookery in the Mediterranean.

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LOGGERHEAD INCIDENTAL CATCH BY LONGLINE FISHING IN SICILY SEA (LINOSA 1994-2001)

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INTRODUCTION

This paper illustrates some of the activities made in the Pelagie Islands within sea turtle protection and rehabilitation programmes that have been conducted from 1994 to present. The rehabilitation centre in the Island of Linosa was in fact created in 1995 and is now part of the EU-Life Project (Life NAT/IT/006271) "Urgent conservation measures of *Caretta caretta* in the Pelagian Islands" that has been funded at the end of 1999 by the Commission of the European Communities. The project is coordinated by the Provincia Regionale di Agrigento with the organizational support of CTS-Dipartimento Ambiente and involves partnership from Italian Universities (University of Torino and Politecnico of Milano), a CNR-Research Lab (IB-CNR, Firenze), Hydrosphera Association and Legambiente of Lampedusa. The activity in the Pelagie Islands is focussed on loggerhead conservation but also includes observations to evaluate the impact of longline fishing on loggerhead populations in the area. In this respect, a enduring collaboration was set with a number of fishermen that come from Sicily to the Pelagie Islands during the summer season for longline fishing (swordfish capture). Those fishermen provided full access to the turtle bycatch and every individual loggerhead caught by longline fishing is measured, rehabilitated, tagged and released by the Centre of Linosa. In the following, some of the most significant data concerning loggerhead bycatch in the study area are reported and discussed.

MATERIALS AND METHODS

A Rehabilitation Centre was created in 1995 by Hydrosphera, an Italian environmental association. The Centre is located in the Island of Linosa (35° 50' N, 12° 50' E) which is part of the Pelagie Island (Lampedusa, Linosa and Lampione). A collaboration was established with a number of fishermen that come every season to the Pelagie Islands for swordfish fishing. This collaboration was enhanced over the last two years (2000 and

2001) when the Centre in Linosa became associated to an EU-Life Project aimed at the protection and conservation of the loggerhead in the Pelagie Islands. At present, six to eight fishing boats are associated to the project and regularly provide their loggerhead bycatch to the Centre. The loggerheads are measured, rehabilitated, tagged and released at the Centre that is also collecting biometric information and creating a structured project database.

Fish production data for different countries in Europe and in the Mediterranean are made available by the FAO Fisheries Department, Fishery Information, Data and Statistics Unit.

Information up to the year 1999 is available through the FishStat+ Vs. 2.30 software that is freely available on the web (http://www.fao.org).

For the objective of this study, loggerhead bycatch biometric data for the period 1996-2001 provided by CRAM (Fundaciò per a la Conservaciò i Recuperaciò d'Animals Marins) have been also analysed.

RESULTS AND DISCUSSION

The FAO Fisheries Department reports the annual swordfish capture production for all Mediterranean countries. The data show clearly that swordfish production is the highest in Italy (Fig. 1). Major changes occurred during the years and in particular after 1990 possibly as a consequence of the regulations introduced for fishing gears. At present, longline fishing is by far the most used fishing method and it may be assumed that the large part of swordfish captures are made using this type of gear. On average, the Italian swordfish production has been of 6,253±941 tons per year and this

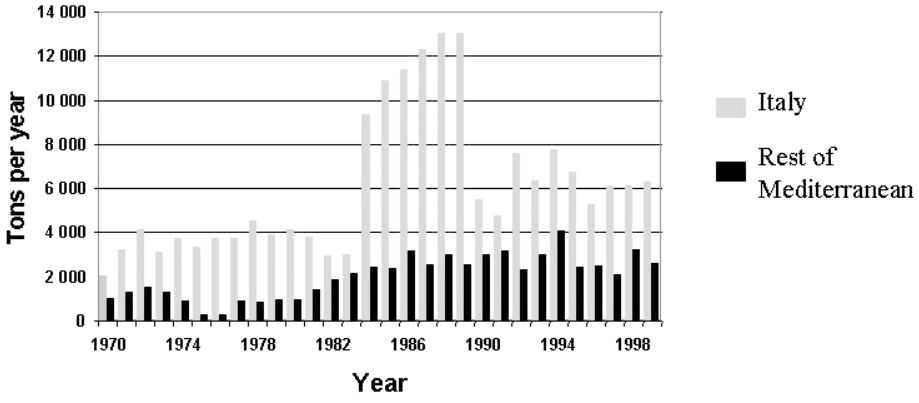

Fig. 1. FAO statistics of swordfish capture production for the Mediterranean region and Italy. The data clearly show that Italy is the largest producer and this may be associated to a very large impact on sea turtles.

number represents the 68.7% of the entire production of the Mediterranean countries that have been monitored during that period. There is already some consensus on the fact that longline fishing has a severe impact of loggerhead populations. Marine turtles of this species are attracted by the baits used by the fishing gears and are very often inadvertently captured by the fishermen. Studies made in the '90s report that 14 to 24 loggerheads may be caught per ton of swordfish captured (Mayol 1986, Camiñas 1988, Aguilar et al. 1995) and using this proportion, the number of loggerhead bycatch in the country should sum up to 87,000-150,000 individuals. In the case of the Pelagie Island and the fleet of fishing boats that has been monitored, the estimated swordfish capture was approximately 16.5 tons per season, while the number of loggerhead bycatch ranged between 4 and 5 individuals per ton of swordfish capture. In another work made in Sicily (Guglielmi et al. 2000), this number varied from 4.7 to 8.5 loggerheads per ton of swordfish catch. When applying this proportion to the national swordfish production as reported by the FAO, the potential number of loggerhead bycatch in Italy could be in the order of 25,000-53,000 individuals. In our studies the immediate mortality rate or, in other words the fraction of loggerheads that deceased in direct consequence of the capture, varied from 4% in 2000 to 9% in 2001. While extrapolating further those values, we can roughly estimate that the number of loggerheads directly impacted by longline fishing in Italy should range from a minimum of 1,000 to a maximum of approx. 4,700 individuals every year.

Not surprisingly, observed trends in bycatch data do support the hypothesis that longline fishing is already having an impact on Mediterranean loggerhead populations. The collaboration established with a partner organisation in Spain (CRAM, Barcelona) allowed us to observe the variation in the median TSCL (Total Straight Carapace Length) of the populations both in southern Spain and in Sicily over the period 1994-2001 (1996-2001 in Barcelona). The results are summarised in Figs. 2 and 3 that show a substantial decline in the median value for both populations (Fig. 2) and indicate that the fraction of loggerhead bycatch with TSCL values higher than 40 cm did decrease significantly from the period '94-'99 to present. We conclude, based on this observation that the loggerhead populations are already declining in the Mediterranean. In fact, other studies have indicated that when the biomass of a given population is reduced by fishing, the mean or median size (length or weight) of individuals in the population tends to decrease (Francis and Smith 1995, Francis and Jellyman 1999). This might not be a universally valid concept, as associated changes in the mean age and the mean size of the population can be better indicators of a decline rather than the size, only. However, the data presented in this paper do support the hypothesis that major disturbance is occurring in the studied species which might eventually lead to a substantial population decline. However we can't exclude a second hypothesis where the increase of numbers of smaller specimens is due to the increasing protection activities on loggerhead nest sites.

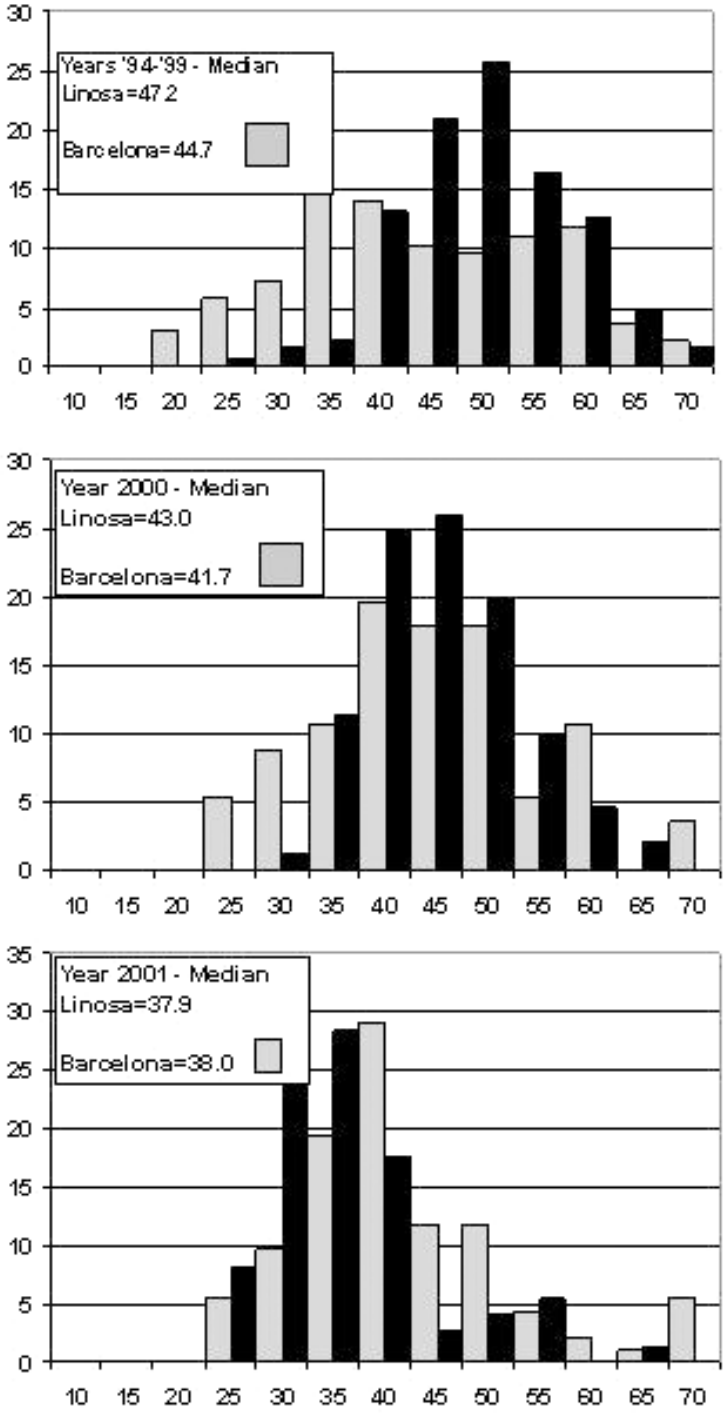

Fig. 2. Frequency distribution of SCL (Straight Carapace Length) measured on loggerhead bycatch in Linosa (Italy) and in Barcelona (Spain). The figure shows a consistent displacement of the distribution over the years (see text for more explanation).

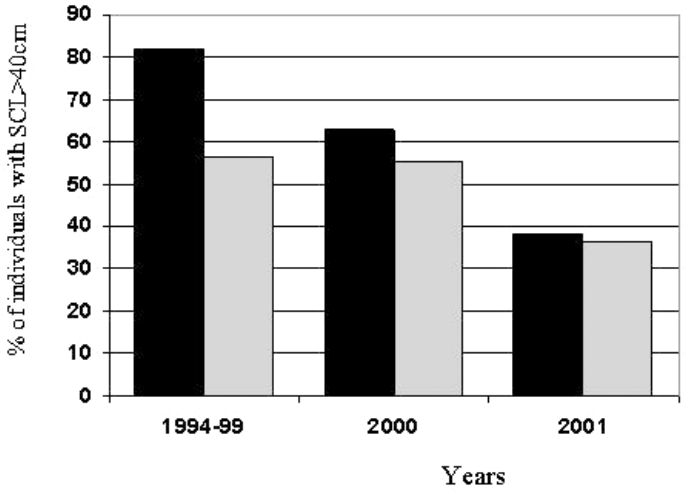

Fig. 3. The fraction of loggerheads whose SCL was exceeding 40 cm is plotted versus the year of the measurements. The data clearly indicate a fast decline in the size of the turtles for both Italy (black) and Spain (gray).

Urgent measures are therefore required at the regional, national and international level to reduce loggerhead bycatch and mortality associated to longline fishing. The research can contribute substantially to identify the most appropriate measures which range from the study of alternative baits (for instance artificial versus conventional) and of modified fishing gears, to a detailed mapping of the major feeding grounds and migrations of loggerheads in the area and a better understanding of loggerhead behaviour in respect to the fishing efforts. The future of marine biodiversity may depend in fact on our ability to create the appropriate premises for sustainable fishing in the region.

ACKNOWLEDGEMENTS

Authors acknowledge the support of the entire population of the Island of Linosa and of Nino Bianchi, the Captain of the fishing boat Gabbiano that provided continued and invaluable help to the research over the years. Other project partners are also acknowledged for support and discussion during the field work and the preparation of this manuscript.

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BIOACCUMULATION OF HEAVY METALS IN NORTHERN ADRIATIC LOGGERHEADS

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INTRODUCTION

The species of sea turtle in the Mediterranean are: *Caretta caretta, Chelonia mydas* and *Dermochelys coriacea*. In the last decade there has been such a rapid reduction of their number, so as to necessitate an increase of protective measures.

One of the biggest threats to the turtles' survival is pollution and there have been studies on paper, plastic and glass, found in the intestine of many animals. There are only few data on the accumulation of heavy metals in their organs (Stoneburner et al. 1980, Sakai et al. 1995, Storelli et al. 1998, Godley et al. 1999, Sakai et al. 2000).

The purpose of this study is to supply more data on the bioaccumulation of heavy metals in different organs of *Caretta caretta*. Due to its characteristics, this information can be part of a wider research that consider specimens of *Caretta caretta* as biological indicators.

METHODS

The specimens of marine turtles for this research includes 10 *Caretta caretta,* found in the northern Adriatic Sea, between Porto Marghera (VE) and Senigallia (AN), during the period of July 1999 and August 2000. The necessary biometric measures have been taken on the rescued animals: weight, carapace's length (CCL) and carapace's width (CCL). Two animals were already dead, the others died later, after a period of hospitalisation. After their death, all animals were preserved in polyethylene bag and frozen at -10°C. After necropsy, samples of liver, kidney, muscle, fat and bone, were taken from each animal, previously defrozen. One part of the tissue was dried a constant mass in an oven.

A range of arsenic, cadmium, chromium, lead, mercury and selenium were determined using acid digestion HNO_3 67% v/v (Suprapur Merck) and H_2O_2 30% v/v (Aristar-BDH) with microwave heating (MLS-1200 MEGA, Milestone). This was followed by analysis using atomic absorption spectrophotometry in a Zeeman graphite furnace for arsenic, cadmium, and lead, hydride generation atomic absorption spectrometry for

selenium and inductively coupled plasma atomic emission spectrometry for chromium.

Total mercury was analysed using automatic solid/liquid analyser AMA-254.

All analyses were conducted under an analytical quality protocol requiring the analysis of blanks and reference materials NRCC DORM-1 "Dogfish Muscle Certified Reference Materials For Trace Metals" and NRCC DOLT-2 "Dogfish Liver Certified Reference Materials For Trace Metals".

RESULTS AND CONCLUSION

Tab. 1 shows the different concentrations of metals in the tissues. For better confrontation amongst metals, the original data have been converted from mg/kg to μmol/kg. The higher concentrations of Se and Cd appear in the liver, value 141 μmol/kg and value 35.2 μmol/kg respectively. Even in the kidney appears a high accumulation of metals: Se and Cd, where Cd, this time, is almost twice the level of Se, even with extreme variations. The metal with the higher concentration in the muscle is Se (median=46.8μmol/kg), even if it is much lower than in the previous two organs; for the other metals, concentration gradually decreases in the following order: Cr, Cd, Hg, As and Pb. Concerning the fat, as for muscle, the element with higher value is Se; the other metals' concentrations are in this

	Chromium	Cadmium	Lead	Arsenic	Mercury	Selenium
Liver	4.65 1.62-9.09	49.7 3.48-122.9	3.97 S.L.R.-12.01	N.D. S.L.R.-8.57	7.06 1.62-13.1	128.2 32.54-310.6
Kidney	12.2 4.78-29.9	180.7 5.48-345.8	4.78 1.22-8.94	N.D. S.L.R.-26.3	4.79 1.70-13.19	103.7 38.6-228.8
Muscle	10.5 4.26-24.7	4.18 0.52-9.90	3.35 0.80-23.05	N.D. S.L.R.-26.27	2.54 1.29-5.06	66.6 21.7-14.77
Fat	15.4±17.4 1.15-55.02	4.44±5.58 0.076-6.66	N.D. S.L.R.-21.3	N.D. S.L.R.-37.7	1.71±2.51 0.040-8.03	46.1±67.5 0.380-75.35
Bone	280.7 96.6-633.8	1.01 0.298-4.80	14.7 1.11-52.4	20.6 1.33-58.7	0.177 0.0270-0.605	17.2 1.26-77.6

Tab. 1. Medium concentration ± SD, min.-max. Values are in μmol/kg. N.D.: Non Definable. S.L.R.: Under the Limit of Detectability.

order: Cr 7.35; As 1.12; Cd 1.01; Hg 0.714 and Pb 0.097 μmol/kg. The bone, is the organ with the higher accumulation of Cr and Pb, but only the first one has a much higher concentration (median=247 μmol/kg), with values ranging from 0.12 μmol/kg for the Hg and 10.0 μmol/kg for the Se (Tab. 1).

In order to collect, synthesise and extract all the scattered information, they've been submitted to a multivaried statistic analysis according to the method of principal

components. Graphics show that the first principal component (interpreted variation = 46.6%) is mainly influenced by the different distribution of metals in the organs (Fig. 1 and 2). There's evidence of an association of the accumulation of Cd, Hg and Se mainly on kidney and liver and of Cr and Pb on the bone. Fat and muscle don't seem to be organs of accumulation for any metal. This could be connected to the different metabolic

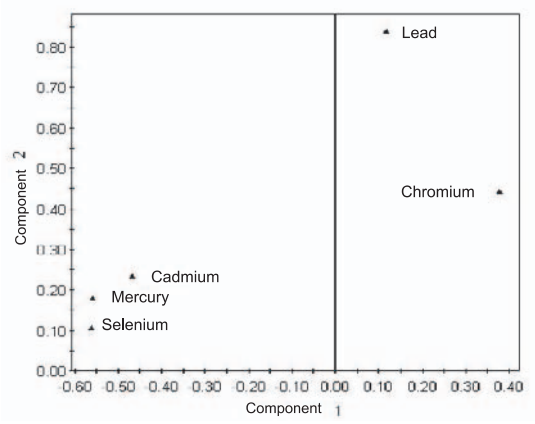

Fig. 1. Coefficients' diagram of the first two principal components.

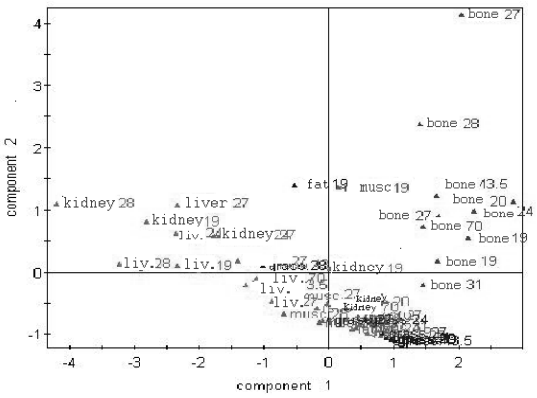

Fig. 2. Dispersion diagram of the first two principal components' data.

functions of this organs associated to the different chemical characteristics of the metals.

The second principal component (interpreted variation = 22.0%) is simply connected to total metallic presence. More interesting is the third principal component (interpreted variation = 14.7%). Fig. 3 and 4, show the contrast between Cr and Pb in the bone and highlights the relation between these metals and the length of the carapace (CCL), direct for Pb and inverse for Cr. For this reason, the dispersion's diagram on the first and third

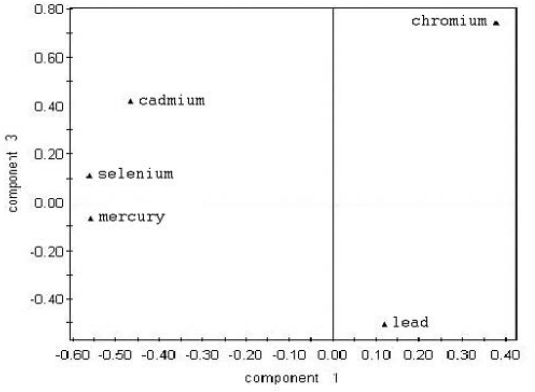

Fig. 3. Coefficient diagram of the first and third principal components.

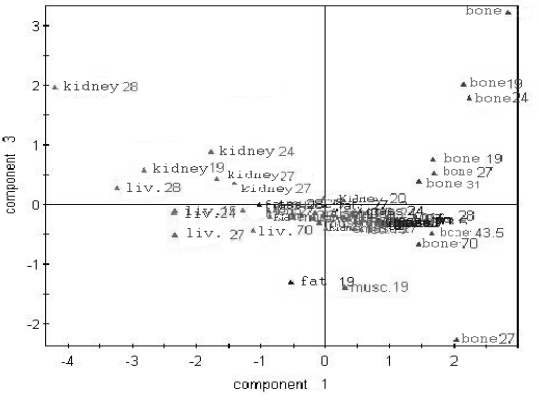

Fig. 4. Dispersion diagram of the first and third principal components' data.

principal components, shows sample of bone in vertical scale, according to dimensions; increasing order from top to bottom. The obtained data, point out few organs as target of specific metals, in particular kidney and liver accumulate copper, mercury and selenium. The bone instead presents generally low levels of metals except for Cr and Pb, and shows a relation with the dimensions of the samples, inverse for Cr and direct for Pb. None of the analysed metals, presents high values in fat and muscle. Thanks to these results, we can affirm that marine turtles have organs where it is possible to find a high concentration of metals. We can consider the species *Caretta caretta* as a reliable biological indicator.

We still have to establish the possible relations between metals' content and marine environment. A further research is necessary to study the information on the bioaccumulation, in details, and the validity of loggerhead turtles as biological indicators.

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REMOVAL TECHNIQUE OF FISH-HOOK FROM THE UPPER OESOPHAGUS IN *CARETTA CARETTA*

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INTRODUCTION

From 1990 the Aquarium "D. Cestoni" of Livorno has been elected as the responsible centre for the Tuscany coasts, involved in rescues of living and dead sea turtles. Actually the Aquarium works within the sea turtles strandings project of the Centre for the Study of Cetaceans (Centro Studi Cetacei), a project that allows to coordinate a national network also for sea turtles.

During the period 1990-2001 a lot of sea turtles were recovered along the Tuscany coast and the most abundant species was *Caretta caretta*. Most of them were captured in nets or others fishery trawls and often they are wounded by hooks. Others were stranded on the coast, affected by stress caused by maritime traffic or pollution or rescued in the open sea. A lot of them were dead but a great number were still alive. When the turtles are recovered still alive the Aquarium is the place for the care, where diagnosis is established and specific therapies and rehabilitation are applied with the hope to release the animals at sea.

Because of the lack of scientific data we work especially in an experimental basis.

METHODS

The following description represent a simple protocol used for the extraction of a hook from the upper oesophagus in *Caretta caretta*. We would like to underline the simplicity of this method due to the fact that it wasn't necessary to incise the turtle skin and the tissue under it and avoided, in this way, the subsequent stress for the turtle.

On 24 July 2000 a loggerhead turtle was moved from Isola d'Elba Aquarium to the Livorno Aquarium. The turtle was 30 kg of weight and about 70 cm of total length and it had a hook in the oesophagus. Infact a piece of fishing-line had been swallowed and extended out of the animal's mouth for a length of about 30 cm. It could not been

extracted manually so it was decided to remove the hook as soon as possible. An emergency operating theatre was prepared to the Aquarium the next day. The animal was treated with a general anaesthesia and we fitted the animal with a plastic mouthpiece as a precaution. Then we used a metal detector to locate the exact hook position and to estimate its size. At this point we followed the course of the fishing-line slowly down through the oesophagus of the animal and it was possible to clutch the hook with specific forceps. After the tip fish-hook localization under the skin it was possible to push it through the skin. Then we kept firmly the hook with the forceps and cut its tip. Now it was possible to extract the hook from the turtle's mouth without causing any other lesion.

After the surgical operation the animal was placed in a seawater tank and did not show excessive signs of stress. Twenty days later it began to self-feed on fish and cuttle-fish. At the end of August the sea turtle was released near Pianosa island, in the Tuscany Archipelago National Park.

When the metal detector investigation is positive and the sea turtle has the fishing line out of its mouth this is the simplest way to remove a fish-hook from the sea turtle upper part of the oesophagus.

But if the sea turtle has not the fishing line out of its mouth and the metal detector is negative it is necessary to proceed with the sea turtle captivity observation in aquarium to verify if it is able to feed or not.

Even if the metal detector investigation is positive, and we are able to localize the hook position, sometimes it isn't possible to locate the tip of the hook or it isn't possible to clutch it with the forceps. In this case it is necessary to remove the hook with a surgical operation, cutting the skin surface only with a very small incision 3 cm long to reach the oesophagus lumen. With specific forceps it is possible to clutch the hook and to evidence its tip in the skin surface and to push it through the skin. Then you must suture the tissues and cure the sea turtle with the necessary post-operation treatment.

BOTH MEDITERRANEAN SPECIES NESTING SIDE BY SIDE: A DECADE OF CONSERVATION, MONITORING AND RESEARCH OF GREEN AND LOGGERHEAD TURTLES

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The coastline of northern Cyprus holds approximately a third of all Mediterranean green turtle nests and is regionally significant for nesting loggerhead turtles (Kasparek et al. 2001). Since 1992, in conjunction with the Department of Environmental Protection and the Society for the Protection of Turtles (SPOT) in northern Cyprus, the Marine Turtle Conservation Project has been monitoring both green and loggerhead nesting activity in northern Cyprus (Broderick and Godley 1996).

In addition to monitoring most nesting beaches during the day, at our main base, Alagadi, on the north coast, we carry out night work. From May until mid August, student volunteers patrol the beach all night. Every turtle that has nested is measured and tagged with both external titanium tags and Passive Integrated Transponders (PIT tags) injected into the shoulder. The practice of both methods of tagging has ensured successful identification of remigrant turtles and given insights into fundamental aspects of their biology (Broderick et al. submitted). As all nests are protected from predation by dogs and foxes using a wire screen, over the last 10 years, 77% of loggerhead and 87% of green nests have hatched successfully.

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COMPARISON OF SEA TURTLE POPULATIONS ON DEVELOPED AND UNDEVELOPED BEACHES OF TURKEY

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INTRODUCTION

Two species of marine turtle have been recorded as nesting in the Mediterranean; the loggerhead *Caretta caretta* and the green turtle *Chelonia mydas* (Groombridge 1990). Hathaway (1972) stated that there are more turtles in the Mediterranean than in any other sea, but Groombridge (1990) noted that no nesting population of marine turtles in the Mediterranean is large by world standards. According to previous investigations, it is estimated that on average some 2,000 female *Caretta caretta* and 300-400 *Chelonia mydas* nest annually in the Mediterranean (Groombridge 1990).

It is estimated that there are 1,360-2,710 *Caretta caretta* nests and 700-1,150 *Chelonia mydas* nests on 17 different beaches (with a total length of 140 km) in Turkey annually (Kaska et al. in press). Using the assumption that each female nests an average of 3 times in a season every 2-3 years (Groombridge, 1990), this means that approximately 453-903 *Caretta caretta* and 233-383 *Chelonia mydas* nest annually on the beaches of Turkey.

The potentially harmful effects of human uses of the nesting beaches have caused much concern (Pritchard 1980, Frazer 1992). However, detailed knowledge of the interactions between human activities and turtle nesting is still inadequate. This study sets out to assess human activities (and other factors potentially harmful to turtles) and turtle nesting, on two different Turkish beaches, over a single nesting season, under the latest data from literature. Kizilot beach has chosen as an example of a developed beach and Patara as an example of an undeveloped beach.

MATERIALS AND METHODS

The areas for this study were Kizilot and Patara beaches, which are located on the coast of Antalya province (Fig. 1). Kizilot beach is 16.4 km long and starts from Manavgat Çay, continuing to the east until Alara Çay. Patara beach has a total length of 11.8 km on the western border of Antalya, and is bisected by Esen Çay. In this study, the eastern part of the beach, with a length of 7 km and only the 1 km western part of the Esen Çay was considered. The study was carried out between 25 May and 23 September 1990 on Kizilot beach, and between 10 May and 18 September 1992 on Patara beach (Kaska 1993). The

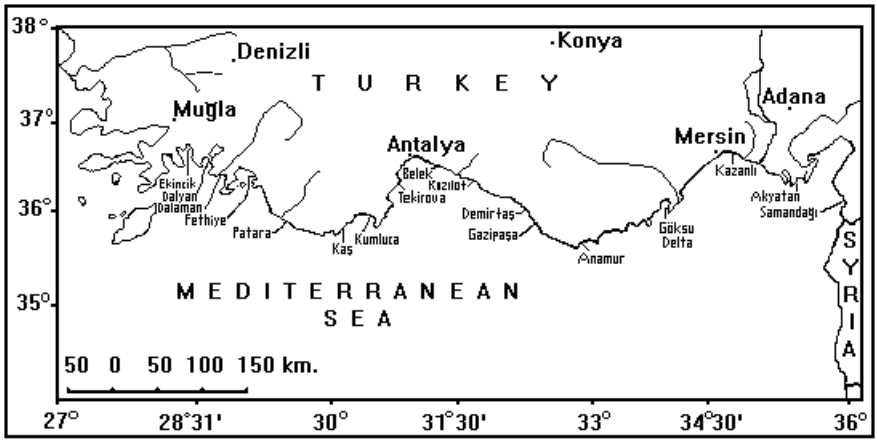

Fig. 1. The main nesting beaches of sea turtles in Turkey.

data referring to these beaches are combined. The low numbers in nesting on undeveloped beach and the high numbers of nesting on developed beach are discussed.

RESULTS AND DISCUSSION

A total of 183 nesting activities were recorded on Patara beach, with 57 of these being nests in 1990. These numbers varied from 35 to 87 until 2000 (see references in Erdogan et al. 2001). During the season of 1990, a total of 295 loggerhead nesting activities on Kizilot beach were recorded, with 143 of these being nests. The number of nests varied from 108 to 146 until 1997 (see references in Türkozan 2000). The proportion of emergences leading to nests on the two beaches was different: 48.5% on Kizilot; 31.1% on Patara, which is statistically significant (X^2=5.903, df=1, P>0.05). There was also significant difference (X^2=10.061, df=3, P>0.01) in the proportion of emergences producing nests in the different months on both beaches. It can be said that one in two emergences resulted in a nest on Kizilot beach, compared with only one in three on Patara beach. Using Mann-Whitney U-test, the emergences density on the beaches is also significantly different (U=181.5, P< 0.05).

Because of sand erosion on Patara beach, the overall hatching success was very low (33.7%), and only two of the 15 nests were produced hatchlings, in the first 20 m from the sea. Success was much higher in the next two zones, but not as high as at Kizilot. Only one nest was made further than 100 m and this was covered deeply by sand erosion and failed to hatch. Note that distances travelled by turtles to make nests on Patara were much greater than at Kizilot. The data on hatching success and hatchlings reaching the sea again shows an effect of distance: the further the nest from the sea, the higher the proportion of

hatchlings that failed to reach the sea on Kizilot and Patara beaches ($r=0.439$, $P<0.05$ and $r=0.996$, $P< 0.01$ respectively).

During the investigation season, 15 (28.84%) nests on Patara and 7 (4.89%) nests on Kizilot were inundated by the high spring tides. The reason that 28.84% of nests are exposed to the wet area is the lowering of the sand near the sea due to the wind erosion on Patara beach. Behind the beach a fence is erected for forestation purposes. In summer, offshore winds blow sand up the beach piling it against the fence and eroding the sand depth close to the sea. In winter, on shore winds would normally blow sand back, restoring the depth at the shore, but the fence reduces this effect with the overall result being that sand depth close to the sea has been reduced.

The factors influencing the nest site selection of marine turtles in the Mediterranean are still unknown, Geldiay et al. (1982) claimed that this is related with water temperature (the water of eastern Mediterranean coast is warmer than the western, i.e., Alanya=28 °C and Dalyan=25 °C), but there are some beaches which are used by both species (e.g. Goksu Delta and many beaches on northern Cyprus). Nests were concentrated on the zones close to the rivers (despite the artificial lights on Kizilot), therefore freshwater sources may be one of the guides for nest site selection of sea turtles.

Although Patara beach is an undeveloped beach, and there are no visible light source on the beach, due to special protection of beach-back vegetation and fences, it holds fewer turtle nests [52 (31.90%)] than Kizilot beach. Kizilot beach has many hotels, 20-100 meters from beach, but holds many more turtle nests [143 (48.47%)]. In addition, we found that one of two emergences resulted in a nest on Kizilot Beach but one of three emergences resulted in a nest on Patara beach. Further study is needed in order to find out the effects of beach development on nest site selection of sea turtles in the Mediterranean.

Eggs can be protected by relocating eggs for incubation under natural conditions (protected areas where eggs are reburied in the sand above the anticipated spring high tide level) or artificial conditions using expanded polystyrene incubators or other non-metal containers (Styrofoam boxes), but Mrosovsky (1982) stated that Styrofoam boxes were 1-1.5 °C cooler than the sand, and said this may cause the masculinization of *Chelonia mydas*. In the absence of data on temperature-dependent sex determination and a thermal transect of a beach, artificial hatcheries should not be used.

The seasonal nesting patterns and the proportion of emergences leading to nests were different on the two beaches. There was a non-uniform spatial distribution of nests perpendicular to the sea. Further research is required in order to understand the effects of beach development on nesting behaviour and nest site selection of sea turtles in the Mediterranean.

ACKNOWLEDGEMENTS

Thanks to the Organising Committee and Regional Activity Centre for Specially Protected Areas (RAC/SPA) and Secretariat of the Convention on Conservation of Migratory Species (CMS) for financial support to attend the Conference.

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NEST AND SAND TEMPERATURES OF SEA TURTLES: CONSERVATION ASPECTS

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INTRODUCTION

Sexual differentiation of sea turtle hatchlings is determined by egg incubation temperature, usually during the middle third of development (Yntema 1979, Yntema and Mrosovsky 1980, Janzen and Paukstis 1991, Mrosovsky 1994, Kaska et al. 1998). Few studies have monitored incubation temperatures in the field, but experiments using artificial nests, or incubators with cyclic temperature fluctuations, suggest that sex is determined as though eggs were incubated constantly at the mean temperature. When eggs are incubated at constant temperatures, there is a narrow range of temperatures over which around 50% of each sex will be produced (pivotal temperature or threshold temperature), and wider ranges above this temperatures produce females and below this threshold produce males (Bull 1980).

For sea turtles, population survival is dependent on the occurrence of a sufficient range of incubation temperatures to produce offspring of both sexes. If the temperature of a nest during the middle third of development is known, then the sex ratio of hatchlings from that nest can be predicted. If in turn this information is known for all parts of a beach throughout a nesting season, then the overall primary sex ratio can be predicted for all hatchlings produced from that beach (Standora and Spotila 1985). Estimates of the sex ratio have also been obtained by combining the nesting distribution with the sexing of samples of hatchlings from different times during the season by Mrosovsky (1994) or from pivotal incubation durations (Marcovaldi et al. 1997).

In this study, only the temperatures were used to predict the sex ratio of a nest, as a continuation of the study (Kaska et al. 1998) about intra-clutch temperature differences of two species of turtles nesting in the Mediterranean.

MATERIALS AND METHODS

Temperatures of loggerhead turtle nests and sand temperatures on the South beaches of Turkey (Fig. 1 in Kaska (2003)) were examined during the nesting season of 2001. Electronic continuous temperature recorders, launched and offloaded via computer, were placed into the middle of the nests. The mean temperature during the middle third of the

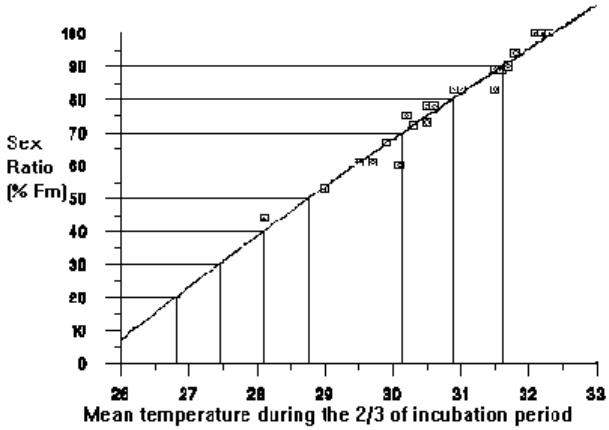

Fig. 1. The relationship between the mean incubation temperature and sex ratio (data combined with Kaska et al. (1998)).

incubation period was closely correlated with the percent sex ratio. Temperature was measured using "Tiny talk" temperature recorders (Orion Components (Chichester) Ltd., UK). The device fits within a 35 mm film case. The accuracy of the device was tested under laboratory conditions against a standard mercury thermometer, and they were found to have a mean resolution of 0.35 °C (min. 0.3 °C, max. 0.4 °C) for temperatures between 4 °C and 50 °C. They were placed either during the oviposition or in the morning of laying. The nest was then covered, and protected with wire mesh against dog and fox predation. Temperature data were offloaded to a computer and the middle third of the incubation period was calculated from the total incubation period, from the night of laying to the day of first hatching.

RESULTS

Temperatures of loggerhead nests on four different beaches (Dalyan, Fethiye, Patara and Anamur) and sand temperatures on seven beaches (Dalyan, Fethiye, Patara, Tekirova, Anamur, Kazanli and Samandag) were recorded during the nesting season of 2001 (see Fig. 1 in Kaska (2003)). The nesting season started at almost the end of May and continued until mid August on all beaches. The majority of the nests were recorded during June and July, since the peak nesting season was during that time. The distances of nest from sea varied between 15 and 40 m. The depths of top and bottom level of a loggerhead turtle nests were 30-50 cm. The clutch size varied from 65 to 108.

The mean temperature of the whole incubation period for all loggerhead turtle nests ranged from 26.1 to 32.9 °C. Maximum temperature increase during the incubation period for loggerhead turtle nests was 4.6 °C (min. 26.5 °C, max. 31.1 °C). Temperature

of the middle third of the incubation ranged from 26.8 to 32.3 °C. All the nests on Dalyan and Patara beaches during the middle third of the incubation period experienced above the pivotal temperature, one nest on Fethiye and one nest on Anamur beach in stony area showed close to the pivotal temperature.

The sex ratio of hatchlings for all nests was also estimated. In the previous study (Kaska et al. 1998) temperatures were recorded and 10-18 hatchlings per nest were sexed, from these results there was a positive correlation (r^2=0.96) between the mean temperature of the middle third of the incubation period and sex ratio (percent female) (Fig. 1). From this figure, we estimated the sex ratio that we recorded the temperature of the nests.

From the above graph, it can be figured out that the pivotal temperature for loggerhead turtles in the eastern Mediterranean is about 28.8 °C and 32.4 °C produce all females.

Sand temperatures and air temperatures were not directly related to the nest temperatures. The air temperatures were warmer on the eastern beaches but nest temperatures were not changed accordingly. The sand temperatures were much more variable on different parts of the beach as sandy, shady and stony parts.

DISCUSSION

Reported sex ratio for sea turtles is generally female dominated (Mrosovsky 1994, Kaska et al. 1998). There was a female biased sex ratio on Dalyan and Patara beaches, but nearly equal sex ratio on Fethiye beach. This may be because of the stones on Fethiye beach, since these may cause some coolness on the nests.

Mean incubation temperatures may be adequate to predict sex ratios only in sea turtles that have deep nests which experience little temperature fluctuation (Bull 1980, Morreale et al. 1982). The results of this work show that mean temperatures during the middle third of incubation period can be used for predicting sex ratio. The variety of relationship between pivotal and beach temperatures suggested that diversity of sex ratios in different populations should be expected. Pivotal temperatures for all sea turtle species are reported to lie within a 1 °C range (28.6-29.7 °C), and the variety of relationship between pivotal and beach temperatures suggests that diversity of sex ratios in different populations should be expected (Mrosovsky 1994). From these results and previous (Kaska et al. 1998) it can be said that the pivotal temperatures for sea turtles in the Mediterranean is 28.8 °C.

ACKNOWLEDGEMENTS

Thanks to the Organising Committee and Regional Activity Centre for Specially Protected Areas (RAC/SPA) and Secretariat of the Convention on Conservation of Migratory Species (CMS) for financial support to attend the Conference.

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GENETIC MATERIAL COLLECTION OF SEA TURTLES AND PCR AMPLIFICATIONS

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INTRODUCTION

The natal homing hypothesis for the reproductive migration of sea turtles suggest that sexually mature animals return to breed and nest at the same rookery from which they had hatched (Carr 1967). One prediction of the natal homing hypothesis is that each nesting colony should comprise a group of isolated maternal lineages as females assort themselves according to their natal beach. As such, mitochondrial DNA (mtDNA) differences are expected to accumulate among colonies, given the maternal inheritance of this genome (Avise et al. 1987, Meylan et al. 1990).

A review of the relevant literature indicates that the most sensitive method already characterized for genotyping of marine turtles involves PCR amplification and sequencing of a 350-400 bp segment from the mitochondrial 'control region' which overlaps with the $tRNA^{pro}$ gene. The method is described in Norman et al. (1994) for *Chelonia mydas* (Green turtle) in the Indo-Pacific and an essentially identical method by Allard et al. (1994) for Atlantic populations. Bowen et al. (1995) apply the same primers used by Norman et al. (1994) to Pacific populations of *Caretta caretta* (Loggerhead turtle).

The herbivorous green turtle is distributed circumglobally in tropical and subtropical oceans (Carr 1967). An earlier survey of green turtle population structure with mtDNA restriction fragment length polymorphisms (RFLPs) revealed a fundamental bifurcation of mtDNA lineages between Atlantic-Mediterranean and Indo-Pacific nesting colonies and a marked geographical structuring of mtDNA genotypes among Atlantic rookeries (Bowen et al. 1992). Despite the relatively high degree of resolution that mtDNA RFLP analyses have provided for other intraspecific surveys (Avise et al. 1987, Moritz et al. 1987), this approach yielded only eight haplotypes in Atlantic green turtles, too few to resolve intraoceanic phylogeographic patterns and certain aspects of population structure.

There was some more recent work on the genetic aspects of the Mediterranean turtle population (i.e., Bowen et al. 1993, Encalada et al. 1996, Schroth et al. 1996, Laurent et

al. 1998, Kaska 2000). This work is an attempt to find out genetic differences present between the adjacent nesting sites of Turkey.

MATERIALS AND METHODS

The sea turtle nesting beaches at the southern coast of Turkey were patrolled twice (last 10 days of July and August) during the hatching season. The second visit was made to the beaches where there were no hatched nests at the first visit. All of these beaches can be seen in Fig. 1 in Kaska (2003).

	Number of samples collected	
Beach	***C. caretta***	***C. mydas***
DALYAN	2	-
FETHIYE	5	-
PATARA	2	-
TEKIROVA	3	-
BELEK	2	-
KIZILOT	2	-
ANAMUR	2	-
ERDEMLI	-	8
KAZANLI	8	8
SAMANDAG	-	2
Total	26	18

Tab. 1. The number of samples collected from the south beaches of Turkey during the summer of 2001.

On these beaches, in collaboration with any working group there, tissues from dead hatchlings were collected. Beaches were patrolled by us when nobody was working on the beaches. Tissues were dissected from 18 green turtle and 26 loggerhead turtle hatchlings from the south beaches of Turkey during the hatching season of 2001 from hatchlings, which were found dead in the nest column during nest excavation after hatching. One sample per nest was taken (Tab.1). Heart, liver and brain samples from the hatchlings were dissected and preserved in absolute alcohol and stored at room temperature.

DNA PREPARATION FROM ALCOHOL PRESERVED TISSUE

We weighed out a piece of tissue on clean tin foil. 30 mg is a reasonable amount and pressed the tissue sample between clean paper towels to remove excess alcohol. The tissue samples were placed in an Eppendorf tube (1.5 ml) with homogenization buffer (10µl per mg wet weight of tissue) (10 mM Tris pH, 2 mM EDTA, 10 mM NaCl). Total DNA isolations from heart samples were conducted by digesting with proteinase K (15µl/ml) and RNAse A (2µl/ml) and 10% SDS (100µl/ml) at 50 °C for 4 h. Contaminating

proteins were removed three times by sequential extraction with equal volumes of phenol-chloroform and the DNA recovered from solution by ethanol precipitation in the presence of 1.25 M ammonium acetate (1/5 volume of 7.5 M Ammonium Acetate (NH_4OAc) and 2 volumes Ethanol (EtOH) and resuspended in TE buffer (10 mM Tris.Cl (pH: 8.0), 1 mM Ethylene Diamine Tetra Acetic acid [EDTA])) to a final volume of 12µl/mg tissue (Sambrook et al. 1989).

RESULTS

Until now, only tissues were collected and DNA samples were prepared.

FUTURE WORK

These tissues will be used for RFLP (i.e., Karl et al. 1992) analyses since in most of the studies this technique was used. Later the overall genetic differentiation at the level of the nuclear genome by means of randomly amplified polymorphic DNA (RAPD) and mtDNA control region sequences will be made. Finally it can also be used for microsatellite analyses. The results will be discussed with related literature.

ACKNOWLEDGEMENTS

Thanks to the Organising Committee and Regional Activity Centre for Specially Protected Areas (RAC/SPA) and Secretariat of the Convention on Conservation of Migratory Species (CMS) for financial support to attend the Conference.

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PROPOSALS FOR SETTING-UP A CLEARING-HOUSE MECHANISM TO MONITOR MARINE TURTLE POPULATIONS IN THE MEDITERRANEAN*

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Research into and conservation of Mediterranean marine turtles has reached a considerable level, but is conducted mostly without a coordinated approach. For example, there are no regular reports on the status of marine turtles on the Mediterranean, and even the results of baseline surveys, let alone the results of more sophisticated surveys, are often made available to the public only years after the surveys are carried out. Despite numerous assessments, we have no clear idea of population developments over the last 20 years. Moreover, conservation efforts are inadequately coordinated and monitored.

Nevertheless, several attempts have been made in recent years to bring together people working on the research and conservation of Mediterranean turtles, and also to collect data and information on Mediterranean turtles in a more goal-oriented way. Major Pan-Mediterranean efforts include:

1. PAN-MEDITERRANEAN MEETINGS

The meetings of the Standing Committee and related specialised meetings of the Bern Convention of the Council of Europe deal with marine turtles on a regular basis. These meetings are attended by representatives of the contracting parties, and of observer states such as members of the Council of Europe and of 3 African Mediterranean states (Morocco and Tunisia, parties, and Algeria, observer), plus IGOs and qualified NGOs with observer status.

The various meetings of the Barcelona Convention, in particular those organised by the Regional Activity Centre for Specially Protected Areas (RAC/SPA of UNEP/MAP), and including those in the framework of the "Action Plan for the Conservation of Mediterranean Marine Turtles". These meetings are attended by governmental organisations and have some NGO involvement. RAC/SPA has established a network of national focal points.

The "Darwin Initiative Workshop on Marine Turtle Biology and Conservation in the Mediterranean", which took place in Cairo in November 2000 and which brought together turtle researchers from several countries.

**Presentation based on a consultancy to the Council of Europe, Bern Convention*

The "First Mediterranean Conference on Marine Turtles", which took place in October 2001, in Rome, and was a joint initiative by the Secretariats of the Barcelona, Bern, and Bonn Conventions, and successfully brought together scientists and conservationists on a broad basis.

2. AN UMBRELLA ORGANISATION

An attempt to create a Mediterranean Sea Turtle Conservation Network for NGOs and individual experts. Two consultations have been held so far, one at Dalyan in June 1999 and one at Cairo in November 2000, and it is intended to launch the network officially in early 2002.

3. MANUALS, GUIDELINES AND PUBLICATIONS

An "Action Plan for the Conservation of Mediterranean Marine Turtles", which was developed on behalf of RAC/SPA and which was adopted in 1989 (with amendments in 1999), identifying priorities for conservation and management.

An overview of the distribution, population status and conservation of marine turtles in the Mediterranean, which was published by Groombridge on behalf of the Council of Europe over a decade ago (in 1990). A more recent overview by Kasparek, Broderick and Godley, but only of the nesting status of Green Turtles, is now available (published in 2001).

A "Manual of Marine Turtle Conservation in the Mediterranean", which was published by Demetropoulos & Hadjichristophorou in 1995, in cooperation with RAC/SPA, IUCN, the Department of Fisheries, Nicosia, and the Cyprus Wildlife Society. This manual is still regarded as a supplement to practical training in turtle conservation techniques.

A major scientific publication on "Marine Turtles in the Eastern Mediterranean", which emerged from the "Darwin Initiative Workshop on Marine Turtle Biology and Conservation in the Mediterranean" and which was published in autumn 2001, with contributions by 34 authors, as a special issue of the journal "Zoology in the Middle East".

4. INTERNET AND PR WORK

a. Pan-Mediterranean PR work being carried out by MEDASSET and others to promote conservation-oriented issues of Mediterranean interest among decision-makers and the general public.

b. EuroTurtle, which is "Europe's first Sea Turtle Biology & Conservation Web Site for Science and Education", which has been established jointly by King's College,

MEDASSET and Exeter University and which provides up-to-date information on Mediterranean turtles, a comprehensive review of most species including their morphology and distribution, and also a great deal of useful material for children.

c. An internet-based list server discussion network, MedTurtle, which has been set up by the IUCN-Marine Turtle Specialist Group (Mediterranean and north-eastern Atlantic subgroup). This supplements the CTURTLE listserv network which operates worldwide.

Despite these numerous activities, better coordination of turtle research, monitoring and conservation is urgently needed, and it should build on existing efforts and ongoing activities. Taking into account the fact that turtle research and conservation in the Mediterranean has to face the often divergent and competing interests of over 20 governments, many non-governmental organisations and intergovernmental bodies, this goal will not be easily achieved.

In order to overcome these difficulties, the establishment of a "Mediterranean Marine Turtle Clearing-House" to promote and facilitate technical and scientific cooperation among the interested parties is seen as an appropriate tool. The Clearing-House should avoid duplicating services already provided by existing centres and networks. It should be a "Clearing-House of Clearing-Houses", or a switching centre, and should not develop, hold or maintain large databases but rather should link up with national, regional and thematic centres.

Some basic principles which will be essential for the successful running of the Clearing-House should be taken into account:

- Independence,
- Mutual benefit of all stakeholders,
- Equality of access for all interested parties,
- Voluntariness of participation,
- Transparency of operation,
- Efficiency in its operation,
- Respect for intellectual property rights.

Most modern Clearing-Houses are based on the internet, and this seems to be a suitable instrument for a Mediterranean Marine Turtle Clearing-House. However, taking into account that not all Mediterranean countries have equal access to the internet, and that not all Mediterranean turtle workers are equally experienced in dealing with electronic information sources, it is recommended that the Mediterranean Marine Turtle Clearing-House should also include other forms of information management.

This approach needs to be developed step-by-step. The first step will be consensus-

building among the parties concerned.

RECOMMENDATIONS

It is proposed that the "Mediterranean Marine Turtle Clearing-House" will be decentralised and will build on already existing structures, organisations and approaches. It will use modern information technologies, but it will be more than an internet gate. It should consist of four main components:

1. Internet gate

The overall goal of the internet gate dedicated to Mediterranean turtles is to link the various relevant internet sites to each other, rather than to build up new information bases. Nevertheless, it will be necessary at least for a transition period to assist various organisations and individuals to publish their information on the internet and to make it available to the gate users. The management of such a gate usually exceeds what can be expected to be done on a voluntary basis. A gate manager should therefore be employed, at least on a part-time basis. He or she should be based at a professional organisation (intergovernmental organisation, NGO, university institute). The internet gate should be operated under the name "Mediterranean Marine Turtle Clearing-House" rather than under the name of the host institution of the site manager.

2. Meetings and conferences

Regular meetings of turtle workers to exchange information and experience should be given a high priority. The First Mediterranean Conference on Marine Turtles, organised jointly by the Secretariats of the Barcelona, Bern, and Bonn Conventions in October 2001, may be regarded as the first in an ongoing series of Pan-Mediterranean conferences. The experience gained from this should be further evaluated, and the conference concept, if necessary, adopted. The possibility of repeating this conference at bi-annual intervals at the least should be discussed among the organisers.

3. Monitoring reports on the overall status of marine turtles in the Mediterranean

Despite so many efforts to survey and monitor turtle populations on land and at sea, we do not yet know, for example, the actual overall population trends, which should be a vital element for designing conservation and awareness programmes. In order to overcome this bottleneck, it is recommended that overall status reports for the Mediterranean are prepared and that they are updated at least on a bi-annual basis. This assessment requires the development of certain standard formats (standard reporting for single nesting sites and countries) and should be organised by an expert (professional consultant) experienced in gathering and evaluating data from different sources. Both the report itself and the background material should be made available through the Mediterranean Marine Turtle

internet gate and in printed form.

4. Mediterranean Marine Turtle Newsletter

The aim of the newsletter is to disseminate information in a rapid and cost-effective way, and to inform people with the minimum delay about ongoing activities, events, publications, preliminary results, and potential and actual threats. In order to maintain continuity, at least two issues should be published per year, both as hard-copy and in electronic format. The responsibility for publication could rest with one or two individuals who need not necessarily be affiliated to an organisation. It is possible that one of the larger NGOs operating at a Mediterranean level (IUCN Marine Turtle Specialist Group and MEDASSET) or an intergovernmental organisation (secretariats of the Barcelona, Bern or Bonn Conventions) could provide the necessary organisational background. Close co-operation with the MedTurtle listserv discussion network and with the worldwide "Marine Turtle Newsletter" (MTN) is recommended. Funding is required for the editors' expenses and for printing and dissemination.

The individual steps in this approach towards a Mediterranean Marine Turtle Clearing-House are not new, and have already been proposed, planned or considered by single stakeholders. What is new, however, is the proposal that the ownership of these efforts should reside with the entire Mediterranean marine turtle community rather than with a single organisation. Previous experience has shown that turtle workers often do not identify with the activities of other organisations and therefore do not want to contribute to the activities of other organisations. To explain this by an example: a "Mediterranean Marine Turtle Newsletter" under the aegis of a Mediterranean Marine Turtle Clearing-House may have the best chance of being accepted by the entire turtle worker community and of being used as such as an effective tool in information exchange, whereas a newsletter published by any one organisation working on marine turtles will always have to struggle against the competing interests of individuals and organisations.

FISHERMEN AND TURTLES: A PORTABLE EDUCATIONAL KIT FOR SCHOOLCHILDREN

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Since its inception, ARCHELON has tried to utilise the remarkable life cycle of sea turtles, as an instrument in promoting a new attitude to life (Kremezi-Margaritouli 1992). The new attitude requires equal respect for all living and non-living components of our planet. The sea turtle is just the flag species, the animal we know more about, and can better answer the questions that children ask.

It would be considered a failure of our programme, if a child who has participated in it, respected sea turtles but mistreated other organisms. No matter what organism we deal with, the results must be similar: the respect we demand for ourselves, to be able to share with other people and with all the creatures on the planet.

Since 1985, ARCHELON has been interacting yearly with thousands of schoolchildren. Most children participate directly in our educational activities, either at their schools or at the Sea Turtle Rescue Centre in Glyfada (close to Athens) where we have established facilities specifically for environmental education (Kremezi-Margaritouli 1998).

For 7 years ARCHELON has achieved direct contact, by offering four-day cultural trips in Athens area, to schoolchildren originating from the important loggerhead nesting areas at Zakynthos, Bay of Kyparissia and Crete.

Since 2000, schoolchildren have been visiting the Evrotas Environmental Centre, which was established in an abandoned school in Lakonikos Bay, southern Peloponnesus, and then are guided along a Nature Trail designed through sand dunes, in order to have a first hand experience on the plants and animals of the region. A similar Environmental Centre was recently established in the old train station at Agiannakis in the Bay of Kyparissia.

We have indirect contact with the public and especially the schoolchildren through our educational publications and even more through our portable educational kits. The "Turtle Briefcase" has been travelling since 1990 to remote destinations (Kremezi-Margaritouli 1992). It has contributed in making *Caretta caretta* very popular in Greece.

The second educational kit, "Life on the Coast" has been around since 1992. It is based

on the knowledge acquired, after a nation-wide survey, ARCHELON completed in search of new nesting areas. It aims at exploring the particularities of life on the edge, and inspired by the sea turtle that utilises both sea and land to fulfil its biological needs.

We came up with the idea of designing and creating the "Fishermen and Turtles" kit, after observing, that many turtles, admitted to the Rescue Centre, were intentionally injured by humans. It comes a time when all of us, who have worked with endangered species, wonder: how can I help, what can be my participation, in changing negative attitudes and behaviour toward animals, to positive and friendly ones.

The "Fishermen and Turtles" kit, attempts to influence and persuade schoolchildren that fish stocks will not increase if turtles become extinct; and through schoolchildren to persuade adults. All ARCHELON portable kits, aim at providing an opportunity to initiate discussions and exchange opinions, so that all parties are benefited.

This kit is targeted at young people aged between 10 and 18, and comprises the following items:

- A manual with instructions for the teacher as well as bibliography for further reading
- A three-folding desk panel with information on exemplary cases of sea turtles admitted to the Rescue Centre and first aid procedures
- A volume with three activity sheets for primary and secondary school levels, and propositions for activities to be applied indoors and outdoors
- A box with items related to fishery and turtles
- A book entitled " The Book of the Sea"
- The book "Caretta"
- The video tape "Fishes"
- A file-gift to the teacher and the school community

But the most important component of the kit, is the set of 60 slides, with explanatory text. I wish to elaborate on this, in order to show the philosophy behind the "Fishermen and Turtles" kit:

The Introduction deals with the evolution of our planet, the first fishermen and the etymology of the Byzantine word "opsarion" = fish, which mend something small that accompanies bread, the staple diet at that time.

The next chapter, Fishing Methods, deals with coastal fisheries (set gill nets and bottom longlines), bottom trawling, purse seines and high seas fisheries. It also refers to the waste of sea life, caused mainly by high seas fisheries, that sometimes may discard more than 50% of the catches.

The chapter Global State of Fisheries focuses on the depletion of fish stocks, the conflicting policy of the European Union, that, on the one hand provides incentives for

upgrading fishing boats (fleets), and on the other hand, subsidises their withdrawal and destruction. In this chapter it is mentioned that 59% of fishing stocks is fished by 1% of the world's fishing fleets, owned by Japan, USA, China, Russia and EU. Also the damage caused by drift nets, is given a mention in this chapter.

In the chapter Aquacultures, the question is posed whether this can be the answer to the problem.

In the chapter Fishermen the brave character of a traditional fisherman is portrayed. Examples of brave fishermen in Greek history are mentioned too.

The chapter Encounters: from Mermaids to Turtles describes the opposing feelings that are generated by such encounters. A daunting picture for the sea turtles is painted and the case of TED is described followed by the comment: if we want we can.

As a conclusion I copy the last two chapters of the slide show text:

How could I help

A consumer and especially a child can make a difference, if there is a will. We could avoid impacting the sea with recreational fishing. We can enjoy a dive in the sea without removing something, just like we enjoy a walk in the forest without having to hunt.

We should have a fair knowledge on the different fish species, the seasons during which they can be sold on the market, and in the restaurants and the sizes permitted for their fishing. For example: swordfish are allowed to be taken if longer than 1.2 meters (without the "sword") and bogue (ox-eye) 10 cm etc, and we shouldn't buy or eat smaller sizes.

We should not waste food by ordering more than we can consume. We should try to persuade others with our pro-environmental arguments. Knowledge will provide us with all the arguments we need to persuade others.

In general, before we take any action, we should consider, how it could affect the planet. The following example is quite interesting: Greek fishermen co-operate with the ARCHELON Rescue Centre and help protect sea turtles. Some of them even offer free fish for the turtles.

Epilogue

The fish stocks of our planet are a natural resource just like water and soil are. Once upon a time we used to consider natural resources as being limitless, and wasted them without a second thought. Today, nothing can be more wrong than these old beliefs.

ARCHELON is not, and does not want to be a law enforcer. The role of NGOs is to raise awareness and change attitudes and behaviours.

At the Rescue Centre, 100 schoolchildren participate daily in environmental education

programmes. Caretta caretta today is the most popular endangered species in Greece and usually generates positive feelings. But what happens though to the other rare species of our planet?

Jesus Christ, selected his disciples amongst "simple fishermen". This proves the traditionally noble perception, held for fishermen. Humans are not the centre of the world. Respect to all life forms, is effectively, respect to our fellow person.

The roles of the powerful and weak, can easily change when conditions change. The only thing that does not change, is the values we all cherish, and the way we seek, to achieve the motto: "We Can All Live Together".

ACKNOWLEDGEMENTS

I would like to earnestly thank:
Nikos Charalambides, oceanographer, for providing the raw material for the kit.
Makis Spinos, ichthyologist, for his valuable comments.
The LIFE Nature projects for providing funding.
Dimitrios Dimopoulos, biologist, for translating my text.

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RESULTS FROM GENETIC SCORING OF DEAD NESTLINGS OF *CARETTA CARETTA* FROM GREEK BEACHES

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INTRODUCTION

Population genetics is an indispensable source of information for our understanding of the past, present and, by extension, future state of any natural population (Avise 1994). This is particularly so for populations which are under threat or under exploitation by man. With regard to the loggerhead turtle *Caretta caretta*, several population genetics studies have already made significant advances in our understanding of the distribution, migration patterns and nesting habits, all of which are of fundamental importance in drawing a comprehensive and effective strategy for the protection and management of the natural populations of the species (Bowen et al. 1994, 1995, Schroth et al. 1996, Bolten et al. 1998, Laurent et al. 1998). The potential contribution of genetic tools to the understanding of the population biology of the species and its management and protection extend beyond delineating migration and homing patterns. It may provide information on the separate roles of males and females in the spatial genetic heterogeneity of populations, on effective population sizes (which may not parallel the consensus sizes, yet are more sensitive indicators of the species' long-term potential for survival) and on monitoring the effects of protective measures on the genetic wealth of the species. The results reported here address some of these questions.

MATERIAL AND METHODS

One or two dead nestlings were collected during post-hatch excavation of nests, routinely carried out by ARCHELON's monitoring projects, at six nesting beaches of Greece. Part of the tissue was stored in 90% alcohol and shipped to the Institute of Marine Biology of Crete. There has been no attempt to determine stage of development of the nestling at death. The number of sampled nests and the total number of nestlings obtained from each

shore are given in Tab. 1. Each nestling was scored at four microsatellite loci, which are parts of DNA that consist of tandemly repeated dinucleotides normally varying in the number of repeats. We used the primers published by FitzSimmons et al. (1995) and FitzSimmons (1998).

Nesting area	Code	Nests sampled	Total number of nestlings
Lakonikos Bay	LAK	30	59
Bay of Kyparissia	KYP	30	60
Zakynthos	ZAK	33	66
Bay of Chania	CHA	21	34
Rethymno	RET	29	54
Bay of Messara	MES	10	15
TOTAL		**153**	**288**

Tab. 1. Sampled sites, number of nests and total number of nestlings sampled.

RESULTS

1. Allele frequencies and genetic variation

Tab. 2 provides number of nestlings scored, number of observed alleles and observed as well as expected heterozygosities. One observation is that there is no systematic trend for the observed heterozygosity to be larger or smaller than the expected heterozygosity, which in turn means that there are no signs that natural populations deviate strongly from random mating.

2. Genetic differences among nesting areas

Allele frequencies (not shown here in need of space) were used to obtain the degree of genetic relatedness among nesting areas. There was no obvious trend for a correlation between genetic similarity and geographic proximity of sites, for significant deviations from random mating within populations or for the population as a whole.

3. Multiple paternity

The existence of scores for two siblings from the same nest allows an answer to the question of whether the two nestlings have a common father. Detection of multiple paternity through the genotypes of the offspring of a female depends critically on two factors: the number of offspring examined and the amount of variation in the population of the genetic loci used. Out of 24 possible comparisons, in 18 cases the observed value was smaller than the one expected if the hatchlings were full sibs, and in 6 it was larger. Thus, there is reason to suspect that multiple paternity is common.

	Cc7	Cc117	Ei8	Cm84
LAK	45 (17x2+11)	51 (22x2+7)	53 (23x2+7)	46 (19x2+8)
	13	10	7	8
	0.885	0.803	0.789	0.778
	0.642	0.827	0.833	0.778
KYP	37 (12x2+13)	40 (16x2+8)	41 (14x2+13)	45 (18x2+9)
	10	13	9	10
	0.847	0.854	0.825	0.834
	0.920	0.854	0.796	0.722
ZAK	42 (14x2+14)	51 (19x2+13)	50 (21x2+8)	45 (15x2+15)
	10	7	8	9
	0.802	0.656	0.731	0.770
	0.785	0.625	0.793	0.783
CHA	23 (4x2+15)	20 (3x2+14)	28 (8x2+12)	21 (4x2+13)
	14	7	8	7
	0.897	0.712	0.810	0.739
	0.921	0.794	0.900	0.558
RET	28 (7x2+14)	35 (11x2+13)	33 (11x2+11)	36 (11x2+14)
	10	7	8	8
	0.815	0.665	0.761	0.682
	0.809	0.583	0.840	0.620
MES	10 (2x2+6)	13 (4x2+5)	11 (2x2+7)	7 (1x2+5)
	8	8	9	7
	0.849	0.799	0.797	0.819
	1	0.833	0.889	0.667

Tab. 2. Number of nestlings scored (first row), number of alleles observed (second row), expected heterozygosity (third row) and observed heterozygosity (fourth row) for each nesting area and microsatellite locus. The parenthesis in the first row breaks the number of nests scored in those with two scored nestlings (first number) and with one (third number).

4. Triploidy

In the process of scoring we came across nestling that had three alleles (trizygosity), which is incompatible with diploidy. For the whole collection of samples the minimum estimate of trizygosity was 6%.

DISCUSSION

The microsatellite data we obtained are compatible with the null hypothesis that nestlings found in a nesting area are a random sample of the combined nestling population. This is equivalent to saying that we cannot reject the hypothesis that females nesting in different beaches are drawn from the same random mating population. This is not equivalent to

saying that the data provide evidence for this hypothesis, simply that the data cannot reject the hypothesis.

The results are also useful in another context. The observation that a reasonably high amount of genetic variation was found among nestlings from the same beach, as well as in all beaches combined, and that observed heterozygosities did not trail behind expected heterozygosities is an indication that the breeding population of *C. caretta* from which the sampled females originated is large and does not show any signs of inbreeding. This agrees with a model of thorough mixing of adults at the feeding grounds, irrespective of the natal origin.

Multiple paternity may have several implications for the conservation of the species. An obvious difference between a nest with a multiple paternity and one with a single paternity is that the former contains a larger part of the population's genetic variation. This may mean that a higher number of hatchlings may survive from a multiple rather than from a single paternity nest, owing to an improved chance of the sibship to cope with a variety of adverse conditions. It may also mean that genetic competition among individuals may start very early in life, while still in the same nest.

The observation that 6% of the hatchlings appeared to possess three rather than two microsatellite alleles is unexpected. The observation of trizygosity in more than one locus makes triploidy the most likely explanation. This means that one of the gametes failed to undergo meiosis. Triploidy would lead to death at an early stage of development or at some later stage in life. The questions that arise are of several kinds: a) what percentage of deaths among hatchlings is due to trisomy? b) does it result from meiotic abnormalities in the female or male parent? c) does the frequency of these abnormalities relate to stress? These questions cannot be evaluated without specifically designed experiments and field studies.

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CORROBORATION OF THE CRITICAL HABITAT HYPOTHESIS FOR THE LOGGERHEAD SEA TURTLE *CARETTA CARETTA* IN THE EASTERN ADRIATIC SEA

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INTRODUCTION

Following the globally increased interest in research and conservation of declining marine turtle's populations, the first long-term monitoring and tagging programs in the Mediterranean have started on the nesting beaches in Greece and Cyprus in 1981/82. After a decade of beach surveys and studies of nesting biology of the two species which reproduce in the Mediterranean basin, the loggerhead turtle *Caretta caretta* and the green turtle *Chelonia mydas,* little was known about the distribution and biology of species in critical marine habitats, namely the developmental, foraging and wintering areas, as well as about their migratory journeys.

The first analyses of the tag recoveries in the region raised the idea of the existence of over-wintering habitats in Gulf of Gabès in Tunisia (Margaritoulis 1988, Argano et al. 1992).

Indeed, the work of Laurent and Lescure (1994) has supported this hypothesis and classified the area as a benthic developmental and foraging ground for *C. caretta* in the Mediterranean (Margaritoulis et al. 2003).

The other region that has rather recently attracted the interest of marine turtle researchers is the Adriatic Sea. Although marine turtles, namely the loggerheads, were mentioned as part of the indexes of fauna and in museum's catalogues in the 19th and 20th centuries, they were relatively unknown in the Adriatic (Lazar and Tvrtković 1995). Groombridge (1989) has speculated as to the possible importance of the Adriatic as an over-wintering area, but scarce tag recoveries in the region (Margaritoulis 1988) gave just a modest proof of that. The Adriatic recaptures of loggerheads tagged by Italian researches (Argano et al. 1992) followed almost the same pattern as the one of Margaritoulis (1988). However, due to a higher number of tag returns in the region, the authors have proposed the Adriatic to be "an important area where loggerheads search for food", with a "decided tendency towards the northern Adriatic" (Argano et al. 1992).

The systematic collection of data on marine turtles in the eastern Adriatic Sea was started by the Adriatic Marine Turtle Program in 1993. This Program is part of the scientific activities of the Department of Zoology, Croatian Natural History Museum, and it is implemented in collaboration with oceanographic institutes, aquariums and natural history museums in Croatia and Slovenia. With this paper we analyze the role of the eastern Adriatic as a critical marine habitat for the loggerhead sea turtle in the Mediterranean.

MATERIALS AND METHODS

The results are based upon (1) analyses of data on incidental catch and size-class distribution of loggerheads in the eastern Adriatic obtained through questionnaires and interviews with fishermen (extracted from Lazar 1995, with inclusion of new data), (2) migration data obtained by tag recoveries (Lazar et al. 2000), and (3) dietary analysis (Lazar et al. 2002, with inclusion of new data). The results are discussed through a prism of oceanographic characteristics of the Adriatic Sea, and the distribution of the relevant benthic communities.

RESULTS AND DISCUSSION

1. By-Catch Analyses and Size-Class Distribution

The data on interaction of 96 marine turtles (presumably *C. caretta*) and fisheries in the eastern Adriatic were analyzed (Lazar 1995). 72% of the turtles were captured by trawls, generally in depths between 20 and 50 m. The temporal distribution of recoveries suggests the residence of turtles in the region throughout the year (Fig. 1). There seems to be two peaks of by-catch, one in summer and another in winter. The first one may be explained

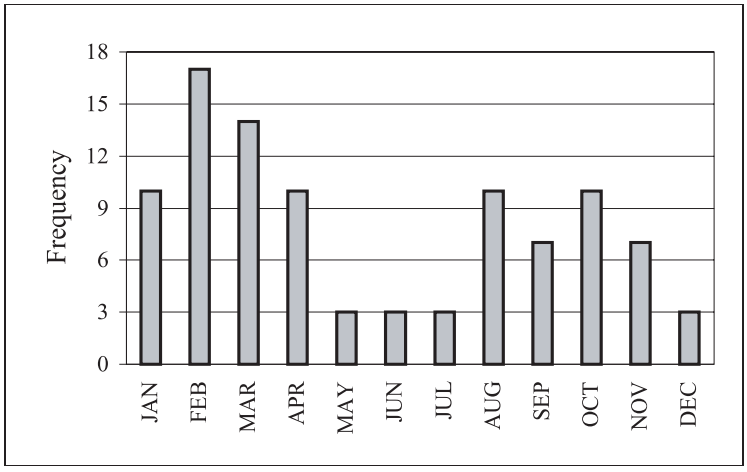

Fig. 1. Temporal distribution of marine turtle by-catch in the eastern Adriatic Sea (n=29, after Lazar 1995).

by a higher activity of animals during the warm period (May-October), when the surface sea temperature may reach even up to 24-25°C (Buljan and Zore-Armanda 1971). Hence, turtles become more active and involved with particular fishing gears. Indeed, a recent study points that by-catch in coastal gill nets is positively associated with the warm season (Lazar et al. in press). On the other hand, captures in trawls, mostly bottom operating, are associated with the cold season (Lazar et al. in press). That indicates the presence of loggerheads in the eastern Adriatic waters during the winter too (Fig. 1), supporting the hypothesis of Groombridge (1989) on the existence of loggerhead's wintering habitats in the Adriatic Sea. Although we are aware of the limits of interpretation of data collected indirectly through interviews and questionnaires, it is interesting that the field studies in the western Adriatic (Italy) performed by on-board observers gave almost identical results (Casale et al. 2003, Gerosa pers. com.).

The size class distribution analyses (Fig. 2) shows the juveniles: adults ratio of 1.3:1, respectively (Lazar 1995). It is obvious that both juveniles and adults frequent the eastern Adriatic. Furthermore, some new data (Lazar, unpublished) suggest the presence of even small pelagic juveniles (SCCL<20cm) in this area (Fig. 2).

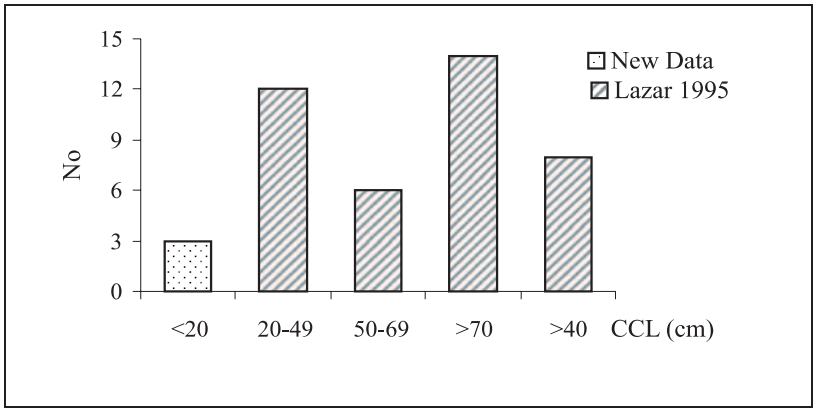

Fig. 2. Size classes distribution of marine turtles in the eastern Adriatic Sea (n=43, after Lazar 1995, with inclusion of new data). The last bar (>40) signifies individuals larger than 40 cm with no further size class specification.

2. Movements, Habitat Utilization and Origin of Loggerheads in the Eastern Adriatic Sea

The high yearly by-catch of 2,500 turtles by Eastern Adriatic fisheries (Lazar and Tvrtković 1995) and of about 3,600 turtles in the western Adriatic (Casale et al. 2003), may be explained only by the immigration of turtles into the Adriatic waters. The eastern Adriatic recoveries of tagged loggerheads showed a possible post-nesting pathway from reproductive beaches in the Ionian Sea into the Adriatic along the eastern coast,

coinciding with the direction of the prevalent surface current (Lazar et al. 2000). The concentration of tag returns in northern Adriatic points to nonrandom travel, emphasizing the importance of this region as a demersal habitat.

The northern Adriatic is characterized by its shallow depth (mean depth: 81.5 m, the mean depth of the Gulf of Trieste: 30 m), high fluctuation of physical parameters throughout the year, high riverine input, soft bottom, and a high productivity. A study on feeding ecology has pointed to the northern Adriatic as a benthic habitat for *C. caretta* (Lazar et al. 2002). Analyses of exclusive and preferential species in loggerhead's diet emphasized the community of coastal detritical bottom mixed with ooze and the biocenosis of coastal terrigenous ooze as foraging habitats. These soft-bottom communities present typical and widespreaded benthic communities in the northen Adriatic, classifying this region as a benthic developmental and foraging habitat for both juvenile and adult loggerheads.

The results show that the Adriatic Sea hosts critical marine habitats for *C. caretta*. Benthic communities in shallow waters of the North and Middle Adriatic constitute rich and easy-available energetic resources for the nutrition of the species. The Gulf of Gabès in Tunisia and the Adriatic Sea present the two widest shallow regions in the Mediterranean basin, with depths less than 200 m. Therefore, it is not strange that the highest number of tag recoveries came exactly from these two areas (Margaritoulis et al. 2003), which seem to represent the two largest demersal habitats for *C. caretta* in the Mediterranean.

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IDENTIFICATION OF A DEVELOPMENTAL HABITAT OF THE GREEN TURTLE IN LAKONIKOS BAY, GREECE

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INTRODUCTION

The Mediterranean population of the Green Turtle *Chelonia mydas* is critically endangered (Baillie and Groombridge 1996). Nesting areas in the Mediterranean are confined in the Levantine Sea, with Turkey and Cyprus hosting about 99% of all nests (Kasparek et al. 2001). Although knowledge on nesting areas of green turtles in the Mediterranean is substantial, information on their marine habitats is rather scarce. Recently, satellite tracking of green turtles has shown a post-nesting coastal migration from Cyprus to Egypt and Libya (Godley et al. 2002). Concerning juvenile green turtles, Baran and Kasparek (1989) have suggested a restricted dispersal, in comparison to loggerheads, and Türkozan and Durmus (2000) indicated a possible feeding habitat in Fethiye (Turkey).

Green turtles in Greece are considered as rather uncommon occurrences (Margaritoulis et al. 1986). In the period 1994-2000, from a sample of 226 turtle strandings, found alive along the coasts of Greece, 8 (3.5%) were identified as green turtles (Panagopoulos et al. 2003).

The beaches of Lakonikos Bay, in southern Peloponnesus, comprise a "major" loggerhead nesting area in Greece (Margaritoulis 2000). Furthermore the bay hosts an important local fishery, mainly based at the port of Gytheion, consisting of bottom trawlers, beach seines, gill netters and bottom longliners. During the fishing period (October through May) of 1989-90 a pilot project of ARCHELON investigated the extent of incidental catch among bottom trawlers and beach seines. The relatively high number of juvenile green turtle captures in the area, suggested a developmental habitat (Margaritoulis et al. 1992). In order to collect more data on this phenomenon a systematic study on incidental catch was implemented from October 1997 until May 2000. This paper presents the results of this investigation.

METHODOLOGY

An awareness project in the port of Gytheion, initiated by ARCHELON in 1989, prepared the ground for evolving good relations with fishermen. Almost all operative

fishing vessels, in this port, were monitored during three fishing periods (October to May) from October 1997 through May 2000. On the average, 25 fishing vessels were monitored: 2 bottom trawlers, 6 beach seines and 17 gill netters and bottom longliners. Fishermen were trained as to the identification of the three possible species of marine turtles they might encounter (loggerhead, green turtle, leatherback). In case of a turtle's capture, fishermen recorded the species and the approximate location and depth of capture. Fishermen were instructed to release immediately all captured turtles, besides the ones needed recuperation.

A complementary investigation was carried out, from May 1997 until December 2000, by project personnel to record, identify and measure all turtles found stranded (live and dead) along the beaches of Lakonikos Bay. Carcasses were buried by local communities or project personnel.

RESULTS

During the three fishing seasons (October 1997 through May 2000), 188 turtles were incidentally captured from the monitored fishing vessels. Of these, 112 (59.6%) were identified by fishermen as *Caretta caretta* and 76 (40.4%) as *Chelonia mydas*. As reported by fishermen, all captured turtles were in good condition and, after recording of data, were released.

In total, beach seines effected 139 captures (73.9%), gill-netters 24 captures (12.8%), bottom trawlers 22 captures (11.7%), and bottom long-lines 3 captures (1.6%) (Fig. 1). Beach seines effected 84.2% of all green turtle captures and 67.0% of all loggerhead captures (Fig. 1).

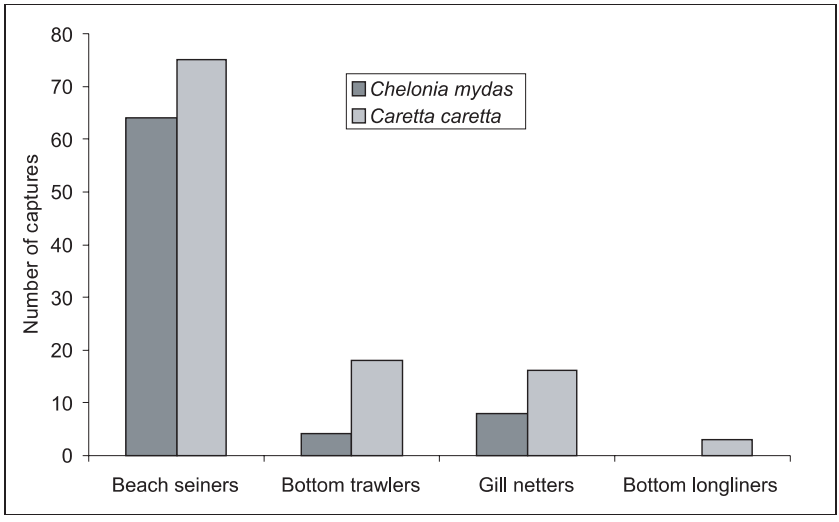

Fig. 1. Turtle captures per species and per fishing gear in Lakonikos Bay.

Spatial distribution of captures in the water column shows that the preferred depth by *Chelonia*, in relation to *Caretta*, is up to 20 fathoms (about 36 m). In deeper waters, captures of *Caretta caretta* predominate (Fig. 2).

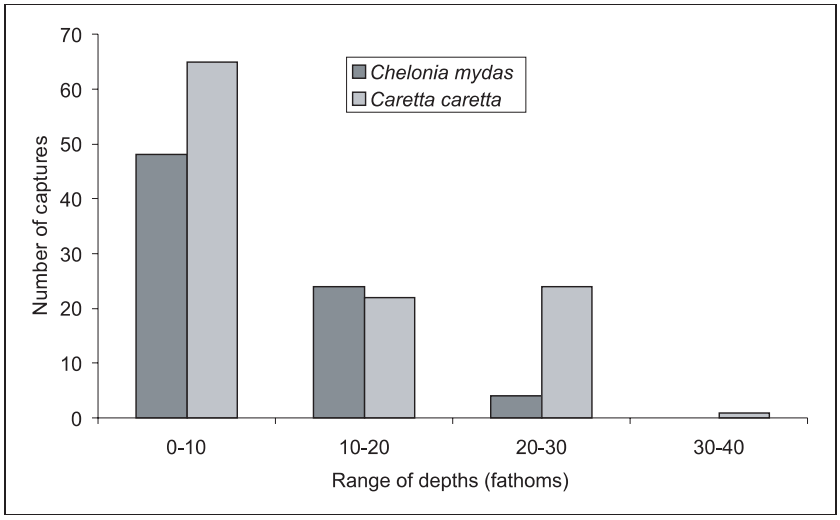

Fig. 2. Turtle captures per species and per depth in Lakonikos Bay.

The bi-monthly distribution of captures per species (combined over the years) over the 8-month fishing season, is shown in Fig. 3. In the months October and November, green turtles predominate whereas in the remaining months (December through May) loggerheads predominate. However, both species are present in the area throughout winter.

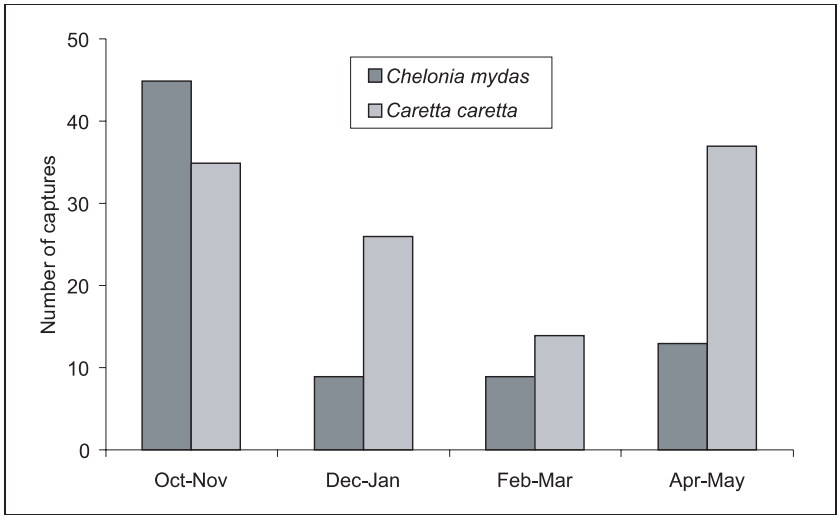

Fig. 3. Bi-monthly distribution of turtle captures per species in Lakonikos Bay.

During the period May 1997 - December 2000, 73 turtles were either found stranded (dead: 67 turtles, injured: 4 turtles), or brought to project personnel by fishermen after capture (2 turtles in good condition). Of these 73 turtles, 42 (57.5%) were identified as loggerheads, 30 (41.1%) as green turtles and 1 (1.4%) as leatherback. Sixty-nine of the above turtles (leatherback not included), measured by project personnel, gave the following Curved Carapace Lengths (CCL) per species: loggerheads 65.5 cm (range: 17.5-90.0 cm, n=41), green turtles 36.4 cm (range: 30.0-67.0 cm, n=28). Distribution of size frequencies per species is shown in Fig. 4. It must be noted, however, that the three largest green turtle individuals were found dead with large hooks and thick lines, belonging to drifting longlines, and thus they are not considered as belonging to the stock residing in Lakonikos Bay.

Analysis of stomach contents of two green turtles (CCLs: 34.5 cm and 30.5 cm), found dead in July 2000 and in August 2001 respectively, revealed almost exclusive consumption of leaves and roots of *Cymodosea nodosa*, with few leaves belonging to *Zostera marina*, both sea grass species present in the Bay.

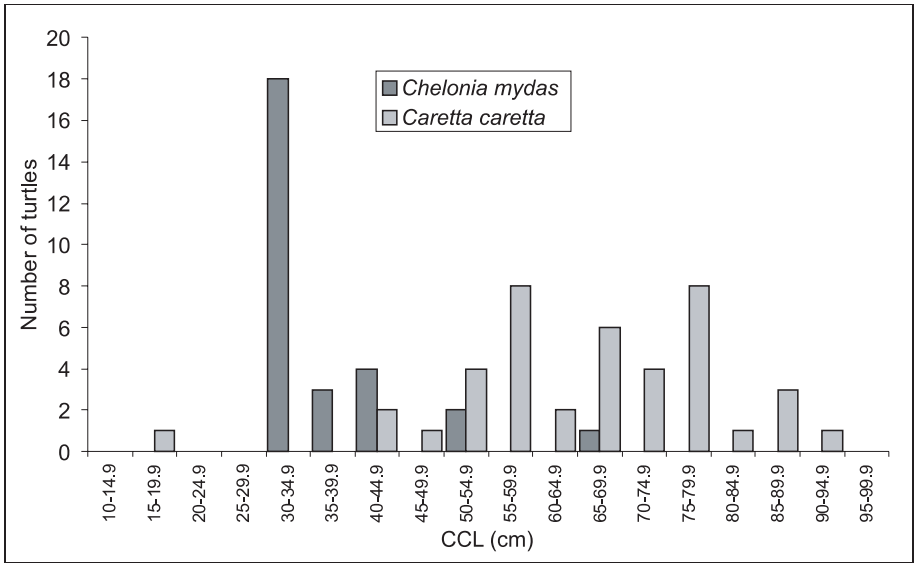

Fig. 4. Size (CCL) frequency distribution per turtle species in Lakonikos Bay.

DISCUSSION

The above work provides strong evidence of a developmental habitat of green turtles in Lakonikos Bay. Turtle species distribution recorded by fishermen on captures is similar to species distribution recorded by project personnel on strandings. As shown by captures during winter and strandings, green turtles are present in Lakonikos Bay throughout the

year. Comparison of sizes, reveal that green turtles in Lakonikos Bay belong to a narrow size class (30.0-44.0 cm, excluding the 3 largest animals, caught offshore), indicating the existence of a specific developmental habitat, which is further confirmed by the documented herbivorous diet in two specimens of the predominant size.

From the results, it is derived that green turtles in the region venture far more west of what was originally thought. Lakonikos Bay is located about 600 km west of Patara (Turkey), the westernmost nesting site of *Chelonia mydas* in the Mediterranean (Erdogan et al. 2001).

The existence of a developmental habitat of the critically endangered green turtle in Greece will certainly modify current national and EU legislation (e.g., inclusion of *Chelonia mydas* in the "priority species" of the Habitats Directive), for a comprehensive regional protection of the species.

ACKNOWLEDGEMENTS

Permit was provided by the Ministry of Agriculture. Work done was included in a LIFE Nature project, financed by the EU and the Ministry of Environment. Stomach contents were identified by P. Panagiotides (National Centre for Marine Research), to whom we are grateful. Many thanks to project personnel and volunteers for their dedication. The project could not have been implemented without the good will and cooperativeness of the fishermen of Gytheion.

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ASSESSING MARINE TURTLE BYCATCH IN THE TRAWL FISHERIES OF GREECE

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INTRODUCTION

A primary threat for marine turtles is incidental catch during fishing operations. Trawl fishing is a major method of commercial fishing in Greece. However, its impact on marine turtles has been only studied locally and in a rather non-systematic way (Margaritoulis et al. 1992). A possibility for a more overall and reliable assessment of marine turtle bycatch and subsequent mortality has been provided through the so-called European Marine Turtle Project (EMTP). Based on a conservation biology approach, including stock composition assessment and life history stage distribution analysis, the EMTP project (98/008) was designed to investigate turtle bycatch in European fisheries that appear to have the greatest impact on population dynamics. These fisheries included (a) drifting longlines in Spain, Italy (Ionian Sea) and Greece, and (b) trawl fisheries in Italy (northern Adriatic) and Greece. Herewith we present the main results of the EMTP work concerning turtle bycatch in the trawl fisheries of Greece.

MATERIALS AND METHODS

The Greek trawler fleet is composed of 427 vessels (1998 data), which are widely distributed in different ports throughout the country. The fishing technique is bottom trawling and its target is fish. Trawling in Greece is forbidden in less than 1 mile from the coast but in some sensitive areas this prohibition extends to 3 miles. A closed season for trawling is imposed annually from 1 June until 30 September.

During the project two major fishing areas (and three ports) have been sampled, the Thracian Sea (ports of Kavala and Alexandroupoli) in the northern Aegean Sea and the Ionian Sea (port of Patra). Sample allocation per port was proportional to the number of trawlers at each port. As trawl fishing in Greece is closed during summer, three calendar quarters were used for sampling: January through March (winter), April through May

(spring) and October through December (autumn). The primary sampling unit was the boat trip, regardless of the number of days of a trip. The units were sampled according to a random extraction giving a sequence of boats belonging to the collaborating pool by port. Data were collected by trained onboard observers. The gear, haul and turtle parameters were taken following a common protocol.

Captured turtles were double tagged, at the trailing edge of front flippers, with monel tags No 681. Straight and curved carapace lengths were taken by using aluminium calipers and flexible tape, respectively. The standard carapace length (SCL) was taken from the nuchal scute (at midline) to the distal tip of the longest supracaudal (notch to tip) and the minimum carapace length (MCL) was taken from the nuchal scute (at midline) to the notch between supracaudals (notch to notch). The physical condition of the turtles was noted as healthy, injured, in comatose state or dead (after Poiner and Harris 1996).

RESULTS AND DISCUSSION

During the two-year project 641 hauls were observed (254 in 1999 and 387 in 2000). Of these, 421 hauls were sampled in the Thracian Sea (193 from the port of Alexandroupoli and 228 from the port of Kavala) and 220 in the Ionian Sea. Some overall statistics of the trawl operation, deducted from the monitored trips, are the following: haul duration (mean: 201.8 min, range: 20-1,005), depth of trawl (mean: 81.5 m, range 5.5-773), speed of trawl (mean: 2.8 knots, range: 1.6-4.1) and haul frequency (mean: 3.6 hauls/day, range: 1-9). However, there is great variability of the above statistics per fishery and port.

In total four turtles (three *Caretta caretta* and one *Chelonia mydas*) were captured during the project (Tab. 1). All captured turtles were in good condition and were released after being measured and tagged. Capture depths ranged from 9 to 49 m, confirming the fact that these turtle species are rarely found in waters deeper than 50 m (Epperly et al. 1995, Poiner and Harris 1996). No turtles were caught during the "winter" quarter (Jan.-Mar.). Because of their size all captured turtles were classified as immature. The size of the smallest loggerhead specimen (CSCL: 34.5 cm), comparable with the smallest loggerheads caught by trawlers in other parts of the Mediterranean (Laurent at al. 1996), probably reflects the minimum size of loggerheads establishing themselves in a demersal phase. The capture of a green turtle (Tab. 1) confirms previous evidence of developmental habitats of this species in Greece (Margaritoulis et al. 1992). It is interesting to note that this turtle was captured in a substrate of sea grass (Tab. 1).

Turtle catch rates, with 95% confidence intervals, ranged in 1999 from zero (Ionian Sea) to 0.06250±0.08521 turtles/day or 0.01219±0.01685 turtles/haul (Thracian Sea) and in 2000 from 0.01851±0.03630 turtles/day or 0.00769±0.01508 turtles/haul (Ionian Sea) to 0.01851±0.03630 turtles/day or 0.00389±0.00763 turtles/haul (Thracian Sea).

	Caretta caretta	*Caretta caretta*	*Chelonia mydas*	*Caretta caretta*
Year	1999	1999	2000	2000
Area	Thracian Sea	Thracian Sea	Ionian Sea	Thracian Sea
Quarter	Spring	Autumn	Spring	Autumn
Capture depth (m)	32.5-38	42-49	9-11	43.5-45.5
Haul start time	15:22	4:35	8:02	5:34
Haul duration (min)	185	175	93	68
H/rope length (m)	27.15	36	43	30
Bottom type	Sand-Gravel	Sand-Mud	Sea grass	Sand
CSCL (cm)	45.0	34.5	47.0	48.0
CMCL (cm)	43.0	33.0		46.5
SSCL (cm)	42.5	31.5	45.0	44.0
SMCL (cm)	40.5	30.5		42.0

Tab. 1. Related parameters of captured turtles in trawl fisheries of Greece.

The catch rates per fishing duration and headrope length (standardised for one hour's fishing and a 30.5 m headrope) get highly variable values, depending on the monitored port fleet. In 2000, the year to which the greater observed effort was allocated, catch rates ranged from 0.00336±0.00062 (95% CI) in the Thracian Sea (Alexandroupoli) to 0.00092±0.00182 in the Ionian Sea (Patra). Such a result indicates the occurrence of specific zones where turtle density is higher, as reported previously in Lakonikos Bay (Margaritoulis et al. 1992). For the total project period (1999-2000) the catch rate in the fleet of Alexandroupoli (mean: 0.00631) is comparable to catch rates reported for the Gulf of Mexico (Henwood and Stunz 1987) and northern Australia (Poiner and Harris 1996) and lower to those reported for the southern North Atlantic (Henwood and Stunz 1987) (Tab. 2).

Areas	*Caretta caretta*	Source
Thracian Sea (Alexandroupoli)	0.00631	Present study
USA southern North Atlantic	0.0456	Henwood and Stunz 1987
USA Gulf of Mexico	0.0025	Henwood and Stunz 1987
Northern Australia	0.0011	Poiner and Harris 1996

Tab. 2. Turtle catch rates (per 30.5 m headrope net and hour) in bottom trawl fisheries.

Turtle catch rates in combination with the available fishing effort statistics (Tab. 3) yield an estimation of the total turtle catch per year for the two study areas (Tab. 4). Taking into account the data of 2000, because of the largest sample size, the total number of turtles caught per year are estimated from 0 to 418 individuals in the Thracian Sea and from 0 to 448 individuals in the Ionian Sea. Such estimation is of low accuracy due to the very small number of turtles caught in each fishing area (only one turtle).

	Thracian Sea		Ionian Sea	
Year	1999	2000	1999	2000
No of vessels (operating)	32	43	84	48
No of fishing days	5817.6	7632.5	14868.0	8179.2
No of hauls	33609.9	34238.3	34057.0	27487.2

Tab. 3. Fishing effort statistics (provided by the Institute of Marine Biology of Crete).

	Thracian Sea		Ionian Sea	
Year	1999	2000	1999	2000
Total turtle catch (days)	364±496	141±277	0	151±297
Total turtle catch (hauls)	410±566	298±261	0	211±415

Tab. 4. Total turtle catch (per 30.5 m headrope net and hour) with 95% confidence.

Direct mortality, i.e. the proportion of turtles found dead in the trawl nets due to drowning or injury, was estimated to be 0% (N=4) and none of the captured turtles was found injured or in a comatose state. Again the results should be taken with caution because of the small number of turtles caught. Turtle mortality because of trawl activities seems generally low in the Mediterranean (Delaugerre 1987, Laurent 1991, Laurent and Lescure 1994, Lazar and Tvrtković 1995, Laurent et al. 1996, Oruç et al. 1996) in contrast to other areas (Henwood and Stunz 1987). Reasons for this, especially for the Greek waters, are probably the shorter haul duration and the lower temperatures during the trawling periods, where the decreased turtle metabolism makes them endure longer periods of apnea (see also Gerosa and Casale 1999).

On the scale of the Greek seas, within the framework of a Mediterranean marine turtle conservation approach, the priority is to locate possible zones with high turtle catch rates by bottom trawlers. If such zones are identified a management option that does not lead to a reduction of the fishing effort would be the use of the Turtle Excluder Device (TED). However, the use of this device, initially developed for shrimp trawlers, might be hindered by the fact that Greek trawlers target almost exclusively fish, including large-sized ones, which would also be excluded from the trawl net by the TED. Therefore a substantial technology effort is required to improve such a device in order to reduce turtle captures without substantial reduction in fish catch.

ACKNOWLEDGEMENTS

The trawler part of the EMTP in Greece was financed 50% by European Commission and 50% by ARCHELON. Onboard data were collected by A. Argyrokastritis, P. Bekas, P. Christopoulos, G. Kokkinos, A. Koutsodendris, P. Leondarakis and A. Dailianis. Recruitment, training and co-ordination of observers was provided by ARCHELON

under the supervision of K. Teneketzis and D. Dimopoulos. J. Dokos assisted in the storing, validation and elaboration of field data.

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THE ROLE OF NON GOVERNMENTAL ORGANISATIONS (NGOs) IN THE PROTECTION OF SEA TURTLES IN EGYPT. - SAVE THE SEA TURTLE PROJECT IN ALEXANDRIA (A CASE STUDY)

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INTRODUCTION

Sea turtles know no boundaries therefore all the scientific institutes, governmental and non-governmental organisations that are involved in sea turtle conservation in the Mediterranean should share the same vision. Namely "saving the sea turtles in the Mediterranean". However each of them has their own agenda that differs according to the way they tackle the problems that affect the sea turtle population in the region. All over the Mediterranean there are organisations interested in various aspects of nesting site protection, rehabilitation activities, public awareness, clean up the beaches campaigns, lobbing & pressure groups, and scientific research concerned with the species. In Egypt the main problems are lack of scientific research, the illegal trade in their meat, blood and carapace, interaction with fisheries and marine pollution (Nada in press). In the last 10 years accelerated efforts have been made in the field of scientific research, pollution management, public awareness and legislation regulating the sea turtle trade.

In spite of these efforts, what was achieved can only be considered as one step forward for marine turtle conservation in Egypt.

THE PROJECT VISION

Is to protect the sea turtle population in the Mediterranean Sea.

THE PROJECT MISSION

To promote sustainable conservation in Egypt through public awareness, educational activities, advocacy and scientific research.

THE AWARENESS CAMPAIGN. - DATA COLLECTION AND SITUATION ANALYSIS

This is carried out to determine the external and internal factors that may affect the awareness campaign. A pilot study was made to determine, who, how, which, why, and where the stakeholders of the sea turtles in Alexandria are. Methods included Strength, Weakness, Opportunity and Threat analysis of the campaign (SWOT analysis), and Political, Economic, Social and Technical influence control (PEST control) (Torok 1997).

PUBLIC HEARING WITH THE STAKEHOLDER REPRESENTATIVES

This activity aimed to determine the different attitudes and point of views of the various stakeholders and to create a dialogue encompassing these different attitudes and different stakeholders. In the public consultation, representatives from the fishermen, fish sellers, sea turtles' meat and blood consumers, Islamic leaders, Christian leaders, related NGOs, police authority, the National Institute of Oceanography and Fisheries, the media, teachers, the Faculty of Science (Marine Science Department), the Alexandria Governorate, the Fishing Co-operative Societies and the Egyptian Environmental Affairs Agency (EEAA) were present. The consultation started with a brief presentation on the problems facing the sea turtles in the Mediterranean and around the world, followed by open discussion chaired by a moderator from the project.

VOLUNTEER AND SUPPORTER RECRUITMENT

This activity aimed to create a group of highly qualified volunteers who care about the turtles. The volunteers were recruited following a number of oral presentations in different locations and with different audiences. At the end of the talk the presenter asked the audience to help in several ways, one of which was to join the Save the Sea Turtles Campaign. Those interested and showing innate or overt abilities were chosen to join the campaign. The volunteers were then trained to make presentations to the different types of stakeholders, to participate in data collection, to join clean up the beach campaigns and to help with the preparation of awareness material.

SEGMENTATION AND TARGETING

This step aimed to identify and target each stakeholder separately since there are major differences in their number, attitudes, educational background, willingness to change and our ability to reach them (Housden 1992, DeAvengo 2000). With each stakeholder several factors were involved in changing their attitude toward the species, these factors included framing of the problem, identifying the situation, developing a target and devising a plan.

DEVELOPING A COMMUNICATION STRATEGY

Habit development and learning are permanent changes in behaviour that occur as a result of reinforced practices. There are many theories explaining how a habit is developed in humans, the most important one is the stimulus response theory (Berelson and Steiner 1964). This suggests that a stimulus affects a person subconsciously and leads to a sequence of five stages: problem recognition, information search, evaluation of alternatives, changing the habit decision and post habit changing behaviour. This step therefore aims to create an appropriate stimulus through an awareness message to motivate, fulfil and satisfy a certain need in each stakeholder, delivered through an appropriate channel after which we test the response of each stakeholder to each message.

The fish restaurant owners: The message was the illegality of the sea turtle trade in their restaurants and the religious aspect of this trade; the channel of communication was through personal negotiation, and the mystery shopper technique was used to evaluate his response. Members of the working team unknown to the restaurant owner visit him in the restaurant a few days later and order a sea turtle meal. If the owner shows a positive attitude refusing to serve the meal, a certificate from the project is sent to him thanking him for his help, if he shows a negative attitude by accepting the order, his name and his restaurant are recorded and sent to the police for the necessary action against him.

The fishermen: The message here was the religious aspect, the legal aspect and focusing on the belief that sea turtles will bring them luck; the channel of communication was through personal negotiation, oral presentations and religious presentation during Friday prayers in the mosque. Evaluation was from records kept of in-depth interviews with a sample of the fishermen.

The consumer of sea turtle meat and blood: The message was the hazards from drinking the blood and the diseases that can be transmitted by it, and the religious point of view; the channel of communication was through oral presentations and the mass media; evaluation of the response of the consumer used questionnaires designed to measure the difference in attitude before and after the presentation.

The school children: The message was that the sea turtle is an important creature, friendly to humans, and which helps in getting rid of the jellyfish (a particular problem on Egyptian beaches); communication was by oral presentations in the schools, poster presentations and colouring competitions amongst the students. The evaluation was done by in-depth interview of a sample of the children after the oral presentation

Mass awareness: The message was the importance of the sea turtle to marine biodiversity, the effect of jellyfish on tourism, and the religious point of view (Islamic teaching holds the drinking of animal blood to be a sin). The message was communicated through T.V.,

press, poster and oral presentations. Evaluation of the effectiveness of the message was made by using questionnaires after the oral presentations and the feedback received through letters, e-mails and telephone calls.

TRAINING OF THE STAKEHOLDERS GROUP OF REFERENCE AND OPINION LEADERS - TRAINING OF TRAINERS (T.O.T)

As raised in the second stage of the Simultaneous Response Theory, people start to search for more information to help them change their habits. In this stage the most effective way of gaining information is consultation with a reference group. These groups can be religious or professional groups and opinion leaders (Moschis 1985). Each segment of stakeholders have their own reference group, therefore this step was implemented to help the reference groups themselves in articulating a vision both about wildlife protection in general and the sea turtle in particular; The channel of communication was through oral presentations, and the evaluation was done through questionnaires given after the end of the presentations. Then Action Plans were developed for each group to communicate their vision about protection and biodiversity.

Islamic and Christian leaders: The vision needed from them was the religious point of view in the face of the destruction of wild life and sea turtles.

Science and biology teachers: The vision needed from them is to show the importance of the turtle in the marine environment, and to focus on the relationship between sea turtles and jellyfish in the food chain.

Local NGOs leaders: The vision needed from them was to spread awareness of the problems that arise from the trade in sea turtles, and the availability of alternatives, such as other sources of protein and proper medical treatment for anaemia and infertility.

Police officers: The vision needed from them is recognition of their responsibility to spread awareness amongst the fishermen as to the illegality of the turtle trade, and the laws that would be used against them if they persist in such practices.

Physicians and pharmacists: The vision needed from them is to communicate their opinion about the hazards of turtle blood consumption and the belief that it's effect in treating weakness, anaemia and infertility is scientifically unfounded.

LOBBYING AND PRESSURE GROUP FORMATION

(not yet implemented)

EVALUATION ANALYSIS, FEEDBACK AND CORRECTIVE ACTIONS

(not yet implemented)

ACKNOWLEDGEMENTS

I wish to thank all the stakeholders that have attended the oral presentations, the interviewees, and those who joined us in the public consultation for their invaluable help and their informative notes, also all the reference groups and the opinion leaders that joined us in the workshops for their participation and their enthusiasm.

My great respect and appreciation to the speakers that helped me in the workshops Mr.Mohamed El Gendy, Dr Adel Abou Zahra, Dr Mohamed Ayad and Dr Samia.

I am sincerely grateful to Mrs. Lily Venizelos, the Trustees and Staff of the Mediterranean Association to Save the Sea Turtles, MEDASSET, for their continuous support and advice.

I cannot forget the valuable help and co-operation in conducting this study from Asmaa, Gilan, Milda, Rehab, Mohamed Refaat and Hassan Shater.

Finally, I wish to thank. Dr. Mohamed Abrahim and Mr. Wahead Salama from the EEAA for their help and co-operation: The Global Environment Facility (GEF small grants) for sponsoring my project, and RAC/SPA (UNEP/MAP) and CMS for their financial support that allowed me to attend the Conference.

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SEA TURTLES, ECOTOURISM AND LOCAL PEOPLE. CASE STUDY: PATARA BEACH, TURKEY

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The existence of CC areas is solely dependent on the economic power of individual states. Lack of funding, especially in developing countries, could result in difficulties in implementing conservation schemes. Alternatively, these areas can be managed through international support such as GEF (Global Environmental Facilities) aid which provide resources for environmental projects in developing countries (collaboration with local NGOs). However, these types of continuous support in the terms of external aid for managing these areas are neither sustainable nor sufficient-enough. Moreover, these types of handouts are not ethically correct. Thus, new alternatives should be designed in order to overcome this obstacle. We advocate that these resources should become financially viable and economically productive areas in order to support conservation schemes and local livelihoods. However, this should be accomplished without allowing unsustainable development practices that can degrade the environment further. Therefore, the compatibility of the commercial activity with the conservation schemes is a criterion for selecting and permitting their operations on protected coastal areas (Nalbantoglu 1999a). We promote that achieving this integrated goal should be through allowing the development of "ecotourism operations" in coastal conservation areas. We advocate that ecotourism operations in coastal conservation areas should be managed collectively with an increasing contribution and participation from local people.

Ecotourism clientele are assumed to be more environmentally aware than the average holiday maker and are willing to spend money to contribute towards conservation (Boo 1990, Drake 1991, Valentine 1991, Cater 1991, Cochrane 1996, Cooper and Wanhill 1997, Nalbantoglu 1999a, 1999b). Boo (1993, p. 16) defines ecotourism as "Nature tourism that promotes conservation and sustainable development. It does this by generating funds for parks and reserves and communities around them and creating environmental education programmes for tourists and locals".

Boyd and Butler (1993, p. 13) add the social aspects of ecotourism operations in to the definition as "... a responsible nature travel experience that contributes to the conservation of the ecosystem while respecting the integrity of host communities and, where possible, ensuring that activities are complementary, or at least compatible, with existing resource-

based uses present at the ecosystem level".

These definitions contain three points that are significant in the effort to promote local economic development in coastal conservation areas while trying to conserve its natural resources: Firstly, ecotourism is a style of tourism that can be used as a ecologically, economically and socially sustainable development tool; secondly, ecotourism can be a tool for conservation in coastal conservation areas and thirdly, ecotourism can also generate educational benefits for tourists as well as for the local communities. An assumption behind ecotourism development is that most of the destruction of coastal areas and their habitats is driven by peoples' need to generate income and improve their lives. Thus, such destruction can be prevented if continuing sources of employment and income can be created that depend upon keeping the coastal resources intact. However, for the effects to take place at the community level, local communities should be involved in the management of ecotourism and coastal conservation schemes (Norris et al. 1998). Yet, the central governments' cooperation is needed for allowing such developments and designing a general institutional framework, devising a guideline for sustainable "ecotourism" development and supervising local community-based management systems (Hames and Vickers 1983, Berkes 1989, McCay and Acheson 1990). Nevertheless, central agencies and local authorities may challenge this statement as inapplicable because of local peoples' lack of ability in participation and decision-making (absence of participation capacity). They might declare that the local people in general lack professional knowledge and abilities that are essential for policy and decision making processes (Isaac and Walker 1988).

Reliable knowledge and scientific information are fundamentally essential for governing coastal resources because they can give legitimacy and acceptance to the policy. Adequate and reliable information cannot be obtained from coastal resources without the local communities participation. Local communities do have the advantage of being close to the resource. They can observe the day to day changes and problems. They also experience the impacts of changes in the resource almost immediately. However, their local indigenous knowledge may not be given in an articulated format, which may not allow them to participate in decision and policy making efficiently. Hence, there is a strong need for encouraging intellectual development of community members in order to organize customary technical and social local knowledge in more process-able and accessible format. Using capacity building processes for local communities is recommended by several studies to encourage, achieve and sustain collective action through creating social learning processes (Checkland and Scholes 1990, Wilson and Morren 1990, Daniels and Walker 1996, Röling and Jiggins 1998). We define capacity building processes as: "Identifying information deficiency in communities and providing them necessary information, furthermore, help them to develop analytical tools through facilitation which

will allow them to take control of their own knowledge processing and subsequently collective development activity".

Under the capacity building activity's framework, several activities can be identified and implemented such as field trips, discussion panels, platforms, public meetings, informal social gatherings, workshops, interactive lectures and seminars, co-operative management meetings that includes the centralized agency's and the local authority's representatives. Active learning through public meetings and other meanings of social learning activities values the knowledge of the participants, it creates opportunities for people to build upon their experiences and expertise and to learn from one another (Daniels and Walker 1996). This process of social learning activity also encourages local people to develop their own collective action system and subsequently allows them to fully participate in decision and policy making mechanisms for managing ecotourism development in coastal conservation areas. Capacity building processes can, through the initiation of social learning, generate collective behavior and genuine respect among the participants. Subsequently, resource user communities can become generators of knowledge and more equal partners in resource management (Warner 1997). During the learning activities facilitators and participants control and generate functional social knowledge that improves local practices and institutional decision-making (Beamish and Bryer 1998).

FIELD WORK

We determined the stages of our fieldwork according to our observational field surveys and literature review outcomes. These stages are:

- Preliminary Survey.
- Forming various separate workshops for the under-represented members of the local community alongside with the workshops for the whole local community.
- Identifying community needs through panels and other forms of discussions (formal or informal) and providing external expertise aid through seminars and interactive lectures.
- Running internal facilitator training workshops.
- Organizing field trips, discussion panels and collaborative meetings.
- Encouraging collective institutional development.

The research initiation process took place between 1990 and 2001. The initiation process was data collection activities and consisted of several stages such as literature review stage and socio-economic survey stage. The second stage included observation outcomes and interviews. The observation outcomes help to identify potential partners, conflicting interests and opinions. A local collective institution (Patara Culture, Tourism, and Heritage Association) is also identified as a potential collaborator with these observations.

The organisation has major potential for providing a foundation base to support collective development and capacity building activities in the area. The interviews with open-end questions were selected as a survey method because they allowed us to collect more detailed information. Thus, it allows more appropriate intelligence gathering in terms of the extraction of more detailed and depth information.

CONCLUSION

We believe, collective ecotourism management at local level with the support of the local community`s efficient participation in decision making mechanism can solve the major conflicts in the case study area. Moreover, it can also set an example for other countries to follow a very similar pathway. This way we can improve the democratic decision making mechanism for protecting the environment as well as the protection schemes themselves. Creating an economical value for environmental assets will improve local livelihoods which in return will generate positive feeling and support for their conservation. Thus, we believe social learning through capacity building process is the most essential tool for achieving collective behaviour and subsequent efficient participation in the governance of coastal conservation areas.

ACKNOWLEDGEMENTS

I would like to thank Elizabeth Nalbantoglu, the Patara Culture Tourism and Heritage Association, the people of Patara, and Ms Jane Taussik, Dr Julian Clifton, Dr Victoria Edwards and all my friends for their great help in the development of this work.

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NATURAL ABUNDANCES OF STABLE CARBON ISOTOPES AS A CLUE TO BETTER UNDERSTAND THE LIFE HISTORY OF LOGGERHEADS

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INTRODUCTION

This paper illustrates some of the activities made by the EU-LIFE Project (LIFE NAT/IT/006271) "Urgent conservation measures of *Caretta caretta* in the Pelagian Islands" that has been funded at the end of 1999 by the Commission of the European Communities. Details concerning this project, its structure and objectives are given elsewhere (Dominici et al. 2003).

This project offered a unique opportunity to access a large number of juvenile and mature loggerheads in the bycatch of swordfish fishermen in the Strait of Sicily. This resource, associated to the possibility of accessing two interesting nesting sites in the Pelagie Islands, suggested to start a study on the natural abundances of stable isotopes, that is briefly illustrated here. This study is now providing new but preliminary data on stable isotopes of Mediterranean loggerheads and part of those will be shown in this paper.

Stable isotopes have been recognized already as a very powerful tool in ecological research (Gannes et al. 1998) and their usefulness may extend also to protection and conservation programmes. Chemical, biological and physical processes lead to distinctive "isotopic signatures" in biological material that allows tracing of the origin of organic substances. To date, animal physiological ecologists have made minimal use of naturally occurring stable isotopes in animal physiological ecology. Marine turtles do not make an exception with a few exceptions (Godley et al. 1998).

MATERIALS AND METHODS

This work was made working with three main types of biological samples: keratin samples

obtained from loggerhead scutes, bones of dead loggerheads and hatchlings. Scute samples were taken from loggerheads incidentally caught by swordfish fishermen in the year 2000 in Strait of Sicily and that were rehabilitated at the rescue centre created in the Island of Linosa (35°50' N, 12°50' E). More than 80 scute fragments were detached manually from the loggerheads and dried. Dry bones were instead collected from sea turtles that died in the previous seasons and buried. Finally, scute fragments were sampled on hatchlings that died among the egg clutches. Most of those samples were preserved in a formaline solution from previous nesting seasons. Samples from the nesting beaches of the Islands of Linosa and Lampedusa were analysed.

Determination of the stable carbon isotopic ratio was made by a Finnigan Delta-S mass spectrometer using a small amount of tissue (few milligrams per sample).

RESULTS AND DISCUSSION

One of the most interesting observation made on the analysed samples was that the mean $\delta^{13}C$ of scutes of juvenile loggerheads in their pelagic stage (mean= -17.8 per mil) was significantly lower than what has been observed on hatchlings (mean= -14.5 per mil). This is somehow not very surprising as a number of processes involving chemical and physical processes are occurring in the developing eggs that might eventually lead to a significant ^{13}C enrichment of the incubating hatchling. Those include respiratory metabolic pathways in the embryo but also the fractionation that may occur between bicarbonate and carbonate and gaseous CO_2 (Zhang et al. 1995) and during permeation of through egg membranes and the egg shells. Further CO_2 diffusion in the sand out of the egg might also provide additional fractionation. All those fractionation effects (Δ) have a positive sign and this may eventually lead to a natural enrichment of the hatchling with the heavier ^{13}C isotope. A more careful observation of the data collected on hatchlings did also suggest that carbon isotope fractionation during egg development is likely a temperature dependent process: the difference between hatchlings sampled in Lampedusa and those taken in Linosa varied in fact of more that 2.5 per mil. This observation has been quite fortunate as the two nesting beaches where the hatchling samples were collected, are extremely different from each other even if they are only a few nautical miles apart. The nesting site on the Island of Lampedusa is on a "white" sandy beach originated from a calcareous substrate while the other, in the Island of Linosa, is located on a "dark" beach originating from a volcanic substrate. Such striking differences in albedo drive a great difference in the sand temperature that finally translates into a large difference in the duration of the incubation period (Fig. 1). When compared with a number of other nesting sites in the Mediterranean, the two sites of Linosa and Lampedusa did rank at the extremes of a linear relationship between sand temperature and the duration of incubation that was found in another study (Godley et al. 2001).

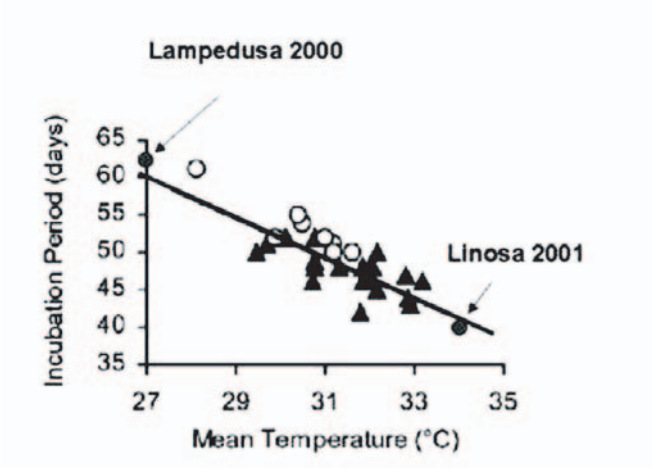

Fig. 1. Duration of incubation period as measured in a number of sites in the Mediterranean is plotted versus the mean temperature of the nests. The figure also reports the data of observations made in Lampedusa (a "cold" beach) and Linosa (a "hot" beach). Those fit to the linear relation found by Godley et al. (2001) which is also shown in the figure and represents the two extremes of the distribution.

The occurrence of such large difference in the isotopic ratio ($\delta^{13}C$) raised the curiosity of understanding if this isotopic "tracer" or "marker" found in the hatchlings that developed under different environmental conditions (cold and warm beaches) can actually persist somewhere in the body of the juvenile and adult loggerheads. The idea that was investigated was that at least a tiny fraction of bone tissue that is formed during embryonic development was not completely removed from the tissues, later on, during growth. The observed persistence of long-lasting biological material in bones has been documented already for several species and also in the sea turtles (Coles et al. 2001). Hence, marginal bones coming from loggerheads that deceased in the previous seasons were excavated and then analysed by assuming that the point of insertion of the T-bone in the marginals was possibly a good candidate position where growth could have been minimal. This section of the marginal has in fact a "pivotal" function, and not much extension should occur in this area. An example of the bone material used in shown in Fig. 2 where a circle indicates the exact portion we sampled. Four consecutive bone samples were obtained by drilling four

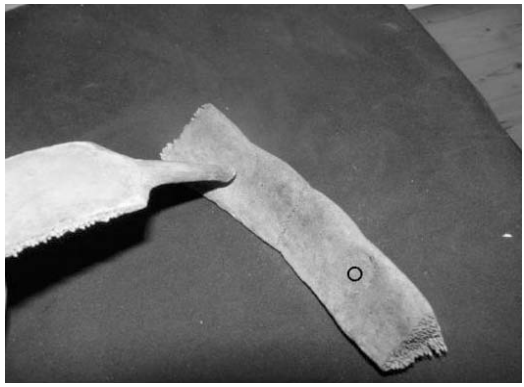

Fig. 2. One sample of marginal bones that have been used for isotopic determination. The circle indicates the area that was sampled which is located at the point of insertion of the T-bone on the marginal.

consecutive holes centred exactly at the point of insertion. In this way, we could in fact analyse samples whose distance from that insertion point varied from 2 to 8 mm in 2 mm steps. The remaining part of the bone was analysed, too. Although the sampled material was quite limited, the results clearly confirmed our hypothesis, as the $\delta^{13}C$ value decreased (became more negative) with distance from the point of insertion (Fig. 3). This indicated that indeed a so called "point zero" may exist in the marginal bone where the isotopic marker remains fixed at least for a significant part of the life of the loggerhead.

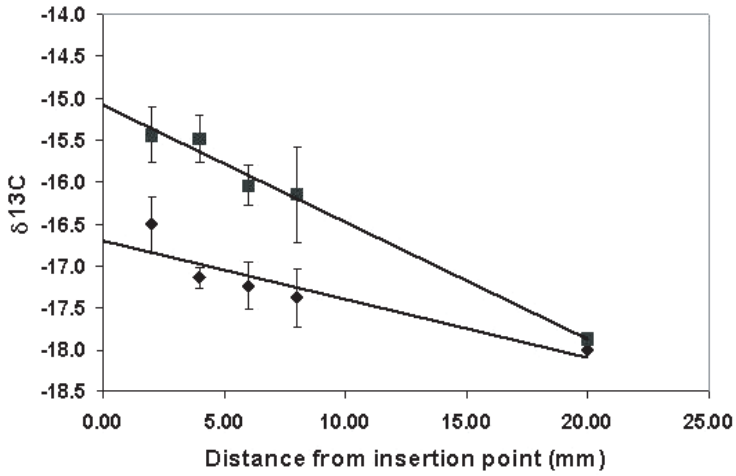

Fig. 3. Carbon isotopic ratio measured on sampled bones of two individuals is plotted versus the distance of the analysed tissue from the centre of the point of insertion. The data clearly show that isotopic ratio decreases while approaching an hypothetical "point zero" which might have been formed during embryonic development of the hatchling.

In conclusion, those preliminary observations are suggesting that isotopic techniques are valuable for investigating both physiological processes and the life history of the loggerheads. The initial hypothesis made about the existence of an isotopic marker associated with the environmental conditions where the hatchling embryo did develop was verified but further investigation with larger samples is obviously required before we can draw any final conclusion. This remains a challenging and interesting area of research, where the collaboration that is developing in these days with other groups working in the western Mediterranean (CRAM, Barcelona, Spain), in the Adriatic sea (Fondazione Cetacea, Riccione, Italy) and in the North Atlantic (Laboratório de Biologia Marinha e Oceanografia, Madeira, Portugal) may play a fundamental role.

ACKNOWLEDGEMENTS

Authors wish to thank Marco Affronte of the Fondazione Cetacea in Riccione (I), Sara

Pont of CRAM in Barcelona (E) and Claudia Delgado of the Laboratório de Biologia Marinha e Oceanografia in Madeira (P) that are already contributing to this study by providing biological samples of turtle scutes and bones.

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INTERACTION BETWEEN MARINE TURTLES AND TRAWL FISHERIES IN THE EASTERN MEDITERRANEAN, TURKEY

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INTRODUCTION

The eastern Mediterranean coast of Turkey is a significant area for marine turtle nesting and feeding (Baran and Kasparek 1989). The area is especially significant as the living and wintering environment for the endangered green turtle (*Chelonia mydas*), which mates and nests on the shores of the region. The area between Mersin and Iskenderun on the eastern Mediterranean coast of Turkey is one of the most prolific fisheries of the country.

Although much of the conservation effort has been focused upon marine turtle nesting areas, the equally important problem of turtle entrapment in fishing nets has been virtually ignored.

Despite being a serious threat to marine mammals and fish, there has been little work the effects of by-catch in Turkey. In 1995, The Society for Protection of Nature (DHKD) and World Wide Fund for Nature (WWF) initiated the first systematic study of the problems of turtles and by-catch in Turkey. It aims to both measure and publicise the problem.

The aim of the research component is to determine:

- the number of turtles entrapped in fishing nets in the Eastern Mediterranean Turkish waters;
- the size of the turtle population;
- the percentage of mortality amongst the sea turtles that are entrapped in nets during the trawling season (September 15th - May 15th).

METHODS

Before the project was initiated (October 1995 - July 1996), a field trip was performed in eastern Mediterranean (i.e., Mersin, Adana-Karatas, Iskenderun and Samandag-Cevlik) fisheries and ports, with the purpose of defining boundaries for areas of study. Dr. Luc Laurent, who has attended this trip, made worthy contributions to our methods. The observations and evaluations made through this study proved the capacity of Mersin and

Iskenderun ports to be too high, and since the communication and controlling facilities would be limited in those areas, Adana-Karatas and Samandag-Cevlik were chosen as pilot study areas for the start of the project. The data obtained from the participating five trawling boats were evaluated in the report for results during the first year. Since this study was the first of its kind and it takes time for fishermen to place trust in such efforts, the number of trawling boats involved was very few during the first year.

For the second year, covering the months between September 1996 and July 1997, Karatas was defined as the only pilot area; this time with the participation of 12 trawling boats. Boats starting off from Karatas do their fishing within a large scope between Mersin and Iskenderun. Karatas is simply surrounded by protected areas - west of Karatas is Akyatan Permanent Wildlife Reserve, east of the area is Yumurtalik Nature Reserve - Yumurtalık is an undoubtedly significant wintering area for *C. mydas*. Karatas, placed in between those two protected areas is the only free-fishing zone.

In the beginning of fishing season, the captains of selected pilot boats were trained about the content of project, marine turtles and questionnaires. During the study, the method used in the prior year was developed, the number of boats were increased, with an observer placed in each boat. All through the working season, a DHKD staff member, was present in trawling boats for 15 days of each month, for data-controlling and building informative relations about the project with boat crews.

All through the project, constant information exchange was established with City and Town Councils of The Ministry of Agriculture and Rural Works, Karatas District Governorship, Karatas Coast Guard Boat and Cukurova University Faculty of Fisheries.

RESULTS

In the 1995-96 fishing season the 5 trawl boats taking part in the project reported that the nets in the eastern Mediterranean entrapped 160 green turtles and 26 loggerhead turtles *(Caretta caretta)* (Oruç et al. 1996). In the 1996-97 period 12 trawl boats reported that trawling nets entrapped 306 green turtles and 116 loggerhead turtles (Oruç et al. 1997).

Between 15 September 1996 and 15 May 1997, 73 days were windy (strong) and stormy, and the boats could not go out fishing during those days.

The turtles trapped in nets were measured from head to tail and their total lengths were determined. 81% of the trapped turtles were juvenile, 30-60 cm in length.

Tab. 1 indicates that most marine turtles are entrapped in trawl nets at a depth of 11-30 m.

During the 1996-1997 fishing season 0.3% of the captured turtles were found dead. None of the 422 marine turtles (*C. mydas* & *C. caretta*) entrapped in the trawl nets had any tags.

Depth (m)	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
C. mydas	31	170	79	11	4	0	0	0	0	0
C. caretta	7	59	25	10	1	2	4	4	1	1
TOTAL	38	229	104	21	5	2	4	4	1	1

Tab. 1. Classification of the captured marine turtles with bottom and midwater trawlers according to the depth.

During the 1996-1997 fishing season, DHKD staff participated 43 fishing cruises on trawl boats. Turtles were entrapped in trawl nets during 20 of those cruises.

DISCUSSION

422 marine turtles (*Chelonia mydas* & *Caretta caretta*) and 437 *Trionix triunguis* were entrapped through the 1996-1997 fishing season, by 12 trawl boats from the port of Karatas, in the fishing area between Mersin and Iskenderun. 8 of the trawl boats with lengths ranging from 18-28 m, used midwater trawl nets, while the other 4 used bottom trawl nets all the time. During 1996-1997 fishing season, 27 trawl boats were registered to port of Karatas.

Most turtles are alive when taken from the nets, and they are put back into the sea by fishermen. Out of 737 turtles, 4.6% were figured comatose or weak while being released from the nets. Some of those turtles, after staying in boats for some time, could manage to regain their strength and swim away. During impromptu training sessions with fishermen, marine turtles were released as soon as they were detected in trawl nets, with the purpose of not causing any harm. However, in that stance, for marine turtles entrapped in nets for a long time, there would be a strong possibility of drowning. Since the knowledge of fishermen on the respiratory systems of marine turtles is limited, they cause harm by early releases without knowing. During daily training sessions, the crew of pilot trawl boats were given information about the respiratory system of marine turtles and summary notes on paper.

T. tringuis lives where river mouths meet the sea, very close to shore. Other sea plants and pastures of shallow seas are significant for Green turtle to feed on. Trawl boats fishing close to shores, cause harm to feeding areas of marine turtles as well as to their lives, by entrapping them in nets. The same part of the sea has significance as a feeding area for fish. Fishing close to the shore, causes threatenes not only marine turtles, but all marine species.

Local fishermen claim that they occasionally see the Leatherback turtle *(Dermochelys coriacea)*. In 1995, one *D. coriacea* was caught dead in nets by fishermen of Karatas. In 1994, one *D. coriacea* was found by Ministry of Agriculture and Rural Works Karatas

District Directorate officials as it landed on the shore dead, its photograph was taken for documentation.

According to data received from Karatas Meteorological Station Directorate, 73 days of the 8 month-long fishing season (240 days) were windy (strong) and stormy. That is, the trawl boats could not go out fishing during those days. From this data, it is possible to infer that 859 turtles were entrapped in nets in about 6 months (170 days).

The results of the project were presented in July 1997 at a workshop organised in Adana. The workshop participants also included the WWF Mediterranean Fisheries Coordinator, the Governorship of Adana, and representatives from the Ministry of Agriculture, Ministry of Environment, Ministry of Forestry, Coast Guard, District Governor of Karatas, academics from universities, and fishermen. Within the group discussions, the roots of the problems were identified, along with possible solutions and responsible authorities. The workshop report was prepared and has been distributed among participants and relevant parties.

A video highlighting the work of the project was prepared for the launch of the International Year of the Ocean (1998) in London. Press articles were prepared and published in several magazines and newspapers. Regular news about the project were published in DHKD's monthly bulletin. DHKD has selected the green turtle as a flagship species to highlight both overfishing in the Mediterranean and the related problems of bycatch.

Involving the fishermen in the project, and getting the cooperation of boat captains to record details of accidental turtle catch helped create a feeling of partnership in the project amongst the fishermen. Training programs designed specifically for fishermen proved very successful in increasing their awareness and their attitudes about threatened species and careful.

This type of communication also leads to a feeling of "partnership" by the authorities, which in turn has positive impacts on the project. Regular visits, lobbying efforts and the workshop helped create a better cooperation between the Ministry of Agriculture, Coast Guard, Governorship of Adana and local authorities.

ACKNOWLEDGEMENTS

The accomplishment of the project would not have been possible without the contributions of the following people:

Our deep thanks to: Kamuran Patrona from the Ministry of Agriculture & Rural Works Protection Control General Directorate; Vice Governor of Adana, Ardahan Totuk; District Governor of Karatas, Erhan Karakaya, Sevinc Göksu from the Ministry of

Agriculture and Adana City Directorate; Kemal Tekin from the Ministry of Agriculture and Rural Works Karatas District Director; the Commander of Coast Guard Boat 43, Muzaffer Mendi (Karatas); Assistant Erhan Akamca from Faculty of Fisheries of Cukurova University, for their valuable support in technical matters, logistics and literature.

The regularity of field and survey work have been made possible through significant efforts of Captains Vecih Özcan, Canan Gayir and their families; Captain Tahsin Kumlu, Mustafa Kumlu, Edip Kumlu, Mehmet Bayrak, Captains Mehmet Özcan, Ercan Ergüneş, Namit Yilmaz, Nasip Yilmaz, Yakup Bayrak, Salim Bayrak, Suphi Bayrak, Hasan Bayrak and DHKD Volunteer Ahmet Gölbasi.

Special thanks to devoted scientist, Dr. Luc Laurent for his recommendations and constructive criticism.

Deep thanks to each and everyone for their help and contribution.

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STRANDING DATA AS AN INDICATOR OF FISHERIES INDUCED MORTALITY OF SEA TURTLES IN GREECE

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INTRODUCTION

Over the past decades, sea turtles in the Mediterranean are faced with increasing threats to their survival. Most of the threats at sea originate from fisheries interaction (Margaritoulis et al. 2003). Despite the ample national and international legislation inadequate enforcement hampers protection measures. Loggerhead (*Caretta caretta*), green (*Chelonia mydas*) and leatherback (*Dermochelys coriacea*) turtles inhabit the Greek seas and these species are protected since 1980. The foundation of ARCHELON, in 1983, was essential in promoting sea turtle conservation. The Stranding Network was initiated in 1988, but it took more than 4 years to become a reliable tool for systematic recording of turtle strandings nationwide. This paper presents sea turtle stranding data reported during the period 1992-2000 throughout Greece in order to draw preliminary conclusions as to the at-sea related mortality.

METHODOLOGY

Stranding reports, in the context of the nationwide Stranding Network, reached ARCHELON from the Coast Guard, Fisheries Authorities, other non-governmental organisations, public institutions, on-site members and concerned individuals. Stranding reports were completed by the person who examined the turtle. The stranding report included: name of observer(s), date, species, sex, condition of the turtle at the time of finding, external injuries, tag information, carapace measurements (length, width), plus any other relevant information. On the back of the report there were instructions and diagrams to facilitate correct determination of the species, sex and measurements. Dead animals were buried on site, either by local communities or project members. Most of injured turtles, found stranded, were transported to the ARCHELON Rescue Centre in Glyfada, Athens. There, the cause of injury was determined by external inspection, radiography and, if the animal died, by necropsy.

In order to study more comprehensively the geographical distribution of the

strandings, the Greek coastline has been divided into 8 sectors: NW (Ionian Sea), PE (Peloponnesus incl. Zakynthos island), KY (Cyclades islands), CR (Crete island), DK (Dodecanese islands), AN (Eastern Aegean islands), NE (Northern Aegean) and EA (Central Aegean) (Fig. 1).

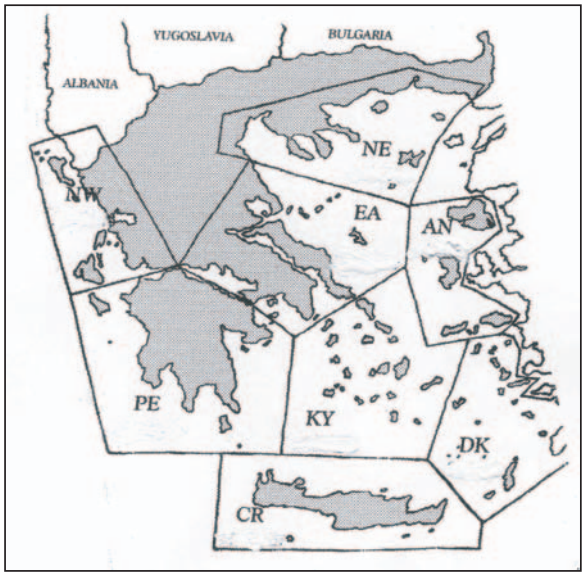


Fig. 1. Sectors along the Greek coastline for the localisation of strandings.

RESULTS

From 1992 to 2000, the total number of turtle strandings reported all over Greece were 1,080. Of these, 957 were reportedly loggerheads, 74 green turtles, 5 leatherbacks and in 44 cases the species was not determined. Taking into account only the identified loggerheads and green turtles (1,031 animals), we see that 92.8% of these were loggerheads and 7.2% green turtles.

With the exception of leatherbacks which had a rather occasional appearance, the other two species were reported with continuity. For those five cases of leatherback turtles, one case was reported in 1992 (NE zone, September), one in 1996 (EA zone, June) and three cases in 1997 (twice at PE zone and once at NE zone, between August and September).

Of the 1,080 strandings reported in the period 1992-2000, 821 (76.0% of the total) were collected during the period 1996 to 2000. The improved efficiency of the Stranding Network during this period provided the opportunity to obtain more and better data. Of the 821 turtles recorded within the period 1996-2000, 728 were loggerheads, 66 green turtles, 4 leatherbacks, and 23 were not identified. If we take into account only the identified loggerheads and green turtles (794 strandings) we see that 728 (91.7%) were loggerheads and 66 (8.3%) green turtles. The annual occurrence of strandings shows an increasing trend in time (Fig. 2). However, this does not necessarily reflects an actual increase in stranded turtles, because the effectiveness of the Stranding Network was improved year by year.

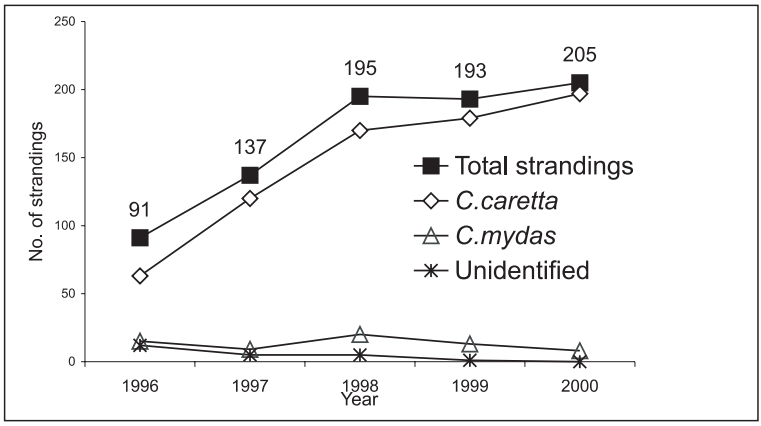
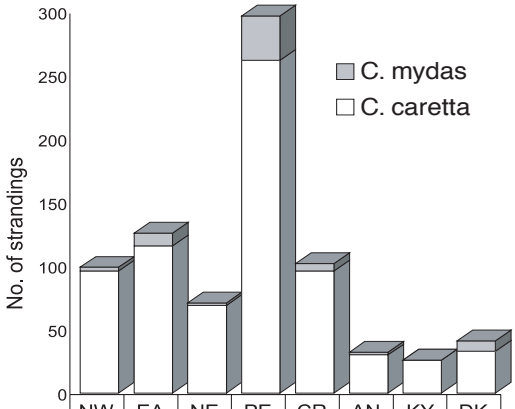


Fig. 2. Turtle strandings per species and year for the period 1996-2000 (N=821).

The geographical distribution of strandings, in the period 1996-2000, is shown per species in Fig. 3. Most strandings of both species were reported from sector PE (where 36.0% of all loggerheads and 53.0% of all green turtles were reported). Then follow sector EA (15.9% of all loggerheads and 15.2% of all green turtles), and sectors CR (13.2% of all loggerheads) and DK (12.1% of all green turtles). However, the greatest proportion of green turtles in relation to total strandings per sector came from sector DK, where 19.5% of all strandings were classified as green turtles, and sector PE with 11.8% of all strandings being green turtles.



	NW	EA	NE	PE	CR	AN	KY	DK
C. mydas	3	10	2	35	6	2	0	8
C. caretta	96	116	69	262	96	30	26	33

Fig. 3. Geographical distribution for stranded sea turtles in the period 1996-2000 (N=794).

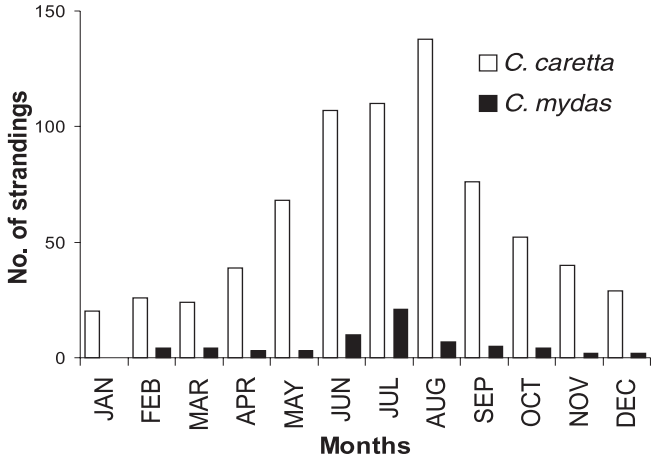


Fig. 4. Monthly distribution of sea turtle strandings in the period 1996-2000 (N=794).

Most of the 794 stranded loggerheads and green turtles in the period 1996-2000 (68.6%) occurred from June through October (Fig. 4).

In the period 1994-2000, 226 turtles, found stranded alive, were admitted to the ARCHELON Rescue Centre in Glyfada. Of these, 218 (96.5%) were loggerheads and 8 (3.5%) green turtles. The causes of the injuries, as deducted from the examination at the Rescue Centre, were classified as follows: 34% with head trauma, 24% with hook ingestion, 22% with injuries from entanglement in fishing nets and lines, and 20% from other causes (boat strikes, diseases, coverage with tar, various mutilations not accounted by fishing interactions, etc.) (Fig. 5). Most head traumas are thought to originate by intentional hits after capture in fishing gear. Net and line entanglement were determined by relevant scars or pieces of the material found on the animal. Overall, it is estimated that

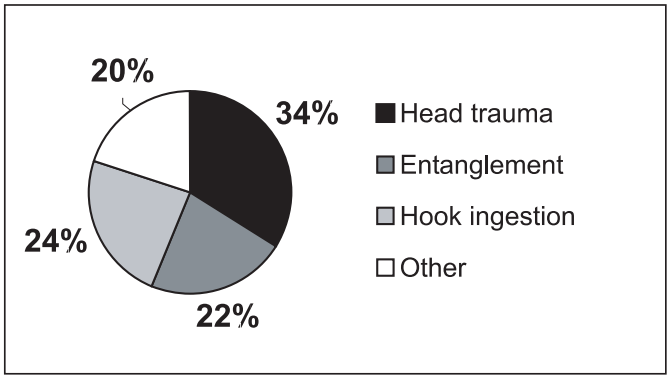


Fig. 5. Causes of injuries on turtles found stranded in the period 1994-2000 (N=226).

about 80% of the stranded turtles, which were admitted to the Centre, were injured because of fisheries interaction.

DISCUSSION

The data suggest that loggerhead and green turtles inhabit the Greek waters throughout the year. The loggerhead is the most common species and can be mostly located around the major nesting regions of Greece during the nesting season. *Chelonia mydas* observed in Greece could originate from populations nesting in Turkey and Cyprus. Most of the green turtles were found stranded in Lakonikos Bay, southern Peloponnesus, where a feeding ground for juvenile green turtles was recently reported (Margaritoulis and Teneketzis 2003). The five leatherback turtles complement a previous study which collected existing records in Greece until 1984 (Margaritoulis 1986). Taking into account only the animals that were transported to the Rescue Centre, and which were properly identified, the overall percentage of green turtles in Greece becomes 3.5%.

Nearly all fishing activities pose a threat to both adult and juvenile sea turtles though more research is needed to determine the relation of the mortality rate and the type of fisheries interaction. Incidental capture in fishing gear seems to affect at least 80% of the turtles found stranded and injured. Of these, 46% concern turtles with hook ingestion and injuries attributed to entanglement; the remaining 34% are turtles intentionally hit on the head, presumably after incidental capture in fishing gear. The latter may arise primarily as a result of the damage caused by turtles to fishing gear, especially in artisanal gill nets and bottom longlines, as well as to other factors like competitive attitudes, prejudice and superstition.

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NEW REPORTS ON PARASITES OF MARINE TURTLES STRANDED ALONG THE ITALIAN COASTS

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INTRODUCTION

Loggerhead turtles (*Caretta caretta*) the most abundant marine turtles in the Mediterranean Sea harbour a great variety of metazoan parasites belonging to the Trematoda, Nematoda, Cestoda and Hirudinea Class. Among these parasites, the digenetic Trematoda have a high species richness. Aznar et al. (1998) found in the loggerhead turtles from the western Mediterranean Sea a typical gastrointestinal helminthofauna composed of digenetic trematodes species with prevalence values varying from 28% to 96%. Further these authors considered the parasite exchange among different species of marine turtles. This seems to be very limited because of both phylogenetic and geographic isolation of loggerhead turtles (Aznar et al. 1998).

This work presents data on the parasite fauna of *Caretta caretta* found in the Italian waters and the authors emphasize the presence of species that usually infect other marine animals.

METHODS

Fourteen loggerhead turtles stranded or caught in the Adriatic Sea (Mediterranean Sea) from 1999 and 2000 were studied for parasites. Parasitological examinations of the stomach and intestine were carried out. The helminths were collected and preserved in 70° alcohol. The nematodes were clarified in lactophenol and the trematodes stained with carmine aluminic acetate, before being studied microscopically. Ectoparasites were also collected. The parasites were identified according to Braun (1901), Looss (1901), Yamaguti (1958), Davies and Chapman (1974), Sprent (1977), Smith and Wootten (1978), Blair and Limpus (1982).

RESULTS

Seven out of the 14 sea turtles had parasites. Trematodes and nematodes with gastrointestinal localisation were found. Ectoparasites belonging to the Hirudinea class

have been found from the body surface of one turtle. The species of parasites found, the prevalence values (P= number of hosts with parasite/number of examined hosts x 100) and the range of the infestation are shown in Tab. 1.

	Infected hosts (number) P	Range of parasites found (min-max)
Endoparasite		
Class Trematoda		
Enodiotrema sp.	(3) 21.4%	0-3
Pleurogonius trigonocephalus	(2) 14.3%	0-18
Cymatocarpus solearis	(1) 7.2%	0-5
Orchidasma sp.	(1) 7.2%	0-11
Rhytidodes gelatinosus	(1) 7.2%	0-25
Class Nematoda		
Sulcascaris sulcata	(3) 21.4%	0-4
Kathlania leptura	(1) 7.2%	0-2
Cucullanus sp.	(1) 7.2%	0-2
Anisakis simplex third stage larvae	(1) 7.2%	0-10 *
Ectoparasite		
Class Hirudinea		
*Ozobranchus margoi***	(1) 7.2%	nd**

* Larvae found also on the serosal surface on the stomach and duodenum
** The number was not determined

Tab. 1. Parasites found in *Caretta caretta.*

DISCUSSION

All the trematodes found in this survey were reported in our previous studies about loggerhead turtles stranded along the Adriatic coasts (Manfredi et al. 1996). These parasites were also reported in sea turtles from the Mediterranean Sea (Sonsino 1893, Stossich 1895, 1897, Looss 1901, Euzet et al. 1972, Sey 1977, Badillo and Raga 1995). Particularly we want to emphasize the finding of *Cymatocarpus solearis*; it is the first finding in a Mediterranean loggerhead turtle after the record of Looss (1901). Previously Yamaguti (1958) listed two species belonging to the genus *Cymatocarpus* namely *Cymatocarpus ondulatus* and *Cymatocarpus solearis* but Blair and Limpus (1982) considered these species to be synonymous and he retained as valid only *Cymatocarpus solearis. C. solearis* seems to be a parasite shared between different species of sea turtles. Braun (1901) found this species in the green turtle (*Chelonia mydas*) and specimens belonging to this

genus were identified in Cheloniidae sea turtles from several other geographic areas and in the leatherback turtle (*Dermochelys coriacea*) (Therfall 1979, Blair and Limpus 1982). A few trematodes such as *Enodiotrema* sp. and *Orchidasma* sp. were not identified to species level because the specimens were immature or the morphometric features were slightly different than previously data.

A higher number of nematode species than those reported in previous studies were found (Sey 1977, Burke and Rodgers 1982, Manfredi et al. 1998). In agreement with to Sey (1977) and Manfredi et al. (1998) *Sulcascaris sulcata* was the most frequent parasite that we found in loggerhead turtles. This Cheloniidae seems to be its most important host. In the intestine of a turtle, nematodes belonging to the genus *Cucullanus* were also found. These nematodes were not identified to species level because we found only females and their taxonomic classification is founded on the morphology of the caudal bursa of the male. Moreover, even if the subfamily Cucullaninae includes species usually parasitic on fish, a species (*Cucullanus carettae*) (Lester et al. 1980) found in the loggerhead turtle has been described.

As for the *Anisakis simplex* type I larvae is concerned, in one turtle we found some larvae free in the stomach and numerous larvae spirally coiled beneath the serosal surface of the stomach and the duodenum. *Anisakis simplex* is a nematode parasite of the cetaceans and the pinnipeds. It has a complex life cycle with various hosts. Euphasiid crustaceans are the intermediate hosts and cephalopods and fish are the paratenic hosts. The latter are the probably source of sea turtles infection. The sea turtles could be rated among the paratenic hosts even though *Anisakis* larvae in sea turtles are not common. To our knowledge this is the first report of *Anisakis* larvae in wild turtles. Only Burke and Rodgers (1982) have previously reported infection of green turtles from Torres Strait Islanders (Australia) with *Anisakis simplex* larvae. These green turtles were farmed and feeding only with raw sardines, which could be the source of the infection. Further in these turtles *Anisakis* larvae infection was found associated with gastric ulceration. In our survey no gastric lesions were associated with the *Anisakis simplex* larvae infection.

One turtle was found infected with leeches identified as *Ozobranchus margoi*. This Hirudinea species occurs on most species of Cheloniidae and it is a cosmopolitan ectoparasite of loggerhead turtles. This ectoparasite is most often located on the soft tissues of the body surface between the carapace and the plastron (axillary and inguinal areas, areas around the mouth and the cloaca) (Davies and Chapman 1974, Schwartz 1974). In the Mediterranean Sea this finding is not common (Meotti et al. 1995). The loggerhead turtle found infected, had numerous specimens of *Ozobranchus margoi* adhered to the neck area. Various developmental stages of the parasites were found. A massive infestation of *Ozobranchus* can induce pathological effects, like anaemia, because it is an haematophagous parasite.

ACKNOWLEDGEMENTS

The authors would like to thank Dr Nicola Zizzo and the Department of Public Health, Pathology, Pharmacology, Toxicology and Animals Welfare of the Bari Veterinary Faculty (Italy) for the opportunity and the facilities to carry out the collection of parasites.

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EXPERIENCES WITH EUROPE'S 1ST MEDITERRANEAN SEA TURTLE WEBSITE: EUROTURTLE

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1. INTRODUCTION

EuroTurtle - a Mediterranean sea turtle Biology & Conservation web site for Science and Education is the result of collaboration between the University of Exeter, Kings College, Taunton and MEDASSET (The Mediterranean Association to Save the Sea Turtles). Set up in January 1997, the site was the first in Europe to be exclusively devoted to the conservation and biology of Mediterranean sea turtles. Its award-winning style and content is very different from other educational sites on the web. EuroTurtle contains overviews of all sea turtle species, a section on the threats to turtles in the Mediterranean (e.g. tourism), identification keys and even an adventure game involving a loggerhead turtle on a Greek island. The site, which is rich with high quality graphics, work sheets, diagrams and on-line activities, had grown in size and popularity to the point where a major redesign became essential. In 2001 a major site redesign was carried out by the Telematics Centre at The University of Exeter with funding kindly provided by MEDASSET.

2. USER NEEDS ANALYSIS

The redesign of the site was informed by end-user needs analysis. In addition to the feedback data provided by users informally, a more formal end-user consultation was conducted with 36 trainee secondary teachers in a focus group setting. These trainee teachers, drawn from a range of subject areas including science, geography, mathematics and modern foreign languages, were all undertaking a supplementary option in information and communication technology to allow them to offer IT as an additional 'string to their bow'. Whilst the majority of students felt that EuroTurtle in whole or in part, could be used within both their main and supplementary subjects, a few felt that it would only be applicable within the supplementary IT subject.

2.1. INFORMAL USER FEEDBACK

Informal, and to all intents and purposes unsolicited user feedback is a major source of usability data. It shows the immediate and 'urgent' concerns of the users, as well as their emerging concerns (Nielsen 1993). It is clear that the sample may not be representative,

and indeed may be disproportionately weighted in favour of dissatisfied users. Since its inception EuroTurtle has welcomed feedback through email direct to the site author, Roger Poland.

2.2. OUTCOMES OF INFORMAL END-USER FEEDBACK

During its lifetime EuroTurtle has received over two thousand emails, the majority from teachers and students. There has also been a significant number of enquiries from the media including, the BBC, The Times, The Daily Telegraph, The Guardian requesting the most up to date information on the present status of sea turtle conservation in the Mediterranean. The majority of responses have been highly complimentary. Some have provided constructive feedback on site improvements, including the following summarised suggestions:

- long pages very difficult to cope with and requested to split into shorter pages
- turtle background image on each page made it difficult for some children to read
- as the site grew and more and more content was added it was difficult for the two key target groups, educationalists and conservationists, to facilitate location of new content relevant to their interests
- original splash screen, which had minimal contact, delayed the user from getting at the real content and was frustrating
- the original game was too long to play as it was scripted in long scrolling pages and had large pictures which were slow to load
- more scientific papers and current articles
- a search engine would be useful
- the site map was an essential navigational aid, but was becoming too complex.

2.3. END-USER FOCUS GROUP

The decision to adopt a focus group as the principal means of formal data collection was taken for a number of consideration. In particular the need to:

- to create an environment which would generate 'users' spontaneous reactions and ideas through the interaction between the participants" (Nielsen 1993)
- to conduct a small-scale survey in view of the limited budget resources
- to balance informal feedback with feedback from a sample of the target group.

In the focus group the trainee teachers were asked to brainstorm ideas for a cross-curricular Mediterranean sea turtle conservation web site to be used in schools. Responses were collated in plenary. This sensitised the students to the next task, performed in inter-disciplinary groups of four, in which they were asked to look together at the original EuroTurtle site, discuss and evaluate it, and then agree their top five recommendations for improving it.

2.4. OUTCOMES OF FOCUS GROUP: COLLATED GROUP IDEAS FOR IMPROVING SITE HAVING USED THE ORIGINAL EUROTURTLE SITE

Whilst there was universal praise for the site, the group generated some useful ideas for the redesign of EuroTurtle. All groups strongly felt that the navigation system needed to be improved, so that it was consistent throughout the site. It was suggested that more use of navigation icons rather than text could be made. The trainee teachers were a little overwhelmed by the amount of content. In order to help the site better address the needs of its core target groups it was recommended that the site should be split up. One site should be designed explicitly for educational users, which the trainee teachers described as a 'junior viewer navigation system'. Suggestions for other 'child friendly' features included more cartoon pictures and more animation. The site map was deemed to be essential but the group found the old map very complicated and 'a bit dissertation plan-like'. It was suggested that the site map should be made clearer, be attached or become the homepage. In assessing the adventure game, the focus group recommended making it more exciting by allowing users to choose their own route. Some felt the game should be less predictable though others felt it needed to have a clearer progression. It was requested that it be made more user friendly by having each scene on single screen to avoid scrolling. Other suggestions included the use of Flash animation and e-commerce to raise funds for turtle conservation.

3. SITE REDESIGN

The site was re-launched with its new domain name at www.euroturtle.org. in July 2001. The following sections summarise the main changes made to the site.

3.1. GENERAL CHANGES

In line with guidelines for accessible multimedia design the site has been designed to give a standardized look and feel to the whole site. This ensures simplicity of navigation, and consistency of style and operation.

The 2001 version utilises frames so that there is always a navigation bar at the top of the screen. The screen is designed so it can be viewed at the two common screen resolutions (1024x768 and 800x600) so that everything is in view at the same time (width). Long pages have been avoided and downward scrolling has been reduced to a minimum.

A number of elements have been implemented to enhance legibility. The 'turtle logo' background pattern has been replaced by a white screen background; the main text colour has been changed to beep blue. Whilst this is more aesthetically pleasing, it also retains high contrast against the white background to improve legibility; a serif font, Times Roman, for main text, and a sans serif font, Arial, for section headings have been used.

3.2. HOME PAGE

The main home page is now more informative and allows the user to enter either the education or conservation websites. There are now two further 'home pages', one for education and one for conservation. Each has a similar layout to aid navigation and understanding. Both sections are easy to navigate between but allow teachers and students to identify educational projects quickly and easily. The 'magazine-style' of the homepage has been adopted to reflect the complexity and depth of the content. The style also reflects the content turnover of the site, which grows on a weekly basis, and to provide clear links to the latest additions to the site. A search utility has been added to the site allowing users to search through the all titles, headings, body text and images contained in the site.

3.3. INSTRUCTIONS AND SITE MAP

The detailed instruction page has been removed, as most users are now familiar with navigation techniques required for web browsing. The site map has been retained although a clearer layout has been used. The EuroTurtle Navigation Medallion has been discarded, as navigation is now possible from the top frame, which appears on every page of the website.

3.4. EDUCATION

The 'Adventure Game', in which students help a female Loggerhead turtle to lay eggs successfully on a sandy beach, has had a number of major changes which now allow the game to be played in less time, making it more enjoyable and 'user friendly'. Each scene from the game is now on a separate page, with new DHTML layer techniques deployed to show results of each decision. The graphics have been downsized to speed up access to the game via low bandwidth connections. A new alternative version in which the user can make the decision of what to do next, removing the element of luck or chance. Both games have also been enhanced with new photographs and graphics.

The 'Bonekit', which motivates and engages children to explore skeletons, has now become fully interactive. Skeletons of a human, a turtle and a frog can be assembled using new 'drop and drag' techniques created using DHTML and JavaScript.

The 'Clickable Turtle' helps children learn the parts of the turtle and then test their memory. The old version has been improved by the removal of pop-up windows and the addition of rollover pop-up descriptions.

A new 'Turtle Parts Identification Game' has replaced the old multiple choice game. In the new, more challenging game, the parts of the turtle have to be labelled by dragging and dropping identifiers. This has been authored through DHTML and Javascript.

'Greentrack' was a separate website, which followed a green turtle via a satellite-tracking beacon as she migrated, from her nesting site to the winter-feeding grounds. Greentrack is now part of the EuroTurtle website.

The 'Identification Keys', in which students use a Dichotomous key to identify sea turtles from drawings and photographs, now have both comparison diagrams 'in view' on the screen at the same time, allowing for easy comparison. In the old version, scrolling was required.

The 'Outlines' section, which provide a brief summary of each of the eight species of Sea Turtle and their distribution, has been split up into lots of small pages to limit scrolling, and to speed up page loading. Navigation to each section is now via drop down menus.

The 'Size Comparisons Section', a measuring exercise involving sea turtle carapace size, is now interactive and involves students entering data into a quiz that also produces a score to indicate degree of accuracy in the turtle measuring exercise. The quiz has been authored using developed using "Hot Potatoes v4.1 by Half-Baked Software".

The 'Virtual Field Station' allows students to become a Sea Turtle Conservation Volunteer on the virtual Mediterranean island of FOURAMOS. The password protection has now been removed and the Virtual Field Station is now freely available for teachers.

The 'Conservation section' has been separated from the education projects so that biologists and conservationists can find relevant information more readily. The MEDASSET section has also been expanded to include scientific papers and press releases that can be downloaded by the visitor to their computer.

The 'Useful weblinks' page is now interactive and the visitors can suggest links. There is also a dedicated 'Feedback Page'.

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MARINE TURTLES IN CROATIA: LEGAL FRAMEWORK AND CONSERVATION EFFORTS

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National Strategy and Action Plan for the Protection of Biological and Landscape Diversity (NSAP) was adopted by Croatian National Parliament in 1999. It is the first document in which protection of nature is planned in an integrated and systematic manner.

Three species of marine turtles are recorded in the Adriatic Sea - loggerhead turtle *(Caretta caretta)*, green turtle *(Chelonia mydas)* and leatherback turtle *(Dermochelys coriacea)*. Only the loggerhead turtle of these three, is a permanent inhabitant although its breeding was not recorded for certain. According to NSAP, Action plan for identification of critical habitats of loggerhead turtle and Action plan for protection of sandy beaches are among priorities. All three species are protected by Naturel Protection Act, although protection does not include their habitats. Proposal of the new Naturel Protection Act (NPA) is in governmental procedure. The new NPA follows the aims and objectives of all relevant international treaties to which Croatia is a party, as well as the EU Directives. Also, we will become a part of the Emerald Network this year.

There remains the problem of accidental and deliberate capturing of turtles in the fishing nets. We are working on educational program to reduce the problem. This program will be presented to local people and fishermen along the coast, with assistance from national and local NGOs.

PARTNERSHIP FOR PROTECTION: THE UK MARINE TURTLES GROUPED SPECIES ACTION PLAN

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INTRODUCTION

Five species of marine turtle have been recorded in UK waters including the leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*), loggerhead (*Caretta caretta*) and Kemp's ridley (*Lepidochelys kempii*) turtles. In 1999, English Nature, a UK government conservation agency, published the Marine Turtles Grouped Species Action Plan (SAP) as part of the UK Biodiversity Action Plan, which itself was a response to the in Rio Earth Summit in 1992 (Anon 1999). The SAP is currently implemented by a partnership of organisations known as the UK Turtle Implementation Group (TIG).

TURTLES IN UK WATERS

Whereas the hard-shelled species are recorded in the UK as cold-stunned strays, the leatherback turtle is widely considered to be a native species to the UK that seasonally migrates to UK waters from tropical nesting sites in the Atlantic (Godley et al. 1998, Pierpoint 2000). Threats to leatherbacks in UK waters include marine litter ingestion, by-catch (particularly entanglement in buoy ropes of bottom-set static gear such as crab pots) and boat strike. UK tourism is also recognised as being linked to the degradation of marine turtle nesting and foraging habitat overseas, for example loggerhead and green turtle nesting beaches in the Mediterranean.

THE UK MARINE TURTLES GROUPED SPECIES ACTION PLAN

The SAP, which can be accessed online at www.ukbap.org.uk, outlines actions committed to by UK statutory agencies and deemed necessary to facilitate the conservation of marine turtles in UK waters and to contribute to the conservation of marine turtles in the UK Overseas Territories. Due to a lack of biological data regarding marine turtle populations in UK waters and most of the UK Overseas Territories, rather than specifying biological targets, the SAP objectives are broad and read as follows: 'Avoid accidental harm to, and by-catch of, marine turtles when present in UK waters' and 'Contribute to international measures for the conservation of marine turtles'.

The 26 actions described under the SAP are categorised under seven separate headings such as 'Future Research and Monitoring' and 'Policy and Legislation'. For example, under Policy and Legislation, action 5.1.7 reads as follows: 'Promote consideration of the impact of EU funded development and activities on marine turtle habitats, in particular on nesting beaches (especially tourist developments affecting southern european nesting beaches), through advice, legislation and requirements for appropriate environmental impact assessments.' Similarly, under the heading Communications and Publicity, actions 5.6.2 reads as follows: 'Publicise marine turtle conservation issues, in particular raising awareness of how the UK public and tour operators may have impacts on turtle populations overseas.'

TURTLE IMPLEMENTATION GROUP (TIG)

In 1999 and on behalf of the UK Biodiversity Group, English Nature appointed the Marine Conservation Society (MCS) and the Herpetological Conservation Trust (HCT) as joint lead partners of the SAP, while Scottish Natural Heritage (SNH) volunteered as contact Government agency. In 2000, MCS secured funding from a UK mortgage lender, Cheltenham & Gloucester. By committing 2 years of funding to the implementation of the SAP, Cheltenham & Gloucester became the first 'Champion' for a marine species under the UK's Biodiversity Action Plan.

Since then, MCS, HCT and SNH have assembled the Turtle Implementation Group (TIG), a coalition of organisations committed to overseeing the implementation of the SAP. At the time of writing the TIG consists of the devolved government conservation agencies English Nature, Countryside Council for Wales (CCW) and Northern Ireland's Environment and Heritage Service (EHS). The TIG also includes the Marine Turtle Research Group (University of Wales, Swansea), University College of Cork (Prof. John Davenport), Marine Environmental Monitoring (consultancy and current custodian of the UK marine turtle sightings and strandings database, TURTLE), the Wildlife Trusts (represented by Cornwall Wildlife Trust), and Euroturtle (the educational marine turtle website www.euroturtle.org).

The TIG has prioritised the implementation of specific programmes, which interpret SAP actions into conservation activities. Research into the ecology of leatherback turtles in UK waters and consequent leatherback conservation is the main priority of the TIG. The first TIG outputs include a UK Marine Turtle Code and accompanying Advisory Note. The Code is a double-sided, laminated document, which will be distributed among sea users, particularly fishermen. The Code gives information on the identification of marine turtles, relevant UK legislation and gives advice on dealing with marine turtles stranded on shore and entangled in fishing gear. Most importantly, the Code gives regional contact

telephone numbers to be used for reporting all marine turtle encounters in UK waters. The Advisory Note is a six-page leaflet, which expands on the information given in the Code and is aimed at local authorities, public aquaria and veterinary practitioners. Both documents, which will be launched in 2002, have been produced in consultation with the fishing industry and have been endorsed by the UK Government and the UK Sea Fish Industry Authority.

Future TIG activities under the SAP include a UK tourist and tour operator awareness programme to ensure that the UK tourism industry has the necessary information and incentives to mitigate against the deleterious impacts of tourism on marine turtle habitat, with specific emphasis on the Mediterranean. The TIG will proactively seek input from the Mediterranean marine turtle conservation community.

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ANALYSIS OF EPIBIONT PRESENCE ON *CARETTA CARETTA* FROM ADRIATIC SEA

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INTRODUCTION

From 1986 more than 400 loggerheads *Caretta caretta* were collected along the Emilia-Romagna shore, northern Adriatic sea, and sent to the turtle hospital research centre of Fondazione Cetacea in Riccione (Affronte and Scaravelli 2001). The center currently works in two rescue points: one at the Delphinursery in Cattolica, a "Turtle Hospital" with a 3,600-litre pool, the other at the Delphinarium in Riccione with a 3-pool system of 200x110x80 cm each. The animals are treated by routine medical protocol and have followed feeding schemes. During the last decade, more than 140 *C. caretta* were hosted and around 120 specimens have been released.

In 1999 a specific research project was established in order to achieve a better knowledge of epibiont presence on the loggerheads. This paper is a preliminary description of the epibiont community found on loggerhead specimens.

MATERIALS AND METHODS

From 1999, 30 living and dead turtles were collected on Emilia-Romagna coasts and measured. Pictures were taken from each individual to provide the distribution, shape and number of epibionts on the shell. On dead turtles all the epibionts were directly collected. The living reptiles hosted in the rescue center were located for one to three days in fresh or shallow water. After this treatment the dead barnacles were collected in the pool or from the host. Samples were fixed in alcohol 70° and later determined, measured (maximum diameter, or length for *L. hilli*, and surface) and stored in collection.

RESULTS AND DISCUSSION

The main bulk of epibionts is represented by barnacles *Chelonibia testudinaria* (Linnaeus, 1758), *Platylepas hexastylos* (Fabricius, 1798), *Stomatolepas elegans* (Costa, 1838) and *Lepas hilli* (Leach, 1818). *C. testudinaria* and *P. hexastylos* barnacles were mainly present on the nuchal, 1st and 2nd vertebral scutes and also on the area comprised among the 10th marginal, 4th costal, 4th and 5th vertebral and the supracaudal scutes of the carapace. Few *Balanus trigonus* (Darwin, 1854) were found associated with the walls of

C. testudinaria. Number, dimension and distribution of the main species are shown in Tabs. 1, 2 and 3.

	All species					*C. testudinaria*					*P. hexastylos*				
Turtle code	Number	Min	Max	Mean	SD	Number	Min	Max	Mean	SD	Number	Min	Max	Mean	SD
1	101	7	29	18.41	5.05	82	10	29	19.82	4.36	19	7	17	12.32	2.87
2	168	3	70	17.6	10.95	134	3	70	19.43	11.49	15	6	19	13.19	3.51
3	121	2	52	8.97	9.26	9	5	30	20.11	8.82	106	2	16	6.51	2.24
4	143	1	40	12.2	7.16	73	2	40	15.19	8.28	64	1	25	9.02	3.98
5	123	1	22	10.5	4.08	63	2	22	12.46	3.88	60	1	15	8.45	3.19
6	166	1	20	6.8	4.74	59	1	20	9.51	5.27	107	1	16	5.31	3.67
7	13	5	13	8.08	2.02						13	5	13	8.0	2.0
8	16	4	18	10.5	3.93	10	7	18	12.6	3.27	6	4	9	7.0	1.9
9	44	2	13	7.68	2.21						44	2	13	8.0	2.0
10	271	1	17	7.14	3.57						271	1	17	7.0	4.0
11	438	1	20	7.01	3.8						438	1	20	7.0	4.0
12	188	1	32	10.51	5.37	25	4	32	13.92	8.6	162	1	20	10.02	4.49
13	151	1	40	9.33	5.88	47	1	40	13.57	7.92	9	5	25	12.22	6.65
14	22	10	34	20.05	7.88	11	16	34	25.55	7.51	11	10	19	14.55	2.7
15	245	1	42	16.54	9.87	141	9	42	23.38	7.43	52	4	19	7.54	2.51
16	17	5	45	25.12	11.48	14	5	45	28.07	10.36	3	9	15	11.33	3.21
17	28	4	10	4.68	2.68						28	4	10	5.0	3.0
18	36	4	8	4.42	1.08						36	4	8	4.0	1.0
19	340	6	33	4.26	2.66	3	23	33	28.67	5.13	337	1	13	4.04	1.26
20	92	4	9	5.15	1.43						92	4	9	5.0	1.0
21	6	25	40	34.83	5.42	6	25	40	35.0	5.0					
22	102	2	45	16.0	13.66	87	3	45	7.95	7.89					
23	133	2	52	9.78	9.38	80	2	52	12.69	10.95	1	0	12	-	
24	18	4	52	23.72	14.16	14	4	52	25.86	15.45	4	13	19	16.25	2.5
25	10	29	40	32.7	3.47										
26	2	10	22	16.0	8.49	1	-	22	-	-					
27	23	9	50	16.7	10.07	5	16	26	20.4	4.72	14	9	14	10.79	1.53
28	1	-	25	-	-	1	-	25	-	-					
29	25	2	36	15.45	13.78	4	27	36	32.0	4.24					
30	2	34	36	35.0	1.41	2	34	36	35.0	1.0					
	S. elegans					*L.hilli*					*B. trigonus*				
Turtle code	Number	Min	Max	Mean	SD	Number	Min	Max	Mean	SD	Number	Min	Max	Mean	SD
2	19	5	11	8	1.93										
3						6	30	45	38	10.61					
4	6	7	11	10	1.51										
12											1	-	4	-	
13	95	2	13	7	2.27										
15	52	1	11	7	1.78										
22	5	6	12	10	2.28	6	18	28	22	5.51	4	2	4	3	1.15
23	49	3	10	5	1.4	3	18	28	22	5.51					
25						10	29	40	33	3.0					
26	1	-	10	-											
27						4	18	50	33	13.2					
29						21	2	15	6	4.76					

Tab. 1. Number and dimensions (maximum diameter in mm) of the barnacles on each individual of *C. caretta* (SD: Standard Deviation).

C. testudinaria is very frequent and many subadults have been collected in the last decades with hundreds of *Chelonibia*, covering carapaces and heads. Favorite sites were on vertebral and pleural scutes. In some cases, when barnacles were present in large number,

	All species	*P. hexastylos*	*C. testudinaria*	*S. elegans*	*L. hilli*	*B. trigonus*
Mean	101.5	82.3	39.6	32.4	8.3	2.5
Min	1	1	1	1	3	1
Max	438	438	141	95	21	4
SD	109.8	116.0	43.9	34.6	6.6	2.1
N	3,045	1,892	871	227	50	5

Tab. 2. Descriptive statistics of the number of barnacle species on 30 *C.caretta.*

they also covered marginal scutes and grew in distorted way to follow the edge of the carapace. One turtle with a barnacle in one nostril and other two with specimens on eyes have been also recorded. This barnacle can grow up to 70 mm of maximum diameter (16.56±9.05 mm on 359 specimens). On large barnacles we found also algae, Bivalvia (*Mytilus* spp.) and small *Chelonibia* growing on the walls or in the radii.

P. hexastylos was already quoted for *C. caretta* in Mediterranean (cfr. Relini 1980, Frazier et al. 1985). This barnacle was collected on more than 75% of the sampled loggerheads (Tab. 3) and was present on the skin of throat, shoulder and flanks but also in many scutes of carapace and plastron. *P. hexastylos* was also very numerous in some turtles with a maximum of more than 400 specimens on one host (diameter 7.25±3.65 mm on 644 specimens). The maximum diameter of collected specimens reaches 25 mm.

S. elegans was collected on about the 23% of the loggerheads (Tab. 3) with a CCL ranging from 45 to 85 cm. The specimens were typically located on throat, shoulder and flank skin, joint in groups of 5 to nearly one hundred individuals, each measuring 1 to 13 (average 8.76) mm of diameter. This crustacean has been already reported for *C. caretta* in central and east Mediterranean areas (Relini 1980, Frazier et al. 1985) but not for Sicily channel (Gramentz 1988).

L. hilli is the only Lepanidae determined in the turtle samples. The crustaceans were found in turtles of 22-85 cm CCL. The total length of collected specimens ranged from 2 to 50 mm. Three to twenty one specimens per turtle at various growth stages were found. There is no correlation between host CCL and length of the Lepanidae. All the specimens were located on the caudal part of the carapace or on the anal scutes.

On 30 turtles with epibionts the relative presence of the different species show a co-dominance of *C. testudinaria* and *P. hexastylos*. The lower frequency of distribution, as number of individuals, of *C. testudinaria*, is in fact compensated by the larger dimension of the crustaceans (Tab. 3). The distribution by groups of the four main barnacles into classes show how *L. hilli* is mainly found in few specimens for turtle. *C. testudinaria* have more numerous small groups as well as *S. elegans*. *P. hexastylos* can be present in larger groups as shown in Tab. 4.

Species	Turtles with barnacles / total turtles	Number of each species / total barnacles	Mean surface of each species / all barnacles area
P. hexastylos	76.67	62.13	24.48
C. testudinaria	73.33	28.6	70.14
S. elegans	23.33	7.45	2.76
L. hilli	20.0	1.64	
B. trigonus	6.67	0.16	

Tab. 3. Presence of barnacle different species on 30 *C. caretta.*

	1-10		11-20		21-50		51-100		101-200		> 200	
	N	%	N	%	N	%	N	%	N	%	N	%
P. hexastylos	5	21.74	5	21.74	3	13.04	4	17.39	3	13.04	3	13.04
C. testudinaria	9	40.91	3	13.64	2	9.09	6	27.27	2	9.09		
S. elegans	3	42.86	1	14.29	1	14.29	2	28.57				
L .hilli	4	66.67	1	16.67	1	16.67						

Tab. 4. Distribution of barnacle groups into numerosity classes.

Few other epibionts species were also collected. In few cases we found groups of *Serpulidae* on adult specimens, associated with algae (green and red) and dense groups of *Chelonibia* on the posterior part of the carapace. A large number of very small *Mytilus cfr. galloprovincialis* was found on some dense group of *C. testudinaria*. *Hirudinea* are very rare with two cases of *Ozobranchus margoi* as well as the presence of only two samples of *Caprellidae*, both found in adult and subadult turtles outside of the sample here considered.

In comparison with other researches (cfr. Frazier et al. 1985, Dodd 1988, Gramentz 1988), the Adriatic community examined appears to have a lower level of diversity. The large number of young and subadults loggerheads in the sample may be an explanation. As well, about 3/4 of the turtles examined were dead at the collection moment so it is probable that some epibionts (the non-sessile) were loose before the analysis.

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THE INVOLVEMENT OF LOCAL COMMUNITIES IN SEA TURTLE CONSERVATION: THE CASE OF EVROTAS DELTA, LAKONIKOS BAY, GREECE

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INTRODUCTION

The involvement of local communities is essential in the implementation of management measures for the conservation of natural ecosystems. A legal framework adapted to the specific local conditions, incorporating natural environment and socio-economic parameters, is required for the effective management. However, for the long-term success of the management policies, it is essential to ensure local consensus and active involvement.

In the Mediterranean, where there is very often intense human activity in the ecosystems that require protection, it is only through the involvement of local societies that the success of the management measures will be safeguarded. The increasing economic pressure in southern Europe, that affects mainly the local economies that depend on agriculture and less those that rely on tourism, results in the reluctance of the local societies towards the implementation of management policies especially when these policies derive from national authorities.

Non-governmental organisations in most cases undertake the task to develop consensus and often proceed with the implementation of management measures at a local level. In countries such as Greece, where due to structural deficiencies the national mechanism is unable to encounter the increasing management demands (18% of the Greek territory has been proposed for inclusion in the European network NATURA 2000), non-governmental organisations are likely to be commissioned even for the elaboration of local management plans.

Herewith we present ARCHELON's project in Lakonikos Bay, southern Peloponnesus, as a case study for the involvement of local communities.

THE STUDY AREA

The Evrotas Delta forms one of the last remaining important wetlands in southern Greece and is proposed as a NATURA 2000 site comprising 5,820 ha.

Even though the Delta has suffered extensive destruction and considerable reduction in size due to human activities, today it is considered one of the last strongholds for wildlife in the area. Terrapins, freshwater snakes and more than 210 species of birds have been recorded, many of which are rare or threatened, like the imperial eagle and the black stork.

Until the eighties, the principal agricultural product in the area of Evrotas river was cotton which was traditionally grown even before the 18th century. This was followed by rice, to finally end up in the expansion of citrus fruits, olive trees, and vegetables. About 70% of the inhabitants in the Evrotas river basin are mainly occupied with agriculture, which takes up 63% of the land. Coastal fishing constitutes an important secondary activity.

DEVELOPMENT OF STRATEGIES

Lakonikos Bay is a "major" nesting area in Greece holding about 200 loggerhead nests annually (Margaritoulis 2000). ARCHELON has been running a monitoring project in the area since 1984. The project focuses on monitoring and protection of loggerhead clutches as well as public awareness actions. Over 600 volunteers from Greece and other countries have participated in the project.

The pillars of the project's strategies in the area were:

- Long-term presence in the field. The fact that the project started and expanded gradually with limited resources and using volunteers as its main driving force gained local acceptance and appreciation.
- Intensive and persistent monitoring and protection. Our efforts to protect sea turtles, often under difficult conditions, gained the appreciation of the locals who became more aware of the importance of protecting this species and its habitats.
- Persistent social presence. The very existence of international volunteers in the local community helped develop local understanding and acceptance for our work.

PROJECT IMPLEMENTATION

During the last sixteen years, ARCHELON undertook the commitment to approach the local community (Sioris et al. 2000) and ensure its active involvement in the protection of sea turtles and their habitats in the area of the Evrotas Delta in the Bay of Lakonikos.

ARCHELON in its effort to gain the involvement of the local community, implemented various activities whose common characteristic is the multi-level intervention in the local community:

- Local schoolchildren. Environmental education projects were started in 1989.

Between 1997 and 1999, 52 presentations were carried out and 1,767 students aged 7-17 years participated.

- Fishermen. By setting up pilot programmes between 1989 and 1991 (Margaritoulis et al. 1992), the project started to intervene in order to tackle the problem of accidental capture of sea turtles in fishing gear. In co-operation with the local fishermen, 188 captures were recorded between 1997 and 2000.
- Visitors. During the summer beach patrols were carried out aiming to inform beach users, most of who live in nearby areas. During the summer months of 1998-2000, a total of 1,586 beach users were directly informed with the help of local schoolchildren.
- Cultural events. Project members participated in events organised by the local communities by conducting environmental education activities for children, slide shows, photo exhibitions, etc. Between 1998 and 2000, the project participated in 21 local events and conferences informing a total of 7,034 people.
- Local authorities. Realising the importance of interaction with the local authorities, consultation meetings were organised with the municipalities and the prefecture on the progress of ARCHELON's activities in the area. During the last three years ARCHELON has been actively involved in the preparation of protection measures for sensitive zones in the area of the Evrotas Delta (pollution, degradation of dune areas).

For the development and maximisation of the outcome of the above activities, the following factors played a significant role:

- The implementation of a LIFE-Nature project (1997-2000) ensured the acquisition of equipment and other material (scientific instruments, vehicles, communication tools, information material), facilities (seasonal Information Stations, the creation of the Environmental Centre and the Nature Trail in a nearby sand dune ecosystem, the establishment of the Communication Office for Fishermen), activities coverage (papers, conferences) as well as the necessary for legislative purposes studies (Management Plan, Special Environmental Study).
- Good and close connections with primarily the local, as well as the national press. The co-operation with the local radio stations provided the local community with immediate and direct information by means of press releases and live interviews with project members.
- ARCHELON's central office support, and specifically through its Secretariat, Volunteer Section, Environmental Education Programme, Rescue Centre and Stranding Network.

STRATEGIC RESULTS

Following the implementation of above main actions, some strategic results can be summarised as follows:

- Direct protection of sea turtles. Managing the problem of private and public light pollution on the nesting beach, as well as raising awareness and co-operation with fishermen has helped to reduce two of the most serious threats to sea turtles in the area.
- Restoration of sand dunes. The implementation of this activity (following a pilot project) on a larger scale with the active involvement of the local municipalities ensured the effective recovery of the degraded dune systems in the area of Evrotas Delta (Rebetz et al. in press).
- Public Awareness. With the support of the local municipalities bilingual informative material on the Evrotas Delta was issued, information stations and the Environmental Centre operated and several educational activities were carried out.
- Ecotourism infrastructure. The establishment of the Environmental Centre and the Nature Trail, realised with the support of the local municipalities by providing an old school and land, attracted hundreds of visitors every year. The municipalities are sharing the administration costs and are covering all maintenance and equipment costs of these facilities.

CONCLUSION

The project's strategy in the area has first of all managed to eliminate the principle threats to sea turtles and their habitats in the area of Evrotas Delta. It is important that these threats were not dealt with in the form of "external intervention" in the area, but with the involvement of the local community, which ensured the long-term viability of the solutions provided.

Moreover, the active involvement of people and local authorities in efforts to protect and sustain the environment creates new dynamics on a local level: the local community discovers the natural value of their area and reduces activities that may have a detrimental effect on it.

The preparation and partial application of a Management Plan as well as the Special Environmental Study (which contains the possibility of issuing relevant legislation) effectively ensures the establishment of appropriate mentalities and infrastructures for sustainable development in the area. Further, the active support of the local municipalities (Elos and Skala) is the vehicle that can guarantee a viable future for Nature and Man in Evrotas Delta and set an example for other areas in Greece and in the Mediterranean.

ACKNOWLEDGEMENTS

The project received at times financial assistance from European Commission in the context of various instruments (ACNAT, LIFE Nature). Permits to work with an endangered species were provided by the Ministry of Agriculture. We thank project personnel and volunteers who spent considerable effort to work closely with the local communities.

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THE INFLUENCE OF HUMAN ACTIVITIES UPON FEEDING OF THE LOGGERHEAD SEA TURTLE, *CARETTA CARETTA*, IN THE WESTERN MEDITERRANEAN: COSTS AND BENEFITS

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INTRODUCTION

Conservation of sea turtles is a complex task that requires knowledge of different aspects of biology such as breeding, migration and foraging (Burke et al. 1993). In particular, how turtles use trophic resources, and how human activities interfere with habitat use are crucial for effective population management (Bjorndal 1999). However, studies of diet and gut contents in marine turtles are constrained by opportunistic sampling, which obviously limits the scope of the conclusions. Turtle sampling usually comes from two sources, i.e., incidental captures by fisheries and strandings.

The loggerhead sea turtle (*Caretta caretta*) is seriously threatened in the western Mediterranean, particularly due to fisheries interaction (Tomás et al. 2003 and references therein) and debris ingestion (Tomás et al. 2002). Information on diet and debris ingestion of this species in this area is limited to the analysis of isolated individuals (references in Tomás et al. 2001).

This presentation discuss the feeding strategy and the effect of debris consumption on juvenile loggerheads from the western Mediterranean based on two relative large samples of diverse origin. We also try to ascertain the extent to which human activities generate costs and benefits for this species.

METHODS

We present data from analyses of digestive tract contents of 54 loggerhead turtles (range of CCL: 34-69 cm) captured at sea and seized by Spanish authorities, and 30 individuals (range of CCL: 37-72 cm) stranded along the Valencian Community coasts (from 40°31'N/0°31'E to 37°51'N/0°45'W) from 1995 to date. No information about the locality of capture of the seized turtles was available, but data on size, prey species, parasitic fauna and fatty acid composition confirmed a western Mediterranean origin (Tomás et al.

2001, 2002). Biometric variables were measured during the necropsies (Tomás et al. 2001). Solid items including organic matter, debris and substratum were collected from the guts.

The number of prey individuals and prey species were recorded in the sample of seized turtles. Debris ingestion was quantified in this sample by the frequency of occurrence of items longer than 1cm, and the measurement of wet volume to the nearest 0.5 ml. Additional analyses are currently being developed with the stranded turtles, so here we will only include data on the frequency of occurrence of prey and debris and total wet volume of debris. Prey groups were arranged based on taxonomic and abundance criteria.

The importance of the different prey groups in the seized turtles was tested using a Friedman test with a post hoc comparison. The associated Kendall concordance test was used to examine the predictability of the diet composition from turtle to turtle. Examination of raw data suggested the hypothesis of that fishes had been ingested in patches of discarded by-catch. This was examined based on a Monte Carlo simulation in which fish species were independently assigned to the 54 turtles according to their frequency of occurrence; then, we compared the observed variance with variances obtained in 1,000 replicas obtained by this method (see details in Tomás et al. 2001). Cephalopods might also be ingested as by-catch, but were not included in this analysis due to their low number.

RESULTS

Diet and Feeding Ecology

Fifty of the 54 seized turtles and 26 of the 30 stranded turtles had food items in their digestive tracts. In the seized turtles we identified 47 animal taxa (28 to the species level) from 8 phyla (with 32 new dietary records for *C. caretta*) (Tomás et al. 2001). We also found one sea-grass and 3 algae. In the seized turtles, all identified species had a very low occurrence (< 30%) and mean number of individuals per turtle (< 1 individual); the only exception, *Pyrosoma atlanticum* with a mean of 41.2 ± 239.1 individuals, is accounted for by the presence of 1,699 and 485 colonies in two turtles (Tomás et al. 2001). Mean number of prey species per turtle was 3.9 ± 3.8. Tab. 1 quantifies the importance of the different prey groups found in seized and stranded turtles. In the seized turtles, the Friedman test revealed significant numerical differences among prey groups (χ^2=16.72, 4 d.f., n=50, p< 0.001); a post hoc comparison (p< 0.05) defined a clear division into three categories: fish; tunicates, crustaceans, molluscs; other invertebrates. However, the low concordance of the five prey groups across turtles (W=0.09) indicates that the numerical importance of each group greatly varies from turtle to turtle. This heterogeneity and unpredictability in the diet seems to be observed in the sample of stranded turtles, in

	Seized turtles N= 54				Stranded turtles N= 30
Prey groups	No. of turtles	Mean ± S.D.	Range	Total number	No. of turtles
Fish	31	3.8±6.4	0-29	206	10
Pelagic tunicates	19	46.3±248.3	0-1,699	2,314	11
Crustaceans[a]	28	1.2±1.8	0-8	63	7
Benthic mollusks[b]	14	0.5±1.1	0-5	25	6
Cephalopods	11	0.5±1.8	0-12	26	9
Other invertebrates	17	1.1±2.2	0-10	56	6
Algae & seagrass	9	-	-	-	8

[a] Decapods and isopods. [b] Gastropods and bivalves.

Tab. 1. Frequency of occurrence, mean (with S.D.), range and total number of individuals for prey groups found in the seized loggerhead turtles from the western Mediterranean, and their frequency of occurrence in the turtles stranded in Valencian Community coasts.

which fishes and pelagic tunicates are also prevalent. Data on distribution in the gut and the degree of digestion of fish and cephalopods found in the seized turtles confirmed that many of these preys were ingested long before the turtles were captured (Tomás et al. 2001). The variance of fish species richness in the 1,000 simulations ranged from 0.64 to 2.22, far lower than the observed variance (3.22). Therefore, fish species exhibit a highly significant positive association among turtles ($p < 0.001$).

Debris Ingestion

Forty-three of the 54 captured turtles and 25 of the 30 stranded had debris in their digestive tracts. A high number of the turtles showed small amounts of debris (36 seized turtles and 17 stranded turtles had less than 20 ml of debris). More than 10 different types of debris were identified. Of the 43 seized turtles with debris, 27 (62.8%) had eaten more than one type of debris (mean number of types per turtle=2.5, S.D.=1.8, range: 1-8). We observed also apparent differences in the types of debris ingested among turtles. Anthropogenic debris appeared in 41 and 25 individuals from the two turtle samples, plastics being the most prevalent debris (Tab. 2). Plastics varied greatly in consistency, shape and colour. Tar was also common, but 44.2% of total tar volume was found in a single animal. Other types of debris, such as paper, Styrofoam, hooks and lines, net fragments and other varied types, had a lower occurrence (Tab. 2). Numerically, debris made up almost a half of the items (including preys) ingested by the seized turtles (mean percentage of debris items with respect to total items=41.6%, S.D.=28.6), and both types of items, preys and debris, appeared mixed in the turtles.

Debris	Seized turtles N= 54					Stranded turtles N= 30
	No. of turtles	Volume (ml)	$Mean_V$ ± S.D. (range)	No. of items	$Mean_I$ ± S.D. (range)	No. of turtles
Plastics	41	199.5	3.7±7.02 (0-40)	219	4.1±6.6 (0-36)	20
Tar	14	115.5	2.1±7.5 (0-51)	-	-	6
Paper	3	5.5	0.1±0.6 (0-4)	4	0.007±0.3 (0-2)	1
Styrofoam	9	15	0.3±0.8 (0-2)	10	0.2±0.4 (0-2)	1
Wood and reed	13	53.5	1±2.7 (0-12.5)	68	1.3±3.4 (0-18)	7
Hooks and lines	3	7	0.08±0.4 (0-1.5)	3	0.06±0.2 (0-2)	15
Net fragments	6	4.5	0.1±0.3 (0-1.5)	7	0.1±0.4 (0-2)	8
Other debris	4	4	0.3±1.5 (0-10.5)	6	0.1±0.4 (0-2)	3

$Mean_V$: mean volume per turtle. $Mean_I$: mean number of items per turtle.

Tab. 2. Quantification of the different types of marine debris found in the digestive tracts of 54 turtles seized in the western Mediterranean, with their frequency of occurrence in 30 turtles stranded in Valencian Community coasts.

DISCUSSION

In the seized turtles, discarded by-catch, principally fish, was the most important food source. Fish were ingested in patches of floating items since most of the species found are fast swimming, thus they are unlikely captured by the turtles. This phenomenon has rarely been reported, and raises the question over whether fisheries may have a role in supplying food for juvenile loggerheads in the western Mediterranean. Fish were also an important prey group in the stranded turtles, which appears to support this hypothesis. If turtles are attracted to fishing areas due to the presence of discarded material, this can contribute to maintain high number of individuals this area, perhaps increasing incidental mortality (Shoop and Ruckdeschel 1982). Pelagic tunicates, crustaceans, molluscs, and a large variety of other invertebrates were also found in both samples. All identified prey species had low occurrence and abundance, and prey composition was largely unpredictable; this result provides evidence that the diet of loggerheads is highly opportunistic.

Marine debris also occurred frequently, but in low volume in most of the turtles. This observation coupled with the lack of apparent pathologies related to debris suggest that debris ingestion, in most cases, is not a direct cause of death, but perhaps is able to cause sublethal effects in the turtles (Tomás et al. 2002 and references therein). The fact that plastics were the most frequent item can be explained by its higher proportion at sea than other types of debris (Laist et al. 1999). The finding of a large variety of debris items might

suggest that they are abundant in the environment. Several authors have suggested that active debris ingestion occurs by mistake due to similarity to prey species, e.g., plastic bags are confused with jellyfish (references in Tomás et al. 2002). However, this cannot be ascertained until more studies are carried out to investigate the ability of turtles to discriminate shape and colour, and to determine how loggerhead turtles detect their preys. Our data suggest that juvenile loggerheads are non-selective with respect to feeding decisions, which makes them prone to the threats derived from human activities.

ACKNOWLEDGEMENTS

We thank the department of Pathology and the AVAFES Association of the Universitat Autónoma de Barcelona (Spain) for the necropsy of the turtles captured at sea. Javier Badillo kindly assisted us in laboratory work. This study has been supported by project PVCYT No. GV-2542/94 of the Generalitat Valenciana.

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A TWELVE-YEAR SURVEY ON STRANDINGS AND CAPTURES OF SEA TURTLES IN THE EASTERN SPANISH COAST

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INTRODUCTION

Long-term studies on strandings over large coastal areas provide valuable information on sea turtle biology and conservation. Such studies give an overview of incidence and effects of all the potential threats affecting sea turtles in coastal waters. Stranding studies are also useful in detecting massive mortalities of sea turtles in coastal waters and support other studies for estimating abundance of sea turtle populations (Tomás et al. 2003a).

Various anthropogenic threats can seriously affect sea turtles in the Valencian Community (east Spain): Firstly, the pressure of growing human populations along the coasts of this region over recent decades disable the establishment of sea turtle nesting beaches. This demographic pressure and the increased development of tourism in the region produces greater litter spills along the coasts and at sea, every year, principally in summer time. Secondly, several fisheries cause a high number of incidental captures of sea turtles, particularly the swordfish long-line fleet that by-catches thousands of loggerheads every year in these waters (Aguilar et al. 1995). Data on sea turtle strandings and captures along the coasts and coastal waters of the Valencian Community have been recorded since 1989 as part of the agreement between local authorities (Generalitat Valenciana) and the University of Valencia (UV). Here we report all the data collected in the period between 1989 and 2000 and the special situation observed in 2001.

METHODS

The Valencian Community (from 40°31'N/0°31'E to 37°51'N/0°45'W) is comprised of 419 km of coast and includes some coastal and marine reserves. This region constitutes 3 provinces (from north to south): Castellón province (114 km of coast), Valencia province (105 km) and Alicante province (200 km).

Data of strandings and captures were collected sporadically until 1995, when a database was created and data collection was systematized. Collection of live turtles and the carcasses has been thanks to the strandings network composed by several public and private institutions and coordinated by the research team of the Marine Zoology Unit of the

Cavanilles Research Institute (UV). Live animals were moved to a rehabilitation centre, while the carcasses were brought to the research installations of the UV for measurement (curved carapace length notch to tip (CCLn-t), maximum curved carapace width (CCW) and other biometric variables) and for necropsies. The necropsies were performed to determine cause of death, but also for studies of epibionts (Badillo et al. 2003), parasites (Aznar et al. 1998), diet analysis, and debris ingestion (Tomás et al. 2003b).

Despite the existence of a comprehensive stranding network, not all the turtles stranded or captured have been examined, due to logistical problems or to the removal of the carcases from the beach by, for example, the beach-cleaning service before we arrived to the stranding location.

RESULTS

Between 1989 and 2000, 258 (21.5±11.1 per year, range 9-44) stranded loggerheads, *Caretta caretta,* were recorded in this region, with a further 43 captured at sea. In the present year we have registered 109 loggerheads (94 strandings and 15 captures), making a total of 410 loggerheads detected since the beginning of this study. Fig. 1 shows the annual tendency of strandings and captures between 1995 and 2001. Of these 410 loggerheads, a total of 146 (27% of the stranded ones and 87.9% of those captured at sea) were found alive. The 71.9% of these live turtles were recovered and tagged (54 of them with RAC/SPA programme tags) and were subsequently released in marine reserves areas. Mean CCL was 54 cm (SD=12.26, N= 168). We did not detect differences in size (CCL) distribution from year to year (ANOVA: F= 1.022, p= 0.413). One green sea turtle, *Chelonia mydas,* and two leatherbacks, *Dermochelys coriacea,* were recorded here prior to 1994.

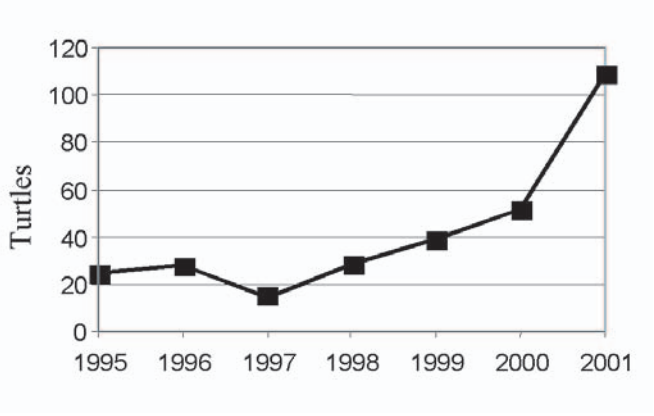

Fig. 1. Annual tendency of the number of loggerheads stranded or captured in the coasts and coastal waters of the Valencian Community.

More turtles were registered in the province of Alicante than in the other two provinces. However, values of strandings and captures relative to number of coastal towns or to kilometres of coastline show that the province of Valencia seems to be as important as Alicante (Tab. 1).

Province	Length of coast (km)	Coastal towns	Turtles registered	Turtles/coastal towns	Turtles/km of coast
Castellón	114	14	45	3.2	0.39
Valencia	105	15	141	9.4	1.34
Alicante	200	19	224	11.8	1.12
Total	419	48	410	8.5	0.98

Tab. 1. Absolute values and densities (as turtles registered by coastal towns and stranded turtles by kilometre of coast) of turtles reported in the Valencian Community and its provinces between 1989 and September 2001.

Strandings occur throughout the year, but are more frequent from July to September (Fig. 2a). A bimonthly distribution of strandings and captures by province in 2001 showed that in the end of May and early June most of the turtles appeared in Alicante, decreasing in number in this province and increasing in a northerly direction towards the provinces of Valencia and Castellón in July and early August. In late August and September turtles were found less frequently in these latter provinces, appearing in high numbers again further south in Alicante (Fig. 2b).

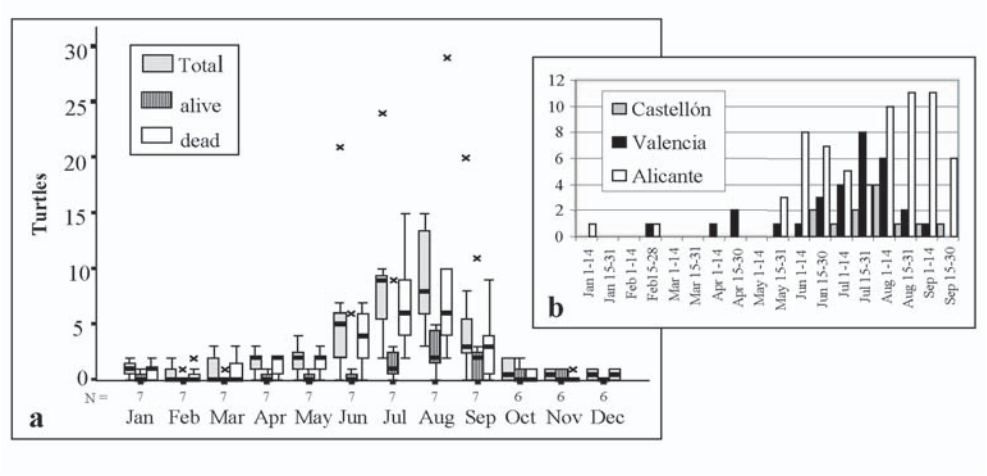

Fig. 2. **a.** Mean number of loggerhead turtles stranded and captured in the Valencian Community by month for the period 1995-2001. Note the outliers corresponding to 2001; **b.** Bimonthly distribution of strandings and captures by provinces in 2001.

The main registered cause of stranding was interaction with long-line fishery (132 out of the 351 stranded turtles). Evidence of stranding due to oil and tar, entanglement with nets or large plastic objects, collisions with boats and debris ingestion were also detected in the stranded turtles (Fig. 3). Captures at sea were attributed to several types of fishery and also to recreational boats (Fig. 3). Some of the sea turtles were affected by more than one threat (e.g., oiled or entangled turtles having a long line hook in the oesophagus).

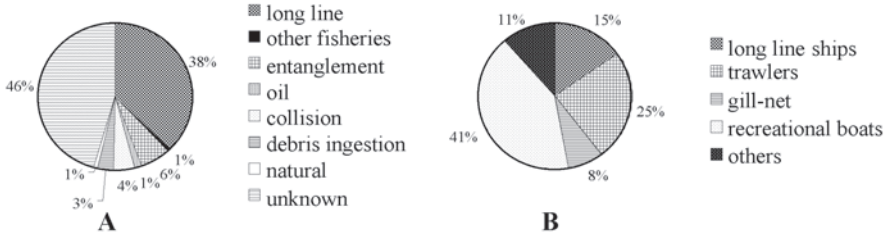

Fig. 3. Causes of stranding (A) and captures at sea (B) of loggerheads in coasts and coastal waters of the Valencian Community between 1989 and September 2001.

DISCUSSION

Two possibilities may help to explain the increasing numbers of strandings and captures in the study area: Increasing anthropogenic threats to turtles, and, more likely, the improvement of the network developed for their detection. However, the spectacular number of strandings reported in 2001 (twice the number detected in 2000) may be the consequence of an important entry of turtles into the waters of this region during this year, since no significant improvement has occurred in the stranding network compared to 2000. This influx of turtles probably occurred from the south, based on the temporal trend of stranding distribution by provinces in a south north direction early in summer season and vice versa later in autumn, and also on aerial surveys over this period (Tomás et al. 2003a). This assumption is consistent with the migration patterns of loggerheads in the western Mediterranean proposed by Camiñas and de la Serna (1995), whereby it is suggested that the turtles move from south to north in Spring, returning south in early Autumn. None the less, this information must to be further examined in the light of information on fishing effort and other human activities in the waters of the 3 provinces throughout the year.

Our data confirm that the loggerhead stocks in this region are composed mainly of juvenile and subadult individuals, and that their size distribution is constant from year to year. Our results also support at-sea studies (e.g., Aguilar et al. 1995), which states that long-line

fishery is the most important threat for loggerheads in the western Mediterranean.

The present study reveals that there are substantial densities of loggerhead turtles in the Valencian Community throughout the year and that this stock is under threat from an increasingly developing tourist industry and fishing activities. Continued efforts are necessary to ascertain trends in the importance and tendencies of the anthropogenic threats affecting sea turtles in this side of the Mediterranean. Measures designed to reduce the incidental captures by fisheries and educational programs for tourists and sailor become also essential to reduce these threats.

ACKNOWLEDGEMENTS

This study is the result of the work of the whole team of the Marine Zoology Unit, from the Cavanilles Institute of the UV. We thank A.M. Power for the English revision of the ms. Thanks also to the Conselleria de Medio Ambiente, Generalitat Valenciana for economic support, and to all the institutions implicated in the stranding network.

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FIRST AERIAL SURVEYS OF LOGGERHEAD SEA TURTLES, *CARETTA CARETTA*, IN WESTERN MEDITERRANEAN WATERS

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INTRODUCTION

The western Mediterranean constitutes an important feeding ground for juvenile loggerheads sea turtles, *Caretta caretta,* which come from eastern Mediterranean and Atlantic populations (Laurent et al. 1998). In addition, Camiñas and de la Serna (1995) proposed that a reduced stock of adult individuals of this species remain in the area throughout the year, especially in the Balearic Islands and the Columbretes Archipelago. To date, abundance estimates of loggerhead sea turtles in the western Mediterranean have been based on data from strandings (Raga and Salinas 1990, Camiñas 1996) or incidental captures by fisheries (Laurent 1991), especially by the Spanish long-line fleet (Camiñas and de la Serna 1995). However such samplings are opportunist and both are prone to different types of bias. The first type of sampling is subject to the chance of finding turtles on the beach; in the second one, the attraction of the turtles to bait can bias the estimations of abundance and also of natural distribution. Instead of such indirect sampling, aerial surveys are more appropriate when little is known about turtle distribution and abundance in a marine area (Henwood and Epperly 1999). Although also subject to some bias, related principally to factors affecting visibility, aerial sampling can cover large areas in short time allowing the distribution and abundance of turtles to be measured at precise points in time. Aerial samplings for estimations of sea turtle population have never been carried out to date in the western Mediterranean.

The present study summarises the preliminary results of aerial surveys performed within the framework of a project for the identification of areas of especial interest for marine conservation in the Spanish Mediterranean, financed by the Spanish Ministry of Environment (Raga et al. 2001). The results presented here represent a starting point to ascertain patterns of spatial and seasonal distribution and to obtain more precise estimation of the loggerhead sea turtle stock in the waters of the western Mediterranean.

METHODS

In 1998, two preliminary flights were undertaken by helicopter in the Columbretes zone, using exploratory designs of survey transects. Subsequently, loggerheads were recorded in 16 aerial surveys performed in coastal waters, from Delta del Ebro (south Tarragona, 40°41'N- 0°53'E) to Aguilas (Murcia, 37°22'N- 1°38'W) from June 2000 to July 2001. The study area comprised a strip of between 16.8 to 56 nautical miles (nm) in width from the coastline (an overall area of 6,886 nm^2, 23,619 km^2). We used a push-pull aircraft (CESSNA-337) for the surveys, flying at airspeed of 85-90 knots and at an altitude of 150 m. Flat windows limited the observation vertically down the aircraft. The area covered was divided into 4 sample units (sectors, Fig. 1) due to an aircraft autonomy of 6 h. Surveys were undertaken following the transect line methodology (Buckland et al. 1993, 2001) and line transects were designed in a zig-zag pattern within each sector, except in the second one covering the Columbretes Archipelago. The latter sector warranted special attention because of its Marine Reserve status and so, parallel transects with higher coverage were undertaken (Fig. 1).

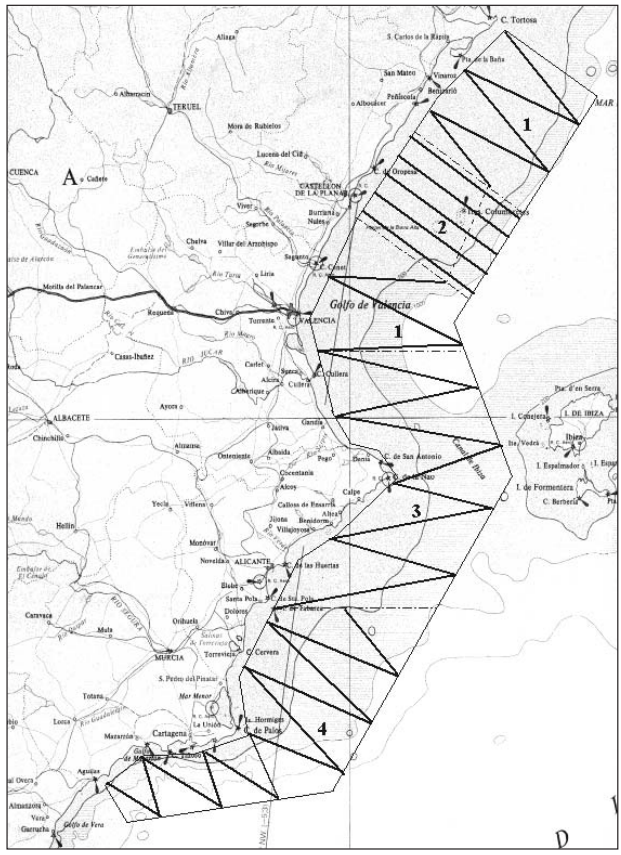

Fig. 1. Study area with the 4 sample units and the transects.

We positioned all the turtles observed in each transect using GPS (Global Positioning System). Data on environmental factors affecting visibility (i.e., beaufort, glare and percentage of cloud coverage) were collected. We flew for surveys only in days with a beaufort lower than 3 to reduce visibility bias. Data on human activity, marine debris aggregations and pollution were also collected.

Quantification of the abundance is based on the number of turtles and the sighting rate (SR: number of turtles/ nautical miles on effort) by flight.

RESULTS

In the two preliminary flights with helicopter 113 turtles were observed, most of which were detected during the second flight (Tab. 1). A total of 613 turtles were detected in the 16 aircraft flights. From these 613, we detected 581 on effort (i.e., during the course of transect) and the remainder were observed outside of the transects. The mean number of turtles per flight was 36.31±30.99 and the mean SR was 0.134±0.102 (n= 16). Tab. 2 illustrates the mean number of turtles and the mean SR by sector. In spite of the fact that the flights were restricted to optimal environmental conditions based on weather predictions, some weather variability affected some surveys; e.g., rain and storms during the flight performed on 5 April 2001 probably contributed to a reduction in sightings on this survey. If we eliminate this flight, the mean SR in sector 2 rises to 0.174, with a reduction of its standard deviation to 0.11 (n= 4).

Date	Sector	Survey effort (in nm)	Survey time (in hours)	Study area (nm^2)	No of turtles (on effort)	No of turtles (off effort)	Sighting rate (turtles/nm)	Sighting rate (turtles/h)
winter 13/02/1998	2	168.4	2.17	611	9	1	0.052	4.15
summer 21/07/1998	2	168.4	2.10	1,174.8	63	40	0.374	30.00
AIRCRAFT at an altitude of 150 m and an airspeed of 85 kn								
spring 02/06/2000	2	175	2.05	605.9	58	1	0.331	28.29
spring 13/06/2000	4	183.5	2.00	826.5	13	0	0.071	6.50
summer 18/07/2000	1	313	3.68	2,540	64	1	0.204	17.38
summer 19/07/2000	2	175	2.05	605.9	18	0	0.103	8.78
summer 20/07/2000	3	368.5	4.33	2,446	61	3	0.166	14.08
summer 07/09/2000	4	307.5	3.62	1,900	38	2	0.124	10.51
summer* 21/07/2000	4	131	1.53	1,054	3	1	0.023	1.96
winter 22/02/2001	2	200	2.35	1,200	33	6	0.165	14.04
spring 03/05/2001	1	284.5	3.38	2,277	19	6	0.067	5.62
spring 04/05/2001	2	200	2.35	1,200	1	2	0.005	0.43
spring 23/05/2001	3	356.5	4.17	2,811	51	2	0.143	12.24
spring 24/05/2001	4	333	3.90	2,156.7	125	10	0.375	32.05
summer 26/07/2001	1	280	3.38	2,277	27	0	0.096	7.98
summer 25/07/2001	2	200	2.35	1,200	19	11	0.095	8.09
summer 27/07/2001	3	325	4.17	2,811	13	0	0.04	3.12
summer 28/07/2001	4	295.5	3.90	2,156.7	38	7	0.129	9.74
Total		**4,128**	**49.22**		**581**	**52**		

* Flight incomplete because of a sudden increase in the beaufort

Tab. 1. Turtles observed in the surveys during the course of transect (on effort) and outside the transect (off effort) and sighting rate registered in each flight.

DISCUSSION

We obtained sighting rates comparable or greater than those constructed from data reported in another study with similar sampling methodology and with greater coverage (see Epperly et al. 1995). However, we must interpret our results carefully due to several constraints within the sampling strategy: Firstly, the surveys were subject to a continuing optimisation; thus, some of them presented lower coverage and less uniformity. Secondly, in order to estimate the entire population using aerial sampling is necessary to determine the proportion of turtles at the surface in relation to those present in the entire water column (Henwood and Epperly 1999), and we did not know that proportion in the study area.

Despite these difficulties, we can propose the following patterns of distribution: Turtle density appears to be relatively higher in the sectors 2 and 4. Eliminating the flight affected by the rain and storms (see results) we observed the sector 2 to have the highest SR. Within this sector there exist both the Marine Reserve of Columbretes and an important fishing area, especially for trawling vessels. The marine fauna protected in the Nature Reserve and the by-catch discarded by fishermen could provide a constant and abundant supply of food for turtles thus maintaining the high abundance in this sector. In fact, fishery by-catch has been reported to be the most important food for loggerheads incidentally captured in the north Spanish Mediterranean waters (Tomás et al. 2001). Regarding high SR in sector 4, representativeness of this value is questionable due to its high standard deviation (Tab. 2) and this mean value was certainly due to the high number of sightings in the flight undertaken on 28 May 2001 (Fig. 2). Based on this aerial survey and on stranding data (see Tomás et al. 2003) we suggest that in the Spring months of 2001 a high number of turtles have entered in the study area from the south. Spring immigration of subadult loggerheads into foraging areas have also been reported using aerial surveys in another location (Epperly et al. 1995).

	N	Mean SR	SD	Mean No of turtles	SD
Sector 1	3	0.12256	0.07246	36.67	24.01
Sector 2	5	0.13986	0.12135	25.8	21.28
Sector 3	3	0.1162	0.06694	41.67	25.32
Sector 4	5	0.14426	0.1362	43.4	48.15

Tab. 2. Mean sighting rate (SR) and mean number of turtles, with the corresponding Standard Deviation (SD), obtained in each sector.

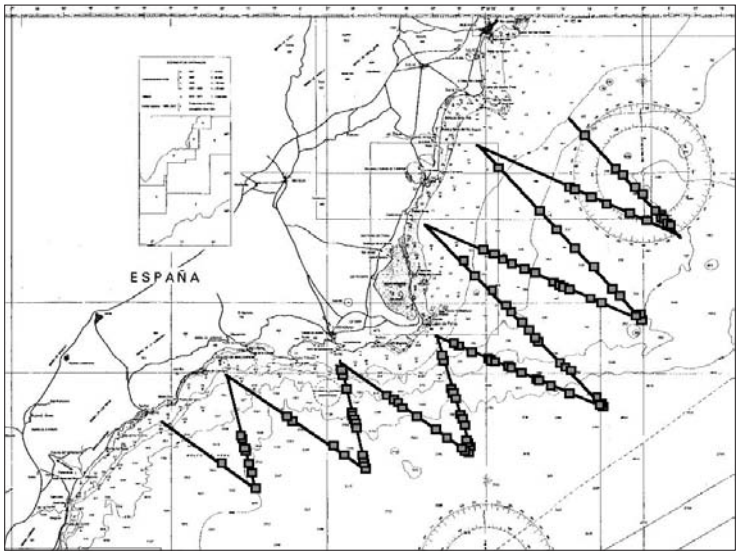

Fig. 2. Flight undertaken on 28 May 2001 in sector 4, with the sightings of turtles indicated.

More sampling is necessary in some sectors to obtain more precise measures of differences in spatial distribution; as well as more in autumn and winter months to accurately measure differences in seasonal abundance and distribution patterns inside the study area. Further analyses using the programme DISTANCE (Laake et al. 1993), together with more surveys, are planned to provide further estimates of the loggerhead abundance in this area and to more precisely determine spatial and seasonal differences. None the less, these preliminary results provide evidence that loggerheads are present in considerable numbers throughout the year in the Spanish Mediterranean waters.

ACKNOWLEDGEMENTS

This study was performed within the project "Programa de Identificación de Áreas de Especial Interés para la Conservación de Cetáceos en Aguas del Mediterráneo Español", funded by the Environment Spanish Ministry. We thank Javier Martínez and Dr. E. Crespo their collaboration in the surveys as observers, and the last also for his technical assistance and valuable methodological comments. Thanks also to Dr. P. Hammond for his methodological help. We especially thank Celia Agustí for her valuable contribution.

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INTERACTION BETWEEN TRAWLS AND LOGGERHEAD TURTLES IN THE NORTHWESTERN ADRIATIC SEA

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INTRODUCTION

Many factors in the Mediterranean Sea contribute to the definition of the loggerhead turtle (*Caretta caretta*) as an endangered species, such as the loss of coastal habitats, intense tourist activities and incidental capture by different fishing methods (Gerosa and Casale 1999). The latter are factors of remarkable importance in the northwestern Adriatic Sea, that is the area under analysis in this study.

The coast line between Sacca di Goro and the mouth of the Reno river, extending for 38.4 km, includes 159 bathing establishments with approximately 60,000 tourists arriving during July and August. Furthermore, this coastal area is also subject to intense year round fishing activity, using mainly trawl and midwater pair trawl methods. There is a significant presence of loggerhead turtles in the waters along the coast, reported throughout the year and already subject of study by regular monitoring since 1996 (Vallini 2000).

METHODS

Studies have been carried out by CHELON since 1999 and they are still running on the interaction between the fishing methods used by fishermen in Porto Garibaldi (northwestern Adriatic Sea) and the loggerhead turtle. During this period a trawl net fishing boat has been continuously monitored for 10 months. All data have been collected using different methods:

- by researchers on board the fishing boat during regular fishing days;
- through surveys directly carried out by the fishermen during the fishing activities;
- by encouraging local fishermen (without researchers on board) to convey any accidental capture specimen to port or handing it over to the Coast Guard harbour office.

Short training courses were held on board to make fishermen aware of the problem and encourage their responsibility in administering first aid to turtles in trouble, collecting

data and filling in the relevant forms. These forms, even if simplified, have been provided with the same basic data required on standard sheets as date, time, position, presence or lack of turtle inside the net, integrated with specific data as sea depth and time of net lowers.

RESULTS

From November 1999 to April 2001 (except for the biological stop off period, from 26/07/00 - brought forward to 18/07/00 due to mucilage build up - to 4/09/00) eighteen expeditions have been carried out with researchers on board. Furthermore, data collected from July 2000 have been integrated with 128 surveys regarding the presence or lack of turtles inside the net also without researchers on board, carried out directly by the fishermen of the monitored fishing unit.

Courses held by fishing boats during expeditions with the researchers on board were steered inside the following area: 44°57'N - 012°41'E - 44°24'N - 012°13'E. In the period of study just one turtle was captured, in autumnal season, with researchers; 51 were conveyed to port without researchers on board and twelve animals captured during surveys by the fishermen during the fishing activities and directly released alive in the sea.

Technical data concerning the nets used by the boat monitored during fishing expeditions are indicated in Tab. 1. The net trawls on average three times per day with an average fishing time of 7.36 hrs (SD: 2.24; MAX: 9.37; MIN: 2.52) per fishing day and an average of 3.30 hrs (SD: 1.16; MAX: 4.45; MIN: 0.18; N=43) per haul. Net has been rarely used at depth of over 20 m.

Overall length	**26.22 m**
Sack length	**5.8 m**
Mesh at the top of mouth	**28x28 mm**
Sack mesh	**19x19 mm**

Tab. 1. Technical data regarding trawl net used.

Surveys carried out directly by the fishermen of the fishing boat from the beginning of July 2000 are related to turtle specimens which have been captured during 128 surveys taken also without researchers on board (Fig. 1); on the columns the value of CPUE (Captures Per Unit Effort) data obtained by the fishing boat which was monitored during the whole period as defined in this study.

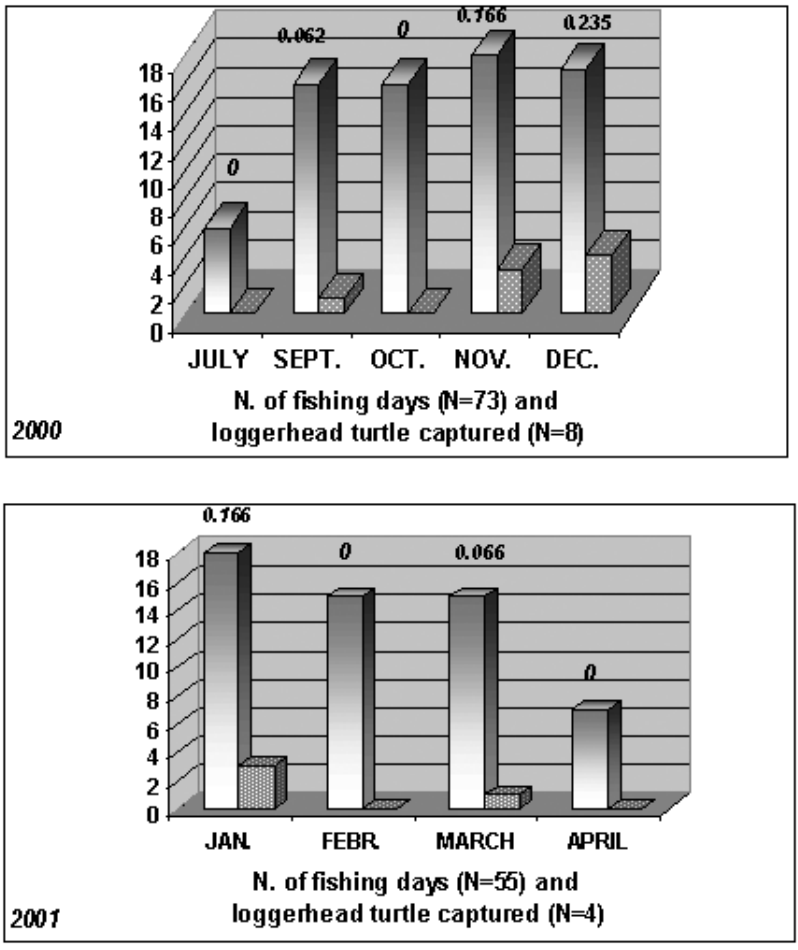

Fig. 1. Number of trawling expeditions (grey columns) and captured turtles (grey point columns) in 2000 and 2001.

DISCUSSION

Expeditions with researchers on board show a catch rate of 0.05 turtles for fishing day: a very low number if compared to other Mediterranean areas (Margaritoulis et al. 1992, Gerosa and Casale 1998) and to the midwater pair trawl method, which showed a rate of 1.33 animals per expedition during the same period (Vallini et al. in press a). The data collected directly by fishermen still indicate low catch rate, especially during spring and summer months, while they raise within the winter season. When compared to the midwater pair trawl method, which guarantees 100% loggerhead turtles survival rates with an average time of 55 min, the trawl method reported nine deaths, all during autumn, including six cases of captured specimens which were already dead and three cases died

soon afterwards with considerable loss of water from air tubes. Once again these data show a strong impact, especially in reference to adult turtles; the considerable amount of water present inside air tubes was found in fact in both captured and also in stranded specimen, after necropsy - latter data obtained by a comparative analysis - (Vallini et al. in press b).

ACKNOWLEDGEMENTS

We would to extend special thanks to the Porto Garibaldi, Ravenna and Goro Coast Guard harbour offices for their constant support and assistance, and to the fishermen of Porto Garibaldi for their outstanding work in this area.

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SUSTAINABLE TOURISM AND SEA TURTLES: ANALYSING THE MEDITERRANEAN EXPERIENCE... FOOTSTEPS IN THE SAND

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INTRODUCTION

The paper seeks to examine in depth the past, present and future of sustainable development as it affects the sea turtles of the Mediterranean region, in the light of 18 years experience gained in the sea turtle nesting areas of the Mediterranean, examining how man and turtles have come into mortal conflict, the sea turtles the inevitable loser.

THE STRUCTURE OF TOURISM. - ITS STRENGTHS AND WEAKNESSES

The migratory instincts of man, dormant for a time, with modern means of travel have erupted in the formalised annual migration we call tourism. Tourism is an aggregation of a number of very diverse sectors that are often mutually exclusive, ranging from educational or eco-tourism to a cheap foreign "pub-crawl". It is vitally important that area tourism authorities should clearly define which sector they are aiming at. The impacts on the locale vary widely.

-The early arrivals: Live close to the cultures and environment around them.
-The immigrants: Buy or rent local property becoming a part of the community.
-The day visitors: Arrive from areas higher up the tourism ladder, benefiting the local economy.

THE WEALTHY TRAVEL SET

Patronise the first luxurious hotel, the smell of real money permeates the scene, and locals start to look for ways they can cash in. All kinds of peripheral tourist services appear. This is the beginning of the end for Cottage Industry Tourism. Eventually the wealthy set move on to the next "in" destination, and with empty rooms the locals look around for new sources of tourists. Using advertisements they inevitably come to the attention of the Mass Market Tour Operators (MMTOs). Soon major foreign investment in any remaining undeveloped pocket aims to make the tourist captive in its own mass market tourism facilities. The early arrivals have started the whole process elsewhere, the immigrants have sold up and followed them in disgust, the day visitors dry up, the wealthy set avoid the place like the plague. But even this

is not sustainable, the fickle tourists move on. A barren, degraded, culture-less concrete hell has replaced the original idyllic setting. Many of the locals have moved or been driven out. The only option left is industrial development, completing the environmental and cultural destruction. This is the unending, inevitable chain of events on the tourism circuit, each step following the other so reasonably. Who could deny the local inhabitants the right to pursue their dreams of a better life financed by the tourist dollars?

SUSTAINABLE TOURISM DEVELOPMENT (STD). - IS IT A VIABLE PROPOSITION?

The Brundtland Commission definition is "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WC ED 1987). Note the word "needs", such an imprecise word. It can mean anything from mere survival to Hollywood villa lifestyle. The EC defines STD as "development which meets the needs of present tourists and host regions while protecting and enhancing opportunity for the future. It is envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, and life support systems." (Eckert and Cremer 1997). Nowhere have we seen this happen on nesting sites. Both of these definitions are formulated with reference to normal, fully functional areas, NOT the biotope of an endangered species. The needs of the present generation influenced by market forces, overrides the need of the future generations to retain severely depleted stocks of species. STD seems to merely represent a vehicle for addressing the problems of mass tourism rather than as a means of integrating the needs of all tourist groups. (Aronsson 1994, Fyall and Garrod 1996). So far, development on turtle nesting beaches has proved to be a disaster for nesting turtles. We really should not be talking about STD; we should be talking about sustainable turtle populations. In Zakynthos, Greece, the lack of compensation payments on the newly established National Marine Park in Laganas Bay, site of the largest *Caretta caretta* nesting population in the Mediterranean has led to rampant illegal tourist development. The full horrors of this has been widely reported elsewhere, culminating in legal action against Greece in the European Court of Justice. Recently the protected area of Belek, Turkey, was the recipient of a British Airways award as a flagship for eco-friendly development. The year has seen 800 metres of Caretta and Chelonia nesting beach destroyed by sand extraction, four new hotel complexes, permanent beach furniture, photo-pollution, fishing, with speedboats and jet-skis operating along the shore (MEDASSET 2001). At Akamas in Cyprus, a putative National Park, nesting place for *Chelonia mydas*, where a World Bank management study called for strict protection and conservation, the Government has given permission for the construction of a hotel complex, a marina, car parks, roads, holiday villas etc. and much more is planned to follow (Yiordamli 2000).

SEA TURTLES. - CAN THEY COMPROMISE?

Can any endangered species compromise? The sea turtles are unavoidably in direct conflict with the tourists, their nesting coincides with the tourist season. It is clear from experience in Greece and Turkey, that the biggest problems are encountered on turtle nesting beaches when accommodation and entertainment developments are allowed on the edge of the sand, and in the accompanying extremely fragile dune systems.

ECONOMICS. - MARKET FORCES AND PRESSURES

According to the World Tourist Trade Council (WTTC), by 2007 worldwide total revenues from tourism will reach US$ 7.1 trillion, almost double the 1997 level and 10.9 % of the world's GDP. The largest industry in the world. Small wonder that Governments spend vast sums of money promoting international tourism to attract revenues representing up to 10.6% of their GDP and 7% of GDP (Ellul 1996). Experience shows it is a myth that tourism is a highly profitable industry. Permanent infrastructure built at high cost to provide necessary civil facilities to cope with the peak demands of July/August, are used at varying levels during a period of 4 months, then maintained virtually unused during the remaining 8 months of the year. The industry has to maximise income during the tourist season in order to survive 8 months without cash flow. This is the reason why despite the huge amount of cash flow generated in the season, the majority of tourist developments change hands frequently, and economies are made with the infrastructure, raw sewage and waste is piped into the sea, water supplies fail etc., Unlike some other seasonal industries, tourism cannot use the down season to stockpile holidays. Basically tourism itself is not a sustainable industry.

TOURISM TRENDS AND PROJECTIONS. - STATISTICS AND FORECASTS

WTTC forecast in 1997 that over the following decade tourism around the world would grow by 42.3%. That year during 5 summer months charter flights alone delivered approx. 275,000 tourists to the airport at the heart of what was to become the Zakynthos National Marine Park (ZNMP). We could then realistically expect that in 2007 around 391,000 tourists would be arriving by the same method. But, NO, just two years later the figure had already reached close to 400,000, and although figures for 2001 have not yet been published, realistic estimates are close to 500,000. Such is the power of the mass marketing of "cheap" package holidays by organisations in far away countries, who are not stakeholders in the target location and whose profits fill pockets elsewhere. Given 500,000 charter flight visitors. If we assume that they will stay an average of two weeks each, we have 1 million visitor weeks over say a period of 20 weeks, giving an average weekly tourist population of 50,000. We know that approx. 50% of tourist facilities in Zakynthos are along the shore of Laganas Bay, within the ZNMP (Dimopoulos 2001), so from May to

September there are a daily average of 25,000 tourists from charter flights in the 14.2 km² land area of the protected core zone of the ZNMP. Up to 8 (sometimes more) ferries arrive per day from June to September, each with a capacity of 600-900 passengers, so it is easy to infer that arrivals by ferry are in the thousands per day. A survey conducted in 1991, regarding tourist motivations revealed that only 18.34% had reasons to deliberately choose Zakynthos, only a mere 2.5% mentioned wildlife, and a massive 56% said they would have been quite happy to have visited another similar resort (Prunier et al. 1993). This indicates that the mass tourist trade in the ZNMP is predicated solely on the sales efforts of the tour companies and the willing compliance of the local operators.

ECOSYSTEM VALUE. - ILLUSION OR REALITY?

Learned academics have tried to devise a system of biotope valuation in the pursuit of applied STD. However, no biotope can be valued in isolation. One must only appreciate the role that the sun plays here on earth to appreciate this. Can you put a value on the sun? Physical monetary evaluation can only depend on market forces, and we all can see where that gets us.

HUMAN FRAILTIES. - HUMAN NATURE...

Self-interest is the prime motivator. First self, second money, third more money. Only after these will others be considered.

POLITICAL REALITIES. - COST OR CREDIT?

In Spain, the front-runner in Mediterranean Tourism, the chief problem plaguing mature coastal destinations which were first developed in the 60s and 70s, is saturation of the urban space, aggravated by seasonal fluctuation. In addition to the environmental impact, this entails a shortfall in infrastructures, e.g., roads, drinking water supply, services and so forth, the remedying of which has called for years of investment. The model is prone to problems in the medium and long term, and a start has therefore already been made on the design and application of measures to limit growth and remedy the greatest impact. The Spanish government are now providing financial incentives for the tourists to go elsewhere in Spain (Ellul 1996).

SUMMING UP

To successfully manage tourism it is necessary to fully understand all the varying facets of the industry, and the different characters of the tourists involved. Is it logical that cheap mass tourism directed at the lager lout or the ordinary family be allowed to inundate fragile ecosystems and endangered species habitats? Many would be just as happy sunbathing beside swimming pools, close by all the entertainment they want without

destroying precious ecosystems. Foreign tour operators whose dynamism is driving the mass tourism growth, must be made responsible for the results of their aggressive sales techniques. Relocation of undesirable tourists should be considered. Harsh, but very just! Those responsible for tourist regulation in protected areas, or areas with fragile ecosystems and endangered species must make decisions, what places are to be preserved for ecotourism; for cultural tourism; for family holidays; and where to build the mass tourism facilities. Numbers of tourists to ecosensitive locations must be controlled so as not to exceed a finite level at which they will not degrade the location. We have learned that it is wise to control the number of passengers on a boat, what we have to understand is that like a boat, a valuable fragile ecosystem can also sink without trace.

ACKNOWLEDGEMENTS

We wish to thank a Friend of MEDASSET, who gave us the benefit of his 10 year experience in the tourist industry.

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THE ASSESSMENT OF SEA TURTLE NESTING ACTIVITY IN TURKEY AFTER 1994 SURVEY AS A REVIEW

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INTRODUCTION

Turkey has large remaining populations of both loggerheads *Caretta caretta* and green *Chelonia mydas* turtles within the Mediterranean. The results of comprehensive status survey supported by DHKD (Turkey's Society for the Protection of Nature) and WWF for breeding season 1994 were compared with previous years and the following years in terms of nest numbers and nest densities of sea turtles and their habitat status.

METHODS

Data for 1994 study (Yerli and Demirayak 1996) was produced from observation during the months June, July and August according to methodology of Whitmore and Dutton (1985) and Ehrhart (1982).

RESULTS AND EVALUATION

Two species of marine turtle use beaches within Turkish national boundaries for nesting breeding purposes, the Loggerhead Turtle is the most frequently found. The Green Turtle nests only in few of the most easterly beaches, Kazanlí, Akyatan and Samandağ. The beaches shown in Fig. 1 were found to be most important breeding grounds in Turkey coast (Baran and Kasparek 1989). The length of these beaches is about 132 km. Nest numbers and nest densities for each beach are given in Fig. 2. There are the differences between years for the same beach in terms due to natural fluctuation or the lack of monitoring or inefficient study. The status of nesting beaches and sea turtle populations have been reviewed under the highlights of study Yerli and Demirayak (1996) for each beach (Tab. 1). Main threats are still affecting the nesting beaches.

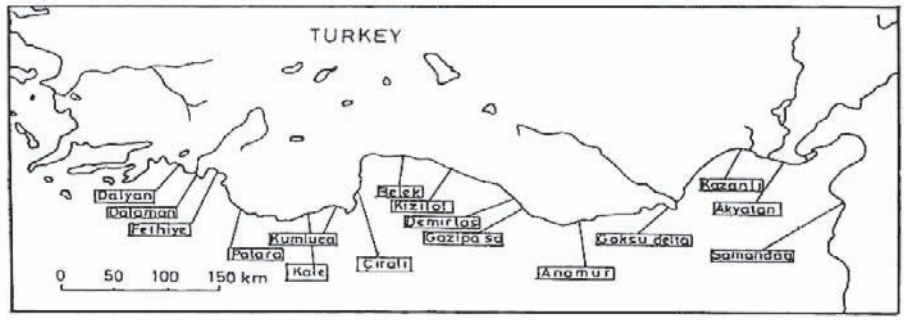

Fig. 1. The major marine turtle nesting beaches of Turkey.

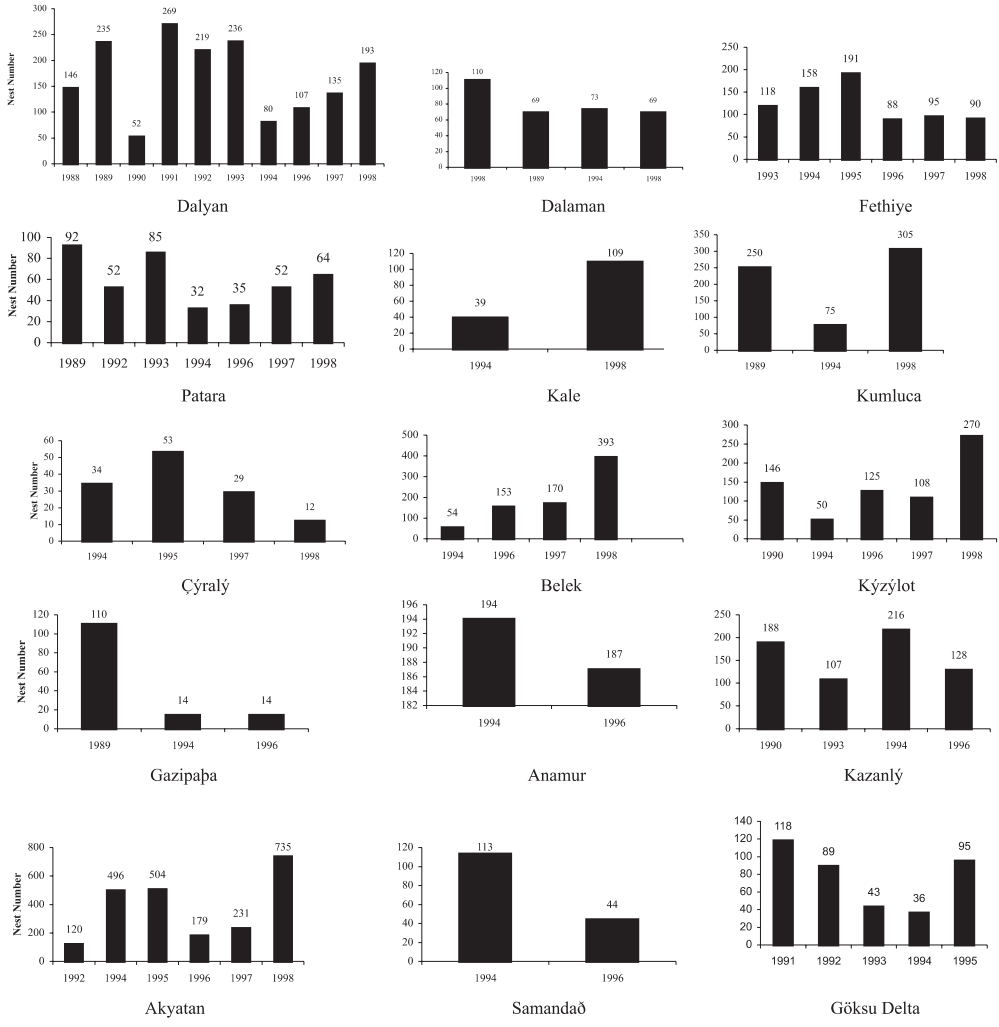

Fig. 2. Number of *C. caretta* nests on beaches (Kazanli, Akyatan, Samandağ for *C. mydas*). Sources: Aureggi et al. 2000, Baran and Kasparek 1989, Baran et al. 1992, 1997, Gündoğdu et al. 1988, 1990, Macdonald and Brown 1992, Oruç 1999, Peters and Verhoeven 1992, Peters et al. 1994, Van Piggelen and Strijbosch 1993, Toker and Demirayak 1996, Türkozan 2000, Yerli and Canbolat 1998a, 1998b, Yerli and Demirayak 1996, Yerli et al. 1998.

Beach	Section	Sea turtle potential	Erosion	Sand Extraction	Tourism	Industry, pollution and marine debris	Settlement and secondary hoves	Agriculture	Light pollution	Fisheries	Predation	Disturbance during nesting	Protection status
Dalyan	Dalyan	H	L	L	H	L	L	L	L	L	H	L	SPA
Dalaman	Dalaman	M	L	L	M	Paper factory	H	L	H	L	M	L	SPA (only west side)
Fethiye	Çalış (2.5 km)	M	L	L	H	H	H	L	H	L	M	L	SPA,SIT
	Yanıklar (4.5 km)	M	L	L	M	L	M	L	M	L	M	L	SPA,SIT
	Akgöl (1 km)	M	L	H	H	L	H	H	H	L	M	L	SPA,SIT
Patara	Patara	H	H	H	H	L	L	L	M	L	H	L	SPA
Kale	Kale	M	L	H	L	M	L	M	M	M	L	L	None
Kumluca	Kumluca	H/M	H	H	H	L	M	M	H	M	L	L	None
Çıralı	Çıralı	M	L	H	H	L	L	L	L	L	L	L	SIT National Park
Tekirova	Tekirova	L	L	M	H	L	H	L	H	L	L	L	None
Belek	Belek	H	M	H	H	L	H	L	H	L	L	L	SPA
Kızılot	Kızılot	H/M	M	H	H	L	H	L	H	L	L	L	None
Demirtaş	Demirtaş	L	L	L	H	L	H	L	H	L	L	L	None
Gazipaşa	Gazipaşa	L/M	L	L	M	L	M	M	L	L	L	L	None
Anamur	Anamur	H	H	H	H	M	H	M	H	L	H	L	SIT
Göksu Delta	Göksu Delta	H	H	H	H	Paper factory	H	H	H	H	H	L	SPA, SIT Ramsar Area, Wildfowl Area
Kazanlı	K1 (2.2 km)	H	H	L	M	H	M	L	H	M	L	H	None
	K2 (0.5 km)	H	H	L	M	H	M	L	H	M	L	H	None
	K3 (0.5 km)	H	H	L	M	Soda Chrome Factory	M	H	H	M	L	H	None
Akyatan	Akyatan	H	H	H	L	M	L	M	L	H	H	L	Wildlife Reserve
Samandağ	Samandağ	H	H	H	H	M/H	H	M	H	M	M	H	None

Tab. 1. Present status of nesting beaches in Turkey (SPA: Specially Protected Area, SIT: Area with archaeological and/or natural importance, L: low, M: Medium, H: High)

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FIRST DATA ON THE LOGGERHEAD TURTLE (*CARETTA CARETTA*) IN SLOVENIA (NORTH ADRIATIC)

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INTRODUCTION

The implementation of the Action Plan for the conservation of Mediterranean marine turtles that was adopted within the framework of MAP, includes among others, a co-ordinated marine turtle tagging programme, entrusted to the UNEP/MAP Regional Activity Centre for Specially Protected Areas. The implementation of the programme in Slovenia is co-ordinated by the Regional Institute for the Conservation of the Natural and Cultural Heritage Piran and carried out by the Aquarium in Piran in co-operation with the Marine Biological Station (MBS-NIB).

The aim of this report is to present the first data regarding the status of the Loggerhead Turtle in the Slovenian part of the Gulf of Trieste (northern Adriatic). It should be pointed out that there is a complete lack of knowledge regarding the occurrence of the Loggerhead Turtle in Slovenia. According to Mršić (1997) and Tome (1999) "the Loggerhead Turtle is occurring in the Slovenian coastal waters", but without any precise statement regarding its status. Lipej et al. (2000) reported that loggerhead turtles are accidentally entrapped in fisherman nets, and considered them to be rare in the Slovenian coastal waters.

METHODS

The data regarding loggerhead turtles were collected by the authors in the period 1995-2001 (see Tab. 1). Dead specimens (caught dead in nets or found stranded on the coast) are housed in the Natural History Museum of Slovenia in Ljubljana. All live specimens caught in nets by Piran fishermen were delivered to the Piran Aquarium, where they have been tagged and subsequently released.

Parameter	N	%
No. of all records	60	100
No. of records of live specimens	36	60
No. of specimens, collected in fisherman nets	32	53.3
No. of specimens observed	4	6.7
No. of collected specimens,which were released	32	53.3
No. of dead specimens	24	40
No. of stranded specimens	4	6.7
No. of specimens, found dead in nets	20	33.3
No. of tagged specimens	27	45
No. of dead tagged specimens	2	3.3

Tab. 1. Data on the occurrence of the Loggerhead turtle (*Caretta caretta*) in the Slovenian part of the Gulf of Trieste in the period 1995-2001.

RESULTS AND DISCUSSION

The number of loggerhead turtles studied by authors in the period 1995-2001 varied from 4 to 27 specimens per year (Fig. 1). The increase of number in the last year should be attributed to the increased sampling effort. The establishment of closer co-operation between fishermen and the researchers of the Piran Aquarium play an important role as well.

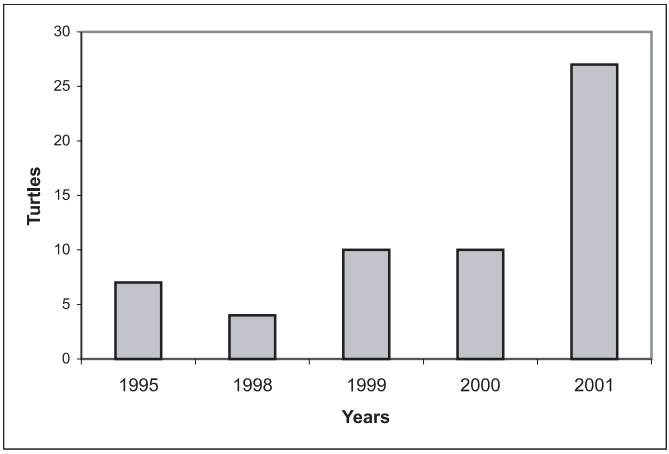

Fig. 1. Number of loggerhead turtles *Caretta caretta* collected in Slovenian coastal waters in the period from 1995 to 2001.

The Loggerhead Turtle is occurring in Slovenia waters from May to October, but mostly in August (31%)(Fig. 2). The occurrence seems to be mainly correlated with the temperature. The size frequency distribution of loggerhead turtles, collected in our study,

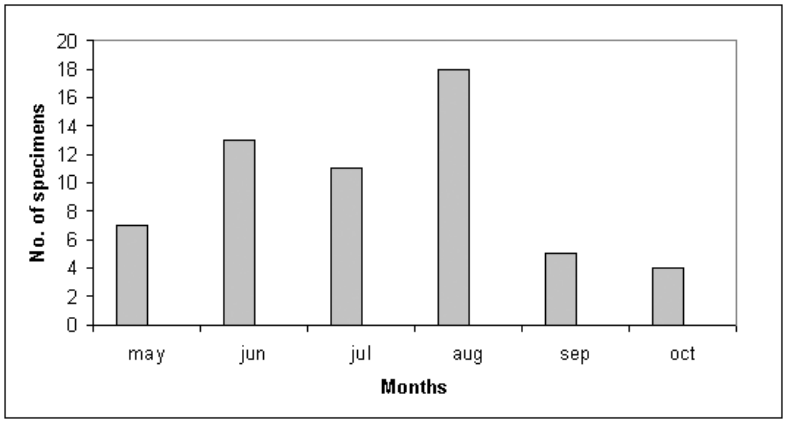

Fig. 2. Seasonal distribution of loggerhead turtles collected in Slovenian coastal waters in the period 1995-2001.

showed that the majority of specimens were juveniles, measuring less than 50 cm (Fig. 3). However, the data should be taken with caution, since bigger specimens may have tear the nets or were to heavy for fishermen to deliver them to the Piran Aquarium.

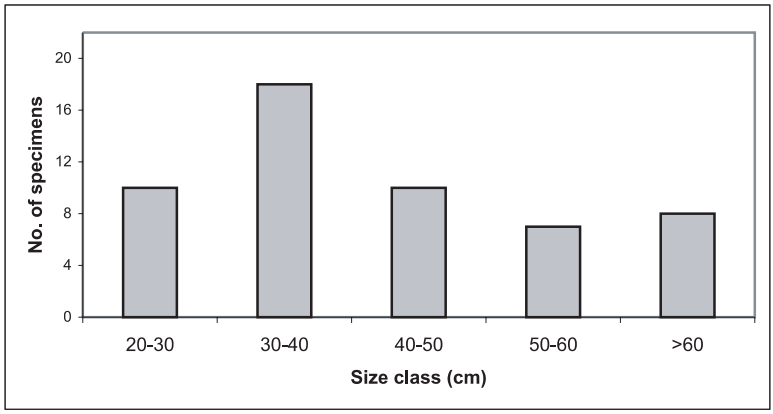

Fig. 3. Size frequency distribution of loggerhead turtles measured by authors in the period from 1995-2001 in Slovenian coastal waters.

The tagging programme started in 1995, but it is from 1998 that its implementation is more accurate, due also to an informal awareness campaign carried out among the fishermen by the Piran Aquarium. Up-to-date 27 specimens of the Loggerhead Turtle were tagged. One of the specimens tagged was reported in waters off Ravenna, Italy. On the other hand, two tagged turtles were recovered dead in Slovenian waters. One specimen was tagged by the Naples Zoological Station (Italy) and the other by the Sea Turtle Protection Society (Greece).

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CONFERENCE HIGHLIGHTS

Legislation

1. Strengthening the enforcement and implementation of existing instruments (legislation, programmes), including setting up of SPAMIs

Mediterranean riverine states may be invited to conclude agreement in view of progressively setting up of a network of SPAMIs (Special Protected Areas of Mediterranean Importance) for nesting, feeding and wintering sites of marine turtles, as well as on main migratory routes. Other legal instrument can be further explored.

Habitat protection and interaction with stakeholders

2. Identifying and mapping important marine habitats

There is an acute need to identify and map marine habitats relevant to turtles at sea. This is a priority for research as it is likely to provide valuable information for conservation purposes.

3. Initiating and/or strengthening protection of already identified critical nesting areas

There is urgent need to obtain better protection and enforcement of protection measures for key nesting sites.

4. Designating protected areas prior to development, following a precautionary approach

Designation of protected areas for marine turtles should preferably precede development, thus applying the precautionary approach.

5. Drawing management plans for areas of importance

All areas of importance for marine turtles, and especially the ones with development, need to be subject to management plans containing measures aimed at minimising adverse impacts on marine turtles.

6. Early involvement of local communities and stakeholders key to success

In protected areas or in areas to be protected, involvement of local communities at an early stage is key to conservation success. A wide consultation process with local communities and appropriate stakeholders is recommended. In this context it is of importance to connect with the fishing and tourism industry (locally and also international tourism operators).

7. Reassessing tourism activities for the benefit of sea turtle conservation and implementing strict controls at critical nesting areas

In areas where tourism interferes with marine turtle conservation, tourism needs to be modified so as to enhance the value of marine turtles in compatible ways with their conservation. In important nesting areas tourism activities should be strictly controlled to avoid interference with conservation priorities.

Fisheries interactions

8. Determining real impacts of fisheries to be able to propose possible gear modification, changes in fishing practices, etc.

Given the high number of marine turtles caught by fisheries, there is an acute need of more precise data on the real impact of fisheries on marine turtle populations, so it may be possible to draw conservation conclusions, such as the possible need for gear modification and/or changes in fishing practices.

9. Emphasising action on high seas fisheries, requesting ICCAT and GFCM to collect information and report on bycatch

Special emphasis for impact should be given to high seas fisheries, with data on by-catch reported to organisations such as GFCM and ICCAT.

Research and monitoring

10. Collecting necessary information (e.g. age of maturity, survivorship) so as to facilitate population modelling

In order to elaborate functional population models it is necessary to acquire reliable information on various population parameters.

11. Focussing research

Research efforts to be focussed on:

– size, structure and dynamics of populations,
– better estimates needed of impact of each type of fishery in different fishing grounds (caution should be taken in extrapolating large scale total catch or mortality from local catch or mortality rates),
– delayed mortality estimates (due to fisheries interaction).

12. Extending migration studies (including satellite telemetry) and genetics so as to assist in the identification of critical habitats

Migration studies and genetics should be seen as a priority line of research for their potential in providing useful conservation information.

13. Establishing and/or continuing long-term monitoring programmes to permit informed management decisions

The most important fact in monitoring is consistency over a long period of time.

Awareness/education

14. Raising awareness and training of fishermen to reduce mortality

As reduction of marine turtle mortality is so dependent on attitudes and knowledge of fishermen, it is vital to invest in awareness with them and training them, adapting techniques and tools with respect to local cultures, values and views. Results of training and awareness efforts should be properly assessed.

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