Workshop para a elaboração de uma experiência que possa diminuir as capturas acidentais de tartarugas marinhas nos Açores

Workshop to design an experiment to determine the effects of longline gear modification on sea turtle bycatch rates

2 - 4 September 1998

Horta, Faial, Açores
Portugal

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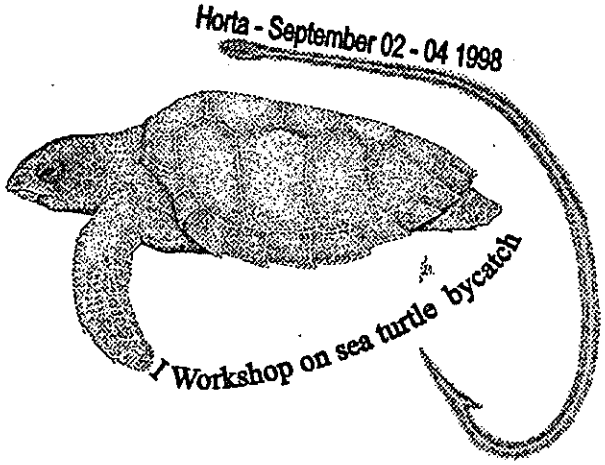

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Acknowledgments

This workshop was funded by the U.S. National Marine Fisheries Service. Additional support was provided by the University of the Azores, Department of Oceanography and Fisheries; the Azores Ministry of Agriculture and Fisheries; and the Archie Carr Center for Sea Turtle Research, University of Florida. We are grateful for the support of Barbara Schroeder and Earl Possardt of the U.S. National Marine Fisheries Service.

Workshop para a elaboração de uma experiência que possa diminuir as capturas acidentais de tartarugas marinhas nos Açores

Agenda

1 de Setembro 1998: Chegada dos convidados à cidade de Horta (Alojamento: Horta Hotel)

2 de Setembro 1998: Workshop Dia 1 (Localização: Câmara do Comércio, Travessa da Misericórdia)

9:30 - 10:00	Abertura. **Helen Martins** (Moderadora do Workshop)
	Apresentação dos Participantes
	Boas vindas. **Helder da Silva**
	Agenda do Workshop. **Alan Bolten**
10:00 - 10:50	Apresentações genéricas (As apresentações terão um limite máximo de 15 minutos, com 10 minutos adicionais para a discussão)
	Objectivos do Workshop **Mário Pinho e Eduardo Isidro**
	Síntese da pesca do Espadarte com palangre, nos Açores (técnicas, equipamento, isco, etc.). **Alexandre Silva**
10:50 - 11:15	INTERVALO PARA CAFÉ
11:15 - 12:30	Apresentações genéricas, continuação
	Revisão da informação disponível sobre o capturas acidentais de tartarugas em pesca de palangre, nos Açores. **Manuel Fernando Serpa**
	Análise do programa de observação da pesca de palangre nos Açores. **Rui Prieto;** apresentado por **Alexandre Silva**
	Análise do POPA (Programa de Observadores para as Pescas dos Açores) no que diz respeito a observações de tartarugas marinhas. **Rogério Feio**
12:30 - 14:00	ALMOÇO (A refeição será em grupo, no restaurante O Barão)

14:00 - 14:30	Estudo da vida das tartarugas marinhas nas águas dos Açores. **Alan Bolten**
14:30 – 15:30	Apresentação de um desenho experimental, a fim de estimular a discussão. **Eduardo Isidro** e **Mário Pinho**
15:30 - 16:00	INTERVALO PARA CAFÉ
16:00 - 17:30	Desenho Experimental e Análise
	Discussão das variáveis experimentais, desenho experimental e analise.
17:30	ENCERRAMENTO do Dia 1

3 de Setembro 1998: Workshop Dia 2

9:30 - 11:00	Síntese do Dia 1. **Alan Bolten**
	Agenda para o Dia 2
	Desenvolvimento do desenho experimental e análise
11:00 - 11:30	INTERVALO PARA CAFÉ
11:30 - 12:30	Desenvolvimento do desenho experimental e análise (continuação)
12:30 - 14:00	ALMOÇO (A refeição será em grupo no restaurante O Barão)
14:00 - 15:30	Desenvolvimento do desenho experimental e análise, (continuação)
15:30 - 16:00	INTERVALO PARA CAFÉ
16:00 - 17:30	Finalização do tema: Desenho Experimental e Análise
	Começo da discussão sobre logística no decorrer da experiência (altura do ano, localização, embarcações, etc.) e estipulação de um orçamento
17:30	ENCERRAMENTO do Dia 2

4 de Setembro 1988: Workshop Dia 3

9:30 - 11:00	Síntese do Dia 2. **Alan Bolten**
	Agenda para o Dia 3
	Discussão e conclusão sobre a logística para o decorrer da experiência
11:00 - 11:30	INTERVALO PARA CAFÉ
11:30 - 12:30	Elaboração do orçamento para a concretização do projecto.
12:30 - 14:00	ALMOÇO (A refeição será em grupo no restaurante O Barão)
14:00 - 15:30	Finalização da estipulação do orçamento para a concretização do projecto
15:30 - 16:00	INTERVALO PARA CAFÉ
16:00 - 17:30	Síntese do Workshop e Conclusões Distribuição de tarefas para o Relatório do Workshop
	Encerramento do Workshop

Workshop to Design an Experiment to Determine the Effects of Longline Gear Modification on Sea Turtle Bycatch Rates

Agenda

1 September 1998: All out of town participants arrive in Horta

2 September 1998: Workshop Day 1 (Location: Camara do Comercio)

9:30 – 10:00	Opening. **Helen Martins** (Workshop Moderator)
	Introduction of Participants
	Welcome. **Helder da Silva**
	Workshop Schedule. **Alan Bolten**
10:00 – 10:50	Background Presentations (Background presentations will be limited to 15 minutes with an additional 10 minutes for discussion)
	Objectives of the Workshop. **Mário Pinho** and **Eduardo Isidro**
	Review of swordfish longline fishery in the Azores (techniques, equipment, bait, etc.). **Alexandre Silva**
10:50 – 11:15	COFFEE BREAK
11:15 – 12:30	Background Presentations, continued
	Review of available information on turtle bycatch in longline fisheries in the Azores. **Manuel Serpa**
	Review of longline observer program in the Azores. **Rui Prieto** presented by **Alexandre Silva**
	Review of POPA (Observer program for fisheries in the Azores) with respect to sea turtle observations. **Rogério Feio**
12:30 – 14:00	LUNCH (We will eat as a group at O Barao)

14:00 - 14:30	Review of life history of sea turtles in the waters around the Azores. **Alan Bolten**
14:30 - 15:30	Presentation of an experimental design to stimulate discussion **Eduardo Isidro** and **Mário Rui Pinho**
15:30 - 16:00	COFFEE BREAK
16:00 - 17:30	Experimental Design and Analysis
	Discussion of experimental variable, design and analysis
17:30	ADJOURN Day 1

3 September 1998: Workshop Day 2

9:30 - 11:00	Review of Day 1. **Alan Bolten**
	Schedule of Day 2
	Development of experimental design and analysis.
11:00 - 11:30	COFFEE BREAK
11:30 - 12:30	Development of experimental design and analysis, continued
12:30 - 14:00	LUNCH (We will eat as a group at O Barao)
14:00 - 15:30	Development of experimental design and analysis, continued
15:30 - 16:00	COFFEE BREAK
16:00 - 17:30	Finalize experimental design and analysis
	Begin discussion on the logistics for conducting the experiment (time of year, location, boats, etc) and development of budget
17:30	ADJOURN Day 2

4 September 1998: Workshop Day 3

9:30 - 11:00	Review of Day 2. **Alan Bolten**
	Schedule of Day 3
	Discuss and finalize logistics for conducting the experiment.
11:00 - 11:30	COFFEE BREAK
11:30 - 12:30	Develop budget for conducting the experiment.
12:30 - 14:00	LUNCH (We will eat as a group at O Barao)
14:00 - 15:30	Finalize budget for conducting the experiment.
15:30 - 16:00	COFFEE BREAK
16:00 - 17:30	Workshop Review and Conclusions.
	Distribute assignments for Workshop Report
	Adjourn Workshop

Workshop Participants

A. Direcção Regional das Pescas

Helder da Silva

B. University of the Azores, Department of Oceanography and Fisheries

Alexandre Silva

Eduardo Isidro

Helen Martins

João Tátá Regala

Jorge Fontes

Manuel Fernando Serpa

Mário Pinho

Rogério Ferreira

Rogério Feio

Verónica Neves

C. Direcção de Serviço de Conservação da Natureza

Manuel Veríssimo

D. Commercial fishermen

Genuíno Madruga, Horta

Jorge Gonçalves, Horta

José Sebastião Nunes, Corvo

José Maria Ferreira Faria, Flores

E. Participants from the United States

Alan Bolten (Archie Carr Center for Sea Turtle Research, University of Florida)

Jerry Wetherall (US National Marine Fisheries Service, Hawaii)

Abertura

Helen R. Martins

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Minhas Senhoras e Meus Senhores

Estou muito contente por ter a honra de abrir este Workshop e para ser a sua moderadora durante estes 3 dias. Penso que conseguimos reunir as melhores cabeças possíveis para chegar ao nosso objectivo.

Antes de mais é importante que nos conheçamos bem para ter uma discussão frutífera. Peço a cada um que diga o seu o nome e o seu local de trabalho e outras observações de interesse. Eu chamo-me Helen Martins ou Helena Martins na versão Portuguesa. Sou investigadora de Departamento de Oceanografia e Pescas, onde trabalhei deste o princípio, ou seja desde hà 22 anos. (Outros participantes: Helder Marques da Silva, Alexandre Silva, Eduardo Isidro, João Tátá Regala, Manuel Fernandes Serpa, Mario Pinho, Rogério Ferreira, Rogério Feio, Veronica Neves, Manuel Verissimo, Genuino Madruga , Jorge Gonçalves, José Sebastião Nunes, Jose Maria Ferreira Faria, Alan Bolten, Jerry Wetherall.)

O nosso assunto neste Workshop é o problema das tartarugas marinhas. Estas tartarugas são um grupo de repteis muito antigos. Já existiam nos mares há 100 milhões de anos, viviam no tempo dos dinossáurios, e representam uma parte distinta da biodiversidade do mundo. Nos séculos XVIII e XIX as tartarugas eram muito abundante e tiveram populações que contavam um milhão ou ainda mais. Mas nas últimas centenas de anos o Homem destruiu a habilidade das tartarugas de manter os seus números, que baixaram drasticamente através de capturas intencionais e capturas acidentais da pesca, destruição de áreas de alimentação, destruição dos locais de desova e descanso e, mais recentemente, a poluição dos oceanos.

Hoje em dia quase todas as populações estão em declínio, algumas a um ritmo drástico e outras já estão extintas. Cada vez mais há uma crescente preocupação para as capturas acidentais.

Hoje em dia todas as tartarugas dos Açores (5 espécies) estão incluídas na lista vermelha da União Internacional de Conservação da Natureza como em perigo ou vulneráveis e todas as tartarugas marinhas estão incluídas na Convenção de Comercio Internacional de Espécies em Perigo de Fauna e Flora Selvagem (CITES) e na Convenção

de Conservação de Espécies Migratórios de Animais Selvagens (CMS). É evidente que uma força para proteger estes animais da extinção tem que ser exercida a uma escala global e através da colaboração entre governos, cientistas, pescadores e o publico em geral. Eu penso que aqui nos Açores temos a oportunidade de conseguir uma colaboração deste género. Os resultados deste workshop podem ter importância também para outras regiões dos oceanos.

Obrigada!

Opening Remarks

Ladies and gentlemen,

I am very happy to have the honour to open this workshop and to be your moderator during these 3 days. I do think that we have managed to bring together the best people possible to reach our objective.

First of all it is important that we get to know each other well in order to have a fruitful discussion. I would ask each of you to present yourselves by your name, place of work, and other information of interest. My name is Helen Martins or Helena Martins in Portuguese version. I am a researcher at the Department of Fisheries and Oceanography (DOP) of the University of the Azores, where I have worked for the last 22 years. (Other participants who introduced themselves in turn were: Helder Marques da Silva, Alexandre Silva, Eduardo Isidro, João Tátá Regala, Manuel Fernandes Serpa, Mario Pinho, Rogério Ferreira, Rogério Feio, Veronica Neves, Manuel Verissimo, Genuino Madruga , Jorge Gonçalves, José Sebastião Nunes, Jose Maria Ferreira Faria, Alan Bolten, and Jerry Wetherall).

The topic of this workshop is the problem of marine turtles. These turtles constitute a group of ancient reptiles that already lived in the oceans more than 100 million years ago and existed in the time of the dinosaurs. They represent a distinct part of the bio-diversity of our planet. In the 18th and 19th centuries turtles were very abundant, and populations existed with more than a million individuals. However, during the last hundreds of years humans have destroyed the ability of turtles to maintain their numbers which have decreased drastically through intentional and accidental capture by fishermen, destruction of feeding areas and resting places, destruction of nesting beaches, and, more recently, pollution of the oceans.

Today almost all populations show decline, some at a drastic pace and some are already extinct. Worldwide, there is a growing concern with accidental capture of sea turtles in commercial fisheries.

Today all the turtle species in the Azores (5 species) are included in the Red List of IUCN as endangered and all marine turtles are included in CITES and in CMS. It is evident that a program to protect these animals from extinction has to be carried out on a global scale and through governments, scientists, fishermen and the general public. I do think that here in the Azores we have the opportunity to achieve such a collaboration. The result of this workshop may have importance also for other regions of the world's oceans.

Thank you!

The Swordfish Fishery in the Azores: an Overview

Alexandre Aires da Silva

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This paper aims to provide a background about the swordfish fishery in the Azores within the scope of the *I Workshop on Sea Turtle Bycatch*, Horta, 2-4 September 1998.

Historical Background of the Fishery

The swordfish (*Xiphias gladius*) fishery in the Azores has already been described (Pereira, 1988; Simões and Silva, 1994; Simões, 1995). The fishery started in 1987 following the strong incentives for swordfish exploitation given by the *VII Azorean Fisheries Week* as well as the good experimental fishing results obtained during 1985-1986 (Fernandes 1987, Pousa, 1987). Prior to 1987, the capture of swordfish in the Azores was considered a bycatch of the demersal fishery with landings not exceeding 30 tons per year.

Fleet Identification

The longline fleet targeting swordfish in the Azores can be first divided into two main components according to place of registration: Azores and Mainland Portugal fleets. The Azorean fleet can be further classified into three main components according to physical characteristics of the vessels and fishing regime: the open-deck wooden boats (ODWB), small-size cabin-deck boats (CDB_1) and large size cabin-deck boats (CDB_2). The average physical characteristics for each of the fleet components are given in Table 1.

Table 1. Average physical characteristics for each component of the swordfish fleet operating in the Azores. ODWB: open-deck wooden boats; CDB_1: small-size cabin-deck boats; CDB_2: large-size cabin-deck boats; MPB - Mainland Portugal boats.

Fleet	Fleet component	Overall length (m)	Engine power (HP)	Gross tonnage (GRT)
Azores	ODWB	10	37	5
	CDB_1	14	173	27
	CDB_2	28	581	157
Mainland Portugal	MPB	26	516	122

The open-deck wooden boats (ODWB; Figure 1.A) consist of small-size fishing boats mainly operating within 3 miles off the coasts of S. Miguel Island (Simões, 1995). This artisanal fleet fishes for swordfish during the summer season and shifts to the demersal fish community in winter months. Longline sets with an average number of 800 hooks-per-set are carried out on a daily trip basis. The open-deck wooden boats entered into the fishery in 1991, and have increased in numbers from that year (Figure 2.A). Seventeen fishing permits were given to this fleet component in 1998.

Like the ODWB fleet component, the small-size cabin-deck boats (CDB_1; Figure 1.B) target swordfish during the summer season and shift to the demersal fish community in winter months. This type of boat lacks freezing capacity, staying for about one week at sea. One longline set is carried out per day using an average number of 1500 hooks. The fishing effort is mostly localized around the coastal areas and the fishing banks of the Central Island Group. This fleet component exhibited a strong increase in numbers during the early 1990s, peaking at 40 permits in 1993 (Figure 2.A). After that period, the number of permits given to component CDB_1 has declined continuously to 26 in 1998.

Large-size cabin-deck boats fishing for swordfish throughout the year represent the third Azorean fleet component (CDB_2; Figure 1.C). This component conducts fishing campaigns that can take about a month at sea due to the large freezing capacity of the vessels. One longline set with an average number of 2500 hooks is carried out on a daily basis. During the winter months the large-size cabin-deck boats extend their fishing areas outside the Azorean EEZ. Number of fishing permits for the component CDB_2 reached a maximum of 20 permits in 1994, then declined to 9 permits in 1998 (Figure 2.A).

The Mainland Portugal fleet fishing for swordfish in the Azores is similar to the Azorean CDB_2 component in physical characteristics of vessels and fishing regime (*cf.* Table 1; Figure 1.C). This fleet mostly lands in the Portuguese and Spanish Mainland, in the harbors of Aveiro and Vigo, respectively. Unlike the Azorean fleet, the number of fishing permits given to the Mainland fleet exhibited a strong increasing trend during the 1990s (Figure 2.B). A total of 15 permits was given to this fleet in 1998.

Fishing Gear and Methods

The longline gear consists of a mainline to which branchlines with hooks are sequentially attached at a fixed distance (Figure 3). The mainline is suspended in the water column with a system of buoys attached by floatlines. The gear configuration can slightly change according to the maximum desired fishing depth (i.e., changing the length of the floatlines).

Two different types of longline gear are used in the swordfish fishery in the Azores: the Spanish and the US longline. Although both gears mostly use hook number

17/0, they differ in the type of the mainline, arrangement of gear components, and crew number (Fernandes, 1987).

The type of mainline used in the Spanish longline is twisted polyethylene. In the US gear, the mainline is 3.50 monofilament nylon. All of the gear components of the Spanish longline (i.e., the mainline, branchlines and buoys) are assembled on land. The US longline components are stored separately onboard, with the gear being continuously prepared during the set. Lastly, the operation of the two types of gear involves a different crew number. The fishing crew for Spanish longline requires 15 men; this number is reduced to 7 men for US longline operation.

Although the Azorean fleet has adopted both the Spanish and US gears, the acceptance of the former has been gradually increasing in the region. The Mainland Portugal fleet mainly operates with the US longline gear.

The swordfish fishing is carried out during night hours due to the negative phototropism exhibited by the species. For this purpose, the longline set finishes at dusk and the hauling operation starts at dawn. While the main type of bait used by the Azorean longline fleet is Spanish mackerel (*Scomber japonicus*), the Mainland Portugal fleet uses squid as well. The use of light-sticks in the swordfish fishery in the Azores is not a common practice.

Fishing Areas

Most of the fishing effort carried out by the Azorean and Mainland Portugal swordfish fleets is carried out in the waters around the Azores. A total of 5774 longline sets was reported in fishing logbooks during the period 1993-1998 (see Figure 4 for distribution map). A proportion of 87.2% (n=5037) of these fishing operations are confined to the area 36-48° N, 18°-42° W (ICES X), which contains most of the Azorean EEZ. Although the incidence is low, the distribution of the Portuguese longline fleet in the North Atlantic extends to the waters off the Iberian Peninsula and the African coast.

Identification of Bycatch

Bycatch of the swordfish fishery in the Azores consists mainly of pelagic sharks, particularly the blue shark (*Prionace glauca*) and the shortfin mako (*Isurus oxyrinchus*) (Silva et al., 1996). Other species–such as the common thresher (*Alopias vulpinus*), bigeye thresher (*Alopias superciliosus*), smooth hammerhead (*Sphyrna zygaena*), tope (*Galeorhinus galeus*) and the galapagos shark (*Carcharhinus galapaguensis*)–are also represented in the shark bycatch. The bigeye (*Thunnus obesus*) and blue marlin (*Maikaira nigricans*), respectively, represent most of the tuna and billfish bycatch.

Bycatch of marine turtles in longlines targeting swordfish in the Azores is poorly known. Information on this issue was presented during this workshop (see Serpa and Prieto et al. in this volume). The loggerhead turtle (*Caretta caretta*) is the species most commonly caught. The leatherback (*Dermochelys coriacea*) has already been recorded during longline experimental fishing activities carried out by the Department of Oceanography and Fisheries, University of the Azores (Silva et al., 1996).

The bycatch of marine birds associated with the longline fishery in the Azores is virtually unknown.

Fishing Seasons

Two fishing seasons can be identified for the longline fishery targeting swordfish in the Azores: swordfish season and blue shark season. Catch rates for blue shark and swordfish exhibit a pronounced seasonal and asynchronic nature (Figure 5). While the highest catch levels of the former species are obtained in the Spring, the fishing season for the latter targeted species is from May to December. Blue shark bycatch represents a major proportion of the total catch taken by the fishery, reaching a minimum of 22% and a maximum of 86%, respectively, during October and May (Figure 6). Shortfin mako catch levels are less than 5% of the total catch during the entire year.

Landings of Swordfish and Pelagic Sharks

Reported landings of swordfish, blue shark and shortfin mako in the Azores during the period 1993-1997 are shown in Figure 7. Landings of swordfish exhibit a peak of 463 metric tons (mt) in 1995, followed by a decline to 178 mt in 1997. Reported catches of blue shark increased from 1993 to 1996, peaking in 1996 at 328 mt. After that period, landings declined to 92 mt in 1997. Although the discard levels associated with the swordfish fishery are not quantified, blue shark discards by the Azorean longline fleet are believed to be high. This conclusion is supported by the non-existence of a stable market and little demand for blue shark products within the Azorean region. Discard levels for this species by the Mainland's longline fleet are known to be extremely low. This results from the existence of two asynchronic fishing seasons for the targeted swordfish and for blue shark in the Azores (Figure 5), and the increasing demand for shark products in European markets (Fleming and Papageorgiou, 1997).

Landings of shortfin mako in the region averaged about 8.2 mt per year during 1993-1997, with a maximum of 12 mt landed in 1995. Discard levels for this shark are extremely low due to the high quality of its meat.

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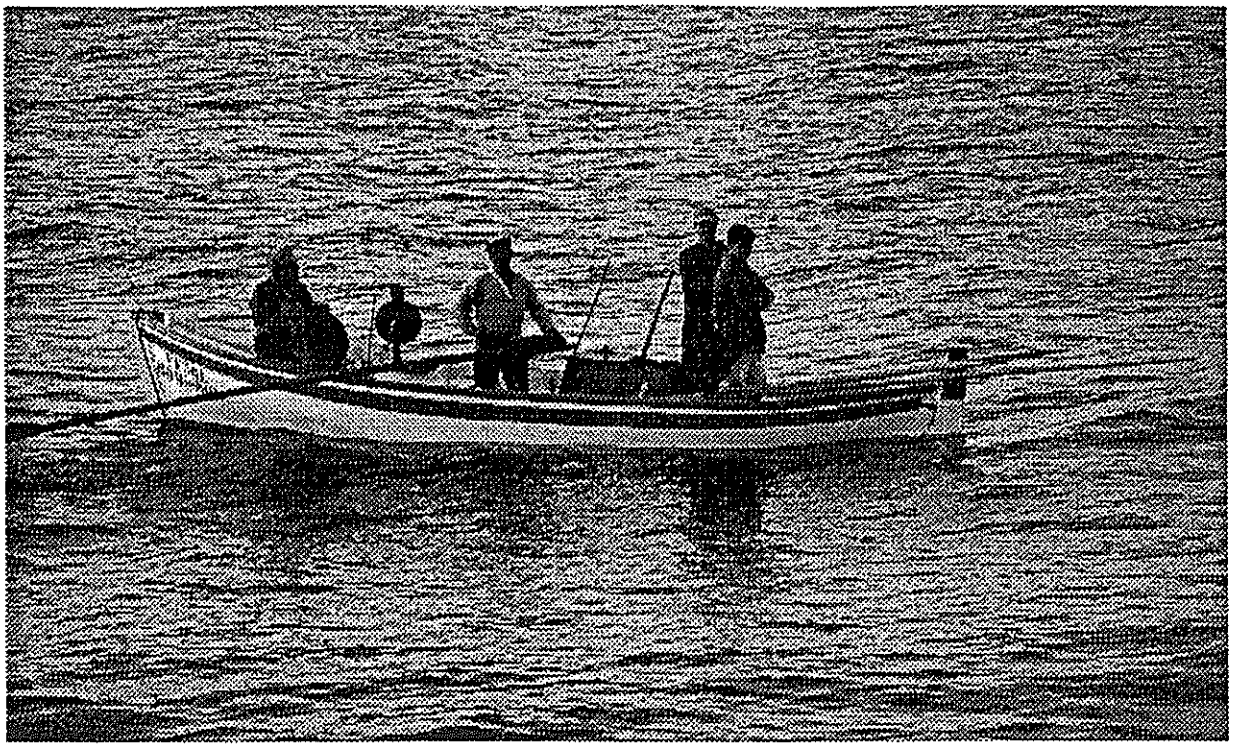

Figure 1. Components of the longline fleet fishing for swordfish in the Azores: A - Azorean open-deck wooden boats (ODWB);

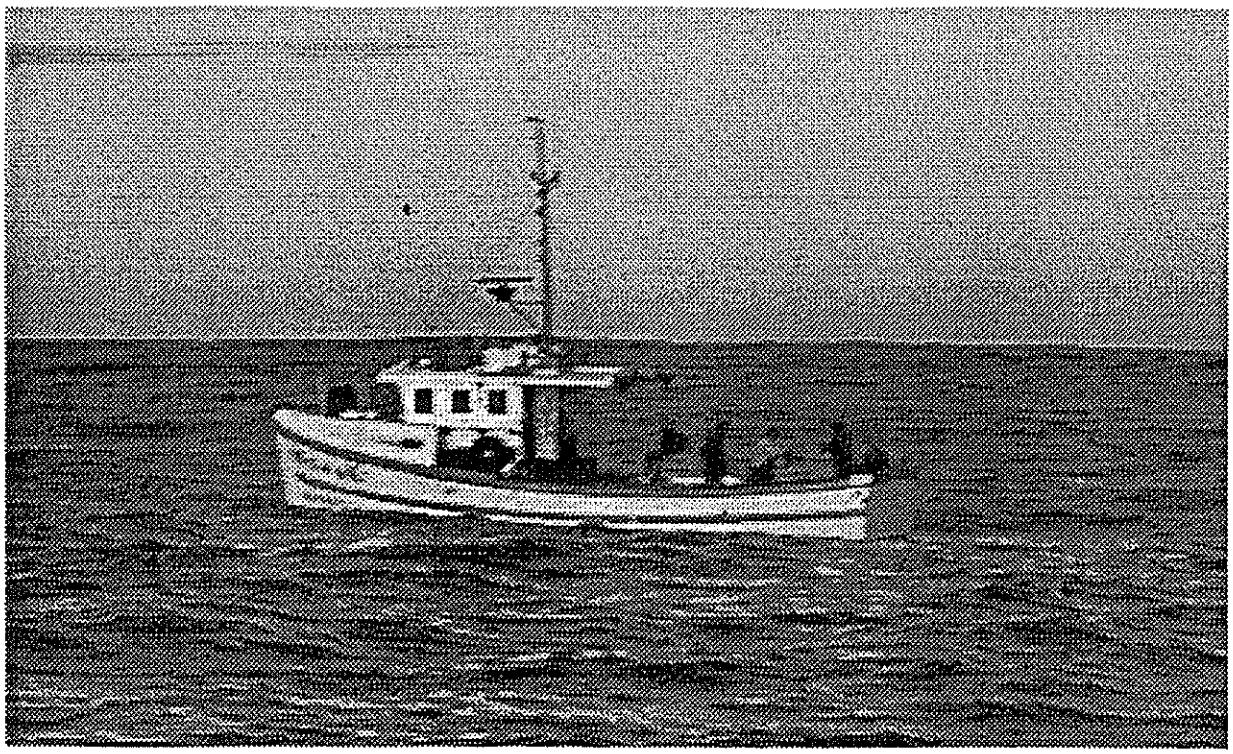

Figure 1. Components of the longline fleet fishing for swordfish in the Azores: B - Azorean small-size cabin-deck boats (CDB_1);

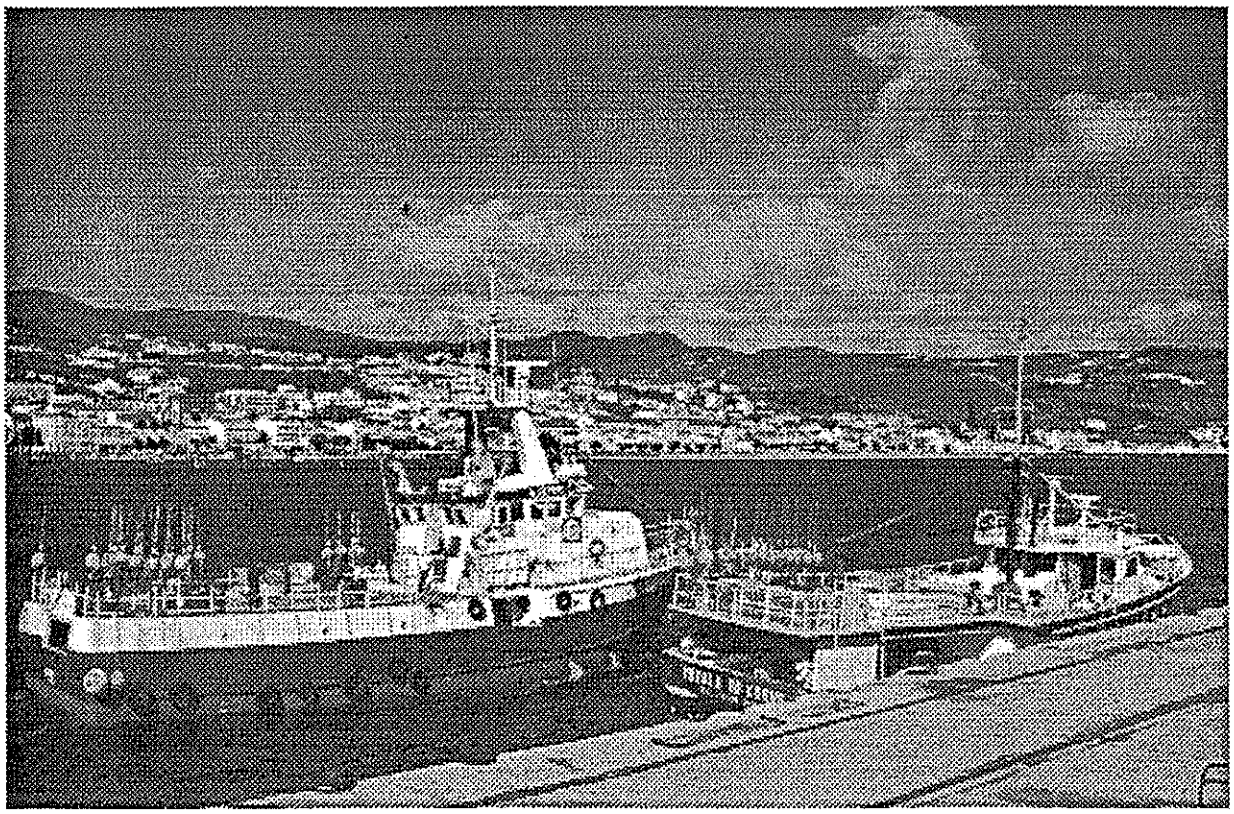

Figure 1. Components of the longline fleet fishing for swordfish in the Azores: C - large-size cabin-deck boats from the Azores and Mainland Portugal (CDB_2; MPB)

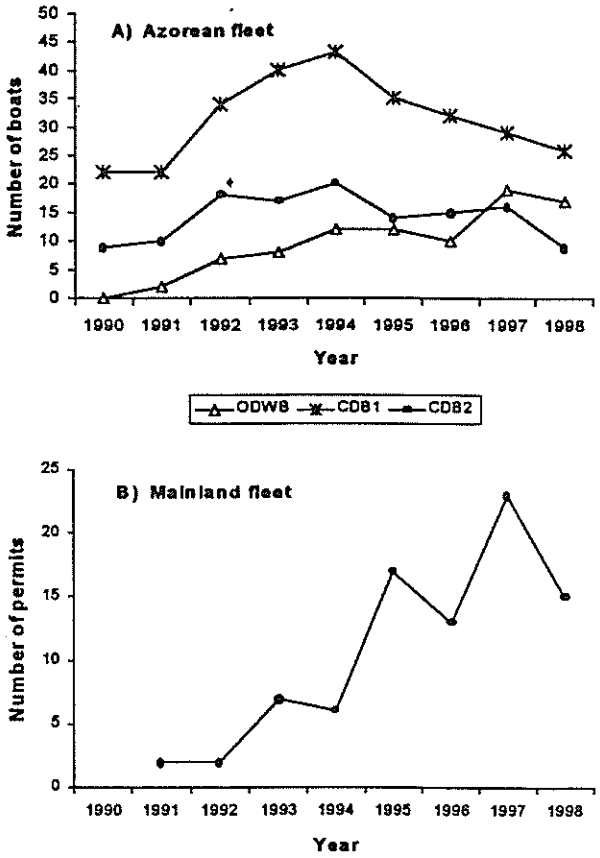

Figure 2. Number of fishing permits (=boats) for the longline fishery in the Azores, 1990-1998.

A - Azorean fleet (ODWB - open-deck wooden boats; CDB_1 - small size cabin-deck boats; CDB_2 - large-size cabin-deck boats).

B - Mainland Portugal fleet.

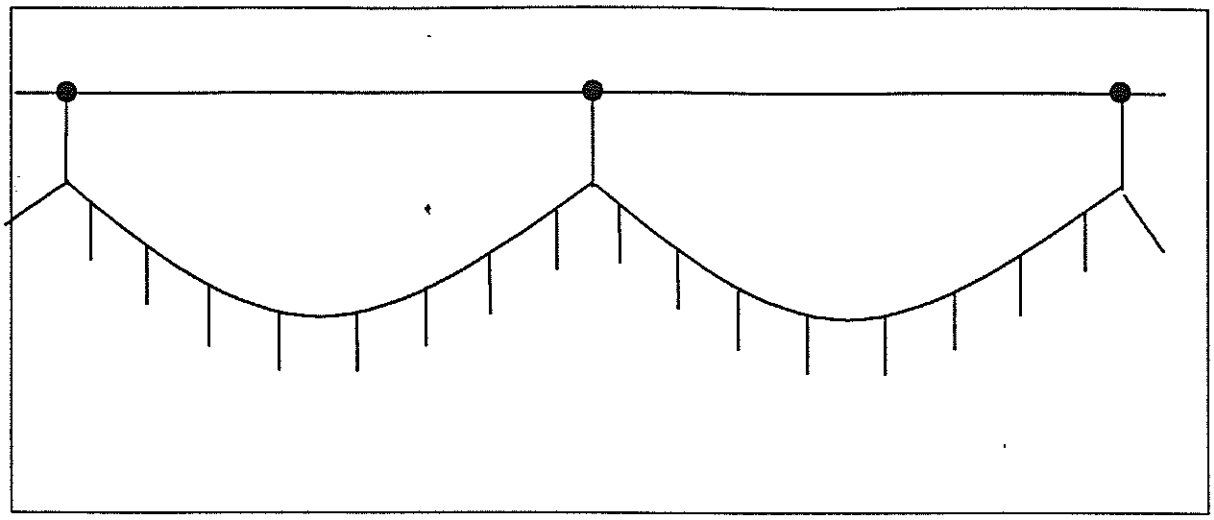

Figure 3. Longline gear.

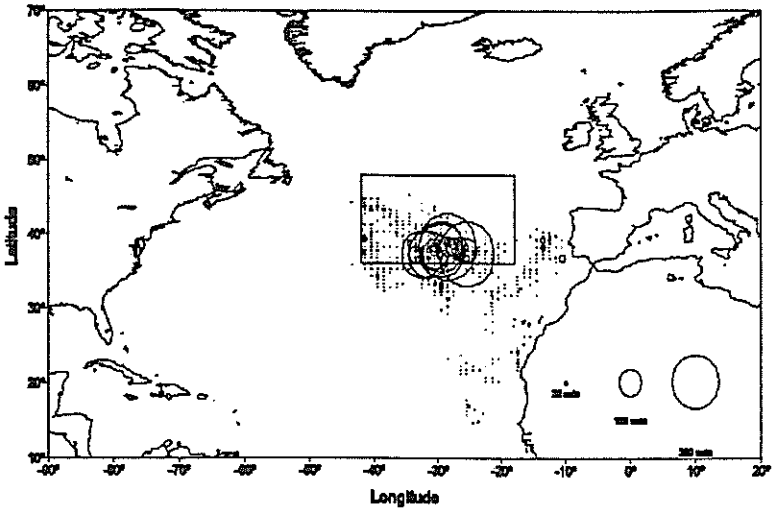

Figure 4. Longline sets reported in Portuguese fishing logbooks, 1993-1998. The rectangular area represents the ICES area X which contains most of the Azorean EEZ.

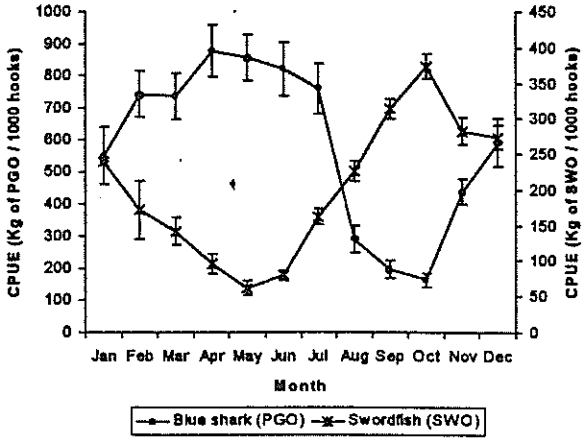

Figure 5. Monthly mean catch rates of swordfish (SWO) and blue shark (PGO) in the Azores, 1993-1998. Vertical lines represent 95% confidence intervals of the mean estimates.

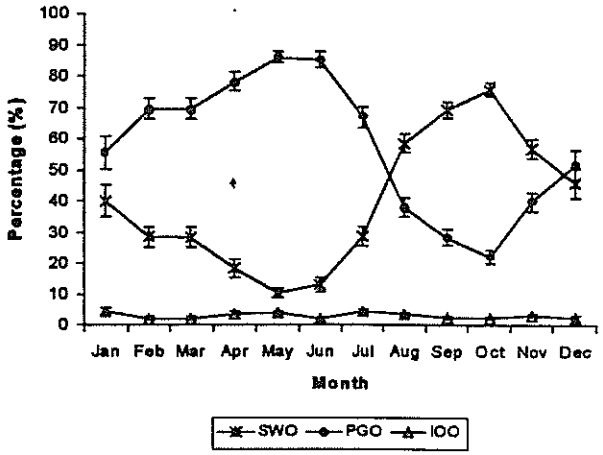

Figure 6. Monthly mean catch proportions of swordfish (SWO), blue shark (PGO) and shortfin mako (IOO). Vertical lines represent 95% confidence intervals of the mean estimates.

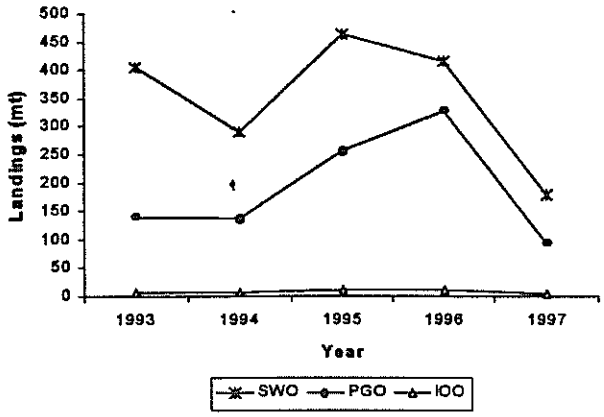

Figure 7. Yearly landings (metric tons) of swordfish (SWO), blue shark (PGO) and shortfin mako (IOO) in the Azores, 1993-1997.

Informação disponível sobre a pesca acidental de tartarugas nos Açores

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Infelizmente pouco ou nada existe de informação registado em qualquer organismo oficial, no entanto e dentro do possível, tentarei dar alguns registos pessoais, outros através de diálogos com mestres de outras embarcações e também através da assistência de algumas descargas.

Irei começar por capturas recentes em duas embarcações no ano de 1996, visto ser aquelas que tenho um registo mais concreto:

Em Setembro e Outubro no palangreiro 'S.Miguel', capturou-se cerca de 100 tartarugas em 22 lances, 15 deles junto às ilhas dos grupos Oriental e Central e nalguns bancos; os restantes 7 lances foram efectuados mais distantes, mais precisamente no Banco Voador, Banco Sarda e um no Banco Gigante. Nos primeiros 15 lances foram capturadas cerca de 90% de tartarugas com maior incidência no Mar de Prata, ilha de S. Miguel e Baixo de S. Mateus, ilha do Pico. As capturas foram de 10 toneladas de espadarte, 12 toneladas de tubarão, 0.5 tonelada de atum e cerca de 100 tartarugas careta como já mencionado. A temperatura das águas variou de 20-22 graus Celsius. A média de anzóis foi de 1000. O isco variou em 75% cavala e 25% lula.

Em Novembro e parte de Dezembro, o palangreiro polivalente Mar de Cristal, capturou cerca de 40 tartarugas em 16 lances, todos eles junto aos Bancos de S. Mateus, Banco de Açor e Mata de Prata. Dois deles foram efectuados junto à ilha de S. Miguel. As tartarugas foram capturadas na maioria no mês de Novembro e junto ao Baixo de S. Mateus, tendo-se capturado 6 exemplares num só dia. Capturou-se na totalidade 8 toneladas de espadarte, 6 toneladas tubarão, 300 kg de atum patudo e cerca de 40 tartarugas careta como acima mencionado. As tartarugas em média tinham um peso de 30 kg, a média de anzóis por lance foi de 900. O isco foi em percentagem de 75% de cavala, 15% de lula e 10% de filete de tubarão. O número de embarcações na zona variava de 2 a 4.

Posso desde já mencionar que nos meses de Julho e Agosto encontrámos indivíduos de vários pesos e comprimentos, a partir de Setembro já encontrámos indivíduos mais seleccionados e com maior peso. Poderá isto significar que os indivíduos mais pequenos atravessam as nossas águas nos meses mais quentes, mais concretamente em Julho e parte de Agosto.

Numa outra experiência minha, a bordo de um atuneiro palangreiro japonês, nos meses de Março e Abril de 1991 nos mares dos Açores, onde obtivemos alguns exemplares não representativos, na ordem de 3 a 5 exemplares, sendo dois deles tartarugas de couro. O número reduzido de exemplares poderá estar relacionado com dois factores: a temperatura reduzida que variou à superfície entre 15 e 16 graus e também pelo facto da pesca ser dirigida ao atum rabilo, ou seja, feita a grandes profundidades, ficando o longline a uma média de 80 metros de profundidade.

Ainda outra experiência foi levada a cabo, a bordo de um palangreiro dinamarquês/ canadiano 'IMAQ FISH', dirigida ao atum rabilo. A campanha teve início em Junho de 1990 tendo terminado em Setembro do mesmo ano, esta campanha foi efectuada por mim e por outro colega, tendo sido iniciada nos mares dos Açores até à costa do Canadá. Em virtude das capturas baixas em tunídeos e de ocorrência de grandes quantidades de espadarte, alterou-se o palangre, dirigindo-se apenas para esta espécie.
Nesta campanha, capturou-se vários exemplares de tartarugas, mais precisamente, nos meses de Junho e Julho, sendo estes sempre recolhidos nos anzóis junto das bóias.
Nos finais de Julho, quando nos afastámos para WNW da ilha das Flores, surgiram sempre alguns indivíduos de grande porte (entre 20/30 kg). No entanto, à medida que subíamos para Norte a cerca de trezentas milhas do Grand Bank, deixámos de capturar qualquer exemplar.

As capturas dos 30 lances foram de 4 patudo (bigeye), 7 galha-à-ré (yellowfin), 9 rabilo (bluefin), 38 tintureira (blue shark), 39 espadarte (swordfish), 20 tartarugas careta (*Caretta caretta*) e 3 tartarugas de couro (*Dermochelys coriacea*). Com a mesma embarcação fez-se ainda uma experiência ao espadarte, no mês de Novembro, resultante do número de espécies capturadas na experiência anterior e dos maus resultados em espécies de tunídeos.Embora a época propícia já tivesse passado, ainda capturou-se 11 exemplares de tartarugas careta (*Caretta caretta*), 3 tartarugas de couro (*Dermochelys coriacea*) tendo uma delas pesado 415 kg; a pesca foi feita mais à superfície e as temperaturas das águas mantiveram-se entre os 19 e 18 graus Celsius. Em resumo, as capturas totais foram de 2 rabilo, 1 patudo, 2 galha-á-ré, 1 voador, 3 tintureiras, 4 rinquim, 104 espadartes, 11 tartarugas (8 tartaruga careta e 3 tartarugas de couro).

Campanha de atum com palangre na embarcação 'António Duarte'. Esta experiência foi levada a cabo nos meses de Novembro e Dezembro de 1989 e Janeiro e Fevereiro de 1990, tendo como objectivo o atum de Inverno. Em 32 lances efectuados, capturou-se 910 tintureira, 114 espadarte, 3 patudo, 2 voador, 8 rinquim , 3 tartarugas de couro e 2 tartarugas careta. O pequeno número de tartarugas capturadas deveu-se à época do ano e também ao palangre ser dirigido ao atum, ficando este a maior profundidade.

Em resumo, poder-se-á concluir que as tartarugas incidem mais nos meses de Junho, Julho e parte de Agosto, capturando-se mais indivíduos quando a pesca é dirigida a espadarte. Verificou-se que a maior parte dos indivíduos são capturados nos anzóis junto às bóias. Nas minhas experiências verifiquei de que à medida que o Verão avançava, os

indivíduos eram na sua maioria de grande porte e poucos se avistavam à superfície. Ainda fiquei com a ideia de que, nos fins de Agosto até meados de Setembro, parece ser mais reduzido o número de tartarugas, surgindo novamente em Outubro e Novembro, em especial quando as condições climatéricas são favoráveis.

Queria também salientar, que grande parte das tartarugas ou até mesmo a sua maioria, são rejeitadas ao mar pelos pescadores sem entrar no navio, muito em especial, nos palangreiros de maior profissionalismo e de grande porte. Na alagem do palangre, o tempo perdido com uma tartaruga bastaria, para recolher dois a três anzóis, daí não haver motivação para recolher para bordo as tartarugas, sendo na sua maior parte cortadas pelo estralho. Só raramente, quando as condições do estado do mar e a pescaria é favorável é que as tartarugas são desiscadas do anzol e largadas ao mar.

Posso adiantar com alguma segurança que, o número de tartarugas a desprenderem-se dos anzóis durante a alagem é quase insignificante, apenas poderá acontecer esporadicamente num grande palangreiro a grande velocidade, na época de Inverno onde as condições do mar são muito desfavoráveis.

Posso concluir que em todas as campanhas efectuadas por mim, só uma vez foi registado a recolha de uma tartaruga sem vida e raramente outras vinham com aparência de cansaço e fraqueza.

Espero que, em discussão e diálogo possamos definir com maior rigor estas ideias assim como outras questões.

Information on Accidental Capture of Marine Turtles in the Azores

Manuel F. Serpa

Unfortunately nothing has previously been recorded on accidental capture of sea turtles by the longline fleet in the Azores. This report is based on the personal experience of the author who has had the opportunity to take part in several longline fishing surveys from 1989 to 1996. This is a summary of my experiences.

November 1989 to February 1990, F/V "António Duarte". Experiment with winter longlining for tuna.
Results of 32 sets: 910 blue sharks, 114 swordfish, 3 bigeye, 2 albacore, 8 mako sharks, **2 loggerheads** and **3 leatherback turtles**.
Remarks: The small number of turtles was due to the fact that it was winter and that the target species was tuna which means that the lines were set too deep to catch turtles.

June to September 1990, F/V "IMAQ FISH". Experiment with longlining for tuna from Azores to Canada. However, as few tuna were caught, the gear was changed to target swordfish.

Results from 30 settings: 4 bigeye, 7 yellowfin, 9 bluefin, 38 blue sharks, 39 swordfish, **20 loggerheads** and **3 leatherback turtles**.
Remarks: Several turtles were caught in June and July, always on the hooks close to the buoys. At the end of July, we caught several large turtles (20 - 30 kg) WNW of Flores, Azores. Farther north, when 300 nautical miles from the Grand Bank, no more turtles were seen.

November 1990, F/V "IMAQ FISH". Experiment in longlining for swordfish.
Results: 2 bluefin, 1 bigeye, 2 yellowfin, 1 albacore, 4 mako sharks, 104 swordfish, **8 loggerheads** and **3 leatherback turtles**.

March to April 1991. Japanese longliner for tuna.
Results: **3 loggerheads,** and **2 leatherback turtles**.
Remarks: Very few turtles due to low temperature (15° to 16° C) and that the line was set as deep as 80 m, the target species being tuna.

September to October 1996, F/V "S. Miguel". Longlining for swordfish.
Results in 22 sets: 10 tons of swordfish, 12 tons of shark, 0.5 tons of tuna, and about **100 loggerhead turtles**.
Remarks: 90% of the turtles were caught at Mar da Prata, south of S. Miguel and the Bank of S. Mateus, south of Pico. The water temperature was 20-22° C. The bait was 75% mackerel and 25% squid.

November to December 1996, F/V "Mar de Cristal". Longlining for swordfish.
Results in 16 sets: 8 tons of swordfish, 6 tons of shark, 300 kg of bigeye, and **40 loggerhead turtles**, with an average weight of about 30 kg.
Remarks: Each set had an average of 900 hooks. The bait was 75% mackerel, 15% squid, and 10% shark filets. The number of fishing boats in the area varied from 2 to 4. Most of the turtles were captured in November at the bank of S. Mateus, south of Pico, where up to 6 were taken in one day.

Concluding Remarks

The turtles seem to be more likely to be caught from June to the middle of August, and most of them were caught when the fisheries were directed at swordfish. One also observes that the majority are caught on hooks close to the buoys.

My experience is that, at the end of the summer when few turtles are seen on the surface, the turtles that are caught are larger. Thus, in July and August one finds individuals of variable sizes, while from September onwards one finds more larger individuals. From my experience, the number of turtles caught in the fisheries diminishes from the end of August to the middle of September and increases again in October and November especially under favorable weather conditions.

Most of the turtles are not hauled onboard. Especially on the larger vessels, they are rejected by the fishermen by cutting the line. Only rarely, when the sea is smooth, is the turtle freed from the hook onboard and put out to sea.

The number of turtles that manage to free themselves from the hook at sea is insignificant. This only happens with large boats at great speed under bad weather conditions.

Only once in my experience was a turtle hauled aboard dead. In general, the turtles did not show signs of being weak or tired.

I hope that through discussion and dialogue it will be possible to develop these ideas as well as other questions regarding the accidental capture of turtles.

Turtle Bycatch Study in the Longline Fisheries of the Azores

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Abstract

An study was conducted to try to quantify the bycatch of marine turtles by the longline fisheries in the Azores. The sampling method was designed to provide information about the fishery and associated bycatch as catch per unit effort and biological data on the turtles and other species caught accidentally, especially blue sharks. The mean capture for 1000 hooks per month varied between 0.036 and 0.753, respectively, in May and July, with the number of turtles captured per set between 0 and 7. Most of the turtles were hooked in the mouth. Of the 27 turtles captured, 19% were caught on hooks baited with mackerel, 11% with squid, and the remaining (70%) with unidentified bait. Only one of the 27 turtles was found dead. The data presented constitute the preliminary results from the study. We plan to put more observers on longline fishing boats during the coming months.

Introduction

During recent years there has been increasing concern regarding the accidental capture of turtles in longline fisheries as a threat to some populations. A few years ago this fishery was considered to cause little harm to turtle populations (Hillestad et al., 1995), but further studies on population dynamics and accounts from fishermen in some areas indicate otherwise. It is probable that the impact the fishery has on turtle populations varies with area and the different techniques used.

To better understand this impact and manage turtle populations affected by this fishery, it is critical to quantify the capture rates and compare the results from different areas and techniques to develop management strategies wherever necessary. The study presented here was designed to address this problem and to serve as a guideline in the design of more complex and broader studies.

Overview of Sea Turtle Biology in the Azores

In the Azores EEZ, loggerheads (*Caretta caretta*) constitute the overwhelming majority of marine turtles, whereas green turtles (*Chelonia mydas*) and leatherback turtles (*Dermochelys coriacea*) occur occasionally (Martins, pers. comm.). Studies of size distribution, tagging and recapture experiments (Carr, 1986; Bolten et al., 1993, 1995) and

more recently of genetics (Bolten et al., 1998) show that the post-hatchling loggerheads from the east coast of North America are carried by the oceanic currents to the eastern Atlantic, through the Azores, Madeira, Canary Islands, and perhaps the Cape Verde Islands. The movements of these turtles are probably associated with the North Atlantic Gyre System, and the duration of the pelagic stage is estimated to be between 10-12 years (Bolten et al., 1995).

The pelagic-stage loggerheads found around the Azores have curved carapace lengths varying between 10 and 60 cm, with a mean of 33.6 cm, and represent an early stage of the life history of the turtles nesting in the southeastern United States and Yucatan Peninsula. The loggerhead turtles frequenting the Azores waters are thus immature animals, which have a high probability of reaching maturity and are therefore very important to the maintenance of the population.

Study Design

The longline fishery in the Azores is supposed to be directed at swordfish (*Xiphias gladius*), but recent studies show that two main seasons occur, and the catch between February and June is composed mainly of blue sharks (*Prionace glauca*). Between June and December the catch is mostly composed of swordfish (see Silva in this volume). The gear can also differ, and two different set-ups are used which fish at distinct depths.

The study was designed to cover the two seasons, and efforts were made to sample the two set-ups. In order to carry out this study, some companies fishing in the Azores with longline gear were contacted, and they agreed to take onboard one observer to monitor the fishery. The sampling method was designed to provide information about the fishery and associated bycatch as catch per unit effort and biological data on the turtles and other species, especially blue sharks. Whenever a turtle was caught, the observer would stop any other work to record the data on the turtle and to attend to it, if necessary.

The data collected for turtles were:

1. Species
2. Measurement of the curved carapace length
3. Collection of skin sample for DNA analysis
4. Capture
   - Method of capture (hook or entanglement)
   - Condition (dead; weak; strong)
   - Position of hook or entanglement
   - Position of the hook in the digestive tract (if applicable)
5. Other pertinent observations

After the data were collected, the turtle was tagged and released, and observations were made on its behavior. In the case of a dead turtle, the right front flipper and stomach were frozen.

The first observer was put on the fishing boat "Altair" in May, and the sampling was made between May and August. The observer trained one of the fishermen, and during the months of June and July, this fisherman collected the data.

Preliminary Results

The data presented below constitute the preliminary results from the study and are presented only to give an idea of the benefits a program of observers could bring to the understanding of the sea turtle longline bycatch.

The size frequency of loggerhead turtles (*Caretta caretta*) caught in the swordfish fishery between May and August is presented in Figure 1. The mean capture for 1000 hooks per month varied between 0.036 and 0.753 (Figure 2), respectively, in May and July with the number of turtles captured per set between 0 and 7.

Of the 27 turtles captured, most of them (25) were hooked in the mouth; only one was hooked in the eye, and another in the flipper. Except for one turtle with a hook in the junction of the jaw that could not be removed, all of the turtles that were brought onto the boat were freed from hooks and lines. Only one of the 27 turtles was dead. In addition, the fishermen reported an undetermined number of turtles captured in June that were not hauled onto the boat due to their large size (two of them were leatherback turtles, and the others were loggerheads). These turtles were set free by cutting the line attached to the hook and thus the position of the hook is not known.

The relation between capture and the baits used is presented in Figure 3. Of the 27 turtles captured, 19% were caught on hooks baited with mackerel, 11% with squid, and the remaining (70%) with unidentified bait.

Conclusions

The results of this study are preliminary, and we intend to put more observers on longline fishing boats during the coming months. It is, thus, too soon to draw any conclusions about the bycatch of marine turtles around the Azores in this fishery. Nonetheless, we believe that as data are collected in this way, there will be a better understanding of the magnitude of the bycatch, as well as of the way in which it occurs. In addition, information on other species can also be gathered in this way and can help in the management of the fishery.

The work achieved during this first phase was not only encouraging scientifically. It also showed that a close collaboration with the fishermen could produce good results regarding the conservation of turtles. The fishermen on "Altair" and the owner of the company were very receptive to the study and even eager to learn how they could help the turtles. It is reasonable to think that more fishermen and companies would be receptive not

only to have other observers onboard, but also, in some cases, to try alternative techniques to reduce the bycatch, if this is proved to be necessary.

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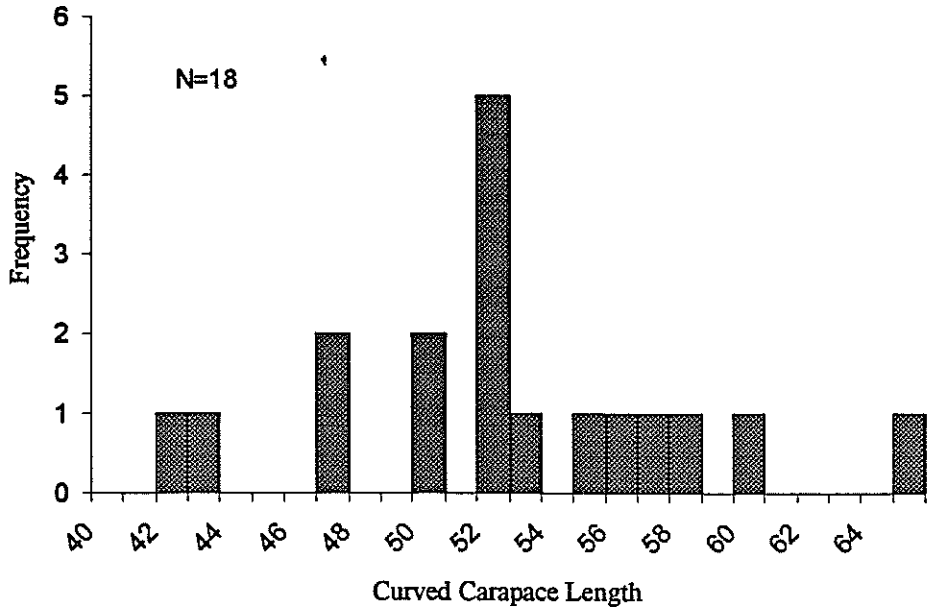

Figure 1: Size distribution of loggerheads captured by longline fisheries around the Azores

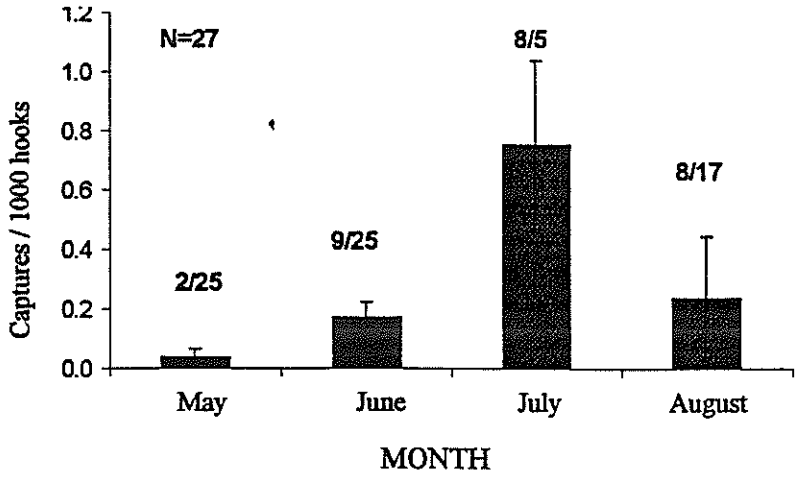

Figure 2. Mean capture of loggerhead sea turtles in longline fisheries around the Azores. Fractions above the bars represent the number of turtles caught per number of sets. Error lines represent the error at a confidence level of 0.95.

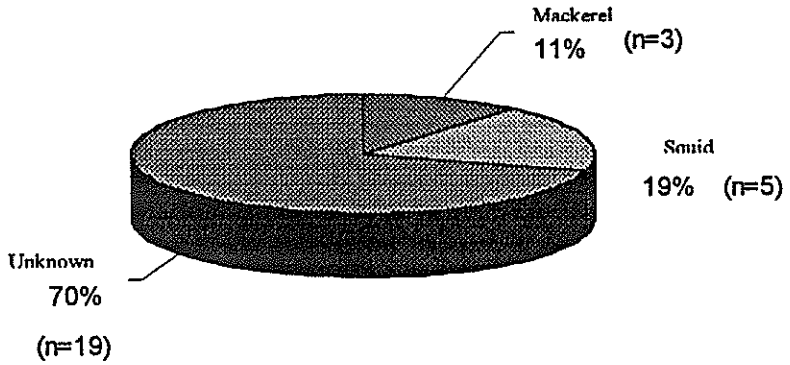

Figure 3: Distribution of bait type for loggerhead turtles captured in the longline fishery around the Azores

Programa de Observação para as Pescas dos Açores (POPA)
Aspectos relacionados com tartarugas Marinhas

Observation Program for Fisheries in the Azores (POPA):
Aspects Related to Marine Turtles

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English Summary

As part of the Observer Program for the Fisheries of the Azores (POPA), information related to sightings and tagging of turtles is also collected. That information is recorded by the 10 observers contracted for POPA on the tuna fishing vessels. All of the data presented here are related to the sampling period between 15 May and 31 July 1998. One of the objectives of this work is to relate the turtle sightings to the environmental conditions (temperature, beaufort and visibility). The results revealed no significant relation between temperature and turtle abundance. There is a very significant relation between visibility and beaufort (state of the sea) and the number of turtle sightings. This relationship suggests that atmospheric conditions can interfere with the detection of turtles at sea and that better environmental conditions improves the detection by the observers. From a total of 390 sighted individuals, 50 were tagged, corresponding to 12.8%. The tagged individuals had a minimum curved carapace length of 17 cm, a maximum of 55 cm, and a mean of 33.5 cm.

O POPA é uma proposta apresentada pelo DOP/UA que permite, por um lado, conhecer de forma objectiva as suspeitas que recaem sobre os pescadores açorianos relativamente à captura ilegal de cetáceos e, por outro lado, recolher dados sobre as pescas e espécies marinhas açorianas.

O POPA surge como consequência final dos vários contactos entre as partes interessadas na implementação deste programa (Industria Concerveira -COFACO-, Associação de Armadores da Pesca do Atum e Similares dos Açores -APASA- , Departamento de Oceanografia e pescas da Universidade dos Açores -DOP/UA-, "Earth Island Institute", Serviço Açoreano de Lotas -LOTAÇOR-, "University of Hawaii" e a conserveira "Starkist Seafood"), com o patrocínio da Direcção Regional das Pescas dos Açores. Estes contactos surgiram como consequência do acordo de princípios em que estas entidades reconhecem que o POPA possa ser organizado e gerido pelo Centro do IMAR -

Instituto do Mar da Universidade dos Açores (DOP/UA), de modo a poder contribuir para a atribuição do estatuto "dolphin safe" ao atum capturado nos Açores.

O objectivo fulcral do POPA, tendo por base uma inegável qualidade científica, é o de assegurar que não haja mortalidade intencional nem perseguição deliberada de cetáceos pelas tripulações das embarcações atuneiras. Este objectivo será assegurado pela presença de observadores embarcados nos navios atuneiros. Aproveitando este facto, pretende-se obter complementarmente dados científicos sobre cetáceos e outras espécies marinhas (caso das tartarugas e aves marinhas), bem como sobre a pescaria (capturas, esforço de pesca, preenchimento de diários de bordo, etc.).

No decorrer das campanhas de observação os 10 observadores contratados para o POPA, recolheram informação relacionada com avistamentos e marcação de TARTARUGAS. Os resultados obtidos são consequência de uma primeira abordagem estatística resultante da base de dados do POPA ainda em desenvolvimento. Esta fase do trabalho corresponde a uma abordagem preliminar que relaciona os avistamentos de tartarugas com as condições ambientais do meio (temperatura, beaufort e visibilidade).

Os resultados demonstram uma relação significativa entre o estado do mar (Beaufort) e o número de tartarugas avistadas, G = -0,40; p = 0,00; n = 74 (figura 1). No caso da visibilidade *vs* o tartarugas avistadas verifica-se também uma relação significativa entre as variáveis, G = -0,49; p = 0,00; n = 74 (figura 2). Os resultados obtidos revelam que condições ambientais influenciam a detecção de tartarugas por parte do observador e sugerem que melhores condições ambientais favorecem essa detecção.

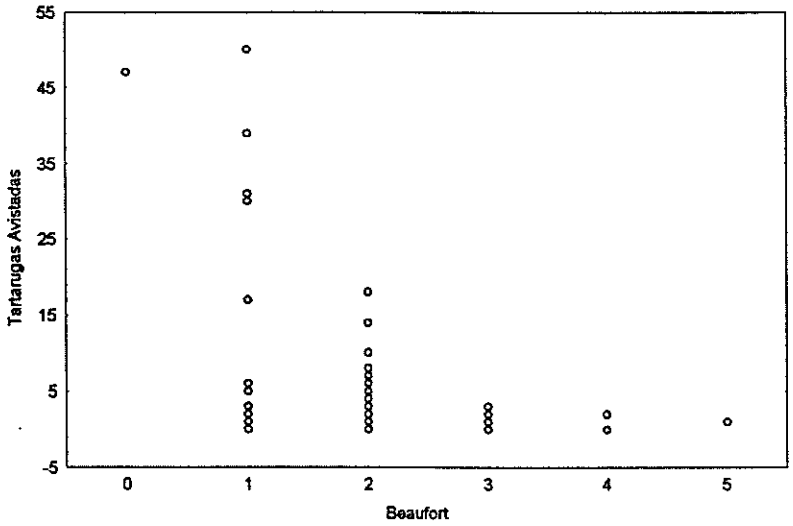

Figura 1 - Relação entre o Beaufort (estado do mar) e o número de tartarugas avistadas.

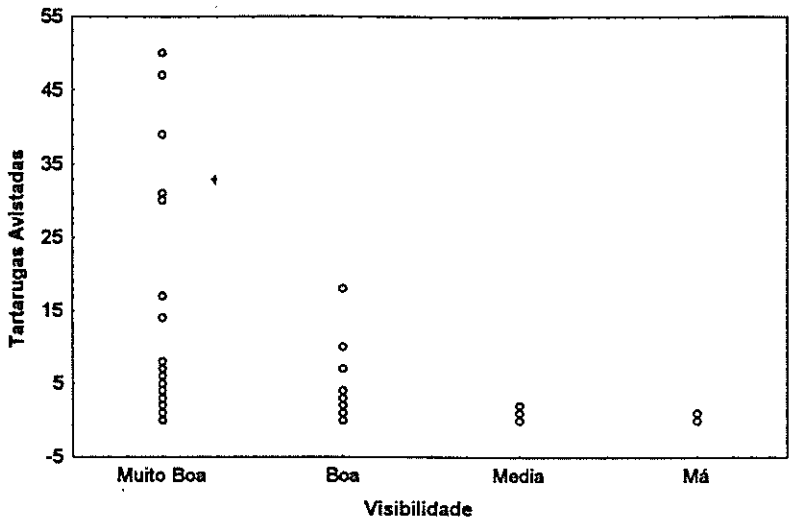

Figura 2 - Relação entre a visibilidade e o número de tartarugas avistadas.

No que diz respeito ás classes de comprimento dos indivíduos marcados, os resultados revelam um comprimento médio da carapaça de 37,5 cm, tendo sido o comprimento máximo de 55 cm e o mínimo de 17 cm, para o total de 50 indivíduos marcados (figura 3).

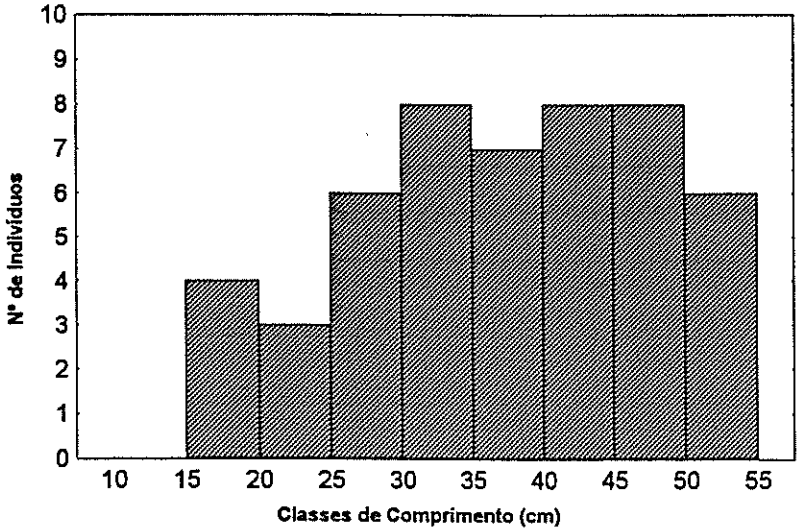

Figura 3 - Classes de comprimento das 50 tartarugas marcadas.

Aproximação ao desenho experimental e revisão das variáveis experimentais, com o objectivo de estimular a discussão

Approach to the Experimental Design and Review of the Experimental Variables with the Objective of Stimulating Discussion

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English Summary

The loggerhead sea turtle, *Caretta caretta*, comprises a part of the bycatch of the swordfish longline fishery. The available information on this fishery and respective bycatch is scarce. Thus, it is difficult at this point to elaborate a clear sampling and experimental design. The objective of this presentation is to perform a brief review of hook fishing aspects and selectivity properties, as well as to summarize the main experimental variables and the possible types of the experiments to compare them. As any experiment has its own set of assumptions and difficulties, at the end, two types of experiments will be discussed – experiments in captivity and experimental fishing – with the objective of stimulating further discussion.

Sumário

A tartaruga *Caretta caretta* é capturada acidentalmente na pesca de palangre do espadarte. A informação estatística e biológica disponível, não permite, nesta altura, elaborar um desenho experimental claro. O objectivo desta apresentação é o de rever brevemente os aspectos da pesca com anzol e as suas características selectivas, assim como o de rever as principais variáveis experimentais e o tipo de experiências que se podem fazer para as testar. Como cada experiência tem os seus pressupostos e dificuldades, submete-se à discussão, no final e com o objectivo de estimular a discussão, dois tipos de experiências: experiências em cativeiro e pesca experimental.

Introdução

O método científico consiste em analisar o problema, formular uma ou mais hipóteses, testar essas hipóteses através de experiência(s) cujos resultados, após tratamento matemático ou estatístico, conduzam à rejeição ou aceitação das hipóteses iniciais. Qualquer exercício de desenho experimental está, assim, dependente do problema e das hipóteses levantadas, e tentará, à priori, responder a três tipos de questões: Como recolher

a informação necessária para testar a hipótese, onde e quando recolher essa informação e quantas amostras serão necessárias (Krebs, 1989).

Tipo de experiências

Uma forma simples de classificar as experiências consiste em dividi-las em dois grandes grupos - manipuláveis e observacionais (Scheiner & Gurevitch, 1993) - sendo óbvio que esta classificação é muito artificial e que a maior parte das experiências caiem necessariamente entre estes dois tipos opostos (ver fig. 1).

Tomando a pesca comercial como uma experiência, uma vez que ela é uma fonte de dados cuja análise poderá servir para encontrar padrões temporais e espaciais correlacionáveis quer com a biologia das espécies quer com a estratégia ou com o regime de pesca, tudo o que se pode dizer é que dificilmente poderá responder ao problema posto neste "workshop" - desen*ho de uma experiência com o objectivo de determinar o efeito de algumas modificações no palangre de meia água, utilizado na pesca do espadarte, de forma a diminuir a captura a*cidental de tartarugas - mas que, todavia, deve ser compreendida em detalhe. A informação existente sobre a pescaria do espadarte e sobre as respectivas capturas acidentais, nomeadamente as de tartaruga, é muito escassa, e pouco ajuda na elaboração de um desenho experimental. Apesar disso, a análise prévia das capturas da pesca do espadarte (ver Silva, neste volume) já responde à pergunta de quando se deve fazer uma pesca experimental nos Açores. A resposta é, obviamente, na altura em que a captura acidental de tartarugas é maior, i.e., entre Junho e Outubro.

Convém, nesta altura, salientar que o problema que se está a analisar neste workshop é bastante complexo e que uma revisão da bibliografia sobre a selectividade do anzol mostra que este assunto ainda não está bem resolvido (ver McCracken, 1963; Pope et al., 1975; Ralston, 1982; Morais, 1990; Lokkeborg & Bjordal, 1992; Kenchington, 1993; Otway & Craig, 1993; Erzini et al., 1995, 1997; Millar, 1995; Sousa, 1996; Sousa et al., in press). De facto, caso se opte por uma pesca experimental, há que entender que há muitos factores em jogo, alguns difíceis de controlar e medir (e.g. interacções inter/intra específicas, comportamento perante a arte, factores ambientais, etc.), que podem aumentar de tal forma a variabilidade das capturas que só uma amostragem enorme poderá tornar o efeito dos tratamentos estatisticamente detectáveis. Isto significa que, com o conhecimento disponível, é difícil prever quanto tempo ou quantos lances ou quantas amostras serão necessárias para que, através de uma pesca experimental, se obtenha a informação suficiente para testar o efeito de determinadas variáveis. Significa também que, neste caso, é aconselhável testar um número reduzido de factores ou variáveis e recolher o maior número possível de amostras (executar um número elevado de lances).

Considerando o que se disse no parágrafo anterior, não se deve, por isso, esquecer as experiências em tanques ou gaiolas, uma vez que elas permitem controlar melhor uma série de factores adicionais, isolar os tratamentos e replicar experiências. No entanto, é de salientar que a execução deste tipo de experiências será sempre difícil nos Açores, por falta

de locais naturais adequados (i.e. pouco expostos a uma acção intensa do mar, no caso das gaiolas), e que não há informação suficiente sobre o stress, e consequentes alterações comportamentais, induzido pelo cativeiro nas tartarugas. A alteração do comportamento dos animais em cativeiro é de facto o maior "handicap" deste tipo de experiências, levando, frequentemente, o investigador a preferir a pesca experimental.

Pesca com anzol e variáveis principais

Independentemente do tipo de arte de anzol utilizada, podem-se distinguir três etapas na captura com anzol: atracção, captura e escape (Bjordal, 1981). Em cada uma destas etapas, os factores ou variáveis que possivelmente terão maior influência e que são mais facilmente manipuláveis encontram-se sublinhados na tabela 1.

Conclusões

Nesta apresentação e nas apresentações anteriores, ficou claro que o conhecimento actual sobre a pesca do espadarte e sobre o "bycatch" de tartarugas é insuficiente quer nos Açores, quer noutras áreas de pesca, e que é importante que esta informação comece a ser recolhida num futuro próximo. Ficou também claro que as variáveis a testar, para responder ao problema posto neste workshop seriam: Tipo e tamanho de isco, tipo e tamanho de anzol, profundidade de pesca e tipo de estralho. O possível efeito de atracção das bóias foi também mencionado. Algumas destas variáveis, nomeadamente o tamanho do anzol e tipo de estralho, embora importantes na captura acidental de tartarugas, teriam certamente um impacto muito grande no rendimento da pesca do espadarte, pelo que quaisquer medidas baseadas no resultado desta experiência seriam difíceis de implementar. Sugere-se assim que estas variáveis não sejam testadas e que se focalize a atenção nas restantes variáveis. O tipo e tamanho de isco deve também merecer mais alguma reflexão como variável a analisar, uma vez que a *Caretta caretta* parece ter uma alimentação generalista (Preen, 1996) e que a alteração do isco também pode conduzir a alterações significativas nos rendimentos de pesca (ver e.g. Lokkeborg & Bjordal, 1993).

Como base para a discussão que se segue, apresenta-se um esquema de um palangre de meia-água, cujo desenho e características deverão ser definidas e completadas, tendo como objectivo a pesca experimental (Fig. 2), embora se insista que se debata previamente a possibilidade da realização de algumas experiências em cativeiro. Neste aparelho há ainda que prever a colocação de instrumentação para monitorizar o comportamento da arte (e.g. TDRs) e a sistematização da amostragem de forma a que a sua aplicação no campo seja tão simples quanto possível, que os dados resultantes sejam tratados como se o processo fosse verdadeiramente aleatório e que a informação recolhida seja tão completa quanto possível de forma a que se possa tirar algumas conclusões sobre a interacção entre as variáveis, o comportamento da espécie e alguns factores ambientais. Deve-se ainda acrescentar que, de acordo com as conclusões anteriores, a pesca experimental deverá ser feita entre Junho e Outubro, num local onde seja mais provável encontrar tartarugas e espadarte, com um aparelho de características idênticas, mas com uma dimensão ligeiramente menor que o

utilizado na pesca comercial (i. e. com um menor número de anzóis, porque o processamento de pescado e informações a registar tornam a alagem mais morosa).

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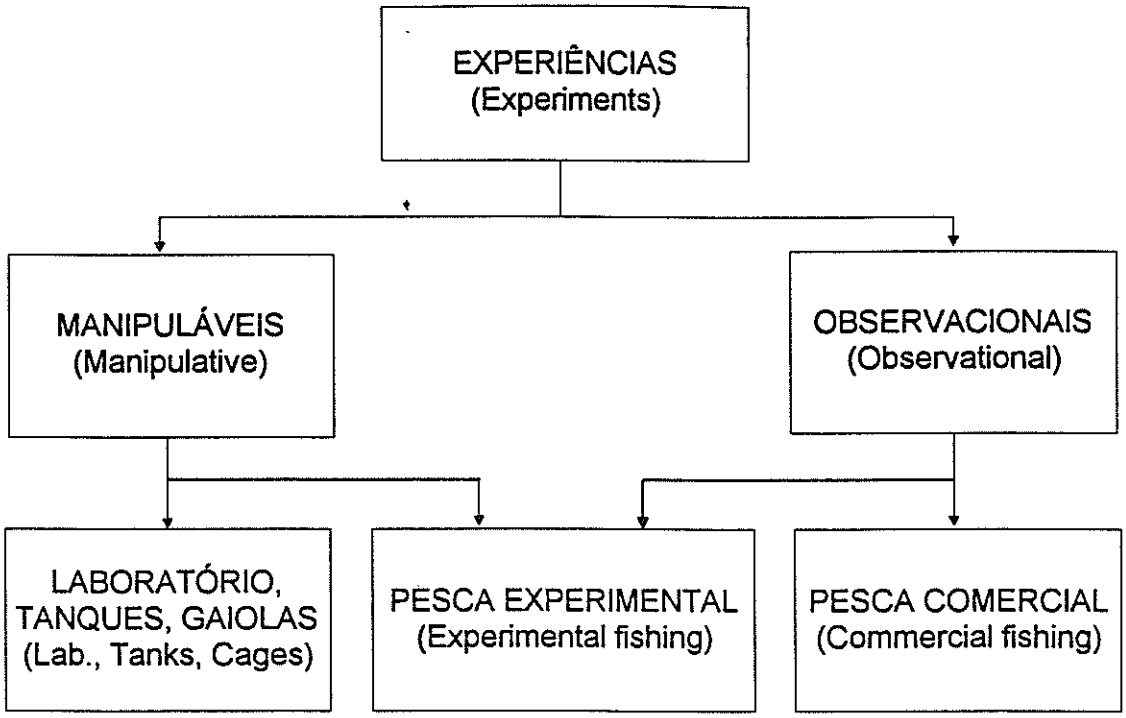

Figura 1 - Tipos de experiências.

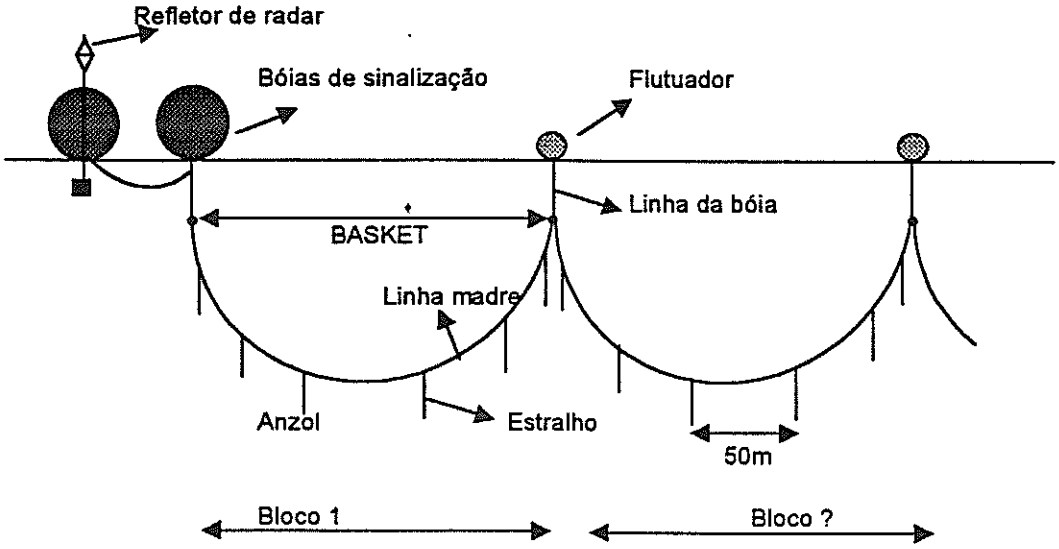

Figura 2 - Esquema geral de um palangre de meia água, a ser completado através da discussão.

Tabela 1 - Etapas da captura com anzol e variáveis principais. As variáveis consideradas mais importantes estão sublinhadas.

ETAPAS	VARIÁVEIS
ATRACÇÃO: (Atraction)	Isco, profundidade, variáveis ambientais vs factores biológicos da espécie (e.g. correntes, luz ou transparência da água, distribuição vertical e horizontal da espécie, comportamento alimentar, atracção pelas boias, etc.).
CAPTURA: (Capture)	Tamanho e forma do anzol vs factores biológicos da espécie (outros factores e.g. espaçamento dos anzóis, saturação do aparelho, competição inter e intraespecífica, comportamento alimentar, tamanho da boca, etc.).
ESCAPE: (Escape)	Tamanho e forma do anzol, tipo de estralho vs factores biológicos da espécie (outros factores e.g. aprendizagem através de contactos prévios com a arte, comportamento alimentar e forma como engole o anzol, etc.).

Experiment to Evaluate Gear Modification on Rates of Sea Turtle Bycatch in the Swordfish Longline Fishery

Objective

Conduct an experiment to evaluate effects of gear modification on rates of sea turtle bycatch in the swordfish longline fishery in the Azores. The primary variables to be evaluated are hook shape ("J" Anchora vs. Mustad circle/curve), bait (squid vs. mackerel), and buoy line depth (3 fathoms vs. 6 fathoms). Although the primary objective is to evaluate rates of sea turtle bycatch, the effect of gear modification on the location of hooking (e.g., mouth vs. esophagus) will also be evaluated. The location of hooking has very important implications for the survival of the hooked turtles.

Justification

1. Results from this experiment will have broad application and can be applied to swordfish longline fisheries around the world.

2. The sea turtle population impacted by the swordfish longline fishery in the Azores is the early juvenile pelagic stage for turtles that nest in the southeast USA.

Background

The problem of sea turtle bycatch in longline fisheries has been recognized worldwide (for review, see Balazs and Pooley 1994, Williams et al. 1996). Bolten et al. (1994) presented preliminary data on bycatch of loggerhead sea turtles (*Caretta caretta*) in the swordfish longline fishery in the Azores. The waters around the Azores are an important developmental habitat for the pelagic stage of the Atlantic loggerhead population. Using mtDNA sequence analyses, Bolten et al. (1998) determined that the source rookeries for this pelagic population are primarily in the southeastern USA. Therefore, the nesting population of loggerheads in the southeast USA is the primary population impacted by the swordfish longline fishery in the Azores.

Design of the Experiment

An experiment was designed using "American Gear" configuration (nylon line with steel leader) with the following three variables:

1. hook type: "J" Ancora 17/0 (Spanish) vs. Mustad circle/curve
2. bait: squid vs. mackeral
3. depth of buoy line: 3 fathoms vs. 6 fathoms.

Workshop participants identified other variables (e.g., light sticks), but there was consensus that the three variables chosen were the most important. The experiment will be conducted during the 4 primary months of the swordfish fishery in the Azores (June, July, October, and November). A commerical longline fishing vessel (with a commercial crew) from the Azores will be chartered to conduct the experiment. The experiment will consist of a minimum of 60 sets (approximately 15 sets per month) with 960 hooks per set. For each set at each of the two buoy line depths (3 fathoms [n = 30 sets] or 6 fathoms [n = 30 sets]), the experimental design will allow for the following comparisons to be statistically evaluated:

Hook 1[A] vs. Hook 2[B]	480 hooks for each treatment
Bait L[C] vs Bait C[D]	480 hooks for each treatment
Hook1 Bait L vs Hook1 Bait C vs Hook2 Bait L vs Hook2 Bait C	240 hooks for each treatment

[A] Hook 1 = "J" Ancora
[B] Hook 2 = Circle/Curve Mustad
[C] Bait C = Cavala = mackerel
[D] Bait L = Lula = squid

The following diagram illustrates the experimental array. The starting order of bait and hook type will be randomized each day to avoid position effect within a gear array. Because every experimental variable change is associated with a major gear change, this experimental array will faciliate changes in variables and data collection. For example, bait type will change at every large buoy and hook type will change at every radar reflector buoy.

```
|>                    |>                    |>                    |>
OoooOoooOoooOoooOoooOoooOoooOoooOoooOoooOoooOoooOoooOoo... continued
|____||____||____||____||____||____||____||____||____||____||____||____...
Bait C   L    C    L    C    L    C    L    C    L    C    L    C
(n=24 hooks for each bait unit = basket)

|_____________________||_____________________||_____________________||_____________...
      Hook 1                Hook 2                Hook 1                Hook 2
      n=96 hooks            n=96                  n=96                  n=96
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|> = radar reflector buoy
O = large buoy
o = small buoy

1. The buoy line will be either 3 fathoms or 6 fathoms
2. There will be 6 hooks (with 9-meter leaders) on each mother line; hooks will be spaced at 25-30 m.

Schedule

An excellent window of opportunity now exists to pursue this experiment in the Azores because of both political will and interest from the commercial longline fleet in the Azores. We propose that the experiment begin in June 1999.

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Comentários de encerramento

Helen R. Martins

Segundo a primeira teríamos o nosso Director Ricardo Santos a afzer o encerram, ento do workshop. Porém, ele teve outros compromissos e a tarefa passou para mim.

Antes de mais, quero agradecer profundamente ao nosso colega Alan Bolten pela sua iniciativa, entusiasmo e paciência com o fim a levar a cabo com sucesso este projecto e ao Jerry Wetherall do National Marine Fisheries Service do E.U.A. que fez a longa viagem do Hawaii para nos apoiar e aos pescadores que fizeram o sacrifício de nos dar algum do seu precioso tempo para nos ajudar. Também agradeço aos meus colegas no DOP que apresentaram comunicações para nos ajudar a perceber melhor o nosso objectivo.

Para todos, muito obrigada!

Closing Remarks

According to our first agenda our Director, Ricardo Santos, was to have closed this workshop. However, as he had to be away on other duties, the task was left to me.

First of all, I would like to thank profoundly our colleague Alan Bolten for the initiative, enthusiasm and patience he has shown in order to bring the workshop to a successful conclusion, and also Jerry Wetherall of the National Marine Fisheries Service who came a long way from Hawaii to support us. We are very grateful to the fishermen who sacrificed their time to help us with their expertise.

A special thank you to my colleagues at DOP who presented information that made us better understand our objective.

Many thanks to all of you!