PROCEEDINGS OF THE WORKSHOP ON

COMMON DOLPHINS: CURRENT RESEARCH, THREATS AND ISSUES

Held at the

European Cetacean Society 18th Annual Conference,

Kolmården Djurpark, Kolmården, Sweden, 1st April 2004

Editors:

Karen Stockin[1,2], Adriana Vella[3] and Peter G.H. Evans[4]

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CONTENTS

Contents 3

Workshop Programme 4

Stockin, K. and Vella, A. Introduction 5

Vella, A. Common dolphin *Delphinus delphis* research and conservation requirements in the Central Mediterranean around the Maltese Islands 8

Brereton, T., Williams, A., and Martin, C. Ecology and status of the common dolphin *Delphinus delphis* in the English Channel and Bay of Biscay 1995-2002 17

Ridoux, V. Operational interaction between common dolphins *Delphinus delphis* and pelagic trawl fisheries in the North-East Atlantic: From behavioural and environmental perspectives 26

Murphy, S. Geographical variation in aspects of morphology in the common dolphin *Delphinus delphis* 27

Bearzi, G., Politi, E., Agazzi, S., Bruno, S., Costa, M., Bonizzoni, S., and Gonzalvo, J. The decline of short-beaked common dolphins *Delphinus delphis* in Eastern Ionian Sea coastal waters 33

Mussi, B. and Miragliuolo, A. Short-beaked common dolphin *Delphinus delphis* in the waters of Ischia Island: A relic population unit of primary importance in the Italian Seas 34

Stockin, K. and Vella, A. Concluding remarks 41

List of workshop participants 43

PROGRAMME

08:30 **Registration**

Introduction

09:00 **Karen Stockin** *Coastal-Marine Research Group, Massey University and Biscay Dolphin Research Programme*

Session 1: ***Spoken Presentations***

09:20 **Adriana Vella** *Conservation Biology Research Group, University of Malta*
Common dolphin *Delphinus delphis* research and conservation requirements in Central Mediterranean around the Maltese Islands.

09:40 **Tom Brereton** *Biscay Dolphin Research Programme*
Seasonal and temporal trends in common dolphin *Delphinus delphis* in the Western Atlantic 1995-2004.

10:00 **Vincent Ridoux** *Centre for Research of Marine Mammals, University of La Rochelle*
The common dolphin *Delphinus delphis* in the Bay of Biscay: The by-catch issue from the stranding and ecological perspectives.

10:20 **Sinead Murphy** *Department of Zoology, University College Cork*
Geographical variation in aspects of morphology in the common dolphin *Delphinus delphis*, and shifts in distributional patterns in the North-East Atlantic.

10:40 **Joan Gonzalvo** *Tethys Research Institute and University of Barcelona*
The decline of short-beaked common *Delphinus delphis* dolphins in Eastern Ionian Sea coastal waters.

11:00 **Coffee Break**

Session 2: ***Discussion Session***

11:15 **Discussion**

12:15 **Conclusions and recommendations**

13:15 **Final thanks and closure**

INTRODUCTION

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To date, two species of common dolphin are recognised worldwide: the short-beaked (*Delphinus delphis*) and the long-beaked (*D. capensis*), with a subspecies of the long-beaked (*D. capensis tropicalis*) also acknowledged. Despite its widespread presence throughout most European waters, many aspects of common dolphin biology and ecology, including abundance, distribution and taxonomy, remain unclear.

The purpose of this workshop was to bring together managers and researchers from different disciplines who work with common dolphins, in order to discuss and review the current scientific research, issues and threats facing European common dolphins. The workshop took place on Saturday 1st April 2004 at Kolmården Zoo, Sweden immediately after the 18th Annual Conference of the European Cetacean Society. The workshop was attended by 33 participants from ten countries, listed at the end of this volume.

For the proceedings of this workshop, we invited a further contribution to those presented at the meeting – from Barbara Mussi of *Delphis*, Mediterranean Dolphin Conservation. We are very grateful to all contributors for their submissions, and to the Kolmården Djurpark and European Cetacean Society for kindly hosting the meeting.

We also forward our thanks to Giovanni Bearzi for his initial assistance in the planning of the workshop, Lissa Goodwin for taking minutes during the workshop, and Simon Berrow for chairing the meeting.

COMMON DOLPHINS (*DELPHINUS DELPHIS*) STATUS IN THE CENTRAL AND SOUTHERN MEDITERRANEAN AROUND THE MALTESE ISLANDS

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INTRODUCTION

Since 1997, a conservation biology research project focusing on cetaceans in the Central and Southern Mediterranean Sea around the Maltese Islands has managed to increase accurate information of the various species inhabiting these waters (Vella, 1998; 2000a; 2000b). Among the species studied, this paper focuses upon the common dolphin, *Delphinus delphis* in the Mediterranean. This species/subpopulation rated as endangered in the Mediterranean (EN A2abc - IUCN 2003 - http://www.redlist.org) necessitates particular conservation assessment, monitoring and management planning in this region (IUCN, 2003; Reeves *et al.*, 2003). This ongoing long-term research therefore also aims at contributing valuable information (Vella, 2000b) required in relation to the *Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area* (ACCOBAMS). Although Mediterranean cetaceans are legally protected by Maltese law, through specific legal notices, this field conservation research is, to date, the only scientific effort around the Maltese Islands that may furnish the required details for local conservation measures to be implemented. Common dolphin distribution, abundance, habitat preference, behaviour, and associations with fisheries that are exploited in the same area are among the parameters studied. Marine habitat degradation and resource over-exploitation are considerations that need to be addressed since both may affect cetacean survival in the region. Part of the study area, closer to the Maltese Islands is shown in Fig.1, and includes most of the fishing area utilised by Maltese fishermen.

Over-exploitation of cetacean food resources, and disturbance or by-catch during fishing are important factors affecting cetacean survival (Hall *et al.*, 2000), and thus the common dolphin in this region also needs to be investigated further to understand in greater detail the impacts of increasing regional fishing activities on the species' survival. Outside the 25 mile zone or "conservation zone" around the Maltese Islands, Maltese fishermen share the area with numerous other fishermen from other Mediterranean and Non-Mediterranean countries, particularly during the blue fin tuna (*Thunnus thynnus*) fishing and blue fin tuna penning season as well as during the dolphin fish (*Coryphaena hippurus)*/pilot fish **(***Naucrates duclor*) fishing season (Vella, 2001). These activities are of particular importance to species such as the common dolphin that may be increasingly affected by the burgeoning fishing effort in this Mediterranean region. Local fisheries' statistics show declines in catch amounts for most exploited fish species in recent years. Knowledge of the impacts of these trends on common dolphins is necessary for both sustainable resource utilisation and effective preservation of legally protected species such as common dolphins. A first attempt to draw a picture of the status of this species in the Mediterranean Sea has been undertaken and points towards further research needs (Bearzi *et al*., 2003). Ongoing long-term research efforts in Mediterranean areas would be required to continue to highlight and guide actions for conservation and monitoring targeting this species in the Mediterranean in the near future.

METHODS

This paper presents work from field research undertaken around the Maltese Islands year round between 1997 and 2003, including both boat (N=302) and plane (N=41) surveys. Results and observations were obtained after a total strip transect of 28,000 km^2 was covered using boat and

aerial surveys, using methods described in Vella (1998). During these field observations, the following parameters were recorded: overall numbers, group sizes, behaviour (feeding, mating, young rearing, diving-time sequence, etc.), and association with fishing activities and fish stocks in the area. Photo-identification studies are also in progress for common dolphins in the research area. Land-based surveying is another aspect of this research work, and although it is not the best method to study common dolphins, some groups have been observed from land with powerful binoculars. This method proved useful in monitoring the behaviour of the solitary young common dolphin in B'Bugia Port/Bay in October 2001.

Maltese fishermen's activities and problems out at sea have been considered as well (Vella, 1998), and another questionnaire was undertaken in 1999. Research on the associations of this cetacean species with fish species of economic value or exploited by local fishermen is another priority so as to look into the extent of influence on the common dolphins' behaviour and survival.

A record of common dolphin strandings and possible causes of death are noted, with a particular follow-up on what is seen out at sea during field trips, as well as considerations of the problems these species may be facing in their environment. These methods allow for the assessment of seasonal variation in both cetacean abundance and the possible associations between different cetacean species and the different fisheries exploited.

RESULTS

The overall group sizes for *D. delphis* in this region seem to vary according to the time of year, with summer and autumn being the seasons with greatest group sizes (Table 1). The benefit of aerial surveys was indeed felt much more during this time of year when groups were found to extend over a much greater area with sub-groupings also noted. Due to this, even density measures may have benefited from the use of aerial surveys (Table 2).

The very interesting associations of this species with various fisheries, especially in this southern and central part of the Mediterranean, should not be underestimated, particularly considering the economic importance of two of the fisheries (blue fin tuna and dolphin fish). Ongoing work on this aspect may assist in increasing our knowledge on these relationships and their direct impacts on common dolphin survival. Tables 6 and 7 summarise preliminary findings in this field.

Coverage of the relatively large research area forming part of this study is also possible due to the aerial survey work. It would be useful to sustain this effort, concurrent with the ongoing boat surveys. The overall distribution of sightings around the Maltese Islands is shown in Figure 1, which also indicates the preference for deep and offshore waters, except during the summer and autumn months when these dolphins may also be found closer to shore.

As part of the cetacean conservation research project, this paper also provides a list of suggested requirements and recommendations (see discussion) for the conservation of *Delphinus delphis* in this part of the Mediterranean.

Largest group sizes (150-250) were observed in the months of September and October (75% of sightings during this period were of large groups), indicating seasonality and migrations in a south-easterly or easterly direction in the region at this time. Very often the only way of obtaining a reasonable group size estimate in these cases was through aerial surveys, due to the spread of numerous groups of 25 to 50 individuals travelling together.

Table 1: Group size of common dolphins *Delphinus delphis*

From field sessions with common dolphin observations:

Average Group Size**: 25 (N=95)** St. Dev.: **30** Group Size Range: **1 to 250**
Average sighting frequency per hour in research area: **0.015/hr**

Table 2: Density of common dolphins in Central-Southern Mediterranean

Combined distance strip transect estimates of the parameters used to obtain an overall estimate of the number of Common dolphins in the research area around the Maltese Islands.

Parameter	**Estimate**	**%CV**	**95% Conf. Interval**
Group density/km^2	0.006	11.5	0.003 - 0.016
Dolphin density/km^2	0.140	29.5	0.068 - 0.295

Table 3: Associations of common dolphins with fisheries of economic importance in this region

The following interactions are noted to be seasonal in the research area:

Blue fin tuna are in the research area between May and July: 35% of common dolphin sightings during this period were in association with this species.

Dolphin fish are in the research area between August and January: 40% of common dolphins sightings during this period were in association with this species.

Table 4: Cases of solitary common dolphins close to the Maltese coasts.

In 2001, two cases of solitary common dolphins were recorded for the first time in this region, since prior to this, the smallest group size recorded was of two individuals. Both lone individuals were observed close to the Maltese coasts.

First case on 27th June 2001 the individual was an adult. It was observed in the same area for two days.

Second case observed from the 11th to 23rd October 2001: the dolphin was young observed in the polluted B'Bugia Port/Bay area. The individual remained in the area until it was found dead and in an advanced stage of decomposition. No evidence of infections or parasitic infestation was detected in the examinations undertaken by Dr. A. Casha (vet) who was asked to undertake a post-mortem autopsy by the Environment Protection Department in Malta. The autopsy showed that the animal had no food in its stomach and intestines, and that water may have penetrated part of her lungs. Vital organs were found to be in functional order. The animal's teeth were very small, nearly transparent and hollow, aging this young female dolphin at less than one year.

Table 5: Stranding records of common dolphins between 1997 and 2001 in the Maltese Islands

1. October 1997	Young dolphin with tail wound (nearly cut off)
2. June 1999	Adult decomposed - DNA identification
3. June 1999	Adult with wound in head
4. October 2001	Young lone dolphin found dead after observed alive for days in the harbour

Table 6: Major Exploited Fisheries	Summer	Autumn	Winter	Spring	*Common dolphins' association*
Blue fin tuna long-line fishing activities off shore	*			*	*yes*
Foreign purse-seine tuna fishing off shore	***			**	*yes*
Dolphin fish fishing activities off shore	**	***	*		*yes*
Coastal fishing with trammel nets					*no*
Trawlers and dredge nets from close to off shore	*	*		*	*yes (offshore)*
Foreign illegal drift nets for swordfish offshore	**	**			*yes*
**** Low degree of association = 1 to 5% associated sightings/reports***					
***** Moderate association = 6 to 30% associated sightings/reports***					
****** Strong association = 35 to 50% of associated sightings/reports***					

Table 7: Maltese seasonal fishing activities (excluding foreign pursening)	**Summer**	**Autumn**	**Winter**	**Spring**
Long-line for blue fin tuna - *offshore*	***			***
Long-line for swordfish - *offshore*	***	**	*	**
Deep Longline for deep dwelling fish and squid - *offshore*	**	*	**	**
Trammel nets for *coastal* cuttlefish, red mullet, squid, bogue, octupus	***	**	***	***
Net - dolphin fish, pilot fish and mackerel - *offshore*	*	***	***	
Trolling - dolphin fish, frigate mackerel - *coastal and offshore*	**	***		
Trawling - squid, shrimps, prawns, red mullet, bogue - *close to off shore*	**	***	**	***
**** Low catch; ** Medium catch; *** Maximum catch***				

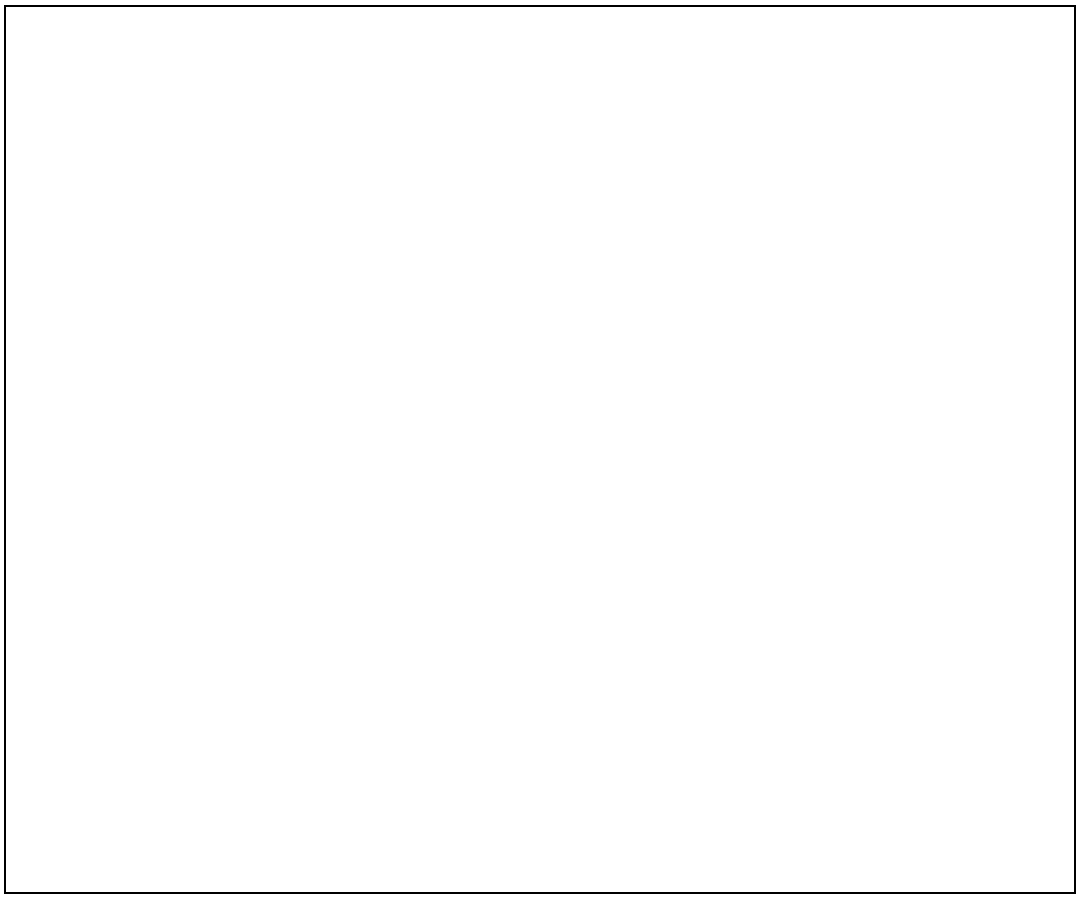

Figure 1. Map of the sighting distribution of common dolphins *(this map is a subset of the entire research area. The area, between the two blue contours, indicates the region with the greater frequency of common dolphin sightings).*

DISCUSSION

Through this research project, the estimate of abundance of common dolphins in this region of the Mediterranean was found to compare well with the higher densities and abundance estimates in certain southern parts of the Mediterranean (Tables 1 & 2). Indeed, several authors have indicated that this species appears to increase in abundance as one goes southward of the 38°00' N latitude (Politi *et al*., 1992, 1994; Notarbartolo di Sciara, 1993; Frantzis, 1996; Pulcini & Pace, 1998; Sagarminaga & Cañadas, 1998). However, since few studies have been undertaken year-round in the Mediterranean, it is also important to consider possible differences in abundance and distributions due to seasonal changes. Especially when planning protected areas or management programmes for long-term conservation of common dolphins, it is vital to establish the locations and sizes of home ranges, the extent of seasonality in home range use, and the extent of fidelity to any migration paths taken by the species between areas used. The common dolphins in this region appear to show large home ranges, with a marked increase in group sizes and abundance close to the Maltese Islands during the September and October period. During this period, common dolphins are also observed to travel closer to land than is typical of the species at other times of the year in this region. Thus the Maltese Islands may either be positioned in the middle of the travel path of common dolphins during these months, or due to its position on a continental shelf, they

may be situated at an important location for the species during the summer/autumn period of the year. The association between *D. delphis* and local fisheries of economic importance (such as blue fin tuna and dolphin fish) indicate clear seasonal movements in relation to prey availability.

The greater exploitative competition for natural resources in the Central/Southern Region of the Mediterranean may be seriously jeopardising the survival of this species (Table 3) as is suggested by the number of strandings and possible increasing incidence of solitary dolphins in this region (Tables 4 & 5), especially during peaks in fishing effort offshore between May and December. The strandings of common dolphins in June and October, together with the incidence of lone individuals in June and October may be pointing further to serious conflicts and distress between fishing activities and this species during these periods. The fact that fishing activity for blue fin tuna and dolphin fish peaks in these two months may need to be considered in the near future for the survival of the species in this region of the Mediterranean. It is hoped that ACCOBAMS (ACCOBAMS, 2000) may assist and promote long-term monitoring and management programmes in the various regions, where work is already ongoing, so as to reinforce environmentally sustainable fishing practices and promote areas for common dolphin survival in the Mediterranean. Since the Maltese Islands are situated in an area of the Mediterranean where common dolphins are relatively abundant, it is essential that plans to effectively protect the species in this area be given urgent consideration, possibly through the setting-up of a marine conservation area.

Requirements and recommendations for conservation of common dolphins

The following are the Maltese Islands Cetacean Research Project's recommendations for actions to be taken for the conservation of the local short-beaked common dolphin population, especially in this region of the Mediterranean.

Common dolphin (*Delphinus delphis*) research is far from saturated, as our knowledge of this species in the various Mediterranean regions still needs to be tackled in detail if we really wish to be able to plan any comprehensive and long-term conservation strategy (Vella 1998; 2000a; 2001; Bearzi *et al* 2003).

Differences in behaviour, habitat and prey species preferences in different Mediterranean regions need to be understood and appreciated prior to the consideration in any realistic long-term conservation plan.

Comparison of the various research techniques adopted to date to study this species need to be addressed, considering both their weaknesses and advantages. One clear weakness of small boat surveys includes possible inaccuracies with regard to the number and population structure due to the tendency of common dolphins to travel in large groups and spread themselves over a wide area, as has been observed in aerial surveys. Planning management strategies on inaccuracies or incomplete information has its risks. A precautionary approach needs to be adopted in immediate conservation plans while working towards more accurate data collection. Photo-ID work (which is also undertaken locally) also assists in understanding the population in detail but this takes time and effort, especially with offshore groups.

We need to increase our understanding of the association between common dolphins and their prey species. The impacts of these associations arise from human exploitation of the dolphin prey species/fisheries in each region of the Mediterranean and Black Sea. This has different direct and indirect effects on the common dolphins in different areas. Locally, both the bluefin tuna and the dolphin fish fishing seasons play important roles in the lives of common dolphins. The increasing sophistication of fishing gear must also be considered in the light of possible advantages or disadvantages to the natural ecology of cetacean species. The impacts of increased large-scale purse-seining in the Southern-Central Mediterranean region need to be addressed through sustained research and monitoring (Vella, 2001).

Associations of common dolphins with other cetaceans in areas where these associations exist also need consideration, since cetacean monitoring should whenever possible be considered holistically, due to the resources required in time, human effort, equipment, and funds to sustain such vital assessments. Occasional associations, including possible competition, with offshore bottlenose, striped and Risso's dolphins, and sperm whales may need further study.

Environmental factors affecting common dolphin movements and distribution need to be addressed and compared among different Mediterranean regions. Human activities affecting dolphins include chemical, plastic and sound pollution and increasing boat traffic, whilst natural factors include climate change and introduced species (also influenced by man), which may be altering Mediterranean food chains.

The Maltese Islands are situated in a region of the Mediterranean Sea where common dolphins are relatively abundant, and the islands are situated at the centre of the Mediterranean making research in this crucial area possible. It is therefore essential that ongoing research and monitoring receive ACCOBAMS' support with the aim of effectively promoting protection of the species in this area. The project, which has been undertaken since 1997; has encompassed a very large area extending beyond Maltese territorial waters; it has sampled information throughout the year; and utilised both sea and aerial surveys. It should be taken advantage of by ACCOBAMS as a project to assist in efforts towards practical common dolphin conservation (Vella, 2000b).

This workshop, dedicated to *Common Dolphins: Research and its Conservation* at the European Cetacean Society's Conference in Sweden (April 2004), represents an important step towards gathering feedback from all those persons in a position to do so. The workshop has indicated how different and unique are common dolphin groups/populations in each region. Molecular genetics of the various groups may assist in the verification of the extent of differences between dolphin groups found in each region. Such workshop/conference activity should be considered on a regular basis for species considered to be vulnerable, such as the common dolphin. ACCOBAMS may enjoy the benefits of such sustained cumulative scientific assessment of conservation research and activities.

ACCOBAMS needs to insist that the countries that are signatories to this agreement take responsibility for supporting scientific research to assist towards effective monitoring, and updating policy and management on a national, regional, and Mediterranean-wide level. One effective way would be to insist in having a research and a policy representative/entity from each country, and to have both actively involved in ACCOBAMS meetings, assessments, and actions. Research and conservation recommendations, without policy and implementation to back them up, are as weak as policy and action plans without research and up to date knowledge.

The previous point may not be reached unless local field researchers in each country are kept fully informed by ACCOBAMS of ongoing objectives, and are also encouraged to continue their research and their vital contribution to increasing knowledge on how common dolphins are doing, and what activities or factors present in the environment may negatively affect their distribution, numbers, and survival. The upcoming website on common dolphins will surely assist towards increasing awareness on the research efforts undertaken, and knowledge in various parts of the Mediterranean and Black Sea.

One needs to encourage the study of mother-infant separation problems in this vulnerable Mediterranean species. Also important is the need to understand the pathology and parasitology associated with this species, and the best or most effective way to intervene in situations when live common dolphins find themselves at risk of dying unless assisted in care for a short period before release again. This is particularly relevant to the local situation since lone common dolphins have been observed. One case was indeed an infant separation which remained unattended until the animal died in October 2001 (Vella, 2002). Thus a network of effective Mediterranean specialised cetacean veterinary assistance, working in collaboration with local cetacean researchers (who may

assist with up to date information of the species' group/population in the area) and local authorities (for coordinated action to be encouraged), needs to be considered locally in case of live stranding emergencies. At present, the national action plan for stranded cetaceans only focuses upon dead stranded dolphins.

Last but not least, one should consider a network of Marine Protected Areas in the Mediterranean, large enough to allow common dolphins to survive in the future. The planning and management of such MPAs would need detailed consideration of updated and local/regional information. Potential sites for marine conservation areas assisting common dolphin population conservation are being formally recommended to ACCOBAMS as a result of this ongoing Central and Southern Mediterranean Research project, which highlight alternative areas also around the Maltese Islands.

ACKNOWLEDGEMENTS
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Thanks go to M. Dalebout and G. Lento of the University of Auckland for identifying the decomposed specimen found on the 15th of June 1999 as common dolphin.

REFERENCES

Bearzi, G., Reeves, R.R, Notarbartolo di Sciara, G., Politi E., Canadas, A., Frantzis, A., and Mussi B. 2003. Ecology, status and conservation of short-beaked common dolphins *Delphinus delphis* in the Mediterranean Sea. *Mammal Review*, 33 (3), 224-252.

Frantzis, A. 1996. Cetaceans and cetology in the Hellenic seas. Pp 114-118. In: *European Research on Cetaceans* – 10 (Ed. P.G.H. Evans) Proceedings of the 10th Annual Conference, ECS. Kiel Germany. 334pp.

Hall, M.A., Alverson, D. L., and Metuzals, K.I. 2000. By-catch: problems and solutions in *Seas at the Millennium: An Environmental Evaluation* (Ed. C. Sheppard), chapter 116. Elsevier Science.

Notarbartolo di Sciara, G., Venturino, M.C., Zanardelli, M., Bearzi G., Borsani, F., and Cavalloni, B.1993. Cetaceans in the central Mediterranean Sea: Distribution and sighting frequencies. *Boll. Zool. 60: 131-138*.

Politi, E., Bearzi, M., Notarbartolo di Sciara, G., Cussino, E., and Gnone, G. 1992. Distribution and frequency of cetaceans in the water adjacent to the Greek Ionian Islands. Pp 75-78. In: *European Research on Cetaceans – 6* (Ed. P.G.H. Evans) Proceedings pf the 6th Annual Conference, ECS, San Remo, Italy, 20-22 Feb 1992. ECS, Cambridge, UK 254pp.

Politi, E., Airoldi, S., and Notarbartolo di Sciara, G. 1994. A preliminary study of the ecology of cetaceans in the water adjacent to the Greek Ionian Islands. Pp 111-115. In: *European Research on Cetaceans – 8* (Ed. P.G.H. Evans) Proceedings of the 8th Annual Conference, ECS, Lugano, Switzerland 288pp.

Pulcini, M., and Pace, D.S. 1998. Behaviour and ecology of *Delphinus delphis* around the Ionian Island of Greece. In: *European Research on Cetaceans 12*: (Eds. P.G.H. Evans & E.C.M. Parsons) Proceedings of the 12th Annual Conference, ECS, Monaco, Jan. 1998, ECS, Valencia, Spain, 436pp.

Sagarminaga, R., and Canadas, A. 1998. A comparative study on the distribution and behaviour of the common dolphin (*Delphinus delphis*) and the striped dolphin (*Stenella coeruleoalba*) along the South-Eastern Coast of Spain. In: *European Research on Cetaceans 12*: (Eds. P.G.H. Evans & E.C.M. Parson) Proceedings of the 12th annual conference of the ECS, Monaco, Jan. 1998, ECS, Valencia, Spain, 436pp.

Vella, A. 1998. Cetacean Surveys around the Maltese Islands and Maltese Sea-User Cetacean questionnaire study. In: *European Research on Cetaceans 12*: (Eds. P.G.H. Evans & E.C.M. Parson) Proceedings of the 12th annual conference of the ECS, Monaco, Jan. 1998.

Vella, A. 2000a. Cetacean research and conservation around the Maltese Islands. In: *Monitoring and Conservation of Birds, Mammals and Sea Turtles of the Mediterranean and Black Seas*, (Eds. Yesou & Sultana), Proceedings of the 5th Medmaravis Symposium, Gozo, Malta October 1998. EPD-Malta, 317pp.

Vella, A. 2000b. Cetacean Conservation Research and Action around the Maltese Islands (Central and Southern Mediterranean Sea) In *ACCOBAMS Bulletin* Issue No. 3 pp.24-26 & 28: (Ed. K. Topfer) 2000. Cetacean conservation research around the Maltese Islands (Central and Southern Mediterranean Region).

Vella, A. 2001. Fisheries Exploitation and Cetacean Survival in the Central Mediterranean Region, in *Abstracts Manual of the 14th Biennial Conference on the Biology of Marine Mammals* 2001 - Conference on Marine Mammals organised by the International Society for Marine Mammal Science, in Vancouver, B.C. Canada.

Vella, A. (*in press*) *Delphinus delphis* (common dolphins) status in the Central and Southern Mediterranean around the Maltese Islands. *European Research on Cetaceans, 16:* (Ed. P.G.H. Evans) Proceedings of the 16th annual conference of the ECS, Monaco, April 2002, ECS, Liège, Belgium.

ECOLOGY AND STATUS OF THE COMMON DOLPHIN *DELPHINUS DELPHIS* IN THE ENGLISH CHANNEL AND BAY OF BISCAY 1995-2002

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INTRODUCTION

The common dolphin *Delphinus delphis* is one of the most widely distributed cetacean species in the world, occurring in both pelagic and coastal warm (10-28° C), tropical, sub-tropical and temperate waters and in the northern and southern hemispheres. No overall population estimates are available for Europe, although regional estimates include 75,000 for the Celtic Sea (Hammond, *et al*., 1995), 61,000 for eastern Atlantic continental shelf waters between Ireland and Spain (excluding the Bay of Biscay) (Goujon *et al*., 1994), and 14,700 for the Alboran Sea (Forcada & Hammond, 1998). This paper focuses on the ecology and status of the common dolphin *Delphinus delphis* in two important seas in a European context for the species - the English Channel and Bay of Biscay. The European common dolphins have been recently identified as a separate species, and more specifically as the short-beaked common dolphin *D. delphis*, (Heyning & Perrin, 1994; Rosel *et al*., 1994). However, the taxonomy of common dolphins is complex and forms an active area of research. This paper uses the previous nomenclature of *D. delphis* for common dolphin agg. throughout.

D. delphis is protected at a European level under a number of policy mechanisms. It is listed on Appendix II of CITES (allowing controlled trade), and Appendix II of the Bern Convention and Annex IV of the EC Habitats Directive which bans the keeping, sale or exchange, as well as deliberate capture, killing or disturbance. It is also on Appendix 2 of the Bonn Convention and is covered by the terms of the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS), a regional agreement under the Bonn Convention. In terms of global legislation, there is protection under the United Nations Convention on the Law of the Sea, which calls on signatories to co-operate over the conservation of cetaceans, including work through appropriate international organisations for conservation management and research. It enables coastal states or international organisations to go beyond the provisions of the Convention in prohibiting, limiting or regulating the exploitation of marine mammals. *D. delphis* is listed as lower risk 'conservation dependent' in the 1996 IUCN Red List of Threatened Animals (Baillie & Groombridge, 1996), because of the need for conservation measures to minimize by-catch in eastern tropical Pacific tuna and other fisheries.

In spite of having a) a wide distribution and b) extensive legislative protection, the current status and population trend of *D. delphis* in European waters is of conservation concern. Direct and indirect threats include fisheries interactions and pollution. The accidental capture (by-catch) in fishing nets is widely considered to be one of the main threats to common dolphin and other cetacean populations in Europe (Kirkwood *et al*., 1997, Bennett *et* al., 2002, Tregenza & Collet, 1998). A feature of the past decade has been the annual stranding of hundreds of dead *D. delphis* along French and adjacent UK coasts during the winter months. For example, between January and March 2003, 265 dolphin strandings were recorded on England's south-west coast with the majority attributed to by-catch (Data source: The National Cetacean Strandings Programme at the Natural History Museum, London). These large scale mortality events have turned cetacean by-catch into a major public and political issue.

In western European waters, information on the distribution and abundance of *D. delphis* has largely been collected through opportunistic sightings schemes, strandings or from localised, periodic line transect surveys carried out during the summer months. The SCANS survey

(Hammond *et al*., 1995) did not record any *D. delphis* in the English Channel, whilst surveys have not yet been undertaken to estimate overall population estimates in the Bay of Biscay. Few ship-based systematic studies have been carried out during the winter months or over successive years in these waters, and as a consequence seasonal patterns of distribution and temporal trends in abundance are unclear.

Since 1995, the Biscay Dolphin Research Programme has been carrying out cetacean surveys each month and each year along a fixed route through the English Channel and Bay of Biscay using standardised line transect methods. With ten years of monthly year-round effort-related recording, a unique time series database of *D. delphis* sightings has been generated for both pelagic and neritic waters.

This paper summarises some of the results from the first eight years of survey effort, describing the distribution, population structure and relative abundance of the common dolphin *D. delphis* in areas sampled by the ferry route. These data have considerable potential to contribute to current understanding of the ecology and status of *D. delphis* in European waters and to help evaluate the effectiveness of current legislative and policy mechanisms aimed at conserving this cetacean species and other marine biodiversity.

METHODS

Survey area

Data on the distribution and abundance of *D. delphis* in the English Channel and Bay of Biscay were obtained through surveys on the P&O ferry, the MV *Pride of Bilbao*, which sails between Portsmouth, England and Bilbao, Spain (between latitudes 43º to 51º N and 0 to 8º W). Surveys were carried out by Biscay Dolphin Research Programme (BDRP) volunteers, under the sponsorship of P&O Ferries (formerly P&O Portsmouth at the time of these surveys).

A wide range of oceanographic features were sampled along the c. 1,000 km ferry route including continental shelf waters (50-200 m deep), submarine canyons, sea mounts, the Celtic-Biscay shelf slope (water depth 200-3,000 m deep) and the abyssal plain of the Bay of Biscay (>3,500 m deep). The Celtic-Biscay shelf slope extends through the waters south of Ireland, southwest of England and west of France, within the 200 nautical mile zones of these countries and is an ecosystem of high primary productivity. For the analysis, the survey area was divided into seven areas, based on geographic location, broad habitat type and bathymetry (Table 1, Figure 1b). Note that the demarcation between some of the regions (especially the north end of the Cap Breton Canyon slope and the abyssal plain) is somewhat arbitrary, as fine-scale sea bed mapping data are unavailable.

Survey methods

On each survey, effort-related cetacean recording was carried out by a team of three experienced observers, using standard survey methods developed for ships of opportunity ('ShOps') by the Cetacean Group of the Mammal Society (subsequently forming the Sea Watch Foundation - Evans, 1995) and the Biscay Dolphin Research Programme (Brereton & Williams, 2001). Recording was made from a fixed position on the bridge of the ship, at a height of 32 m and speed of 15-22 knots, by a team of three observers used in rotation, each scanning an arc of 135 degrees ahead of the ship. Data collected for each *D. delphis* sighting included age and number of individuals, position (using the ships differential GPS), angle of sighting (using the ship's compass binnacle), distance to the sighting (estimated using a graduated hand held calibration device), behaviour and weather/sea conditions (including sea state). Effort-related data collected at 15-30 minute intervals (or whenever the course of the ship changed) included direction of travel, speed and position of the ship, and sea and weather conditions.

Survey effort

Each survey comprised a four-day return crossing made at the end of each month of the year. The return crossings enabled the whole of the route to be sampled at least once during daylight hours in the summer, and approximately 75% of the route in the winter. The main gaps in survey coverage

were (1) January (boat in refit for much of the time) and (2) the northern Celtic-Biscay shelf-slope and the abyssal plain during the winter months (November to February), when the ship generally crossed these areas in darkness. Between August 1995 and December 2002, more than 100 monthly survey trips were completed (including some extra trips in July and October), with data from 87 surveys included in this analysis. More than 70,000 km of survey effort were completed in a wide range of sea states (range 0-11, mean 3.5). Sightings rates are known to be affected by the detectability of animals in relation to the ship and weather conditions (particularly sea state) (e.g. see Buckland *et al*., 1993, Evans & Hammond, 2004); however, no attempt has been made here to correct the data in this analysis.

The full extent of monthly survey effort by sampled region is given in Figure 1a. The ferry followed a scheduled route, but the course altered periodically (due to weather and other factors). In total, effort-related *D. delphis* sightings data were obtained from 85 International Council for the Exploration of the Sea (ICES) grid-cell rectangles, measuring 15' latitude by 30' longitude, between 3-6°W and 43.5-49°N (Figure 1b).

RESULTS

Overall population status

D. delphis was identified as the most frequent (recorded on 97% of trips) and abundant cetacean species on the ferry transect surveys over the eight calendar year survey period. In total, more than 700 confirmed sightings (40% of total number of sightings) were made of approximately 23,000 'individuals' (40% of total number). Additionally, a further c. 150 sightings of 2,100 animals were considered to be of either *D. delphis* or the closely related striped dolphin, *Stenella coeruleoalba*. *D. delphis* was widely distributed occurring in 75% of ICES grid cells sampled, between latitudes 43°29' to 49°50' N and 2°58' to 5°58' W. The main gap in distribution was in the central English Channel (east of 2°45'W) between Portsmouth and the Cotentin (Cherbourg) Peninsula of Northern France (north-east of the Channel Islands). Group sizes of up to c. 2,000 individuals were recorded on occasions, although approximately two-thirds of groups comprised less than ten individuals (mean group size: 32; SD: 113). There were 33 records (ca. 5% of total) of singletons.

Regional status

Although *D. delphis* was widely distributed, there were clear regional differences. Analysis of effort-related survey data indicated that the two core areas for this species along the ferry (transect) route were the North Biscay shelf (where the largest number of individuals was recorded) and the north Biscay shelf slope (highest density). Collectively these two areas accounted for more than 80% of individuals counted (Table 2). Along the north Biscay shelf slope an average relative density of more than 100 dolphins per 100 km of survey effort was estimated for *D. delphis*, compared with less than 20 dolphins per 100 km effort in all other areas. A substantial number of *D. delphis* sightings were made in the western English Channel (ranked second in terms of sightings rate), although this area was lowest ranking in terms of number of individuals counted when the data were corrected for effort (Table 2). Although relatively few individuals were counted (lowest rank) in south Biscay shelf (coastal) waters off northern Spain, this was considered largely due to a lower survey effort. Effort corrected relative density estimates suggested that these shelf waters (ranked third) may support relative high densities of *D. delphis*.

Seasonal distribution and abundance

D. delphis was recorded in all months, although the available data indicated there were marked seasonal patterns in status across the ferry route as a whole, with two distinct peaks apparent, in July (mid-summer) and December (early winter) (Figure 2). Grouping the data into quarterly seasons gave similar bimodal peaks in abundance: with the highest densities recorded in the winter (December to February, relative density 61.4 animals per 100 km effort), followed by the summer (July to September, relative density 45.2/100 km), and the lowest densities in the spring (March to May, relative density 8.7/100 km).

D. delphis was recorded year-round (most months and in each quarterly 'season') in each region, although there were striking seasonal changes in abundance within and between regions. Two important patterns were apparent: (1) an inshore movement towards coastal shelf waters during the winter months (including into the western English Channel), peaking in December (Figure 3a); and (2) a substantial aggregation at the northern Biscay shelf slope in the summer, chiefly in July, with far fewer in all other areas (Figure 3b). For deep offshore Biscay waters (abyssal plain and Cap Breton Canyon slope), effort corrected sightings data suggested that abundance was more uniform in these areas over the season, although more winter survey data are needed to fully confirm this. The high relative density estimates encountered along the northern Biscay shelf slope in July, comprised infrequent sightings of very large groups (statistically significantly higher mean group sizes than the rest of the year, Figure 4), and a high proportion and abundance of recently born calves (Figure 5).

DISCUSSION

D. delphis was identified as the most abundant cetacean species in the surveyed areas of the English Channel and Bay of Biscay, with year-round presence detected throughout in both waters. These data suggest a large continuous *D. delphis* population (in latitudinal terms), which is likely to be of considerable conservation importance in European terms.

Although sightings were recorded in all months at the study areas, there were striking seasonal patterns in distribution and abundance. No detailed analysis has yet been carried out (in part due to the low annual sample sizes), but the two main seasonal patterns of distribution were identified in a consistent manner through the years: (1) inshore winter movement, and (2) aggregation into the northern Biscay shelf slope in summer. These two seasonal movements have considerable conservation implications. In the western English Channel, the substantial winter immigration (more than 10-fold increase over the spring and summer months) coincided with the winter pelagic trawl fishing season for sea bass *Dicentrarchus labra.* This result is of conservation concern as the fishery is strongly suspected as a key source of *D. delphis* by-catch in the region over the last decade (ASCOBANS, 2000; Defra, 2003; Ross & Isaac, 2004).

Secondly, **t**he high densities and very large group sizes of *D. delphis* at the northern Biscay shelf slope recorded in July, also associated with calving/post-calving in the early summer period, indicate that *D. delphis* is particularly vulnerable at this time of year, and protection measures should be considered to conserve core areas of seasonal distribution.

Despite being the most widespread and abundant cetacean, *D. delphis* is at potential risk in the Bay of Biscay and English Channel from fisheries, pollution and other anthropogenic activities, which in turn are likely to impact on the marine ecosystem as a whole. Currently, much work is being put into the development of biodiversity indicators at regional, national and international scales following the Convention of Biological Diversity in 1992 (Anon, 1999; Hilty and Merenlender, 2000; Gregory *et al*., 2002; UNEP/CBD/SBSTTA/9/INF/26, 2003; European Environment Agency, 2004a; 2004b). The annual population status of *D. delphis* should be considered as a candidate marine biodiversity indicator (Brereton *et al., in press*, a). *D. delphis* is a sensitive species (to environmental changes) and relatively easy to monitor. Furthermore, a substantial year-round, time series database of abundance data is currently being developed through the Biscay Dolphin Research Programme and other systematic marine survey programmes using cost-effective Ships of Opportunity (Brereton *et al*., *in press*, b, c). The latter are improving spatial coverage in the region. Data from these scientific survey programmes should enable seasonal and annual abundance indices to be developed and abundance trends to be assessed for *D. delphis*. Data of this sort could play an important role in helping European governments to evaluate the effectiveness of marine biodiversity action measures and marine resource management policies in conserving *D. delphis* and other marine biodiversity.

REFERENCES

Anon. 1999. *Quality of Life Counts: Indicators for a Strategy for sustainable development for the UK*. DETR, London.

ASCOBANS 2000. *Proceedings of the Third Meeting of the Parties to ASCOBAN*S, Bristol, UK, July 2000. ASCOBANS, Bonn, Germany.Baillie, J., & Groombridge, B. 1996 *IUCN Red List of Threatened Animal*s. IUCN, Gland, Switzerland.

Bennett, P.M., Jepson, P., & Deaville, R. 2002. *Cetacean strandings investigation: England and Wales and Poseidon Database*. Report CR0177 conducted for the Department of the Environment, transport and the Regions. Institute of Zoology, The Zoological Society of London, UK.

Brereton, T., Williams, A.D., & Williams, R. 2001. A low-cost method to determine bathypelagic and seasonal occupancy of fin whale *Balaenoptera physalus* in the Bay of Biscay, In: *European Research on Cetaceans –14* (Ed. by P.G.H. Evans), pp. 14–18. European Cetacean Society, Rome, Italy.

Brereton, T., Williams, A.D., & Martin, C.M. In press (a). Preliminary studies in identifying cetacean indicator species to monitor the state of marine biodiversity in west European waters. In: *European Research on Cetaceans –17* (Ed. by P.G.H. Evans). European Cetacean Society, Gran Canaria.

Brereton, T, Wall, D., Cermeño, P., Curtis, D., Vasquez, A., & Williams, A. In press (b). Pan-European cetacean monitoring: the Atlantic Research Coalition (ARC). *European Research on cetaceans – 18.* Proceedings of the 18 th Annual Conference of the European Cetacean Society, Kölmarden, Sweden, 28-30 March 2004.

Brereton, T, Wall, D., Cermeño, P., Curtis, D., Vasquez, A., & Williams, A. In press (c). *Pan-european cetacean monitoring: the Atlantic Research Coalition* (ARC). ARC, Hampshire, UK.

Buckland, S. T., Anderson, D. R. Burnham K. P., & Laake, J. L. 1993. *Distance Sampling: Estimating abundance of biological populations*. Chapman and Hall. London. 446pp

DEFRA 2003. *UK small cetacean by-catch response strategy*. A consultation paper outlining the proposed strategy by the Department for Environment, Food and Rural Affairs, the Scottish Executive, the Welsh Assembly Government and the Department of Agriculture and Rural Development in Northern Ireland to reduce the incidental capture of small cetaceans in UK fisheries. DEFRA, London.

European Environment Agency 2004a. *The state of biological diversity in the European Union*. Proceeding from the Stakeholders' Conference Biodiversity and the EU – Sustaining Life, Sustaining Livelihoods Grand Hotel, Malahide, Ireland. 25-27 May 2004.

European Environment Agency 2004b *EU Headline Biodiversity Indicators.* Proceeding from the Stakeholders' Conference Biodiversity and the EU – Sustaining Life, Sustaining Livelihoods Grand Hotel, Malahide, Ireland. 25-27 May 2004

Evans, P.G.H. 1995. *Guide to the identification of whales, dolphins & porpoises in European seas*. Sea Watch, Oxford.

Evans P.G.H. & Hammond, P.S. 2004. Monitoring cetaceans in European waters. *Mammal Review*, 34 (1-2), 131-156.

Forcada, J. & Hammond, P.S. (1998) Geographical variation in abundance of striped and common dolphins of the western Mediterranean. *Journal of Sea Researc*h, 39, 313–325.

Goujon, M., Antoine, L., Collet, A., & Fifas, S. 1994. A study of the ecological impact of the French tuna driftnet fishery in the North-east: *European Research on Cetaceans* - 8. Proc. 8th Ann. Conf. ECS. Montpellier, France, 2-5 Mar, 1994. (Ed. P.G.H. Evans) European Cetacean Society, Lugano, Switzerland. 288pp.

Gregory R.D., Noble D., Field R., Marchant J.H., Raven M., & Gibbons D.W. 2003. Using birds as indicators of biodiversity. *Ornis Hungarica*, 12-13, 11-24.

Hammond, P.S., Benke, H., Berggren, P., Borchers, D.L., Buckland, S.T., Collet, A., Heide-Jørgensen, M.P., Heimlich-Boran, S., Hiby, A.R., Leopold, M.F, & Øien, N. 1995. *Distribution and abundance of the harbour porpoise and other small cetaceans in the North Sea and adjacent water*s. Final Report to the European Commission under contract LIFE 92-2/UK/27. 242pp.

Heyning, J. E., & W. F. Perrin 1994. Evidence for two species of common dolphins (genus *Delphinus*) from the eastern North Pacific. Natural History Museum of Los Angeles County Contributions. *Science*, 442, 1-35.

Hilty, J., & Merenlender, A. 2000. Faunal indicator taxa selection for monitoring ecosystem health. *Biological Conservation*, 92, 185-197.

Kirkwood, J.K., Bennett, P.M., Jepson, P.D., Kuiken, T., Simpson, V.R., & Baker, J.R. 1997. Entanglement in fishing gear and other causes of death in cetacean stranded on the coasts of England and Wales. *Veterinary Record.* 141, 94-98.

Rice, D.W. 1998. Marine Mammals of the World. Systematics and Distribution. Special Publication No.4. *The Society for Marine Mammalogy*.

Rosel, P. E., A. E. Dizon, & J. E. Heyning. 1994. Genetic analysis of sympatric morphotypes of common dolphins (genus *Delphinus*). *Marine Biology*, 119, 159-167.

Ross, A. & Isaac, S. 2004. *The net effect*. WDCS, Bath, UK..

Tregenza, N.J.C. & Collet , A. 1998. Common dolphin *Delphinus delphis* by-catch in pelagic trawl and other fisheries in the Northeast Atlantic. SC/49/NA9. *Rep. Int. Whal. Commn*, 48. 453-459.

UNEP/CBD/SBSTTA/9/INF/26 2003. Proposed biodiversity indicators relevant to the 2010 target

Table 1: The six regions sampled in the western English Channel and eastern Bay of Biscay by the Portsmouth-Bilbao ferry (transect) route

Area (and code)	Approximate Location	Habitat	Bathymetry (m)	Transect Length (km)*	Survey effort (km)
Western English Channel	1-6W, 48.30-51N	Continental shelf	50-100	370	25789
North Biscay shelf	3-6W, 46.31-48.29N	Continental shelf	100-200	250	17865
North Biscay shelf slope	4-6W, 45.5-47.15N	Shelf slope	200-4000	160	7631
Biscay Abyssal Plain	3.3-5W, 44.20-46N	Abyssal Plain	3500-4400	120	5956
Cap Breton Canyon slope	3-4W, 43.30-44.20N	Canyon & canyon slope	200-3500	105	12754
South Biscay shelf	3-3.3W, 43.2-43.3N	Continental shelf	100-200	20	1567

* one way only.

Table 2: Encounter rates and relative density estimates for the six regions in the English Channel and Bay of Biscay sampled by the Portsmouth to Bilbao ferry (transect) route. (n=709 sightings, n=22901 individuals counted, and n=72205 km travelled). * Note that densities were not corrected for detectability or sea state.

	% no. sightings (ascending rank importance)	% no. individuals counted (ascending rank importance)	Relative Density* - No./100km (ascending rank importance)
Western English Channel	18.2 (2)	8.2 (3)	7.3 (6)
North Biscay shelf	48.3 (1)	46.4 (1)	57.9 (2)
North Biscay shelf slope	15.9 (3)	35.1 (2)	102.5 (1)
Biscay Abyssal Plain	8.7 (4)	4.4 (5)	10.8 (5)
Cap Breton Canyon slope	8.3 (5)	4.6 (4)	11.4 (4)
South Biscay shelf	0.6 (6)	1.2 (6)	18.2 (3)

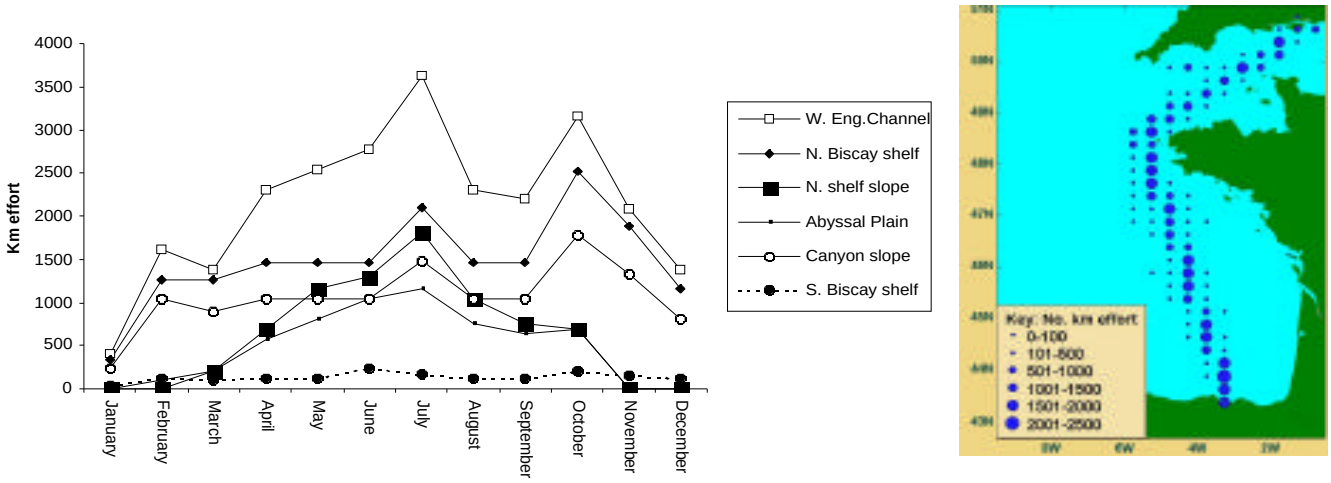

Figure 1: Survey effort in the western English Channel and eastern Bay of Biscay from the Portsmouth to Bilbao ferry (transect) route 1995-2002 (a) for the six regions and (b) by ICES quarter rectangle. N=87 trips, 72205 km effort

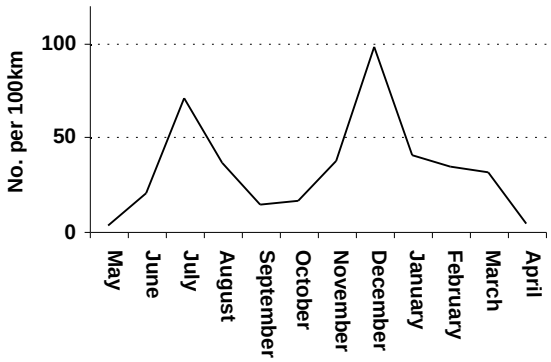

Figure 2: Relative density (no. per 100 km effort) of *D. delphis* in the western English Channel and eastern Bay of Biscay recorded from the Portsmouth to Bilbao ferry (transect) route 1995-2002.

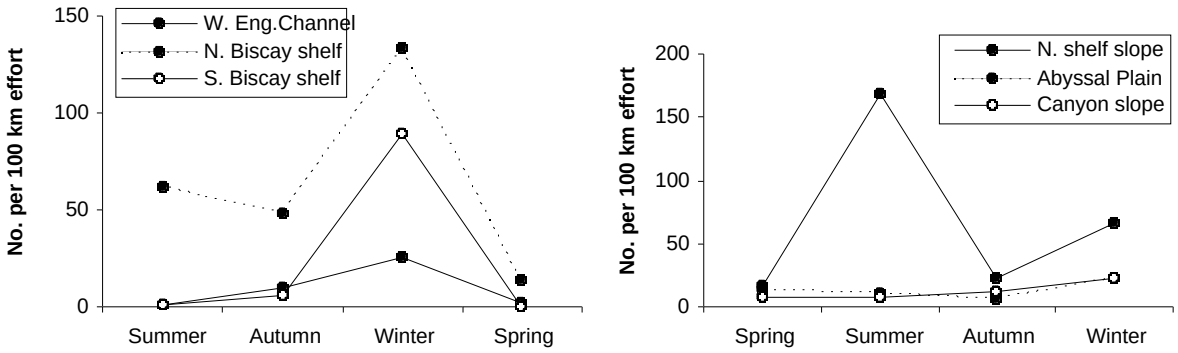

Figure 3: Seasonal relative density of *D. delphis* in (a-left chart) shallow (<200m deep) shelf waters and (b-right chart) deep (>1000m deep) offshore waters western English Channel and eastern Bay of Biscay recorded from the Portsmouth to Bilbao ferry (transect) route 1995-2002. Note variation in left hand start season on x-axis for clarity

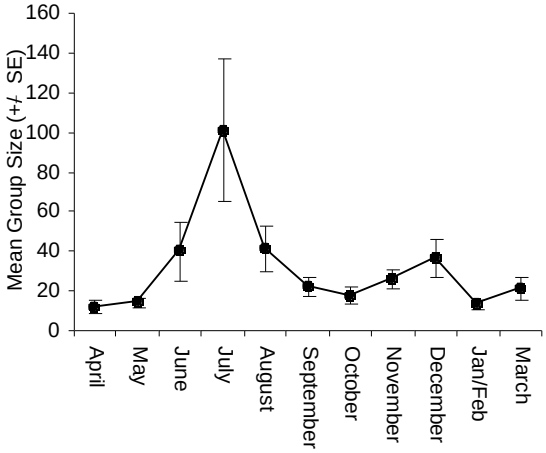

Figure 4: Mean monthly group size of *D. delphis* recorded in the western English Channel and eastern Bay of Biscay recorded from the Portsmouth to Bilbao ferry (transect) route 1995-2002

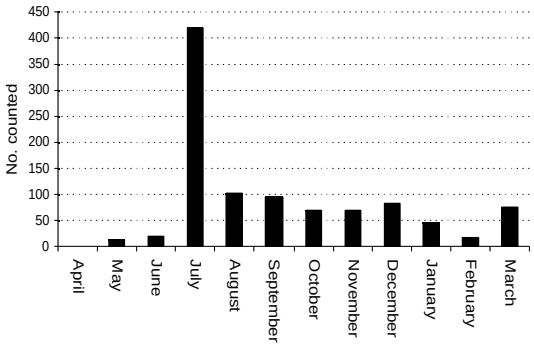

Figure 5: Monthly number of *D. delphis* calves counted in the western English Channel and eastern Bay of Biscay recorded from the Portsmouth to Bilbao ferry (transect) route 1995-2002.

OPERATIONAL INTERACTIONS BETWEEN COMMON DOLPHINS AND PELAGIC TRAWL FISHERIES IN THE NORTH-EAST ATLANTIC: FROM BEHAVIOURAL AND ENVIRONMENTAL PERSPECTIVES

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From 1989 onwards, the time series of stranded common dolphins shows conspicuous events of multiple strandings, during which three-quarters of the individuals have shown evident marks of by-catch. These events occur in winter, last approximately 2 to 3 weeks, and bring ashore 10-20 times more carcasses than expected at this period of the year. Typically, these events have a different sex and age composition than background strandings: males are more represented, as are immature individuals and young adults. It is hypothesised that the biased composition of this incidental mortality could be related to behavioural aspects and that the temporal structure of the multiple stranding events may rely on environmental processes. The social organisation of pelagic dolphins is poorly known because groups can scarcely be studied directly, due to their high mobility and extended home range.

A recent mass stranding of common dolphins in the North-east Atlantic, provided us with the opportunity to investigate the composition of a group of this species. It was made up of 51 individuals, 45 being females older than 7 years, accompanied by six calves of both sexes. It was particularly noticeable that no individual from 2-7 years old was present in the group. This is in agreement with the pelagic dolphin model which suggests that there is a separation of individuals on the basis of their reproductive status. Interestingly, the observed gap in the age distribution matches fairly well the age classes that are the most exposed to incidental capture in pelagic trawls, as suggested by the composition of the multiple stranding events. It is suggested that groups of immature individuals interact with pelagic trawlers for their own food, and thus put themselves at risk, more readily than mothers accompanied by calves would do.

On an environmental point of view, spatial and temporal heterogeneity of dolphin-forage fish and fishery target species could be the basis of the existence of these acute peaks of incidental mortality. A typology of pelagic habitats was proposed by oceanographers showing the mosaic nature of the Bay of Biscay. It is also known, that shoals of pelagic fish such as anchovy, sardine or sea-bass aggregate and disaggregate at small temporal and spatial scales. It is proposed that a particular, still to be identified, environmental factor could determine the establishment of dense fish patches close to the shore, which would attract both the fishing fleets and the top predators, and therefore would temporarily and locally enhance by-catch rates to such a level that the observed stranding rate is multiplied by 10-20 times. Much remains to be done to elucidate the behavioural and environmental factors that determine by-catch peaks of common dolphins in the pelagic fishery.

GEOGRAPHICAL VARIATION IN ASPECTS OF MORPHOLOGY IN THE COMMON DOLPHIN *DELPHINUS DELPHIS*

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INTRODUCTION

In the North-east Atlantic, common dolphins range from subtropical waters off Africa, into the Mediterranean Sea and to 60º N latitude, west of Norway (Haug, 1981; Evans, 1994; Weir *et al.*, 2001). The warm currents of the North Atlantic Drift have enabled common dolphins to inhabit waters above 43º N latitude, which has been established as the northern limit for common dolphin distribution in the North-west Atlantic (Selzer & Payne, 1988). To date, two separate species and one subspecies have been reported within the common dolphin: the short-beaked form (*Delphinus Delphis)*, long-beaked form (*Delphinus capensis capensis*), and an extremely long-beaked version, the subspecies Indo-Pacific form (*Delphinus capensis tropicalis)*, endemic to the Indian Ocean (Heyning & Perrin, 1994; Rosel *et al*., 1994; Jefferson & Van Waerebeek, 2002; Kingston & Rosel, 2004). Previous studies of common dolphins using morphological analysis have shown that the rostrum length/greatest zygomatic width ratio (RL/GZW) for *D. delphis* falls within the range 1.21-1.47, *D. capensis* between 1.52-1.77, and subspecies *D. tropicalis* <2.06. Tooth counts for *D. delphis* range from 42/41 to 54/53, for *D. capensis* 47-57 to 47-60. To date, only *D. delphis* has been identified in the North-east Atlantic, although this has been based on only localised studies, with small sample sizes (Lilljeborg, 1866; Flower, 1880; van Bree & Gallagher, 1978; Amaha, 1994). The present study seeks to clarify which common dolphin species inhabits the North-east Atlantic, using morphometric analysis of skulls.

MATERIALS AND METHODS

Rostrum length and greatest zygomatic width measurements were obtained from 218 skulls, collected between 1901 and 2001. Skulls were collected between latitudes 60º 04' 35" N to 37º 02' 00" N in the North-east Atlantic by stranding and by-catch projects in England and Wales, Scotland, Ireland, The Netherlands, Spain and Portugal. For each dolphin, the rostrum length/zygomatic width ratio (Banks & Brownell, 1969; Evans, 1975; van Bree & Gallagher, 1978; Amaha, 1994; Evans, 1994; Heyning & Perrin, 1994; Jefferson & Van Waerebeek, 2002) was calculated. Upper tooth count was also determined from the higher tooth count between the right and left sides (Amaha, 1994).

RESULTS

In the present study, the range obtained for upper tooth count was 41-56 sockets, and for RL/GZW ratio was 1.12-1.57. However, most ratio values were less than 1.52. The plot of rostrum length against greatest zygomatic width for all the dataset showed no separation of geographical areas (Figure 1). The 95% C.I. for both RL/GZW ratio in all areas also overlapped (Figure 2). Using ANOVA no significant variation was found between areas for RL/GZW ratio in either male (ANOVA, p=0.268) or female (ANOVA, p=0.721) common dolphins. ANOVA also showed no significant differences between areas for upper tooth count in either males (p=0.712) or females (p=0.108).

DISCUSSION

The range obtained for rostrum length/greatest zygomatic width ratio was 1.31 to 1.57 (mean = 1.44, n= 110) in mature common dolphins, although most ratio values were less than 1.52 (95%) and fell within the range outlined by Heyning & Perrin (1994) for *D. delphis*. However, it appears that common dolphins in the North-east Atlantic overlap in body and skull size with both *D. delphis* and *D. capensis* off the Californian coast, and show signs of being an intermediate form. In the present study, mature North-east Atlantic common dolphins ranged in total body, condylo-basal

and rostrum lengths from 185-244 cm, 395.8-480 mm and 233.6-299.6 mm respectively, whereas off the California coast, *D. delphis* ranged from 164-201 cm, 382-445 mm and 218-275 mm, and *D. capensis* ranged from 193-235 cm, 445-498 mm and 286-321 mm respectively (Heyning & Perrin, 1994).

Common dolphins off Southern Australia also show signs of being an intermediate form (Amaha 1994; Bell *et al*., 2002). Bell *et al*. (2002) established that common dolphin skulls overlapped in size with both the long- and short-beaked forms in the North-east Pacific. However, not only do common dolphins off Southern Australia exhibit a greater range of variation compared with common dolphins in the North-east Pacific (Bell *et al*., 2002), but also with common dolphins in the present study. The Southern Australian dolphins ranged in RL/GZW from 1.36–1.73 (mean 1.52), and developed longer rostra (range 225-311 mm) compared with *D. delphis* in the current study. Common dolphins inhabiting waters off Southern Australia have been identified as *D. delphis* using genetic analysis (using mitochondrial DNA has identified control region and cytochrome *b*) (White, 1999).

Common dolphins in the North-east Atlantic have not developed rostra as long as those identified in Pacific long-beaked dolphins, and tooth count data are, on average, within the range found for *D. delphis* in the North-east Pacific. Furthermore, colouration patterns of common dolphins in the North-east Atlantic resemble *D. delphis* inhabiting waters in the North-east Pacific rather than *D. capensis* (Amaha, 1994; Heyning & Perrin, 1994; Murphy, 2004). Therefore until further analysis is carried out, the common dolphin in the North-east Atlantic should be classified as a larger-form of the short-beaked common dolphin *Delphinus delphis*.

Common dolphins in the North-east Atlantic are among the largest-sized short-beaked dolphins documented (Table 1), with the majority ranging in total body length from 91 to 250 cm for males and 95.5 to 230 cm for females (Silva & Sequeira, 2003; Murphy, 2004). One of the smallest-sized common dolphins inhabits the Black Sea. Maximum body lengths in the Black Sea recorded for males and females were 219 cm and 200 cm respectively, but the average body length of sexually mature individuals was 180 cm for males and 170 cm for females (Perrin, 1984; Amaha, 1994). In the Pacific, where the short-beaked common dolphin lives sympatrically with the long-beaked common dolphin *Delphinus capensis* off the Californian coast, the overall body size of the short-beaked form has decreased, possibly due to character displacement (Perrin, 1984). In the eastern tropical Pacific however, where the long-beaked form does not exist (Evans, 1975), the short-beaked form can attain body lengths of 235 cm (Perrin, 2002). Overall, *D. delphis* appears to be a very variable species; however, until further analysis is carried out, i.e. a genetic study, the possibility of further species/subspecies being identified within the common dolphin species complex cannot be ruled out.

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REFERENCES

Amaha, A. 1994. *Geographic variation of the common dolphin, Delphinus delphis* (*Odontoceti: Delphinidae*). Ph.D. thesis, Tokyo University of Fisheries, Japan.

Heyning, J.E. & Perrin, W.F. 1994. Evidence or two species of common dolphins (genus *Delphinus*) from the eastern North Pacific. *Contributions in Science (Los Angeles)*, 442, 1-35.

Banks, R.C. & Brownell, R.L., Jr. 1969. Taxonomy of the common dolphins of the eastern Pacific Ocean. *J. Mammal*., 50, 262-271.

Bell, C.H., Kemper, C.M. & Conran, J.G. 2002. Common dolphins *Delphinus delphis* in Southern Australia: A morphometric study. *Aust. Mammal.*, 24, 1-10.

van Bree, P.J.H. & Gallagher, M.D. 1978. On the taxonomic status of *Delphinus tropicalis* van Bree, 1971 (notes on Cetacea, Delphinoidea IX). *Beaufortia*, 28, 1-8.

Evans, W.E. 1975. *Distribution, differentiation of populations, and other aspects of the natural history of Delphinus delphis Linnaeus in the northeastern Pacific*. Ph.D. thesis, University of California, USA.

Evans, W.E. 1994. Common dolphin, White-bellied porpoise *Delphinus delphis* Linnaeus, 1758. In *Handbook of Marine Mammals,* vol. 4: pp. 191-224. (Ed. S. H. Ridgway & R. J. Harrison). Academic Press, London.

Flower, W.H. 1880. On the external characteristics of two species of British dolphins (*Delphinus delphis*, Linn., and *Delphinus tursio*, Fabr.). *Transactions of the Zoological Society,* 11, 1-5.

Haug, T. 1981. On some reproduction parameters in fin whales, *Balaenoptera physalus* (L.) caught off Norway. *Rep. Int. Whal. Commn.*, 31, 373-378.

Jefferson, T.A. & Van Waerebeek, M.F. 2002. The taxonomic status of the nominal dolphin species, *Delphinus tropicalis* van Bree, 1971. *Mar. Mamm. Sci*., 18, 787-818.

Kingston, S.E. & Rosel, P.E. 2004. Genetic Differentiation among recently diverged delphinid taxa determined using AFLP Markers. *J. Hered*., 95, 1-10.

Lilljeborg, W. 1866. Synopsis of the cetaceous Mammalia of Scandinavaia (Sweden and Norway). In *Recent memoirs of the Cetacea*: Pp. 219-309. (Ed. W. H. Flower). Ray Society, London.

Murphy, S. 2004. *The biology and ecology of the short-beaked common dolphin Delphinus delphis in the North-east Atlantic*. Ph.D. thesis, University College Cork, Ireland.

Perrin, W.F. 1984. Patterns of geographical variation in small cetaceans. *Acta Zool. Fenn*., 172, 137-140.

Perrin, W.F. 2002. Common Dolphins *Delphinus delphis*, *D. capensis* and *D. tropicalis*. In: *Encyclopaedia of marine mammals*: 245-248. (Eds. W.F. Perrin, B. Wursig & J.G.M. Thewissen). Academic press, London.

Rosel, P.E., Dizon, A.E. & Heyning, J.E. 1994. Genetics analysis of sympatric morphotypes of common dolphins (genus *Delphinus*). *Mar. Biol.*, 119, 159-167.

Selzer, L.A. & Payne, P.M. 1988. The distribution of white sided (*lagenorhynchus acutus*) and common dolphins (*Delphinus delphis*) vs. environmental features of the continental shelf of the Northern United States. *Mar. Mamm. Sci*., 4, 141-153.

Silva, M. A. & Sequeira, M. 2003. Patterns of mortality of common dolphins (*Delphinus delphis*) on the Portuguese coast, using strandings records 1975-1998. *Aquat. Mamm*., 29.1, 88-98.

Weir, C. R., Pollock, C., Cronin, C. & Taylor, S. 2001. Cetaceans of the Atlantic frontier, north and west of Scotland. *Continental Shelf Research,* 21, 1047-1071.

White, C. 1999. *Molecular systematics of the common dolphin, Delphinus delphis.* B.Sc. thesis, University of Adelaide, Australia.

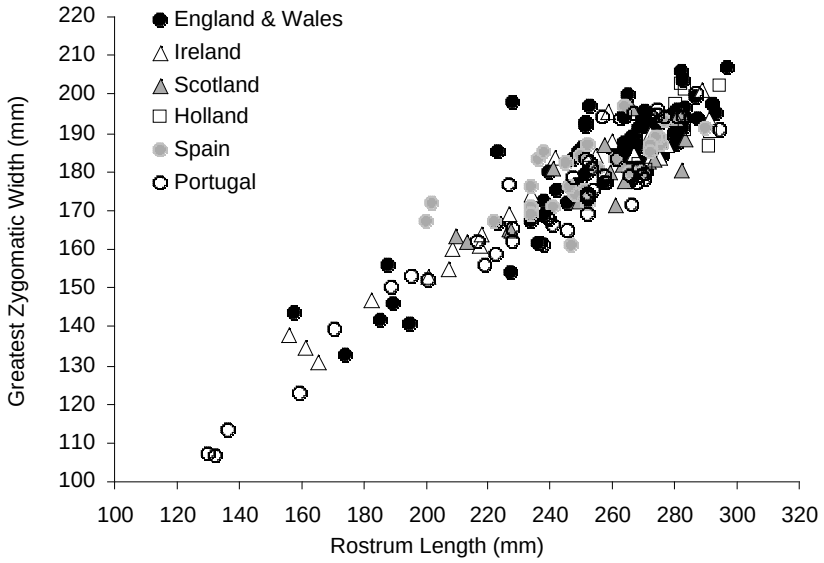

Figure. 1. Greatest zygomatic width (mm) vs. rostrum length (mm) for (a) all common dolphin data (n=218)

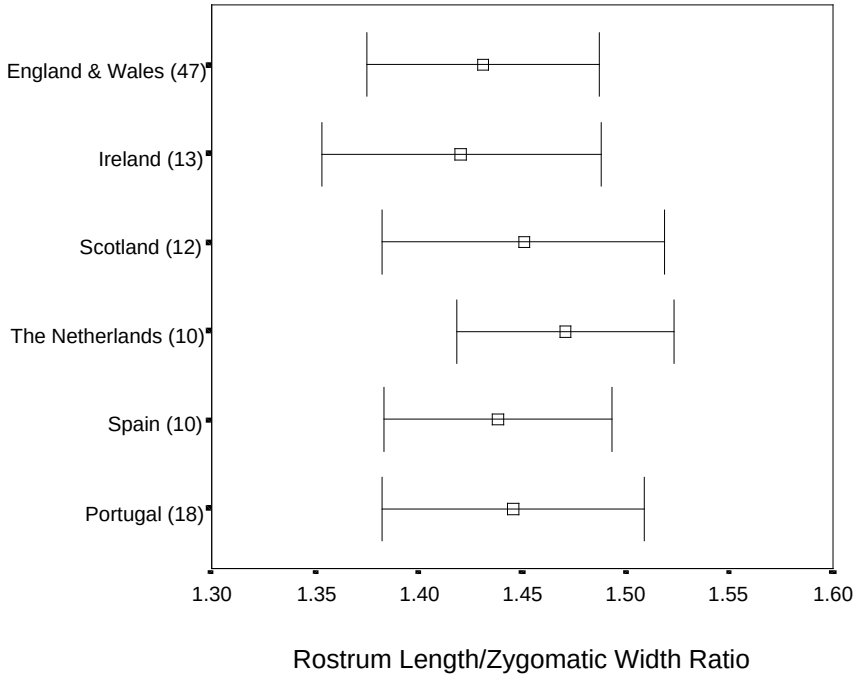

Figure. 2. Means of rostrum length/zygomatic width ratio ± 95% C.I. by geographic area of mature data only. Open squares are means, horizontal bars are ± confidence intervals and numbers are sample sizes.

Table 1. Total body length and age data available for the short-beaked common dolphin *Delphinus delphis* from various geographical areas (Sources: Hui, 1979; Collet, 1981; Collet & Harrison, 1981; Collet & Saint-Girons, 1984; Perrin, 1984; Perrin & Reilly, 1984; Collet, 1992; Collet, 1993; Amaha, 1994; Heyning & Perrin, 1994; Ferrero & Walker, 1995; Perrin, 2002; Silva & Sequira, 2003; Murphy, 2004). * = age at asymptotic TBL value, ** = age and TBL estimates for sexually maturity.

Region	Males asymptotic TBL value (cm)	Female asymptotic TBL value (cm)	Male physically mature mean TBL (cm)	Female physically mature mean TBL (cm)	Male age at physical maturity (yrs)	Female age at physically maturity (yrs)	Male maximum TBL obtained (cms)	Female maximum TBL obtained (cms)
North-east Atlantic *Irish study*	211.6	197.4	212	199.1	11*	9*	231	230
North-east Atlantic *French study*			200**	190**	6-7**	5-7**	248	220
North-east Atlantic *Portuguese study*							250	220
Mediterranean Sea							222	222
Black Sea			180	170	10	10	219	200
North-west Atlantic							236	212
North Pacific Ocean	188.1	179.4			10.5**	8**	211	199
Eastern Tropical Pacific			207	197			211(235+)	199
Southern California Bight			189.5	180.1	7-14**	8-12**	201	193
North-west Pacific *Japanese Study*			183	173	10	10	194.5	182

THE DECLINE OF SHORT-BEAKED COMMON DOLPHINS IN EASTERN IONIAN SEA COASTAL WATERS

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In eastern Ionian Sea coastal waters, around the island of Kalamos, research on short-beaked common dolphins (*Delphinus delphis*) and common bottlenose dolphins (*Tursiops truncatus*) was conducted between 1993-2003 from a small inflatable craft. During 837 survey days, 24,832 km of total effort were distributed within an area of 480 km^2, resulting in 431 common dolphin and 237 bottlenose dolphin sightings. Individual photo-identification was performed extensively throughout this study, making it possible to describe long-term residency patterns and to document changes in the relative abundance of the two species. Despite presenting high levels of sympatry, associations between common and bottlenose dolphins were rarely observed. The formerly highly resident and abundant common dolphin community showed a continuous decline in this area beginning in 1997. Evidence of decline was provided by 1) decreasing encounter rates, 2) decreasing mean group sizes, 3) decreasing total number of individuals photo-identified each year, and 4) a discovery curve reaching an asymptote by 1997, indicating low levels of immigration. In contrast, a relatively stable presence of bottlenose dolphins was observed, some being highly resident and others using the area only occasionally. The reasons behind the local decline of common dolphins are not known, but the observed trends indicated that prey depletion may play an important role. Precautionary management measures are needed to prevent the disappearance of common dolphins from an area that - based on their presence - was included in the Natura 2000 network ("Site of Community Importance") under the 9243 EEC “Habitats” Directive, also considering that in 2003, the Mediterranean common dolphin population was classified as *Endangered* in the IUCN Red List of Threatened Animals.

SHORT-BEAKED COMMON DOLPHIN IN THE WATERS OF ISCHIA ISLAND: A RELIC POPULATION UNIT OF PRIMARY IMPORTANCE IN THE ITALIAN SEAS

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INTRODUCTION: HISTORY AND BACKGROUND

The short-beaked common dolphin, *Delphinus delphis* is a small cetacean species with a wide distribution. However, like most other cetaceans, it is not panmictic and occurs as a series of geographically separate populations (Heyning & Perrin, 1994; Perrin & Brownell, 1994; Jefferson & Van Waerebeek, 2002). In 1996, the short-beaked common dolphin was listed as a lower risk species, 'conservation dependent' in the IUCN Red List of Threatened Animals (Baillie & Groombridge, 1996).

By contrast, in the Mediterranean Sea, conservation problems for the species have been recognized since the 1970s. The UNEP Mediterranean Action Plan (Barcelona, 1975) recommended strong conservation measures to protect the species but without specifying what these measures should be. Determining the conservation status of Mediterranean common dolphins was cited as a priority in past cetacean action plans of the IUCN Species Survival Commission (Perrin, 1988; Reeves & Leatherwood, 1994). The latest such plan notes that they have declined dramatically in the central and eastern Mediterranean and that conservation action is urgently needed to prevent extirpation in this area of the species' range (Reeves *et al*., 2003). In 2003, the Mediterranean common dolphin 'subpopulation' was listed as endangered in the IUCN Red List of Threatened Animals based on criterion A2, which refers to a 50% decline in abundance over the last three generations, the causes of which 'may not have ceased *or* may not be understood *or* may not be reversible' (http://www.redlist.org).

Short-beaked common dolphins in the Mediterranean have undergone a remarkable reduction in their abundance during the last few decades, and have almost completely disappeared from large areas of their former range (Bearzi *et al.*, 2003). A number of interacting factors may have played a role in the decline of common dolphins in the Mediterranean, ranging from natural fluctuations to the impact of human activities. These human-induced threats – based on the available evidence – include factors as diverse as prey depletion, contamination by xenobiotics, direct killing, fishery by-catch and global climate change (Bearzi *et al*., 2003).

Other potential threats to Mediterranean common dolphins include disturbance by recreational vessel traffic, noise from shipping, mineral prospecting (seismic) and military sonar (Notarbartolo di Sciara & Gordon, 1997; Gisiner, 1998; Jasny, 1999), and oil pollution (Engelhardt, 1987; Geraci & St. Aubin, 1990; Würsig, 1990). Although potentially pervasive, these threats remain poorly characterized or have yet to be linked with specific effects on common dolphins in the Mediterranean or elsewhere (Notarbartolo di Sciara *et al*., 2002).

The situation in the Mediterranean Sea underlines that the fate of the remaining animals will most likely depend upon precautionary actions and the adoption of precise conservation measures to prevent further decline. However, it is important that any long- or short-term management decisions that have an impact on either the dolphins or their habitat, are made with the support of

detailed and current scientific information (Rogan & Berrow, 1995). Field surveys on local groups of common dolphins are clearly needed in order to: a) obtain a better knowledge of the behavioural ecology of the species, b) give support to determine the current distribution and abundance in the Mediterranean, and c) suggest appropriate management strategies.

PRELIMINARY DATA

In the south-eastern Tyrrhenian Sea, the presence of a common dolphin population off the northern coast of the island of Ischia, Italy has been consistently documented since 1997. The animals have been sighted on a seasonal basis, mostly in the summer, over the submarine canyon of Cuma, a highly productive marine area characterized by significant pelagic biodiversity and multispecies associations (Mussi *et al*., 2004).

Based on preliminary photo-identification data, 46 recognizable individuals have been catalogued, 19 of these re-sighted in different years, suggesting significant levels of site fidelity. Breeding activities are often observed, and calves are always present in one or more of the group sub-units. Sighted groups are relatively large (mean=65.5, SD=23.94, *n*=41, range 35–100 individuals) and often observed in association with striped dolphins (*Stenella coeruleoalba*), particularly during surface feeding targeting shoaling prey. Surface feeding occurs frequently and the Atlantic saury, *Scomberesox saurus* (a seasonal fish that is highly valued on local markets) is a typical prey of common dolphins (Mussi & Miragliuolo, 2003).

Finally, acoustic data have been recorded since 2000, mostly during feeding and socializing behaviour (Mussi & Miragliuolo, unpublished data). Both whistles and clicks have been heard.

DIRECT THREATS

Boats traffic and collisions

In the busy summer seasons, pleasure boats and ferries crowd these waters. Commercial and passenger traffic in the Gulf of Naples and in the nearby Phlegrean Islands (Ischia, Procida and Vivara) exceeds 200,000 trips/year, and up to 2,000 recreational boats may be moored during the summer in Ischia's harbours (Strada, 2000). Ship collisions in the area have been documented by the authors (Mussi & Miragliuolo, 2003) for four cetacean species including striped dolphins, bottlenose dolphins (*Tursiops truncatus*), sperm whales (*Physeter macrocephalus*) and fin whales (*Balaenoptera physalus*). A dramatic harassment event on Risso's dolphins (*Grampus griseus*) was reported by Miragliuolo *et al*. (2004). Despite the presence of vulnerable cetacean species, the waters around Ischia are commonly used for unofficial offshore races, and the implementation of coastal speed limits is virtually nonexistent.

Driftnetting

A potentially major threat for common dolphins and other cetaceans in the area is represented by the illegal driftnet fishery, sadly known for the heavy toll paid by Mediterranean cetaceans (Di Natale & Notarbartolo di Sciara, 1994; IWC, 1994; Silvani *et al*., 1999). This fishery threatens the local cetacean communities and by-catch events have been documented for striped dolphins, bottlenose dolphins, sperm whales and fin whales (Centro Studi Cetacei 1996, 1997, *in press*; Miragliuolo *et al*., *in press*).

Notwithstanding the EU ban on driftnets since January 1st, 2002, and the publication of a report (Tudela *et al*., 2003) that provided extensive documentation of ongoing, large-scale mortality of several cetacean species, followed by the ICCAT recommendation for the total ban of driftnets from the Mediterranean Sea, illegal fishing with driftnets is still an issue around Ischia. Annually, since 1995, swordfish boats equipped with driftnets have been observed daily in the area from May to August (Mussi *et al*. 1998; Mussi & Miragliuolo, 2003).

In Italy, a Decree by the Fishery Ministry (27 March 2003) authorizes the use of a type of fishing gear called “ferrettare da posta”, i.e. a small driftnet anchored to the bottom. The term “da posta” (anchored) associated with a driftnet merely represents a means to bypass the existing regulations and allow the continued use of driftnets. The deliberate ambiguity of this decree allows fishermen (even those that benefit from the EU conversion plan and receive indemnity funds) to continue the use of driftnets.

The impact on the pelagic fauna of these “ferrettara” driftnets is still unknown owing to a lack of studies and observations in the field. However, such impact is likely to be similar or equal to that of the normal driftnets.

INDIRECT THREATS

Overfishing and prey depletion

Fishermen claim that the fleet targeting the Atlantic saury (locally a key prey for common dolphins) has decreased by one order of magnitude due to the decline in fish stocks. Moreover, purse seiners and trawlers are not requested to comply with the regulations intended to prevent overfishing (Mussi & Miragliuolo, 2003), thereby producing clear environmental damage.

A recent review by Buia *et al.* (2003) reported a remarkable alteration in the structure of Neptunegrass (*Posidonia oceanica*) beds, related to the illegal and uncontrolled trawling. Neptunegrass beds - distributed all around the island of Ischia up to about 30 m of depth - have been monitored since 1975 (Colantoni *et al*., 1982). Terlizzi (1991) analysed the fauna associated with the leaf stratum and found a notable diminution in biomass value in 1988-89, as compared to 1981-1982, as well as an important reduction of biodiversity. Finally, a general survey around the hard bottoms of Ischia conducted by Gambi *et al*. (2003) showed that fish stocks are generally scarce and dominated by non-commercial species.

Pollution

Ischia is close to the Gulfs of Gaeta and Naples, which receive the continuous inflow of three polluted rivers: Volturno, Garigliano and Sarno. These rivers include waters classified as “very bad” in the second report on environmental quality by ARPA Campania (2003); pollutant levels brought by the Sarno river, in particular, are unlikely to be sustainable. Sewage plants on the islands of the archipelago are totally inadequate and lack any kind of systems of purification. Zucco (2003) localised in the island of Ischia six highly polluted discharges and 11 pipes releasing sewage into the sea. Moreover, about 90 unauthorised outlet pipes were counted. The evidence provided above suggests that water pollution may be an issue in the seas surrounding Ischia.

CREATION OF A MARINE PROTECTED AREA (MPA)

The territory of Ischia is divided into six municipalities. This administrative condition does not facilitate the developing of a common strategy to protect the marine environment around the island. This situation should be taken into account when discussing management strategies.

The fishery of Ischia is mainly artisanal. The local cooperative calls for a total protection of coastal marine waters, in order to avoid the current competition with industrial fisheries of the continental Campania and Lazio regions.

The island of Procida has only one municipality and hosts an industrial fleet of trawlers and purse seiners that oppose the creation of an MPA. To enact meaningful conservation strategies, the coastal waters of the Phlegrean Islands should be administered by a single committee, which

should include representatives of the local stakeholders. Unfortunately, this view is opposed by political pressure in favour of a division of the protected territory into several areas to allow for further expansion of tourism.

The coastal waters of Ischia and the southern coast of the island of Procida with the islet of Vivara have been protected by a Ministerial Decree (3 April 2000) following the 92/43CEE and 79/409/CEE Directives dedicated to the conservation of biodiversity and natural habitats. Unfortunately, at the moment the maps with the location of the sites, retrieved from the Campania Environment Sector, are discordant. The Ministry is defining the exact location of the sites. The ambiguity of the precise position of the protected area means that any protection is impossible to enforce (Zucco, 2003). The coastal waters of Ischia, Procida and Vivara are also protected by Coast Guard Ordinances that regulate the movement of boat traffic (including anchoring) and swimming along the whole perimeter of the islands (04/1997 and 07/2000); despite these ordinances, the implementation is non-existent.

A coastal Marine Protected Area institution is expected (Law 394, 1991) for the Phlegrean Islands (Ischia, Procida and Vivara) by the Italian Ministry of Environment. Such an MPA should mitigate some of the direct threats in the coastal waters of Ischia, but the proposed perimeter does not include the dolphins' critical habitat which is mainly pelagic (Cuma's canyon). Another problem for the protection of the dolphins' home range in Ischia waters through the MPA institution is the lack of awareness, both in decision makers and in the general public, about the threats faced by common dolphins.

An MPA, partially devoted to cetacean fauna, could enhance controls in the waters of Ischia. The MPA may restore ecosystem functioning and benefit marine food webs by providing shelter to threatened marine species, thus contributing to the recovery of depleted dolphin prey. Management measures should include: 1) stopping the industrial fishery (purse seiners, trawlers) in the area corresponding to the submarine canyon of Cuma and to the Bank of Forio; 2) monitoring the uncontrolled and illegal fishery that continues undisturbed (including several methods of commercial fishing, also sporting and pleasure fishing, especially the use of explosives in the latter); 3) reducing and controlling the speed limits around the islands, in particularly near Monte Vico, Punta Imperatore and Punta S. Pancrazio and creating dedicated routes for commercial and passenger traffic. This could be very useful in decreasing the speed of the tourist trips around the island, the fleet of which is composed of large and fast motor boats that normally drive at 25/30 knots; and 4) approving a code of conduct and rules on whale watching (today there are no commercial whale watching activities in Ischia, but this should be considered within the MPA to provide for any changes in the future).

The authors of this paper strongly advise the implementation of the above measures and especially the creation of an MPA in order to protect, and prevent any further declines in the common dolphin population around Ischia.

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REFERENCES

Arpa Campania 2003. Primo Atlante Ambientale della Campania – 2003. Sintesi della seconda relazione sullo stato dell'ambiente. Napoli, 2003. 176 pp.

Baillie, J. & Groombridge, B. 1996. *1996 IUCN Red List of Threatened Animal*s. IUCN, Gland, Switzerland.

Bearzi, G., Reeves, R. R., Notarbartolo Di Sciara, G., Politi, E., Cañadas, A., Frantzis, A., & Mussi, B. 2003. Ecology, status and conservation of short-beaked common dolphins *Delphinus delphis* in the Mediterranean Sea. *Mammal Review*, 33. 3, 224–252. Printed in Great Britain.

Buia, M.C., Gambi, M.C., Lorenti, M., Dappiano, M., & Zupo V. 2003. Aggiornamento sulla distribuzione e sullo stato ambientale dei sistemi a fanerogame marine (*Posidonia oceanica e Cymodocea Nodosa*) delle isole Flegree.Pp. 163-186. In: *Ambiente marino e costiero e territorio delle isole Flegree (Ischia, Procida e Vivara – Golfo di Napoli). Risultati di uno studio multidisciplinare.* Editori M. C. Gambi, M. De Lauro e F. Jannuzzi. Memorie dell'Accademia di Scienze Fisiche e Matematiche, Società Italiana di Scienze, Lettere e Arti in Napoli. Liguori Editore. 425 pp.

Colantoni, P., Gallignani, P., Fresi, E., & Cinelli F. 1982. Patterns of *Posidonia oceanica* (L.) Delile beds around the Island of Ischia (Gulf of Naples) and adjacent waters. P.S.Z.N.I. *Marine Ecology*, 3, 53-74.

Centro Studi Cetacei 1996. Cetacei spiaggiati lungo le coste italiane. Rendiconti 1993, 1994. (Mammalia). *Atti Soc. it. Sci. nat. Museo civ. Stor. nat. Milano*, 437-562

Centro Studi Cetacei 1997. Cetacei spiaggiati lungo le coste italiane. Rendiconto 1995. (Mammalia). *Atti Soc. it. Sci. nat. Museo civ. Stor. nat. Milano*, 205-216

Centro Studi Cetacei *In press*. Cetacei spiaggiati lungo le coste italiane. Rendiconto 2001, 2002. *Atti Soc. it. Sci. nat. Museo civ. Stor. nat. Milano.*

Di Natale, A., & Notarbartolo di Sciara, G. 1994. A review of the passive fishing nets and trap fisheries in the Mediterranean Sea and of cetacean by-catch. *Report International Whaling Commission, Special Issu*e, 15, 189–202.

Engelhardt, F.R. 1987. Assessment of the vulnerability of marine mammals to oil pollution. In: *Fate and Effects of Oil in Marine Ecosystems* (Ed. by J. Kuiper & W.J. Van den Brink), pp. 101–115. Martinus-Nijhoff Publishers, Dordrecht, Boston, Lancaster.

Gambi, M.C., Dappiano, M., Lanera, P., & Iacono, B. 2003. Biodiversità e bionomia dei popolamenti bentonici dei fondi duri delle isole Flegree: analisi di diverse metodologie di studio. Pp. 133-161. In: *Ambiente marino e costiero e territorio delle isole Flegree (Ischia, Procida e Vivara – Golfo di Napoli). Risultati di uno studio multidisciplinare.* Editori M. C. Gambi, M. De Lauro e F. Jannuzzi. Memorie dell'Accademia di Scienze Fisiche e Matematiche, Società Italiana di Scienze, Lettere e Arti in Napoli. Vol. 5. Liguori Editore. 425 pp.

Geraci, J.R., & St. Aubin, D.J. 1990. *Marine Mammals and Oil: Confronting the Risks*. Academic Press, San Diego, CA.

Gisiner, R.C. 1998. *Proceedings of the Workshop on the Effects of Anthropogenic Noise in the Marine Environment.*Marine Mammal Science Program, Office of Naval Research, February 1998.

Heyning, J.E., & Perrin, W.F. 1994 Evidence for two species of common dolphins (genus *Delphinus*) from the eastern North Pacific. *Contributions in Science, Natural History Museum of Los Angeles County*, 442, 1–35.

International Whaling Commission (IWC) 1994. Report of the workshop on mortality of cetaceans in passive fishing nets and traps. In: *Gillnets and Cetaceans* (Ed. by W.F. Perrin, G.P. Donovan & J. Barlow), pp. 1–72. Report International Whaling Commission, Special Issue 15. IWC, Cambridge.

Jasny, M. 1999. *Sounding the depths: supertankers, sonar, and the rise of undersea noise.* Natural Resources Defense Council Publications, New York.

Jefferson, T.A. & Van Waerebeek, K. 2002. The taxonomic status of the nominal dolphin species *Delphinus tropicalis* Van Bree, 1971. *Marine Mammal Science*, 18, 787–818.

Miragliuolo, A., Mussi, B., & Bearzi, G. 2004. Risso's dolphin harassment by pleasure boaters off the island of Ischia, central Mediterranean Sea. *European Research on Cetaceans*, 15. 168-171.

Miragliuolo, A., Mussi, B., & Bearzi, G. *in press*. Observations of driftnetting off the island of Ischia, Italy, with indirect evidence of dolphin by-catch. *European Research on Cetaceans*, 16.

Mussi, B., Gabriele, R., Miragliuolo, A., & Battaglia, M. 1998. Cetacean sightings and interactions with fisheries in the archipelago Pontino Campano, southern Tyrrhenian Sea, 1991–1995. *European Research on Cetaceans*, 12, 63–65.

Mussi, B., & Miragliuolo A. 2003. I cetacei della costa nord occidentale dell'isola d'Ischia (Canyon di Cuma). Pp. 213-232. In: *Ambiente marino e costiero e territorio delle isole Flegree (Ischia, Procida e Vivara – Golfo di Napoli). Risultati di uno studio multidisciplinare*. Editori M. C. Gambi, M. De Lauro e F. Jannuzzi. Memorie dell'Accademia di Scienze Fisiche e Matematiche, Società Italiana di Scienze, Lettere e Arti in Napoli. Liguori Editore. 425 pp.

Mussi, B., Miragliuolo, A., De Pippo, T., Gambi, M.C., & Chiota, D. 2004. The submarine canyon of Cuma (southern Tyrrhenian Sea, Italy), a cetacean key area to protect. *European Research on Cetaceans*, 15.

Notarbartolo di Sciara, G., Aguilar, A., Bearzi, G., Birkun, A., & Frantzis, A. 2002. Overview of known or presumed impact on the different species of cetaceans in the Mediterranean and Black Seas. In: *Cetaceans in the Mediterranean and Black Seas: State of Knowledge and Conservation Strategies* (Ed. by G. Notarbartolo di Sciara), pp. 194–196. A report to the ACCOBAMS Secretariat, Monaco, February 2002.

Notarbartolo di Sciara, G., & Gordon, J. 1997. Bioacoustics: a tool for the conservation of cetaceans in the Mediterranean Sea. *Marine Freshwater Behaviour and Physiology*, 30, 125–146.

Perrin, W.F. (1988) *Dolphins, Porpoises, and Whales. An Action Plan for the Conservation of Biological Diversity: 1988–1992.* International Union for the Conservation of Natural Resources, Gland, Switzerland.

Perrin, W.F., & Brownell, R.L. Jr. 1994. A brief review of stock identity in small marine cetaceans in relation to assessment of driftnet mortality in the North Pacific. *Report International Whaling Commission, Special Issu*e, 15, 393–401.

Reeves, R.R., & Leatherwood, S. 1994. *Dolphins, Porpoises and Whales: 1994–1998. Action Plan for the Conservation of Cetaceans.* IUCN/SSC Cetacean Specialist Group, Gland, Switzerland.

Reeves, R.R., Smith, B.D., Crespo, E., & Notarbartolo di Sciara, G. 2003. *Dolphins, whales, and porpoises: 2000–2010 conservation action plan for the world's cetaceans.* IUCN, Gland, Switzerland.

Rogan, E. & Berrow, S.D. 1995. The management of Irish water as a whale and dolphin sanctuary. In: *Whales, seals, fish, and man* (Editors A.S. Blix, L. Wallace, & O. Ulltang), Elsevier Science B.V.

Silvani, L., Gazo, J.M., & Aguilar, A. 1999. Spanish driftnet fishing and incidental catches in the western Mediterranean. *Biological Conservatio*n, 90, 79–85.

Strada, R. 2000. *Studio socioeconomico delle isole di Ischia, Procida e Vivara*. Report to the Zoological Station "A. Dohrn", Ischia, Italy. 60 pp.

Terlizzi, A. 1991. *Evoluzione spazio temporale in alcuni descrittori dell'ecosistema a Posidonia oceanica dell'isola d'Ischia (Golfo di Napoli).* Tesi di Laurea, Dipartimento di Zoologia, Università Federico II di Napoli: 152 pp.

Tudela, S., Guglielmi, P., El Andalossi, M., Kai Kai, A., & Maynou, F. 2003. *Biodiversity impact of the Moroccan driftnet fleet operating in the Alboran Sea (SW Mediterranean).* A case study of the harmful effects inflicted by current IUU large-scale driftnet fleets in the Mediterranean on protected and vulnerable species. WWF Mediterranean Programme. Rome. vi + 78 pp.

Würsig, B. 1990. Cetaceans and oil: ecologic perspectives. In: *Marine Mammals and Oil: Confronting the Risks* (Ed. by J.R. Geraci & D.J. St Aubin), pp. 129–165. Academic Press, San Diego, CA.

Zucco, C. 2003. Evoluzione urbanistico territoriale delle isole Flegree (Ischia, Procida e Vivara). Pp. 303-396 In: *Ambiente marino e costiero e territorio delle isole Flegree (Ischia, Procida e Vivara – Golfo di Napoli). Risultati di uno studio multidisciplinare.* (Editors M. C. Gambi, M. De Lauro and F. Jannuzzi). Memorie dell'Accademia di Scienze Fisiche e Matematiche, Società Italiana di Scienze, Lettere e Arti in Napoli. Vol. 5. Liguori Editore. 425 pp.

CONCLUDING REMARKS

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During this workshop, attention was focussed upon two distinct issues related to *Delphinus delphis*: current knowledge and threats. Initially, discussion began by addressing current knowledge, with the primary focus being uncertainties and unknowns within current research. Key uncertainties raised during this discussion included: stock identity and geographic range, seasonal and long-term movements, genetic distinctiveness, taxonomy and population size. While it was generally agreed that many other regions of research were lacking when it comes to this species e.g., social structure, some disagreement occurred over the relative importance of such research topics from a management and conservation perspective. By-catch was discussed as an example, with emphasis being placed upon the fact that we still have little understanding of when or why by-catch occurs to the extent that it does in this particular species.

The feasibility of certain research techniques/methods were also discussed e.g., the use of photo-identification to determine population size and/or structure. While it appears such techniques are viable for some populations, general consensus was that such methods are clearly not appropriate for all populations of common dolphins. This may be due to the physical environment of the study site or the lack of suitably marked animals within a population. The use of aerial surveys to monitor cetacean-fishery interactions and to study social structure and groupings at different times of the year and in different areas was also discussed. While the majority agreed on the benefits of such a method and the need for making greater use of all aerial studies on common dolphins undertaken so far, it was also recognized that the cost of such surveys may limit their application. Despite the expense of many genetic techniques, delegates undertaking genetic studies described how inexpensive it is to sample skin for genetic analyses. Consequently, in light of the many potential uses for genetic samples, researchers who have access to stranded, dead beach cast or by-caught animals were encouraged to sample animals regardless for future research. It appears therefore that while more sophisticated methods, some of which are already available, should be promoted to better understand the biology of *Delphinus delphis* in the wild, the financial limitation upon most research projects may limit their use.

Other methods discussed included abundance transects, in particular SCANS, was noted. One important point raised here was the issue of seasonal movement and the limitations of 'snap shot' abundance estimates, such as those obtained through SCANS. Generally, the consensus was that abundance surveys can be potentially limited if temporally constrained. Further discussions regarding the use of relative abundance versus absolute abundance data followed, with favour being voiced for the potential benefits of relative estimates. As a consequence of the inherent difficulties of obtaining abundance data in general, further suggestions were posed regarding the management benefits of range data rather than abundance estimates. One suggestion made was that researchers need to identify limits of a population and work within that, rather than just sampling within a nominal geographic area.

During the discussion of threats, opinions were voiced on our true understanding of pressures to this species. The phenomenon of bubble formation found during necropsies undertaken on common dolphins from around the British Isles was raised, and questions relating to the timing of this finding were posed: "Could this be a new threat facing common dolphins, possibly as a result of recent sonar activity, or a pre-existing condition which had previously gone unnoticed in past examinations?" This raised further discussion on the fact that threats change with time, and that, as a consequence, it is inherently difficult to manage against such events. In addressing known threats, many agreed on the need to combine various data types e.g., anthropogenic activities, prey availability, traffic and pollution.

Additional points raised during the discussion related to the need to be able to identify induced changes resulting from direct or indirect anthropogenic pressure, as opposed to changes that result from natural fluctuations and variation. A factor identified and considered to be of significant hindrance to current research efforts was the lack of understanding and co-operation between researchers/institutes regarding research objectives and archived samples. Concerns were also expressed on the amount of inaccessible/unpublished data that exists, and the associated problems this can generate when trying to advance our knowledge of this species.

As a consequence of these concerns, it was decided that an audit of common dolphin research/samples would take place, initially through the format of an ECS discussion group questionnaire. If successful, the results of the audit would be used to generate a register of common dolphin research in Europe. This register would be hosted by the European Cetacean Society on their webpage and would contain an archive sample database which would be searchable and available to subscribers.

ECS SWEDEN 2004 - COMMON DOLPHIN WORKSHOP

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