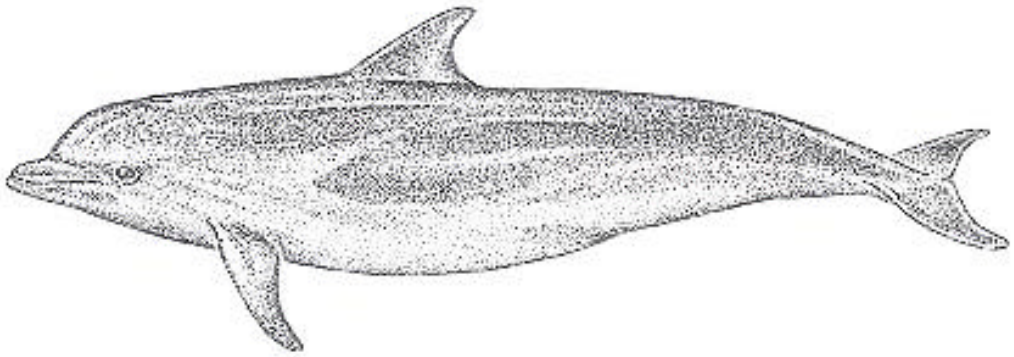
PRD-01/02-02

NOAA TECHNICAL MEMORANDUM NMFS-SEFSC-473

GULF OF MEXICO BOTTLENOSE DOLPHIN STOCK IDENTIFICATION WORKSHOP

14-15 March 2000
Sarasota, Florida

Carrie W. Hubard
Steven L. Swartz



U.S. Department of Commerce
National Oceanic and Atmospheric Administration
NOAA Fisheries
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, Florida 33149

January 2002

NOAA TECHNICAL MEMORANDUM NMFS-SEFSC 473

GULF OF MEXICO BOTTLENOSE DOLPHIN STOCK IDENTIFICATION WORKSHOP

14-15 March 2000
Sarasota, Florida

Carrie W. Hubard
Southeast Fisheries Science Center, NOAA Fisheries
Pascagoula Laboratory, 3209 Frederick Street, Pascagoula, Mississippi 39567

Steven L. Swartz
Southeast Fisheries Science Center, NOAA Fisheries
75 Virginia Beach Drive, Miami, Florida 33149

U.S. DEPARTMENT OF COMMERCE
Donald L. Evans, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Conrad Lautenbacher, Jr., Under Secretary for Oceans and Atmosphere

NATIONAL MARINE FISHERIES SERVICE
William Hogarth, Assistant Administrator for Fisheries

January 2002

NOTICE

The NOAA Fisheries (NMFS) does not approve, recommend or endorse any proprietary product or material mentioned in this publication. No reference shall be made to NOAA Fisheries, or to this publication furnished by NOAA Fisheries, in any advertising or sales promotion which would indicate or imply that NOAA Fisheries approves, recommends or endorses any proprietary product or material herein or which has as its purpose any intent to cause or indirectly cause the advertised product to be used or purchased because of NOAA Fisheries publication.

Cover illustration by Mark Grace.

This report should be cited as follows:

Hubard, C.W. and S.L. Swartz 2002. Gulf of Mexico bottlenose dolphin stock identification workshop, 14-15 March 2000, Sarasota, Florida. NOAA Technical Memorandum NOAA FISHERIES-SEFSC 473, 62 p.

This report has an internal document No. PRD-01/02-02

Copies of this report can be obtained from:

Director, Protected Resources Branch
Southeast Fisheries Science Center
NOAA Fisheries
75 Virginia Beach Drive
Miami, FL 33149

or

National Technical Information Center
5825 Port Royal Road
Springfield, VA 22161
(703) 605-6000, (800) 553-6847
Http://www.ntis.gov/numbers.htm

ABSTRACT

The Protected Species and Biodiversity Branch of NOAA Fisheries' Southeast Fisheries Science Center in Sarasota, Florida convened a workshop on 14-15 March 2000. The purpose of the workshop was to review and discuss existing information on bottlenose dolphin (Tursiops truncatus) stock structure in the Gulf of Mexico, past and present research, and to make suggestions for creating a Gulf-wide research strategy for this species. A panel of 20 researchers from various government agencies and universities participated in the workshop. Current and prior research on Gulf of Mexico bottlenose dolphins was summarized. Methodological, spatial, and temporal gaps in that data were discussed. The panel reviewed the various risks to bottlenose dolphins in the Gulf of Mexico from fisheries, urbanization, and industry. A series of suggestions for future research that would help define bottlenose dolphin stock structure in the Gulf of Mexico were made. These included continuing on-going studies and expanding research into regions of the Gulf that have not previously been studied. It was also suggested that researchers in the Gulf of Mexico begin to collaborate their efforts and data. Assignment tests that could link stranded animals to specific regions of the Gulf would be valuable, and it was suggested that future research attempt to determine which chemical ratios may be useful. The panel suggested that the strategy for identifying bottlenose dolphin stocks in the Gulf of Mexico employ the relatively new "geographical cluster analysis" method using genetic samples as well as other data sets.

TABLE OF CONTENTS

INTRODUCTION

Bottlenose dolphins (Tursiops truncatus) are distributed continuously throughout the continental shelf, coastal, and bay-sound-estuary waters of the northern Gulf of Mexico and along the U.S. mid-Atlantic coast. NOAA Fisheries is responsible for managing this species in accordance with the Marine Mammal Protection Act (MMPA). The management objective under the MMPA is to maintain bottlenose dolphins as functioning components of their ecosystem throughout their full range. Management units under the MMPA are based on stock structure coupled with specific management objectives. Thus, to effectively manage the species, the structure of the bottlenose dolphin population in terms of its component stocks must be understood.

In the aftermath of the 1987/1988 die-off of mid-Atlantic bottlenose dolphins and the subsequent listing of the coastal migratory stock as depleted, the NOAA Fisheries' Southeast Fisheries Science Center (SEFSC) developed a stock identification research strategy and began coordinating efforts with non-NOAA Fisheries' scientists in the U.S. western mid-Atlantic in 1998. This work is still continuing and data will be analyzed to discern distinct stock units and their relationship to the overall population.

In the Gulf of Mexico, numerous independent research programs have examined local bottlenose populations. In some cases, these efforts have generated significant amounts of information on distribution, abundance, movements, genetics, and behavior of bottlenose dolphins in specific locales. However, there has yet to be any integration of this data towards interpreting the stock structure of bottlenose dolphins throughout the Gulf of Mexico.

Currently, bottlenose dolphins in the U.S. Gulf of Mexico are managed as 38 different stocks: one continental shelf edge and continental slope stock, one outer continental shelf stock, three coastal stocks (western, northern, and eastern Gulf), and 33 bay, sound and estuary stocks (Waring et al. 1999). This management approach minimizes the risk to bottlenose dolphins in the absence of adequate stock structure data. A coordinated effort that pools and interprets existing data and guides future research should result in a stock structure scheme more reflective of the actual bottlenose dolphin population and thus yield better informed management decisions.

Recognizing the need to begin a collaborative bottlenose dolphin stock identification program in the Gulf of Mexico, a workshop was proposed and endorsed by the Atlantic Scientific Review Group at its November 1998 and April 1999 meetings. On 14-15 March 2000 a Bottlenose Dolphin Stock Identification Workshop was convened in Sarasota, Florida (Appendix 1). Twenty researchers and experts in population biology affiliated with various NOAA Fisheries laboratories and/or universities and with expertise in fields such as genetics, population dynamics, and photo-identification, participated in the workshop (Appendix 2). The primary goal of this workshop was to discuss and explore possible scientific avenues and activities that would guide future research towards identifying the stock structure of bottlenose dolphins in the Gulf of Mexico. Specific objectives included:

1. reviewing and assessing the available data on distribution, abundance, movements, genetics, and other relevant topics of bottlenose dolphin populations in the Gulf of Mexico;

2. identifying spatial, temporal, and methodological gaps in the current data that may need to be addressed in the future;

3. discussing the concept of stocks and stock structure within the context of bottlenose dolphin management and examining stock structure and population models that may be applicable to the Gulf of Mexico; and

4. initiating a process which will eventually lead to a collaborative Gulf-wide network of bottlenose dolphin researchers working towards elucidating stock structure in the Gulf of Mexico, improved management decisions, and an increased understanding of the species.

SUMMARY OF THE WORKSHOP

Pre-workshop Data Request/Questionnaire

In an effort to review the present status of bottlenose dolphin research in the Gulf of Mexico as comprehensively as possible, researchers throughout the Gulf were contacted two months prior to the workshop (Appendices 3 & 4). A questionnaire was designed to not only collect general information about the researchers, their objectives, the spatial and temporal coverage of their projects, and the methods they employed, but also to ask specific questions about stock structure. This request for data was mailed to researchers currently active or who have previously conducted research in the Gulf, and included a letter explaining the purpose for collecting this data. It was hoped that through networking, most, if not all, of the scientists collecting data relevant to bottlenose dolphin stock structure in the Gulf of Mexico would have an opportunity to respond.

Twenty-one completed questionnaires were returned. The research represented ranges from decade-long studies to graduate student projects in their initial phases. Some of the projects overlap each other with smaller studies encompassed within a larger, more comprehensive research program. The summary of the responses illustrates the main geographical locations where bottlenose dolphin research has occurred in the Gulf of Mexico and which research methods are most commonly employed (Appendix 5). The compilation of references provided by the questionnaire respondents provides a useful bibliography for those interested in Gulf of Mexico bottlenose dolphins.

Workshop Panel

The workshop panel was composed of a diverse group of researchers. The twenty participants were drawn from federal and state agencies as well as universities. Within the NOAA Fisheries SEFSC, the Beaufort, Charleston, Miami, and Pascagoula laboratories were represented at the workshop. T. Eagle represented the NOAA Fisheries' Office of Protected Resources.

All members of the panel had some position or experience that made their participation an asset and contributed to the success of the workshop. Many of the attendees have conducted research on bottlenose dolphins in the Gulf of Mexico (C. Hubard, K. Mullin, J. Reynolds, D. Weller, and R. Wells). Several scientists on the panel were selected due to their expertise in a specific field such as genetics (D. Duffield, P. Rosel), population dynamics (S. Brault, T. Eguchi, D. Goodman, P. Hammond, and B. TAYLOR), or Gulf of Mexico fisheries and habitats (D. Baltz). Others were able to add insight from their direct involvement in the planning and implementation of the bottlenose dolphin research plan in the Atlantic (A. Hohn, A. Read, and K. Urian).

Defining "Stock"

Since the objectives of the workshop included discussing stock structure models and developing a plan to elucidate Gulf of Mexico bottlenose dolphin stock structure, it was imperative that the concept of a "stock" was discussed. To facilitate a discussion on the definition of stocks, panel members received background materials prior to the workshop (Taylor 1997, Taylor 1999, Taylor and Dizon 1996, Taylor and Dizon 1999).

Before bottlenose dolphin stocks in the Gulf of Mexico can be delineated, a "stock" must first be defined. The problem with defining "stock" is that in the past this word has been used to mean many different things. As discussed at the workshop, a stock is not a biological unit. Bottlenose dolphin stocks are purely management units that are utilized to meet management objectives, as designated by the MMPA. These objectives include maintaining stocks as "significant functioning element[s] in the ecosystem of which they are a part." As amended in 1994, the management scheme of the MMPA includes calculating the number of allowable takes by humans [Potential Biological Removal (PBR)] and maintaining optimal sustainable populations (OSP). The MMPA management approach becomes more conservative as the amount of reliable data on a species decreases.

Because anthropogenic risks are not equally distributed across the range of bottlenose dolphins in the Gulf of Mexico and since some population structure has been clearly observed for bottlenose dolphins, understanding the stock structure of this species is crucial to its successful management. Basing a PBR on the estimate of bottlenose dolphins for the entire U.S. Gulf of Mexico instead of estimating PBR for each smaller stock units could risk the depletion or even extirpation of dolphins from some regions of their range within the Gulf of Mexico. Thus in order to effectively implement the MMPA, the stock structure of bottlenose dolphins in the Gulf of Mexico must be defined.

Bottlenose Dolphin Stock Structure in the Atlantic

A die-off of bottlenose dolphins along the U.S. Atlantic coast from June 1987 to March 1988 was the catalyst for defining stock structure in that region (Scott et al.1988). Not only did the geographical and temporal pattern of the die-off give clues to the nature of bottlenose dolphin stocks along the Atlantic coast, but the high rate of mortality caused the population to be listed as depleted under the MMPA (54 FR 41654, October 11, 1989).

In all, two stocks of bottlenose dolphins are recognized in the western Atlantic: the coastal migratory stock depleted by the die-off and an offshore stock (Waring et al. 1999). Although these stocks were defined, many questions remained concerning the boundaries and distinctiveness of each of these stocks. The 1994 amendments to the MMPA required that PBR's be set for these stocks, which in turn requires defining the geographical boundaries of each stock and then adequately estimating abundance for each.

Towards these goals, a workshop was held in February 1997 to develop a multi-method, multi-year research plan to examine stock structure of western Atlantic bottlenose dolphins (Hohn 1997). Among the suggestions in the resulting experimental design were the establishment of a centralized photo-identification catalog, biopsy sampling for genetic analyses, live captures, and satellite tracking.

Differences in Atlantic and Gulf of Mexico geography, oceanography, and even bottlenose dolphin population distribution support that stock identification research strategies will not be identical in these two regions. However, the research tools to study bottlenose dolphin stock structure are the same. Thus it was thought that the Gulf of Mexico research plan would benefit from discussions of the successes and problems encountered during the Atlantic research.

Bottlenose Dolphin Stock Structure in the Gulf of Mexico

Whereas the stock structure of bottlenose dolphins in the Atlantic is probably over-simplified with just two defined stocks (Hohn, pers. comm.), the stock structure of bottlenose dolphins in the Gulf of Mexico represents the other end of the "lumpers versus splitters" spectrum with a total of 38 recognized stocks (Fig. 1) (Waring et al. 1999). Such inconsistency in the designation of stocks is due in part to the events that precipitated the stocks being defined. In the Atlantic, a sudden die-off was the impetus for examining stock structure. In the Gulf of Mexico, a variety of factors acting over a longer period of time helped determine the way Gulf bottlenose dolphins were partitioned.

In the 1970's and 1980's large numbers of bottlenose dolphins were removed from Gulf of Mexico waters for the purpose of public display or research (Scott 1990). For logistical reasons these live captures occurred in shallow bays and were often concentrated in specific locations. For example, 202 dolphins were removed from Mississippi Sound from 1973-1988 (Scott 1990). At the same time, pioneering work in Sarasota Bay showed evidence of long-term site fidelity and a structured bottlenose dolphin community (Irvine and Wells 1972, Scott et al. 1990, Wells and Scott 1990, Wells 1991). With the possibility that residential dolphins existed within these

inshore habitats, the effect of removing large numbers of animals from small areas suddenly had the potential to be quite serious.

Efforts were made to estimate the abundance of bottlenose dolphins in the Gulf of Mexico. A series of aerial surveys were conducted (Blaylock and Hoggard 1994). Focus was given to the semi-enclosed and enclosed inshore waters by making each bay, sound and estuary a separate

Table 1. U.S. Gulf of Mexico bay, sound, and estuary bottlenose dolphin stocks

Texas
- Laguna Madre
- Nueces Bay, Corpus Christi Bay
- Compano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
- Matagorda Bay, Tres Palacios Bay, Lavaca Bay
- West Bay
- Galveston Bay, East Bay, Trinity Bay

Louisiana
- Sabine Lake
- Calcasieu Lake
- Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay
- Terrebonne Bay, Timbalier Bay
- Barataria Bay
- Mississippi River Delta

Mississippi
- Bay Boudreau, Mississippi Sound

Alabama
- Mobile Bay, Bonsecour Bay

Florida
- Perdido Bay
- Pensacola Bay, East Bay
- Choctawhatchee Bay
- St. Andrew Bay
- St. Joseph Bay
- St. Vincent Sound, Apalachicola Bay, St. Georges Sound
- Apalachee Bay
- Waccasassa Bay, Withlacoochee Bay, Crystal Bay
- St. John's Sound, Clearwater Harbor
- Tampa Bay
- Sarasota Bay
- Little Sarasota Bay
- Lemon Bay
- Pine Sound, Charlotte Harbor, Gasparilla Sound
- Caloosahatchee River
- Estero Bay
- Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay
- Whitewater Bay
- Florida Keys (Bahia Honda to Key West)

aerial survey block. These 33 blocks eventually became the 33 bay, sound, and estuary stocks (Table 1). With the exception of the Sarasota Bay estimate which is based on a direct count of known individuals (Wells 1992), the aerial survey estimates are still used for abundance and calculating PBR for the bay, sound, and estuary stocks (Leatherwood et al. 1978, Blaylock and Hoggard 1994, Waring et al. 1999). These 33 stocks cover an area of approximately 26,700 km^2. The total estimate of bottlenose dolphins in these waters is 5,141, with most stocks composed of less than 300 dolphins. Because the rate of fishery mortality or injury is not known for these stocks but does exist at varying levels, and because the removal of a single dolphin would exceed PBR for most of these stocks, all 33 bay, sound and estuary stocks are considered strategic (Waring et al. 1999).

Survey design and oceanography also played a role in the establishment of the other five Gulf of Mexico stocks. Depth contours separate the rest of the Gulf into coastal, continental shelf, and continental shelf edge/slope habitats (Figure 1).

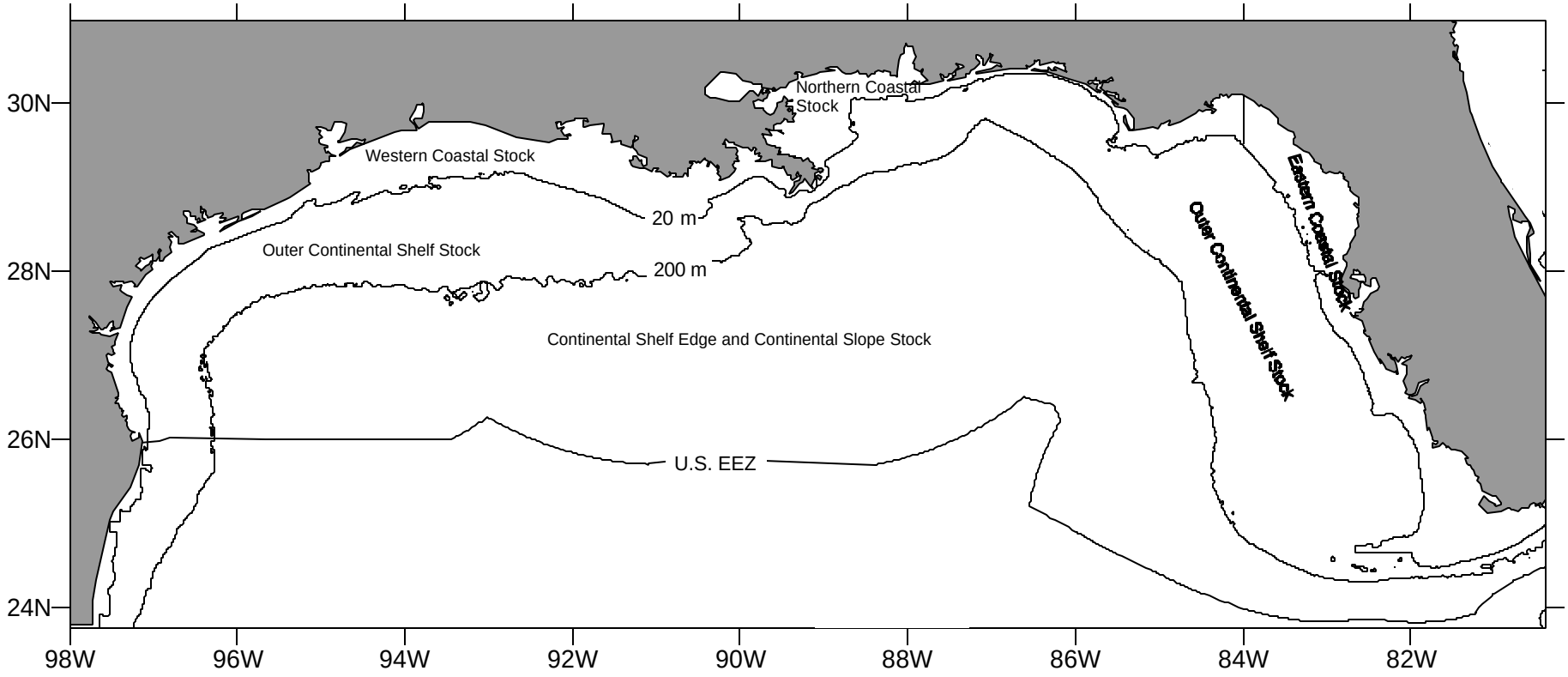


Figure 1. Approximate locations of the 38 U.S. Gulf of Mexico bottlenose dolphin stocks. Each bay, sound, and estuary is considered a separate stock or is part of a geographical stock complex (see Table 1). Official definitions of the other stocks are as follows. All 3 coastal stocks are defined from shore, barrier islands or presumed bay boundaries to 9.3 km seaward of the 18.3 m (10 fm) isobath. The western coastal stock encompasses dolphins inhabiting the nearshore waters from the Texas/Mexico border to the Mississippi River mouth. The northern stock is defined from the Mississippi River mouth to approximately 84 degrees west longitude. The eastern coastal stock is defined from 84 degrees west to Key West, Florida. The Outer Continental Shelf stock is defined as dolphins inhabiting the waters from the Texas/Mexico border to Key West, Florida from approximately 9 km seaward of the 18.3 m isobath to approximately 9 km seaward of the 183 m (100 fm) isobath. The Continental Shelf Edge and Continental Slope stock includes dolphins inhabiting U.S. waters from 9 km seaward of the 183 m isobath out to the U.S. Exclusive Economic Zone (EEZ).

The coastal region encompasses approximately 86,500 km^2 of water. Coastal stocks are further divided into western, northern, and eastern stocks and abundance estimates vary between the three stocks (3499, 4191, and 9912, respectively) (Waring et al.1999).

The outer continental shelf habitat covers about 245,800 km^2. This is the largest bottlenose dolphin stock in the Gulf of Mexico with an estimate of 50,247 dolphins (Waring et al.1999).

The continental shelf edge and continental slope habitat is defined as the waters from 9 km seaward of the 183 m isobath out to the U.S. Exclusive Economic Zone (EEZ). Ship surveys estimate that approximately 5618 bottlenose dolphins inhabit this region and compose this stock (Waring et al.1999).

Bottlenose dolphins in the Gulf of Mexico

In order to recommend future research in the Gulf of Mexico, the panel first discussed what is currently known about Gulf of Mexico bottlenose dolphins, which methods have been employed, and what gaps exist in the data. Refer to Appendix 5 for specific research methods employed by questionnaire respondents.

Methods

- **Shipboard and aerial surveys** have been used extensively in the Gulf of Mexico to survey large areas, especially to study bottlenose dolphins in the offshore waters of the Gulf (e.g., Leatherwood et al.1978, Thompson 1982, Scott et al. 1989, Mullin et al. 1990, Blaylock and Hoggard 1994). These surveys employ line-transect techniques to estimate abundance (Buckland et al.1993).

- **Photo-identification** is probably the most frequently used technique to study bottlenose dolphins in the Gulf of Mexico (e.g., Shane 1977, Gruber 1981, Irvine et al. 1981, Maze 1997, and Weller 1998). Photo-id can provide information on seasonal movements, site fidelity, associations, and community structure. Photo-id also provides guidance in choosing individuals for sampling with other methods such as biopsying, satellite tracking or live captures.

- **Genetic work** in the Gulf of Mexico has evolved from examining chromosomes and red blood cell enzymes to mitochondrial DNA haplotypes, DNA fingerprinting, and DNA microsatellites (e.g., Duffield and Wells 1986, Duffield and Chamberlin-Lea 1990, Duffield and Wells 1991, Urian et al.1996). Although genetic work is still quite limited in the Gulf of Mexico, it began two decades ago and is becoming more frequently used as an important tool for evaluating stock structure.

- **Strandings** of bottlenose dolphins produce a wealth of data; however, the coverage of stranding networks and the thoroughness of the data collected varies across the Gulf coast states. Much of the research on prey species, morphometrics, contaminants, parasites, and genetics initially used or continues to use data gathered from stranded carcasses (e.g., Barros and Wells 1998, Fernandez and Hohn 1998).

- **Morphometrics** have contributed to the differentiation of the two ecotypes of bottlenose dolphins: a smaller inshore form and a larger offshore form (e.g., Hersh and Duffield, 1990).

- **Radio and satellite telemetry** have not been used extensively on Gulf of Mexico bottlenose dolphins, but have been used to look at movement patterns of individual dolphins (e.g., Mate et al.1995).

Data gaps

Bottlenose dolphins are found throughout the bays, sounds, and estuaries of Texas, Louisiana, Mississippi, Alabama, and the west coast of Florida. However, studies have not been distributed uniformly. Some regions have been the focus of long term in-depth research spanning decades (e.g., Sarasota Bay and adjacent waters), whereas others (e.g., Louisiana coast, panhandle of Florida) have been mostly ignored thus far. The reasons for these spatial gaps range from lack of interest or funding to inaccessibility of the environment, such as in much of Louisiana. Temporal gaps also exist in places where research was only conducted during portions of the year or in locations where research was begun, but subsequently lapsed.

Summary

In the Gulf of Mexico, as elsewhere, the biology and ecology of bottlenose dolphins is very complex. They are distributed throughout a wide assemblage of habitats, ranging from the very shallow waters of estuaries to the continental slope up to approximately 1000-m deep. Further complicating matters is the high probability that, similar to the western Atlantic, there are two ecotypes of bottlenose dolphins in the Gulf: a coastal form and a larger offshore form. Over much of the continental shelf (i.e., waters > 10 m in depth), bottlenose dolphins are sympatric with the Atlantic spotted dolphin Stenella frontalis. There is some evidence that hybrids may be present as a result of interbreeding between these two species, making the task of resolving stock structure even more difficult.

The results of the locally based research projects also vary across the Gulf of Mexico. Bottlenose dolphins in the western and northern Gulf may have a community structure similar to bottlenose dolphins along the mid-Atlantic coast. Along the west coast of Florida bottlenose dolphins appear to be organized differently: in smaller, structured, communities that exhibit long term stability. Seasonal movements into and out of bays, sounds, and estuaries have been documented in many locales; however, the direction of and motive for this migration varies from site to site (Shane 1977, Gruber 1981, Irvine et al. 1981, Thompson 1981, Scott et al.1989, Henningsen 1991, Bräger 1993, Fertl 1994, Lynn 1995, Würsig and Lynn 1996, Maze 1997, Hubard 1998, Weller 1998). Despite these differences, some evidence of long-term site fidelity has been observed in most of the studies that focus on identifying individual animals. Currently there has been little direct collaboration among researchers working in different study areas (e.g., comparison of photo-id catalogs).

For further summaries of Gulf of Mexico bottlenose dolphin research see the responses to the questionnaire (Appendix 5) and consult the most recent stock assessment report (Waring et al.1999).

Risks to Bottlenose Dolphins in the Gulf of Mexico

Bottlenose dolphins in the Gulf of Mexico face a variety of anthropogenic pressures. To consider the possible risks to bottlenose dolphin stocks, the workshop participants discussed factors that may negatively affect bottlenose dolphins, their sources, and their geographical distribution in the northern Gulf of Mexico.

Coastal development

As the human population along the Gulf coast increases, shoreline development, wetland loss, and increased dredging and channelization impact coastal dwelling bottlenose dolphins. Increases in the number of people near the coast usually means more watercraft, while industrial expansion can translate to increased exposure to harmful chemicals (see below).

Watercraft

Boats and personal watercraft pose a collision hazard and their presence may disturb bottlenose dolphins, disrupting feeding, resting, or socializing behaviors.

"Swim with" programs

Several businesses along the Gulf coast have promoted swimming with and/or feeding wild bottlenose dolphins. These activities endanger dolphins in several ways: making them more likely to approach boats thereby increasing their chance of being injured, creating a dependence on humans for food, and often subjecting them to unhealthy or unnatural diets. Feeding wild dolphins is illegal and specifically prohibited by the MMPA. Swimming with wild dolphins can disturb the dolphins' behavior which can constitute harassment as defined and prohibited by the MMPA. The habituation of wild dolphins to the presence of humans also poses a threat to people, who are sometimes bitten or otherwise harmed by aggressive dolphins.

Fisheries

A variety of commercial and recreational fisheries exist in the Gulf of Mexico, including purse seining, crab traps, gill nets, and shrimp trawling. These fisheries use lines, nets, or monofilament, all of which pose an entanglement threat to Gulf bottlenose dolphins. Some fisheries, such as trawling for shrimp, may also have a more indirect affect on dolphins such as a habituated dependence on the fishery for food or a reduction in available prey items due to bycatch mortality.

Chemical pollutants

Bottlenose dolphins in the Gulf of Mexico are exposed to a variety of chemical pollutants depending on which region of the Gulf they inhabit. Agricultural runoff may contain chemicals such as pesticides and fertilizers that accumulate in a dolphin's body. Fertilizers may have the added effect of causing eutrophication that leads to harmful algal blooms like red tide that have been shown to kill or sicken fish, seabirds, and dolphins. Industrial areas expose bottlenose dolphins to heavy metals, anti-fouling chemicals, and various petrochemical-processing agents.

Oil and gas industry

Oil and gas industry activities may affect bottlenose dolphins in ways that include: habitat alteration in the form of rigs, increased boat traffic, and the chance of a spill from a well,

pipeline, or tanker. Noise pollution is another factor that may affect bottlenose dolphins. Air and ship traffic, noise from platforms, and seismic surveying have altered the acoustic environment of the Gulf of Mexico.

The panel noted that many of these risks are difficult to quantify and their long term effects on the biology, ecology, and social structure of bottlenose dolphin stocks in the Gulf of Mexico may be extremely difficult to assess, but nevertheless these issues cannot be ignored.

Geographic Cluster Analysis

The workshop included a discussion on ways of modeling populations and new methods of examining stock structure. Barbara Taylor gave a presentation on a new approach that has been used to elucidate the stock structure of Alaskan harbor seals. When a species' range is continuous over a large area, it is difficult to know where to draw the boundaries between stocks. Often these stock delineations are drawn based on geographical features for sampling and logistical reasons. Gulf of Mexico bottlenose dolphins are prime examples of these problems.

Instead of the traditional method of dividing the range into stocks and then analyzing data, this approach uses genetic data to help draw the stock boundaries. Genetic similarity between individuals is examined; however, geographical constraints determine which individuals can be directly compared. Individuals with genetic similarity are clustered and these clusters are ranked to show all plausible stock boundaries. Boundaries can then be selected that fulfill management objectives. Other types of data such as photo-id or telemetry can help ground-truth the stock boundaries, especially by providing information on dispersal.

STRATEGY FOR FUTURE RESEARCH

Considering the available data on Gulf of Mexico bottlenose dolphins and taking into account geographical and methodological gaps in that data, the potential risks to bottlenose dolphins, and the overall theory of stock structure, the panel made a series of suggestions that would improve our understanding of bottlenose dolphin stock structure and status in the Gulf of Mexico. It is hoped that these suggestions should serve as a framework to guide future bottlenose dolphin research in the Gulf of Mexico, outlining higher priority research and aiding in the allocation of any future resources.

1. In the absence of conclusive evidence suggesting otherwise and with data showing some degree of site fidelity throughout the Gulf, it was suggested that the division of bottlenose dolphin stocks in the Gulf of Mexico remain at the current risk-adverse strategy of 38 different stocks.

2. To further understand the differences between inshore and offshore bottlenose dolphins, it was suggested that large-scale ship surveys be conducted along the continental shelf and slope. Line transect theory can be employed to estimate abundance of bottlenose dolphins and biopsies can be obtained to genetically distinguish between the two ecotypes and identify the distribution

of each. These efforts may also help examine the unclear relationship between bottlenose dolphins and Atlantic spotted dolphins in regions where their distributions overlap and interbreeding may occur.

3. Recognizing that there are already samples in-hand that have not yet been analyzed, it was suggested that efforts be made to process and analyze available bottlenose dolphin samples from the Gulf of Mexico. These may include teeth and other tissues collected from live captures and strandings.

4. It was suggested that bottlenose dolphin researchers in the Gulf of Mexico begin or improve collaboration amongst themselves. The major joining force for Atlantic researchers is the Mid-Atlantic Bottlenose Dolphin Photo-Identification Catalog. Creating a centralized or at least regional photo-id catalog(s) of bottlenose dolphins in the Gulf of Mexico would require and encourage cooperation among researchers and could lead to important discoveries regarding home ranges, movement patterns, and genetic dispersal. It is also suggested that, similar to the manatee library, a Gulf of Mexico bottlenose dolphin library be established or at least a CD-ROM be created with relevant bottlenose dolphin references.

5. The panel suggested that the stranding networks be included as part of the collaborative research effort and better utilized as they can provide a wealth of information on life history, feeding habits, and morphometrics as well as fishery interactions. However, the primary problem with strandings is the inability to determine with any certainty where the animal lived when it was healthy.

6. To aid in the assignment of a bottlenose dolphin carcass to one particular stock or region of the Gulf of Mexico, the panel discussed the use of chemical markers. It was suggested that a literature search be conducted to identify chemical pollutants occurring in different areas of the Gulf of Mexico. Furthermore, it was suggested that specific chemicals or ratios of chemicals present in bottlenose dolphin tissue be identified to serve as assignment tests. This research would probably involve the sampling of individuals (e.g., from photo-id catalogs) with a known home range throughout the Gulf. Contaminant studies can also help assess the health of animals in a population.

7. To examine Gulf of Mexico bottlenose dolphin stock structure it was suggested that a framework be developed using multiple data sets similar to the geographically constrained hierarchical clustering method used to elucidate stocks of Alaskan harbor seals. Genetic sampling would be the primary tool in the hierarchical cluster approach. The first step could be a coordinated sweep across the Gulf collecting 40-50 genetic samples of known individuals approximately every 100 km. Other possible sources of data to contribute to the stock structure framework include: photo-id, telemetry, toxicants, fatty acid signatures, and stable isotope ratios from teeth.

8. The panel discussed the importance of photo-id studies. Photo-id serves two main roles in the context of the multiple data set framework: 1) photo-id is a means of ground-truthing models and dispersal rates generated from genetic sampling and 2) photo-id is the primary tool for selecting individual animals to be sampled (e.g., via biopsy or radio/satellite tagging). Acknowledging the

usefulness of photo-id data and recognizing that photo-id data become more meaningful over time, the panel suggested that photo-id research continue at currently established sites. Since there are large geographical gaps in photo-id studies along the Gulf coast, a criteria for selecting new sites was suggested. It was suggested that new photo-id research be conducted in locations: 1) where some data already exists from past studies, 2) with high (e.g., Galveston Bay) or unknown (e.g., Louisiana) levels of risk, 3) that are logistically easy to sample, 4) where known mortality events have occurred, and 5) where there is a reason to suspect a natural break in the population, such as where a sudden change in habitat occurs.

ACKNOWLEDGMENTS

The workshop was held at the Mote Marine Laboratory in Sarasota, Florida. We would like to thank Randall Wells for arranging our scenic venue as well as the Director and staff at Mote. Many thanks to John Reynolds for chairing the workshop. Caterina D'Agrosa was a great help serving as rapporteur, assisting with on-site arrangements, and helping to summarize the workshop. Many of the workshop participants kindly agreed to present their data and expertise to the panel. We are grateful to all the researchers that took the time to complete the questionnaire and share their knowledge of Gulf of Mexico bottlenose dolphins. This workshop was funded by the NOAA Fisheries SEFSC's Protected Species and Biodiversity Branch .

LITERATURE CITED

Barros, N.B. and R.S. Wells. 1998. Prey and feeding patterns of resident bottlenose dolphins (Tursiops truncatus) in Sarasota Bay, Florida. Journal of Mammalogy 79(3):1045-1059.

Blaylock, R.A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Technical Memorandum NMFS-SEFSC-356. 10 pp.

Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (Tursiops truncatus). Marine Mammal Science 9: 434-440.

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

Duffield, D.A. and J. Chamberlin-Lea. 1990. Use of chromosome heteromorphisms and hemoglobins in studies of bottlenose dolphin populations and paternities. Pages 609-622 *in* S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, California.

Duffield, D.A. and R.S. Wells. 1986. Population structure of bottlenose dolphins: Genetic studies of bottlenose dolphins along the central west coast of Florida. Contract Rept. to National Marine Fisheries Service, Southeast Fisheries Center. Contract No. 45-WCNF-5-00366. 10 pp.

Duffield, D.A. and R.S. Wells. 1991. The combined application of chromosome, protein and molecular data for the investigation of social unit structure and dynamics in Tursiops truncatus. Pages 155-169 in A.R. Hoelzel, ed. Genetic Ecology of Whales and Dolphins. Report of the International Whaling Commission, Special Issue 13, Cambridge, U.K.

Fernandez, S. and A.A. Hohn. 1998. Age, growth, and calving season of bottlenose dolphins, Tursiops truncatus, off coastal Texas. Fishery Bulletin 96:357-365.

Fertl, D.C. 1994. Occurrence, movements and behavior of bottlenose dolphins (Tursiops truncatus) in association with the shrimp fishery in Galveston Bay, Texas. M.Sc. thesis. Texas A&M University, College Station. 117 pp.

Gruber, J.A. 1981. Ecology of the Atlantic bottlenosed dolphin (Tursiops truncatus) in the Pass Cavallo area of Matagorda Bay, Texas. M.Sc. thesis, Texas A&M University, College Station. 182 pp.

Henningsen, T. 1991. On the distribution and ecology of the dolphin (Tursiops truncatus) in Galveston Bay, Texas. Diplom thesis. Christian-Albrechts-Univerisitat, Kiel, Germany. 80 pp.

Hersh, S.L. and D.A. Duffield. 1990. Distinction of Northwestern Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-142 in S. Leatherwood and R.R. Reeves, eds. The Bottlenose Dolphin. Academic Press, San Diego, California.

Hohn, A.A. 1997. Design for a multiple-method approach to determine stock structure of bottlenose dolphins in the mid-Atlantic. NOAA Technical Memorandum NMFS-SEFSC-401, 22 pp.

Hubard, C.W. 1998. Abundance, distribution, and site fidelity of bottlenose dolphins in Mississippi Sound, Mississippi. M.Sc. thesis, University of Alabama, Tuscaloosa. 101 pp.

Irvine, B. and R.S. Wells. 1972. Results of attempts to tag Atlantic bottlenose dolphins (Tursiops truncatus). Cetology 13:1-5.

Irvine, A.B., M.D. Scott, R.S. Wells and J.H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, Tursiops truncatus, near Sarasota, Florida. Fishery Bulletin U.S.79:671-688.

Leatherwood, S., J.W. Gilbert, and D.G. Chapman. 1978. An evaluation of some techniques for aerial censuses of bottlenosed dolphins. Journal of Wildlife Management 42:239-250.

Lynn, S.K. 1995. Movements, site fidelity, and surfacing patterns of bottlenose dolphins on the central Texas coast. M.S. thesis, Texas A&M University, College Station, TX. 92 pp.

Mate, B.R., K.A. Rossbach, S.L. Neukirk, R.S. Wells, A.B. Irvine, M.D. Scott and A.J. Read. 1995. Satellite-monitored movements and dive behavior of a bottlenose dolphin (Tursiops truncatus) in Tampa Bay, Florida. Marine Mammal Science 11(4):452-463.

Maze, K.S. 1997. Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site fidelity and habitat use. M.Sc. thesis, Texas A&M University, College Station, TX. 79 pp.

Mullin, K.D., R.R. Lohoefener, W. Hoggard, C.L. Roden, and C.M. Rogers. 1990. Abundance of bottlenose dolphins, Tursiops truncatus, in the coastal Gulf of Mexico. Northeast Gulf Science 11:113-122.

Scott, G.P. 1990. Management-oriented research on bottlenose dolphins in the Southeast Fisheries Center. Pages 623-639 in S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

Scott, G.P., D.M. Burn, and L.J. Hansen. 1988. The dolphin die-off: long term effects and recovery of the population. Proceedings of the Oceans '88 Conference: 819-823.

Scott, G.P., D.M. Burn, L.J. Hansen and R.E. Owen. 1989. Estimates of bottlenose dolphin abundance in the Gulf of Mexico from regional aerial surveys. CRD88/89-07.

Shane, S.H. 1977. The population biology of the Atlantic bottlenose dolphin, (Tursiops truncatus) in the Aransas Pass area of Texas. M.Sc. thesis. Texas A&M University, College Station, TX 239 pp.

Scott, M.D., R.S. Wells and A.B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pages 235-244 in S. Leatherwood and R.R. Reeves, eds., The bottlenose dolphin. Academic Press, San Diego, CA

Taylor, B.L. 1997. Defining "population" to meet management objectives for marine mammals. Pages 49-65 in A.E. Dizon, S.J. Chivers, W.F. Perrin, eds. Molecular genetics of marine mammals. Special Publication Number 3, The Society of Marine Mammals, Lawrence, KS.

Taylor, B.L. 1999 Refining the definition of stocks: a discussion paper. IWC/51/RMP23

Taylor, B.L. and A.E. Dizon. 1996. The need to estimate power to link genetics and demography for conservation. Conservation Biology 10(2): 661-664.

Taylor, B.L. and A.E. Dizon. 1999. First policy then science: why a management unit based solely on genetic criteria cannot work. Molecular Ecology 8:S11-S16.

Thompson, N.B. 1981. Estimate of abundance of Tursiops truncatus in Charlotte Harbor, Florida. NOAA/NMFS/SEFSC/Miami Laboratory, Fishery Data Analysis Technical Report.

Thompson, N.B. 1982. Estimates of abundance of Tursiops truncatus, in: St. Joseph-Apalachicola Bays, Florida, Mississippi Sound, Mississippi, and the Aransas-Copano-San Antonio Bay complex, Texas. Report to National Marine Fisheries Service, SEFC, Miami, Fl 26 pp.

Urian, K.W., D.A. Duffield, A.J. Read, R.S. Wells and D.D. Shell. 1996. Seasonality of reproduction in bottlenose dolphins, Tursiops truncatus. Journal of Mammalogy. 77:394-403.

Waring, G.T., D.L. Palka, P.J. Clapham, S. Swartz, M.C. Rossman, T.V.N. Cole, L.J. Hansen, K.D. Bisack, K.D. Mullin, R.S. Wells, D.K. Odell, and N.B. Barros. 1999. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments-1999. NOAA Technical Memorandum.

Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation, Texas A&M University, College Station, TX. 142 pp.

Wells, R.S. 1991. The role of long-term study in understanding the social structure of a bottlenose dolphin community. Pages 199-225 in K. Pryor and K.S. Norris, eds. Dolphin Societies: Discoveries and Puzzles. Univ. of California Press, Berkeley. 397 pp.

Wells, R.S. 1992. The marine mammals of Sarasota Bay. Pages 9.1-9.23 in Sarasota Bay: Framework for action. Sarasota Bay National Estuary Program, Sarasota, FL.

Wells, R.S. and M.D. Scott. 1990. Estimating bottlenose dolphin population parameters from individual identification and capture-release techniques. Pages 407-415 in P.S. Hammond, S.A. Mizroch and G.P. Donovan, eds. Individual Recognition of Cetaceans: Use of Photo-Identification and Other Techniques to Estimate Population Parameters. Report of the International Whaling Commission, Special Issue 12, Cambridge, U.K. 440 pp.

Würsig, B. and S.K. Lynn. 1996. Movements, site fidelity, and respiration patterns of bottlenose dolphins on the central Texas coast. NOAA Technical Memorandum. NMFS-SEFSC-383, 43 pp.

APPENDICES

APPENDIX 1. WORKSHOP AGENDA

Tuesday March 14, 2000

0900	Introductions	John Reynolds
0915	Background Information/Objectives of the workshop/ Review of current Gulf of Mexico bottlenose dolphin stock structure	Steven Swartz
0945	Introductory paper- Stock structure and management objectives	Barbara Taylor
1020	Break	
	Review of existing research:	
1040	Western Gulf of Mexico	David Weller
1120	Central Gulf of Mexico	Carrie Hubard
1200	Lunch	
1345	Eastern Gulf of Mexico	Randall Wells
1505	Review of research on chromosomes, RBC enzymes, mtDNA haplotypes, DNA fingerprinting and DNA microsatellites	Debbie Duffield
1550	Break	
1605	Review of Atlantic bottlenose dolphin research strategy and implementation	Aleta Hohn
1615	Review of Mid-Atlantic bottlenose dolphin photo-id catalog	Kim Urian
	Review of genetic research in the Atlantic and Gulf	Patricia Rosel
	Review of MMS/NMFS ship and aerial surveys in the Gulf	Keith Mullin
1650	Summary/review of what has been presented, including discussion of spatial, temporal, and methodological gaps in the Gulf	Reynolds/all
1800	Adjourn	

Wednesday March 15, 2000

0830	Explanation of a geographically constrained hierarchical clustering approach to designate stocks using harbor seals as an example	Barbara Taylor
0945	Review and discussion of potential risks to bottlenose dolphins in the Gulf of Mexico: Texas, Louisiana, Central coast, Florida	Reynolds/all
1045	Defining bottlenose dolphin habitat	Don Baltz
1120	Development of a research strategy, including a Gulf-wide research network, and a prioritized list of suggestions for future work	Reynolds/all
1140	Lunch	
1230	Continue developing research strategy	Reynolds/all
1430	Adjourn workshop	

APPENDIX 2. WORKSHOP PARTICIPANTS

Don Baltz
Coastal Fisheries Institute and
Dept of Oceanography and Coastal Sciences
CCEER
Louisiana State University
Baton Rouge, LA 70803

Solange Brault
Dept. of Biology
University of Massachusetts, Boston
100 Morrissey Blvd.
Boston, Massachusetts 02125-3393

Caterina D'Agrosa
NMFS-SEFSC Beaufort Lab
101 Pivers Island Rd.
Beaufort, NC 28516

Debbie Duffield
Dept. of Biology
Portland State University
P.O. Box 751
Portland, Oregon 97207

Tom Eagle
NMFS- Office of Protected Resources
1315 East West Highway
Silver Spring, MD 20910

Tomoharu Eguchi
Dept. of Biology
Montana State University
310 Lewis Hall
Bozeman, Montana 59717-0346

Dan Goodman
Environmental Statistics Group
Montana State University
Bozeman, Montana 59717

Phil Hammond
Sea Mammal Research Unit
University of St. Andrews
St Andrews KY16 8LB
United Kingdom

Aleta Hohn
NMFS-SEFSC Beaufort Lab
101 Pivers Island Rd.
Beaufort, NC 28516

Carrie Hubard
NMFS-SEFSC Pascagoula Lab
3209 Frederic Street
Pascagoula, MS 39567

Keith Mullin
NMFS-SEFSC Pascagoula Lab
3209 Frederic Street
Pascagoula, MS 39567

James Powell
FL Dept. of Environmental Protection,
100 Eighth Ave. SE
St. Petersburg, FL 33701

Andrew Read
Duke University Marine Lab
135 Duke Marine Lab Rd.
Beaufort, NC 28516-9721

John Reynolds
Marine Science and Biology Dept.
Eckerd College
4200 54th Ave. South
St. Petersburg, Florida 33711

Patricia Rosel
NMFS-SEFSC
219 Fort Johnson Rd.
Charleston, SC 29412

APPENDIX 2. WORKSHOP PARTICIPANTS

Steven Swartz
NMFS-SEFSC Miami Lab
75 Virginia Beach Dr.
Miami, FL 33149

Barbara Taylor
NMFS-SWFSC
8604 La Jolla Shores Drive
P.O. Box 271
La Jolla, California 92038-0271

Kim Urian
NMFS-SEFSC Beaufort Lab
101 Pivers Island Rd
Beaufort, NC 28515

Dave Weller
c/o NMFS-SWFSC
8604 La Jolla Shores Drive
P.O. Box 271
La Jolla, California 92038-0271

Randall S. Wells
Chicago Zoological Society
C/O Mote Marine Laboratory
1600 Thompson Parkway
Sarasota, Florida 34236

DATA CALL - REQUEST FOR INFORMATION

Gulf of Mexico Bottlenose Dolphin Stock Identification Program

Dear Colleague:

The National Marine Fisheries Service, Southeast Fisheries Science Center (SEFSC) is planning to convene a workshop in the spring of 2000 to assess the current status of information on bottlenose dolphin populations in the Gulf of Mexico region, and to develop a research plan to address the question of bottlenose dolphin stock structure in the Gulf of Mexico and the biological basis for management units under the Marine Mammal Protection Act (MMPA).

As a first step, we want to contact individual researchers that are currently studying bottlenose dolphin populations in the Gulf of Mexico, and/or that hold information from previous research that would be relevant to the question of stock identification. Once compiled, this inventory will be used to assess the status of current information on bottlenose dolphins in the Gulf of Mexico, and as the basis for developing a comprehensive research strategy to fill data gaps and gather the appropriate information to develop stock models for the Gulf populations.

If you are interested in cooperating in a Gulf-wide collaborative effort to investigate bottlenose dolphin stock structure and/or would like to continue to be kept informed on the progress of this project, please complete the attached questionnaire and return it by February 4, 2000.

BACKGROUND

Bottlenose dolphins (Tursiops truncatus) are distributed continuously throughout the continental shelf, coastal, and bay-sound-estuary waters of the northern Gulf of Mexico and along the western U.S. mid-Atlantic coast. Over the years, numerous independent research programs have examined local bottlenose dolphin populations in the Gulf. These efforts have generated significant amounts of information on bottlenose dolphins in some locales, including data on distribution, abundance, movements, genetics and behavior. What is needed is an integration of these data, including identification of data gaps and areas of additional research, to develop an acceptable interpretation of stock structure that will adequately serve as the basis of "management units" for the conservation and assessment of status of this species in the Gulf of Mexico.

Bottlenose dolphins are in competition with humans for habitat, and are known to be taken in some fisheries including the Gulf of Mexico menhaden fishery, crab pot fisheries, and occasionally in shrimping operations. In some parts of the Gulf of Mexico they are also subject

to “swim with” programs, are illegally fed artificial diets by tourists, are hit by recreational and other vessels, and suffer from unusual mortality events or “die offs” from microbial infections and other causes.

The objective of management under the MMPA is to maintain bottlenose dolphins as functioning components of their ecosystem throughout their full range. Management units under the MMPA are based on stock structure coupled with specific management objectives. Thus, to effectively manage the species, the structure of the bottlenose dolphin population in terms of its component “biological stocks” must be understood. Towards this goal, stock identification research was initiated in the U.S. western mid-Atlantic in 1998 and will continue through 2000. The findings of these studies will be analyzed in the context of population genetics, rates of exchange, unique morphology, seasonal movements, etc. to discern distinct “stock” units and their relationship to the overall population.

The SEFSC recognizes the need for a coordinated collaborative Gulf-wide research program similar to that in place in the Mid-Atlantic to generate information to evaluate stock structure and status of bottlenose dolphins in the Gulf of Mexico. Information on abundance, trends, genetic distinctness, morphology, ranging patterns, and rates of interbreeding, etc. will serve as the biological basis for defining management units for this species in the Gulf of Mexico. This same information can be used to define “distinct population segments” for Population Viability Analyses (PVA) in the context of the Endangered Species Act (ESA), should such apply to bottlenose dolphins in the future. Such a research program will need to build on existing information from the Gulf of Mexico, identify data and research gaps, and guide future research to assure that sufficient relevant information are available to define individual “stocks” for management purposes.

To initiate the development of a bottlenose dolphin research plan for the Gulf of Mexico, the SEFSC will convene a workshop from 14-15 March 2000 to review the current state of knowledge of bottlenose dolphin stock structure in the Gulf of Mexico, discuss relevant stock structure models, and develop a research plan that will build on existing information and guide additional new research to address questions of stock structure. The workshop was endorsed and suggested by the Atlantic Scientific Review Group at its November 1998 and April 1999 meetings as a necessary step for developing a coordinated collaborative bottlenose dolphin stock identification program in the Gulf of Mexico.

The primary goal of this workshop is to develop a research strategy that will allow the identification of distinct “stocks” of bottlenose dolphins that populate the Gulf of Mexico. These “stock” units will serve as the basis for identifying and defining “management units”.

APPENDIX 3. LETTER TO PARTICIPANTS

The objectives of the workshop are:

1. Review and assess the available information on the distribution, abundance, trends, movements, genetics, and other relevant topics of bottlenose dolphin populations in the Gulf of Mexico.

2. Bring together population geneticists, population modelers, and biologists with expertise on bottlenose dolphins to discuss approaches to stock structure interpretation, conceptual population and stock structure models, and develop such concepts as may be applicable to bottlenose dolphin stock structure.

3. Identify spatial and methodological data gaps (i.e., where and what kind of additional information will be needed) and preferred research approaches (e.g., photographic identification, genetic sampling, radio-tagging and tracking, morphology, stable isotope analyses, etc.) required to evaluate alternative population models of stock structure for bottlenose dolphins in the Gulf of Mexico.

4. Develop a research strategy that will guide future research to address the goal of defining bottlenose dolphin “stocks” in the Gulf of Mexico.

5. Propose a cooperative/collaborative Gulf-wide research program and network for future implementation.

DATA REQUEST

Many individuals and organizations have undertaken studies of bottlenose dolphin in previous years, and the existing information from these studies forms the basis for developing a collaborative Gulf-wide stock identification program. We are asking that individual researchers currently studying bottlenose dolphin populations in the Gulf of Mexico, and/or that hold information from previous research that would be relevant to the question of stock identification, contact us and summarize the nature and extent of the information that they have collected. Once compiled, this inventory will be used to assess the status of current information on bottlenose dolphin in the Gulf of Mexico, and as the basis for developing a comprehensive research strategy to fill data gaps and gather the appropriate information to develop stock models for the Gulf populations.

If you are interested in cooperating in a Gulf-wide collaborative effort to investigate bottlenose dolphin stock structure and/or would like to continue to be kept informed on the progress of this project (e.g., receive a copy of the inventory of existing data), please complete the following questionnaire by **February 4, 2000** and return it to:

Ms. Carrie Hubard
NOAA Southeast Fisheries Science Center
Mississippi Laboratory
3209 Frederic Street
Pascagoula, MS 39567

If you have any questions concerning the workshop or this form, please contact Carrie Hubard at chubard@triton.pas.nmfs.gov or (228) 762-4591 ext. 208.

If you know of colleagues that have conducted relevant bottlenose dolphin research in the Gulf of Mexico and did not receive a copy of this form, please forward a copy of the questionnaire to them, or send us their name and address so that we can reach them.

Thank you for your time and interest.

REQUEST FOR INFORMATION
Gulf of Mexico Bottlenose Dolphin Stock Identification Program

INFORMATION SUMMARY FORM

Please complete the following questionnaire by **February 4, 2000** and return it to:

Ms. Carrie Hubard
NOAA Southeast Fisheries Science Center
Mississippi Laboratory
3209 Frederic Street
Pascagoula, MS 39567
Telephone 228-762-4591 ext. 208
FAX No. 228-769-9200

Name:_____

Affiliation:_____

_____

Address:_____

Phone number:_____

E-mail:_____

Please check off the following:

1. What are the major objectives of your bottlenose dolphin research:

_____1. Abundance estimation
_____2. Seasonal distribution and movements
_____3. Stock structure
_____4. Genetics
_____5. Behavior
_____6. Other_____

2. Describe your research area(s) (e.g., specific location names and approximate size):
_____

3. Check the type of habitat found in your research area:

_____1. Bay
_____2. Sound
_____3. Open Gulf of Mexico
_____4. Other - describe _____

4. List the years and/or seasons that your research been conducted and for which you have data:
_____

5. What types of data have you collected, and how many samples, individuals etc?

_____1. Photo-id – # of individuals in collection? _____
_____2. Distribution
_____3. Genetic- # samples?_____
_____4. Acoustic - # samples – hours of recordings ?_____
_____5. Parasites- # Samples?_____
_____6. Morphometrics # Samples?_____
_____7. Contaminants- # Samples?_____
_____8. Telemetry- # Samples?_____
_____9. Stable isotope ratios- # Samples?_____
_____10. Other: Describe_____

6. What methods have you used to collect this data?
_____1. Strandings
_____2. Live captures
_____3. Biopsies
_____4. Photo ID
_____5. Freeze brands
_____6. Other tags, describe_____
_____7. Line transect surveys
_____8. Other search surveys: describe_____
_____9. Radio and/or satellite tracking
_____10. Focal animals observations
_____11. Other: describe_____

7. Have you observed any seasonal migration or movement patterns in your research?
_____ No.
_____ Yes:

8. If yes to No. 7, have these findings been published?
____No ____Yes

9. If yes to No. 8, please provide primary publication reference(s):_____
_____

10. Have you observed emigration (dispersal) and/or immigration within the dolphin population that you have studied?
_____ No.
_____ Yes. If yes, please provide the primary published reference(s): _____
_____

11. Have you observed any human-caused problems (e.g. harassment) or documented mortality resulting from human interaction of bottlenose dolphins in your study area:

_____ 1. No.
_____ 2. From personal watercraft
_____ 3. From boat traffic
_____ 4. From habitat loss or degradation
_____ 5. From fishery interactions: describe
fishery:_____

12. If you have developed theories on how bottlenose dolphin stocks are organized in your area, please describe these briefly on a single separate page and return it with this questionnaire.

13. Please briefly describe your plans for future research on bottlenose dolphin in the Gulf of Mexico:

14. On a separate sheet, please provide a complete listing of your bottlenose dolphin publications that are relevant to the topic of this workshop – stock structure of bottlenose dolphin in the Gulf of Mexico.

Thank you for your contribution.

12. If you have developed theories on how bottlenose dolphin stocks are organized in your area, please describe these briefly.

Western Gulf

Linda-Jane Smith, Texas A&M University, University of Texas Medical Branch
The twenty-eight marked adult and juvenile dolphins with site fidelity for the San Luis Pass-Chocolate Bay area appear to remain year round. They are most commonly found just outside the pass or at the pass in the colder months, and in Chocolate Bay or at the pass in the warmer months. The animals sighted in the Gulf of Mexico are considered to be "transient". They do interact with the resident animals in the Gulf.

David Weller, Texas A&M University, NMFS SWFSC
Resident animals in bay systems, transient animals along Gulf Coast

Central Gulf

Carrie Hubard, NMFS SEFSC
Mississippi Sound is a relatively open environment which large numbers of bottlenose dolphins utilize. Abundance appears to be strongly correlated with season; there are almost twice as many dolphins in the Sound in the summer than there are in the fall and winter. It is quite probable that the dolphins move south into the Gulf during the colder months. Photo-ID results have shown evidence of long term site fidelity; some animals have been seen consistently 4 years in a row and whereas other dolphins freeze branded in 1982 have been resighted in the 1990's, 15-17 years later. Most likely the bottlenose dolphin stock structure in Mississippi Sound is a complicated mix of year round residents and other migratory or transient dolphins.

Eastern Gulf

Randall Wells, Chicago Zoological Society, Sarasota Dolphin Research Program
Bottlenose dolphins are distributed relatively continuously along the central west coast of Florida, through the bays, sounds, and estuaries, and in Gulf of Mexico coastal waters to the west of the barrier island chains. Continuing studies initiated in 1970 using tagging, radio telemetry, photographic identification, and genetics have been examining aspects of stock identification and structure for bottlenose dolphins in the region. Most of the research has focused on Sarasota Bay and vicinity, though additional photographic identification and genetic sampling efforts have been conducted from Tampa Bay southward through Pine Island Sound, and up to five miles offshore of the barrier islands.

Stock structure in this region appears to be complex. Identified dolphins fit patterns ranging from long-term residency to brief appearances in the area. In Sarasota Bay, long-term, year-round residency by about 100-120 dolphins is the predominant pattern (Irvine and Wells 1972, Irvine et al. 1981, Scott et al. 1990, Wells 1991, Wells et al. 1999). Nearly half of the dolphins first identified in 1970-1971 were seen during 1999-2000, along with three subsequent generations of related dolphins (some individuals have been observed more than 600 times over three decades). The dolphins of Sarasota Bay appear to exist in a community of individuals that share the same general home range and pool of social associates (Wells 1986, Wells et al. 1987). Community membership is roughly determined on the basis of members spending more time within a definable home range (> 50%) than outside of it, and their social associations more often involve other dolphins that regularly use this home range (> 50%) than dolphins regularly using other ranges. The Sarasota community's range extends from southern Tampa Bay southward through Sarasota Bay, and into the Gulf of Mexico about 1 km. The ranges of the Sarasota Bay dolphins overlap others to the north, south, and offshore (Wells 1986, Wells et al. 1996a, 1996b, 1997, Fazioli and Wells 1999). Sarasota residents are observed outside of this range from time to time, especially adult males. A few individuals occasionally disappear for periods of days, weeks, months, or years before being resighted in the area. Other individuals appear to simply be passing through the area, and are seen only during a brief period. Immigration and emigration through the 1980's were estimated to be about 3%, but since about 1996 there has been an influx of new adult and juvenile animals into Sarasota Bay, some originating in Tampa Bay, others from the Gulf. At the same time, some core area use by long-term residents has also shifted within the community home range. While the fact that these changes to a previously stable situation correlate with the implementation of the state net ban is suggestive, but not conclusive.

Other long-term (> 10 years) resident dolphins have been identified in the waters of Tampa Bay (Wells et al 1996a), Charlotte Harbor (Wells et al. 1996b), Pine Island Sound (Wells et al. 1997) and the Gulf (Fazioli and Wells 1999). Many individuals have been seen too few times during the limited field efforts in these areas to be able to clearly identify residency patterns. However, movements of dolphins between these regions are unusual, and typically involve only individuals or small groups. Efforts are currently underway to examine the more extensive database from Tampa Bay (Urian in prep).

Genetic studies suggest a biological basis to the community structure indicated for Sarasota Bay and surrounding waters (Duffield and Wells 1986, 1991, in press). Distributions and frequencies of mtDNA haplotypes through the inshore waters of the SEUS and within our central west coast study area show gradations through the basin, and clusters within regions and social units. Preliminary paternity

testing indicates that up to 30% of Sarasota calves may be sired by males from outside of Sarasota Bay.

Relating the documented ranging patterns, social patterns, and genetic findings to stock structure requires a clear definition of "stock" by the NMFS. If stocks are identified for management purposes as involving combinations of bays, sounds and estuaries, what will this mean regarding the potential for large-scale takes being allowed from small long-term stable, multigenerational resident units in individual bays?

Gulf-wide

Debbie Duffield, Portland State University

1. I think that the evidence is good that there are resident and migratory "groups." I believe that the genetic structures of these two are different as a consequence of their social organizations (and that these social organizations are different, as well).

2. I think that there are layers of *Tursiops* "population" units that have ecologically significant differences - and that these also influence social organization and therefore genetic structure. I see the possibility for more than two ecological distinctions among "migratory" groups. This may be related to use of particular depth contours and prey distribution patterns. In other words, there may be a series of populations doing slightly different things: resident, near-shore, further off-shore, etc. out to the very distinctive Atlantic off-shore forms.

3. In all my studies there is evidence of gene flow between "groups." We see evidence of gene flow from outside the Sarasota population into this population and it is a substantial proportion (30-40%). We see this both in paternity studies and in biochemical genetic studies where the heterozygosity levels are very high. In areas where I see evidence of distinction between "groups" using that area, there is also evidence of their interacting with each other - a very good possibility for reproductive exchange as well. We see reproductive exchange of off-shore *Tursiops* (the Atlantic off-shores) into the Gulf at a low but detectable rate and we see evidence of introgression between species such as *Stenella* and *Tursiops*.

4. To-date, there have not been any consistent studies of all regions and "layers" of these dolphins - so we are still in the position of trying to make our generalizations on bits and pieces (even though some of these are very well developed, such as Randy's long-term study of the Sarasota dolphins; and possibly the Indian River dolphins). Defining "population" is difficult because with mobile animals, boundaries are difficult to set and there is clearly evidence of reproductive exchange. However, we don't have enough information to say exchange with which groups. Randy and I have seen evidence in the mtDNA

work that we have been doing that “exchange” does not occur throughout the entire range possible, but that it certainly does occur within certain regions.

5. I think our chore is finding a useful and flexible concept of “reproductive units” that allows us to make some sense of their habitat use and movement patterns, incorporating the potential for reproductive exchange and hoping to delineate some useful stock definitions that make for practical management decisions.

13. Please briefly describe your plans for future research on bottlenose dolphin populations in the Gulf of Mexico.

Western Gulf

Daniel F. Cowan, University of Texas Medical Branch, Dept. of Pathology
Continue to examine stranded dolphins; determine cause of stranding, disease associations, contaminant load (metals, organics).

Dagmar Fertl, Minerals Management Service
Would be interested in pursuing a behavioral ecology of Louisiana *Tursiops s*tudy.

Katherine Maze, formerly of Texas A&M University
For San Luis Pass area: patterns of social affiliation, 1995-present

Linda Price-May, Texas A&M University- Corpus Christi
When funding is found we plan to continue identifying and observing dolphin population use of the Aransas Pass to Port Mansfield area including use of the ICWW. Proposals for genetics and acoustical work are also in prep. Funding for work in this area of the Gulf has been sparse to nonexistent.

Linda-Jane Smith, Texas A&M University, University of Texas Medical Branch
I am continuing low level monitoring of this area (San Luis Pass, Chocolate Bay) and will eventually analyze this data with mark-recapture statistics to evaluate this method as a means of long term follow-up of this population.

David Weller, Texas A&M University, NMFS SWFSC
Photographic comparisons between Texas study sites to examine movement patterns. Complete in progress analysis of South Padre Island database. Synthesize all data collected along Texas coast in one comprehensive book chapter or review article.

Bernd Würsig, Texas A&M University
My students and I will continue to describe numbers, habitat use, and behavior of bottlenose dolphins in coastal Texas. We hope to expand our knowledge of population discreteness with upcoming analyses of an ongoing now 10 year old data base.

Central Gulf

Don Baltz/Cara Miller, Louisiana State University

We are in the initial stages of a 3-year study to characterize the microhabitat and behavior preferences of the bottlenose dolphin population in the northern Gulf of Mexico (Barataria Bay, Caminada Bay). Our study is based on photo-ID so an estimate of abundance (seasonality also), association patterns, and general stock structure will also be assessed.

Carrie Hubard, NMFS SEFSC Pascagoula

Currently only opportunistic data are being collected on Mississippi Sound bottlenose dolphins. With >690 dolphins cataloged and boat based line transect abundance estimates dating back to 1985, we have established an extensive database. It would be worthwhile to continue the photo-ID and line transect work to further examine distribution, home ranges, social structure, and to monitor for changes in abundance. The addition of other methodologies such as biopsy sampling may assist in elucidating stock structure.

Wanda Jones, NMFS SEFSC Panama City, University of Florida

Funding permitting, I would be interested in conducting more inshore behavioral research, communication research, movement pattern (seasonal and daily), abundance surveys, distribution, genetics, and offshore populations behavior and movement patterns within the areas that my present research is being conducted (Cape San Blas to east Destin pass).

Forrest Townsend, Jr., Bay Hospital for Animals

The photo-ID slides and data sheets were sent to Dr. Randy Wells last year for study and cataloging. We continue to work with the stranding cases in this area (eastern Choctaw Bay to Destin pass).

Eastern Gulf

Jennifer Lewis, University of Alabama

I will be conducting behavior and photo-ID work in Old Tampa Bay each season of 2000. I am interested in expanding photo-ID in lower Keys in the future.

John Reynolds III, Eckerd College

genetics; contaminant analyses; fatty acid signatures; continued photo-id; comparisons of populations estimates from aerial and boat-based surveys; association patterns; continuation of collaboration with Mote Marine Laboratory

Randall Wells, Chicago Zoological Society, Sarasota Dolphin Research Program

The following are research projects that are either underway or are planned, but not yet implemented because of lack of funding:

a. Continue long-term monitoring of Sarasota dolphin community (NMFS, Earthwatch support).

b. Complete genetic analyses of archived blood samples from Sarasota Bay and vicinity, interpret relative to long-term sighting and social data.

c. Complete stock structure analyses for dolphins in Tampa Bay, based on sighting data (Kim Urian, Sarasota Dolphin Research Program, UNC Wilmington).

d. Collect and analyze genetic samples and photographic identifications of *Tursiops* in Gulf of Mexico coastal waters, $\leq$ 5 miles from shore, matched to Fazioli photo-ID study area (Anna Sellas, UC Santa Cruz, Mote Marine Laboratory).

e. Collect and analyze genetic samples and photographic identifications of *Tursiops* over the continental shelf, > 5 miles from shore (Dr. Robert Griffin, Mote Marine Laboratory).

f. Initiate concurrent biopsy dart genetic sampling and photographic identification in previous photo-ID study areas: Tampa Bay, Lemon Bay, Charlotte Harbor, and Pine Island Sound.

g. Initiate analyses of stable isotopes and fatty acid signatures from archived and new samples (Nelio Barros, Dana Wetzel, John Reynolds).

Gulf-wide

Nélio Barros, Hubbs-Sea World Research Institute

Analysis of food habits of bottlenose dolphins throughout the Gulf of Mexico (including samples collected during unusual mortality events); analysis of incidence of stomach parasites in the same area

Debbie Duffield, Portland State University

My hope is to continue genetic evaluation of stock and population structure of *Tursiops* and related species throughout their range, including the Gulf of Mexico. The tools I am using include, protein electrophoresis, chromosome analysis, mtDNA haplotype analysis, DNA fingerprinting, DNA microsatellite analysis, and myoglobin-hemoglobin molecular weight analysis. I receive samples regularly from field studies (my primary field study currently is that of Randy Wells in Sarasota; but I do receive samples for comparison from other field

studies being conducted in the U.S.), from stranding networks and from facilities holding and breeding dolphins. This latter source makes it possible to document genetic markers from a variety of capture locations and to verify markers for paternity studies in the wild.

My specific interests are:

a. population and social unit structure of resident groups as compared with migratory groups - as reflected in their genetic similarities and differences
b. genetic analysis of mating system
c. patterns of gene flow between "populations"
d. evidence and quantification of introgression between related species.

Patricia Rosel, NMFS SEFSC Charleston

To date, we have not started any genetic stock ID work in the Gulf of Mexico, as we are currently focusing on the Atlantic. We plan to use information gained from the work in the Atlantic to examine genetic stock ID in the Gulf. A critical factor in being able to do this will be a well-planned sampling scheme in the Gulf.

9. Please provide primary publication reference(s) on any observed seasonal migration or movement patterns.

Bräger, S. 1992. Site fidelity and association patterns of the bottlenose dolphin, *Tursiops truncatus.* M.Sc. thesis. Christian-Albrechts-Univerisitat, Kiel, Germany. 97 pp.

Doty, S.M., E.A. Forys, J.E. Reynolds, III, and R.S. Wells. 1998. Analysis using GIS of home range characteristics and habitat use by bottlenose dolphins, *Tursiops truncatus*, in Boca Ciega Bay, Florida, and surrounding waters. Proceedings of the Sixth Annual Atlantic Coastal Dolphin Conference, Sarasota, FL. 1-3 May.

Duffield, D.A., R. Wells, E.D. Asper, D.K. Odell, M. Solangi. Understandings of bottlenose dolphin population structure from biochemical studies, 1979-1987. Stock workshop held in Pascagoula, MS 1987.

Duffield, D.A. 1980. Electrophoretic comparison of genetic variability in *Tursiops.* In: HSWRI Tech. Rept. #80-122. Ed. E.D. Asper and D.K. Odell.

Duffield, D.A. 1982. Indian River *Tursiops*: genetic studies. *in* Live Capture, Marking and Resighting of Bottlenose Dolphins, *Tursiops truncatus*. Rept. NMFS Contract NA80-GA-C-00063:312-324.

Duffield, D.A. 1986. Investigation of Genetic Variability in Stocks of the Bottlenose Dolphin (*Tursiops truncatus*) and the Loggerhead Sea Turtle (*Caretta caretta*). NMFS Tech. Rept. NA83-GA-C-00036.

Duffield, D.A. and R.S. Wells. 1986. Population structure of bottlenose dolphins: Genetic studies of bottlenose dolphins along the central west coast of Florida. Contract Rept. to National Marine Fisheries Service, Southeast Fisheries Center. Contract No. 45-WCNF-5-00366. 10 pp.

Duffield, D.A. and R.S. Wells. 1991. The combined application of chromosome, protein and molecular data for the investigation of social unit structure and dynamics in *Tursiops truncatus*. Pages 155-169 *in* A.R. Hoelzel, ed. Genetic Ecology of Whales and Dolphins. Report of the International Whaling Commission, Special Issue 13, Cambridge, U.K.

Duffield, D.A. and R.S. Wells. In press. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. *in* C.J. Pfeiffer, ed., Molecular and Cell Biology of Marine Mammals. Krieger Publishing Company, Melbourne, FL.

Duffield, D.A., J.S. Lenox and R.S. Wells. In prep. Geographical distribution of mitochondrial DNA Hinf I haplotypes in bottlenose dolphins of the Gulf of Mexico and southeastern U.S. Atlantic coastal waters.

Eide, S.D., M.E. Bolen, S. Carlson, S.M. Doty, E.A. Forys, J.M. Odell, K.A. Thoms, and J.E Reynolds, III. 1997. Assessment and habitat use of bottlenose dolphins, *Tursiops truncatus*, in Boca Ciega Bay, Florida. Proceedings of the 5th Annual Atlantic Coast Dolphin Conference, Wilmington, N.C. 4-6 April.

Fertl, D. 1994. Occurrence patterns and behavior of bottlenose dolphin (*Tursiops truncatus*) in the Galveston Ship Channel. Texas Journal of Science 46(4): 299-317.

Fertl, D.C. 1994. Occurrence, movements and behavior of bottlenose dolphins (*Tursiops truncatus*) in association with the shrimp fishery in Galveston Bay, Texas. M.Sc. thesis. Texas A&M University, College Station.

Hubard, C.W. 1998. Abundance, distribution, and site fidelity of bottlenose dolphins in Mississippi Sound, Mississippi. M.Sc. thesis, University of Alabama, Tuscaloosa. 101 pp.

Maze, K.S. and B. Würsig. 1999. Bottlenose dolphins of San Luis Pass, Texas: occurrence patterns, site-fidelity, and habitat use. Aquatic Mammals 25(2): 91-103.

Mullin, K.D. 1988. Comparative seasonal abundance and ecology of bottlenose dolphins (*Tursiops truncatus*) in three habitats of the north-central Gulf of Mexico. Ph.D. dissertation, Mississippi State University, Starkville. 135 pp.

Quintana-Rizzo, E. 1999. Associations and habitat use of resident and non-resident bottlenose dolphins in the Cedar Keys, Florida. M.Sc. thesis, University of Florida. Gainesville, FL

Shane, S.H. 1977. The population biology of the Atlantic bottlenose dolphin, (*Tursiops truncatus*) in the Aransas Pass area of Texas. M.Sc. thesis. Texas A&M University, College Station, TX 239 pp.

Shane, S.H. 1980. Occurrence, movements, and distribution of bottlenose dolphin, *Tursiops truncatus*, in southern Texas. Fishery Bulletin 78:593-601.

Shane, S.H. 1987. The behavioral ecology of the bottlenose dolphin. Ph.D. dissertation. University of California, Santa Cruz, CA. 97 pp.

Shane, S.H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. Pages 245-264 *in* S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation, Texas A&M University, College Station, TX. 142 pp.

10. Please provide primary published reference(s) on emigration (dispersal) and/or immigration within the dolphin population that you have studied.

Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (*Tursiops truncatus*). Marine Mammal Science 9: 434-440.

Duffield, D.A. and E.O. Espinoza. 1999. Electrospray ionization mass spectrometric analysis of hemoglobin and myoglobin for differentiation of marine mammal species. Society for Marine Mammalogy. Maui, Hawaii. 28 November – 3 December.

Duffield, D.A. and R.S. Wells. 1991. The combined application of chromosome, protein and molecular data for the investigation of social unit structure and dynamics in *Tursiops truncatus*. Pages 155-169 *in* A.R. Hoelzel, ed. Genetic Ecology of Whales and Dolphins. Report of the International Whaling Commission, Special Issue 13, Cambridge, U.K.

Duffield, D.A. and R.S. Wells. In press. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. *in* C.J. Pfeiffer, ed. Molecular and Cell Biology of Marine Mammals. Krieger Publishing Company, Melbourne, FL.

Duffield, D.A., J.S. Lenox and R.S. Wells. In prep. Geographical distribution of mitochondrial DNA Hinf I haplotypes in bottlenose dolphins of the Gulf of Mexico and southeastern U.S. Atlantic coastal waters.

Eide, S.D. and J.E. Reynolds, III. 1998. Correlations between bottlenose dolphin (*Tursiops truncatus*) and presence of calves in Boca Ciega Bay, Florida and the Florida State ban on commercial netting. Proceedings of the World Mammal Science Conference, Monaco, 20-24 January.

Hersh, S.L. and D.A. Duffield. 1990. Distinction of Northwestern Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-142 *in* S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, California.

Shane, S.H. 1977. The population biology of the Atlantic bottlenose dolphin, (*Tursiops truncatus*) in the Aransas Pass area of Texas. M.Sc. thesis. Texas A&M University, College Station, TX 239 pp.

Shane, S.H. 1980. Occurrence, movements, and distribution of bottlenose dolphin, *Tursiops truncatus*, in southern Texas. Fishery Bulletin 78:593-601.

Shane, S.H. 1987. The behavioral ecology of the bottlenose dolphin. Ph.D. dissertation. University of California, Santa Cruz, CA. 97 pp.

Shane, S.H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. Pages 245-264 *in* S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation, Texas A&M University, College Station, TX. 142 pp.

14. Please provide a complete listing of your bottlenose dolphin publications that are relevant to the topic of this workshop.

Forthcoming Articles

Connor, R.C., R.S. Wells, J. Mann and A.J. Read. In press. The bottlenose dolphin, *Tursiops* spp: Social relationships in a fission-fusion society. *in* P.L. Tyack, R.C. Connor, and J. Mann, eds., Dolphins and Whales: Field Studies of Behavior. University of Chicago Press.

Duffield, D.A. and R.S. Wells. In press. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. *in* C.J. Pfeiffer, ed., Molecular and Cell Biology of Marine Mammals. Krieger Publishing Company, Melbourne, FL.

Duffield, D.A., J.S. Lenox and R.S. Wells. In prep. Geographical distribution of mitochondrial DNA Hinf I haplotypes in bottlenose dolphins of the Gulf of Mexico and southeastern U.S. Atlantic coastal waters.

Duffield, D.A., R.S. Wells, J. Chamberlin-Lea and J.S. Lenox. In prep. Population structure of a coastal resident population of bottlenose dolphins: I. Evaluation of kinship by chromosome heteromorphisms and mitochondrial DNA.

Fertl, D. and D. Weller. In prep. Bottlenose dolphin (*Tursiops truncatus*) mother/calf occurrence and behavior in the Galveston Ship Channel (Texas).

Gunter, K.A., D.A. Duffield, R.S. Wells and J. Chamberlin-Lea. In prep. Population analysis in bottlenose dolphins using R-band chromosome heteromorphisms. (and in thesis form)

Nowacek, S. M. and R. S. Wells. In review. The effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. Marine Mammal Science.

Pabst, D.A., W.A. McLellan, A.J. Read, R.S. Wells, and A.S. Friedlaender. In review. Conservation plan for the Atlantic coastal stock complex of bottlenose dolphins, *Tursiops truncatus*. Draft report to National Marine Fisheries Service.

Reynolds, J.E. III, R.S. Wells and S.D. Eide. In press. Biology and conservation of the bottlenose dolphin. University of Florida Press.

Current Literature

Ackerman, B. B., T. D. Pitchford, B. L. Weigle, J. E. Reynolds III, R. S. Wells and M. A. Baran. 1999. Marine mammals. Chapter 11. Marine mammals. Pages 11-1 – 11-11 *in* J. R. Pribble, A. J. Janicki and H. Greening, eds., Baywide Environmental Monitoring Report, 1993-1998, Tampa Bay, Florida. Tampa Bay Estuary Program, Technical Publication 07-99. St. Petersburg, Florida. July 1999.

Barros, N.B. 1992. Food habits. Pages 41-46 *in* Hansen, L.J. (coordinator). Report on the investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. NMFS SEFSC Contribution MIA-9292.

Barros, N.B. and D.K. Odell. 1994. Bottlenose dolphins on the east coast of Florida: what do we know, what can we learn? Pages 64-67 *in* Wang, K.R., P.M. Payne and V.G. Thayer (compilers). Coastal stock(s) of Atlantic bottlenose dolphin: status review & management. NOAA Technical Memorandum NMFS-OPR-4. 121 pp.

Barros, N.B. and R.S. Wells. 1998. Prey and feeding patterns of resident bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Journal of Mammalogy 79(3):1045-1059.

Bassos-Hull, K., R.S. Wells and K.W. Urian. 1998. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Charlotte Harbor, Florida. Pages 163-170 *in* S.F. Treat ed., Proceedings: Charlotte Harbor Public Conference and Technical Symposium: March 1997. Published by the South Florida Water Management District and the Charlotte Harbor National Estuary Program, 4980 Bayline Drive, 4th Floor, North Fort Myers, FL 33917.

Blaylock, R.A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Technical Memorandum. NMFS-SEFSC-356, 10 pp.

Bräger, S. 1992. Site fidelity and association patterns of the bottlenose dolphin, *Tursiops truncatus.* M.Sc. thesis. Christian-Albrechts-Univerisitat, Kiel, Germany. 97 pp.

Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (*Tursiops truncatus*). Marine Mammal Science 9: 434-440.

Bräger, S., B. Würsig, A. Acevedo, and T. Henningsen. 1994. Association patterns of bottlenose dolphins (*Tursiops truncatus*) in Galveston Bay, Texas. Journal of Mammalogy 75(2): 431-437.

Defran, R.H., and D.W. Weller. 1999. The occurrence, distribution, and site fidelity of bottlenose dolphins (*Tursiops truncatus*) off San Diego, California. Marine Mammal Science, 15: 94-108.

Defran, R.H., G.A. Shultz, and D.W. Weller. 1990. A technique for the photographic identification and cataloging of dorsal fins of the bottlenose dolphin (*Tursiops truncatus*). Pages 53-55 *in* P.S. Hammond, S.A. Mizroch and G.P. Donovan, eds. Individual Recognition of Cetaceans: Use of Photo-Identification and Other Techniques to Estimate Population Parameters. International Whaling Commission, Cambridge.

Defran, R.H., Weller, D.W., Kelly, D., and Espinosa, M. 1999. Range characteristics of Pacific coast bottlenose dolphins (*Tursiops truncatus*) in the Southern California Bight. Marine Mammal Science 15: 109-121.

Duffield, D.A. 1980. Electrophoretic comparison of genetic variability in *Tursiops. in* HSWRI Tech. Rept. #80-122. Ed. E.D. Asper and D.K. Odell.

Duffield, D.A. 1982. Indian River *Tursiops*: genetic studies. *in* Live Capture, Marking and Resighting of Bottlenose Dolphins, *Tursiops truncatus*. Rept. NMFS Contract NA80-GA-C-00063:312-324.

Duffield, D.A. 1986. Investigation of Genetic Variability in Stocks of the Bottlenose Dolphin (*Tursiops truncatus*) and the Loggerhead Sea Turtle (*Caretta caretta*). NMFS Tech. Rept. NA83-GA-C-00036.

Duffield, D.A. and J. Chamberlin-Lea. 1990. Use of chromosome heteromorphisms and hemoglobins in studies of bottlenose dolphin populations and paternities. Pages 609-622 *in* S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, California.

Duffield, D.A. and R.S. Wells. 1986. Population structure of bottlenose dolphins: Genetic studies of bottlenose dolphins along the central west coast of Florida. Contract Rept. to National Marine Fisheries Service, Southeast Fisheries Center. Contract No. 45-WCNF-5-00366. 10 pp.

Duffield, D.A. and R.S. Wells. 1991. The combined application of chromosome, protein and molecular data for the investigation of social unit structure and dynamics in *Tursiops truncatus*. Pages 155-169 *in* A.R. Hoelzel, ed. Genetic Ecology of Whales and Dolphins. Report of the International Whaling Commission, Special Issue 13, Cambridge, U.K.

Duffield, D.A., and R.S. Wells.1993. A discussion on comparative data of wild and oceanarium *Tursiops* populations. Pages 28-39 *in* N.F. Hecker, ed. Proceedings of the 18th International Marine Animal Trainers Association Conference, November 4-9, 1990, Chicago, IL.

Duffield, D.A., S.H. Ridgway and L.H. Cornell. 1983. Hematology distinguishes coastal and offshore forms of dolphins (*Tursiops*). Canadian Journal of Zoology 61(4):930-933.

Duignan, P.J., C. House, D.K. Odell, R.S. Wells, L.J. Hansen, M.T. Walsh, D.J. St. Aubin, B.K. Rima and J.R. Geraci. 1996. Morbillivirus infection in bottlenose dolphins: Evidence for recurrent epizootics in the western Atlantic and Gulf of Mexico. Marine Mammal Science 12:499-515.

Fazioli, K. L. 1999. Distribution, relative abundance, and community structure of coastal bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico off Sarasota, Florida. M.Sc. Thesis, University of California, Santa Cruz. 106 pp.

Fazioli, K. L. and R. S. Wells. 1999. Stock structure of coastal bottlenose dolphins, *Tursiops truncatus*, near Sarasota, Florida. Final Contract Report to National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. Contr. No. 40-WCNF701806. 27 pp + 5 tables, 23 figures, 3 appendices.

Fertl, D.C. 1994. Occurrence, movements and behavior of bottlenose dolphins (*Tursiops truncatus*) in association with the shrimp fishery in Galveston Bay, Texas. M.Sc. thesis. Texas A&M University, College Station. 117 pp.

Fertl, D. 1994. Occurrence patterns and behavior of bottlenose dolphin (*Tursiops truncatus*) in the Galveston Ship Channel. Texas Journal of Science 46(4): 299-317.

Fertl, D. and S. Leatherwood. 1997. Cetacean interactions with trawls: a preliminary review. Journal of Northwest Atlantic Fishery Science 22: 219-248.

Gruber, J.A. 1981. Ecology of the Atlantic bottlenosed dolphin (*Tursiops truncatus*) in the Pass Cavallo area of Matagorda Bay, Texas. M.Sc. thesis, Texas A&M University, College Station. 182 pp.

Hansen, L.J., and R.S. Wells. 1996. Bottlenose dolphin health assessment: Field report on sampling near Beaufort, North Carolina, during July, 1995. NOAA Tech. Mem. NMFS-SEFSC-382, 24 pp.

Henningsen, T. 1991. On the distribution and ecology of the dolphin (*Tursiops truncatus*) in Galveston Bay, Texas. Diplom thesis. Christian-Albrechts-Univerisitat, Kiel, Germany. 80 pp.

Henningsen, T. and B. Würsig. 1991. Bottle-nosed dolphins in Galveston Bay, Texas: Numbers and activities. Pages 36-38 *in* P. G. H. Evans ed., European research on cetaceans - 5. Proceedings of the Fifth Annual Conference of the European Cetacean Society, Sandefjord, Norway, 21-23 February, 1991. Cambridge, UK.

Henningsen, T. and B. Würsig. 1992. Interactions between humans and dolphins in Galveston Bay, Texas. Pages 135-140 *in* Proceedings of the symposium Whales: Biology, Threats and Conservation, Brussels, 5-7 June 1991. J.J. Symoens, ed. Royal Academy of Overseas Sciences, Brussels.

Hersh, S.L. and D.A. Duffield. 1990. Distinction of Northwestern Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-142 *in* S. Leatherwood and R.R. Reeves, eds. The Bottlenose Dolphin. Academic Press, San Diego, California.

Hohn, A.A., M.D. Scott, R.S. Wells, J.C. Sweeney and A.B. Irvine. 1989. Growth layers in teeth from known-age, free-ranging bottlenose dolphins. Marine Mammal Science 5(4):315-342.

Hubard, C.W. 1998. Abundance, distribution, and site fidelity of bottlenose dolphins in Mississippi Sound, Mississippi. M.Sc. thesis, University of Alabama, Tuscaloosa. 101 pp.

Irvine, B. and R.S. Wells. 1972. Results of attempts to tag Atlantic bottlenose dolphins (*Tursiops truncatus*). Cetology 13:1-5.

Irvine, A.B., M.D. Scott, R.S. Wells, J.H. Kaufmann and W.E. Evans. 1979. A study of the activities and movements of the Atlantic bottlenose dolphin, *Tursiops truncatus*, including an evaluation of tagging techniques. NTIS PB-298-042, 54 pp.

Irvine, A.B., M.D. Scott, R.S. Wells and J.H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fishery Bulletin U.S.79:671-688.

Irvine, A.B., R.S. Wells and M.D. Scott. 1982. An evaluation of techniques for tagging small odontocete cetaceans. Fishery Bulletin. U.S. 80:135-143.

Kreho, A., N. Kehtarnavaz, B. Araabi, G. Hillman, B. Würsig, and D.W. Weller. 1999. Assisting manual dolphin identification by computer extraction of dorsal ratio. Annals of Biomedical Engineering, 27:830-838.

Lipscomb, T.P. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. Journal of Wildlife Diseases 30(4): 572-576.

Lynn, S.K. 1995. Movements, site fidelity, and surfacing patterns of bottlenose dolphins on the central Texas coast. M.S. thesis, Texas A&M University, College Station, TX. 92 pp.

Mate, B.R., K.A. Rossbach, S.L. Neukirk, R.S. Wells, A.B. Irvine, M.D. Scott and A.J. Read. 1995. Satellite-monitored movements and dive behavior of a bottlenose dolphin (*Tursiops truncatus*) in Tampa Bay, Florida. Marine Mammal Science 11(4):452-463.

Maze, K.S. 1997. Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site fidelity and habitat use. M.Sc. thesis, Texas A&M University, College Station, TX. 79 pp.

Maze, K.S. and B. Würsig. 1999. Bottlenose dolphins of San Luis Pass, Texas: occurrence patterns, site-fidelity, and habitat use. Aquatic Mammals 25(2): 91-103.

Moors, T. L. 1997. Is 'menage a trois' important in dolphin mating systems? Behavioral patterns of breeding female bottlenose dolphins. M.Sc. thesis, University of California, Santa Cruz. 95 pp.

Mullin, K.D. 1988. Comparative seasonal abundance and ecology of bottlenose dolphins (*Tursiops truncatus*) in three habitats of the north-central Gulf of Mexico. Ph.D. dissertation, Mississippi State University, Starkville. 135 pp.

Nowacek, S.M. 1999. The effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. M. Sc. Thesis, University of California, Santa Cruz. 42 pp.

Nowacek, S.M. and R.S. Wells. 1998. Evaluation of the potential impacts of boat use on a resident community of bottlenose dolphins (*Tursiops truncatus*) near Sarasota, Florida. Pages 94-10 *in* S.A. Rommel, J.E. Reynolds, III, and R.S. Wells, eds., Proceedings of the Sixth Annual Atlantic Coastal Dolphin Conference, May 1-3, 1998, Mote Marine Laboratory, Sarasota, Florida. 120 pp.

Quintana-Rizzo, E. 1999. Associations and habitat use of resident and non-resident bottlenose dolphins, *Tursiops truncatus* (Montagu 1821), in the Cedar Keys, Florida: Insights into social organization. M. Sc. Thesis, University of Florida, Gainesville. 149 pp.

Read, A.J., R.S. Wells, A.A. Hohn and M.D. Scott. 1993. Patterns of growth in wild bottlenose dolphins, *Tursiops truncatus*. Journal of Zoology 231:107-123.

Read, A.J., A.J. Westgate, K.W. Urian, R.S. Wells, B.M. Allen and W.J. Carr. 1996. Monitoring movements and health status of bottlenose dolphins in Beaufort, NC using radio telemetry. Final contract report to the National Marine Fisheries Service, Southeast Fisheries Science Center, Charleston, SC. Contract No. 40-GENF-500160. 37 pp.

Read, A.J., A.J. Westgate, R.S. Wells, D.M. Waples, B.M. Allen, M.D. Scott and A.A. Hohn. 1997. Testing attachment techniques for satellite transmitters on bottlenose dolphins near Sarasota, Florida. Contract Rept. to National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort Laboratory. Contr. No. 40ETNF700036.

Rhinehart, H.R., R.S. Wells, F.I. Townsend, J.C. Sweeney and D.R. Casper. 1991. Blood profiles of free-ranging bottlenose dolphins from the central west coast of Florida. Contract Rept. to National Marine Fisheries Service, Southeast Fisheries Center. Contract No. 40-WCNF-003060. 13 pp.

Rhinehart, H.R., R.S. Wells, F.I. Townsend, J.C. Sweeney and D.R. Casper. 1992. Blood profiles of free-ranging bottlenose dolphins from the central west coast of Florida: 1991-1992. Contract Rept. to National Marine Fisheries Service, Southeast Fisheries Center. Contract No. 40-WCNF-006083. 17 pp.

Sayigh, L.S., P.T. Tyack, R.S. Wells and M.D. Scott. 1990. Signature whistles of free-ranging bottlenose dolphins *Tursiops truncatus*: Stability and mother-offspring comparisons. Behavioral Ecology and Sociobiology 26:247-260.

Sayigh, L.S., P.L. Tyack, R.S. Wells, A.R. Solow, M.D. Scott and A.B. Irvine. 1999. Individual recognition in wild bottlenose dolphins: A field test using playback experiments. Animal Behaviour 57:41-50.

Scott, G.P., D.M. Burn, L.J. Hansen and R.E. Owen. 1989. Estimates of bottlenose dolphin abundance in the Gulf of Mexico from regional aerial surveys. CRD88/89-07.

Scott, M.D., R.S. Wells and A.B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pages 235-244 *in* S. Leatherwood and R.R. Reeves, eds., The bottlenose dolphin. Academic Press, San Diego, CA

Scott, M.D., R.S. Wells, A.B. Irvine and B.R. Mate. 1990. Tagging and marking studies on small cetaceans. Pages 489-514 *in* S. Leatherwood and R.R. Reeves, eds., The bottlenose dolphin. Academic Press, San Diego, CA.

Shane, S.H. 1977. The population biology of the Atlantic bottlenose dolphin, (*Tursiops truncatus*) in the Aransas Pass area of Texas. M.Sc. thesis. Texas A&M University, College Station, TX 239 pp.

Shane, S.H. 1980. Occurrence, movements, and distribution of bottlenose dolphin, *Tursiops truncatus*, in southern Texas. Fishery Bulletin 78:593-601.

Shane, S.H. 1987. The behavioral ecology of the bottlenose dolphin. Ph.D. dissertation. University of California, Santa Cruz, CA. 97 pp.

Shane, S.H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. Pages 245-264 *in* S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

Shane, S.H., R.S. Wells and B. Würsig. 1986. Ecology, behavior, and social organization of the bottlenose dolphin: A review. Marine Mammal Science 2(1):34-63.

Smultea, M. and B. Würsig. 1995. Bottlenose dolphin reactions to the Mega Borg oil spill. Aquatic Mammals 21: 171-181.

Thompson, N.B. 1981. Estimate of abundance of *Tursiops truncatus* in Charlotte Harbor, Florida. NOAA/NMFS/SEFSC/Miami Laboratory, Fishery Data Analysis Technical Report.

Tolley, K.A., A.J. Read, R.S. Wells, K.W. Urian, M.D. Scott, A.B. Irvine and A.A. Hohn. 1995. Sexual dimorphism in wild bottlenose dolphins (*Tursiops truncatus*) from Sarasota, Florida. Journal of Mammalogy 76(4):1190-1198.

Urian, K.W. and R.S. Wells. 1993. Identification of stranded bottlenose dolphins from the central west coast of Florida: 1991-1992. Contract Report to the National Marine Fisheries Service, Southeast Fisheries Center. Contract No. 40GENF200613. 4 pp.

Urian, K.W. and R.S. Wells. 1996. Bottlenose dolphin photo-identification workshop. Final contract report to the National Marine Fisheries Service, Southeast Fisheries Science Center, Charleston, SC. Contract No. 40-EUNF-500587.

Urian, K.W., D.A. Duffield, A.J. Read, R.S. Wells and D.D. Shell. 1996. Seasonality of reproduction in bottlenose dolphins, *Tursiops truncatus*. Journal of Mammalogy. 77:394-403.

Urian, K.W., K. Bassos-Hull and R.S. Wells. 1997. Low level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida. Pages 79-86 *in* S.F. Treat, ed., Proceedings: Tampa Bay Scientific Information Symposium 3; Applying Our Knowledge. Tampa Bay National Estuary Program.

Vedder, J. 1996. Levels of organochlorine contaminants in milk relative to health of bottlenose dolphins (*Tursiops truncatus*) from Sarasota, Florida. M.Sc. thesis, University of California, Santa Cruz. 35 pp.

Wang Ding, B. Würsig, and W. Evans. 1995. Comparisons of whistles among seven odontocete species. *in* R.A. Kastelein, J.A. Thomas and P.E. Nachtigall, eds., Sensory systems of aquatic mammals,. De Spil Press, Woerden, the Netherlands.

Wang Ding, B. Würsig, and W.E. Evans. 1995. Whistles of bottlenose dolphins: comparisons among populations. Aquatic Mammals 21:65-77.

Waples, D. M. 1995. Activity budgets of free-ranging bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay. M.Sc. thesis, University of California, Santa Cruz. 61pp.

Waring, G.T., D.L. Palka, P.J. Clapham, S. Swartz, M.C. Rossman, T.V.N. Cole, L.J. Hansen, K.D. Bisack, K.D. Mullin, R.S. Wells, D.K. Odell and N.B. Barros.1999. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments –1999. NOAA Technical Memorandum NMFS-NE-153.

Weller, D., V. Cockcroft, B. Würsig, S. Lynn, and D. Fertl. 1997. Behavioral responses of bottlenose dolphins to remote biopsy sampling and observations of surgical biopsy wound healing. Aquatic Mammals 23:49-58.

Weller, D.W. 1991. The social ecology of Pacific Coast bottlenose dolphins. M.A. Thesis, San Diego State University, CA. 92 pp.

Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation, Texas A&M University, College Station, TX. 142 pp.

Wells, R.S. 1986. Population structure of bottlenose dolphins: Behavioral studies of bottlenose dolphins along the central west coast of Florida. Contract Rept. to National Marine Fisheries Service, Southeast Fisheries Center. Contr. No. 45-WCNF-5-00366. 70 pp.

Wells, R.S. 1986. Structural aspects of dolphin societies. Ph.D. dissertation, University of California, Santa Cruz. 234 pp.

Wells, R.S. 1991. The role of long-term study in understanding the social structure of a bottlenose dolphin community. Pages 199-225 *in* K. Pryor and K.S. Norris, eds. Dolphin Societies: Discoveries and Puzzles. Univ. of California Press, Berkeley. 397 pp.

Wells, R.S. 1993. Parental investment patterns of wild bottlenose dolphins. Pages 58-64 *in* N.F. Hecker, ed. Proceedings of the 18th International Marine Animal Trainers Association Conference, November 4-9, 1990, Chicago, IL.

Wells, R.S. 1993. The marine mammals of Sarasota Bay. Chapter 9, pp. 9.1 - 9.23 *in* P. Roat, C. Ciciccolella, H. Smith, and D. Tomasko, eds. Sarasota Bay: 1992 Framework for Action. Published by the Sarasota Bay National Estuary Program, 1550 Thompson Parkway, Sarasota, FL 34236.

Wells, R.S. 1994. Determination of bottlenose dolphin stock discreteness: Application of a combined behavioral and genetic approach. Pages 16-20 *in* K.R. Wang, P.M. Payne, and V.G. Thayer (compilers), Coastal Stock(s) of Atlantic Bottlenose Dolphin: Status Review and Management. Proceedings and Recommendations from a Workshop held in Beaufort, NC, 13-14 September 1993. NOAA Technical Memorandum NMFS-OPR-4. 120 pp.

Wells, R.S. 1994. Progress Report: Bottlenose dolphin health assessment workshop. Contract report to National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. 11 pp.

Wells, R.S. and M.D. Scott. 1990. Estimating bottlenose dolphin population parameters from individual identification and capture-release techniques. Pages 407-415 *in* P.S. Hammond, S.A. Mizroch and G.P. Donovan, eds. Individual Recognition of Cetaceans: Use of Photo-Identification and Other Techniques to Estimate Population Parameters. Report of the International Whaling Commission, Special Issue 12, Cambridge, U.K. 440 pp.

Wells, R.S. and M.D. Scott. 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. Page 629 *in* W.F. Perrin, G.P. Donovan, and J. Barlow, eds. Gillnets and Cetaceans, Rep. Int. Whal. Commn (Special Issue 15.).

Wells, R.S. and M.D. Scott. 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Marine Mammal Science 13:475-480.

Wells, R.S. and M.D. Scott. 1999. Bottlenose dolphins *Tursiops truncatus* (Montagu, 1821). Pages 137-182 *in* S.H. Ridgway and R. Harrison, eds. Handbook of Marine Mammals, Vol. 6, the Second Book of Dolphins and Porpoises. Academic Press, San Diego, CA. 486 pp.

Wells, R.S., A.B. Irvine and M.D. Scott. 1980. The social ecology of inshore odontocetes. Pages. 263-317 *in* Herman, L.M., ed. Cetacean Behavior: Mechanisms and Functions. New York: J. Wiley & Sons, 463 pp.

Wells, R.S., M.D. Scott, A.B. Irvine and P.T. Page. 1981. Observations during 1980 of bottlenose dolphins, *Tursiops truncatus*, marked during 1970-1976, on the west coast of Florida. Contract Report to National Marine Fisheries Service, Contr. No. NA-80-GA-A-196, 29 pp.

Wells, R.S., M.D. Scott and A.B. Irvine. 1987. The social structure of free-ranging bottlenose dolphins. Pages 247-305 *in* Genoways, H., ed. Current mammalogy, Vol. 1. New York: Plenum Press.

Wells, R.S., L.J. Hansen, A. Baldridge, T.P. Dohl, D.L. Kelly and R.H. Defran. 1990. Northward extension of the range of bottlenose dolphins along the California coast. Pages 421-431 *in* S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. Academic Press, San Diego, CA.

Wells, R.S., M.K. Bassos, K.W. Urian, W.J. Carr and M.D. Scott. 1996. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Charlotte Harbor, Florida: 1990-1994. NOAA Tech. Mem. NMFS-SEFSC-384, 36 pp. + 8 Tables, 10 Figures, and 5 Appendices.

Wells, R.S., K.W. Urian, A.J. Read, M.K. Bassos, W.J. Carr and M.D. Scott. 1996. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Mem. NMFS-SEFSC-385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.

Wells, R.S., M.K. Bassos, K.W. Urian, S.H. Shane, E.C.G. Owen, C.F. Weiss, W.J. Carr and M.D. Scott. 1997. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Pine Island Sound, Florida: 1996. Final Contract Report to National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. Contr. No. 40-WCNF601958.

Wells, R.S., K. Bassos-Hull and K.S. Norris. 1998. Experimental return to the wild of two bottlenose dolphins. Marine Mammal Science 14:51-71.

Wells, R.S., S. Hofmann and T.L. Moors. 1998. Entanglement and mortality of bottlenose dolphins (*Tursiops truncatus*) in recreational fishing gear in Florida. Fishery Bulletin 96(3):647-650.

Wells, R.S., D.J. Boness and G.B. Rathbun. 1999. Behavior. Pages 324-422 *in* J.E. Reynolds, III and S.A. Rommel, eds., Biology of marine mammals. Smithsonian Institution Press, Washington, DC. 567 pp.

Wells, R. S., H. L. Rhinehart, P. Cunningham, J. Whaley, M. Baran, C. Koberna and D. P. Costa. 1999. Long-distance offshore movements of bottlenose dolphins. Marine Mammal Science. 15:1098-1114.

Wilson, B., H. Arnold, G. Bearzi, C. M. Fortuna, R. Gaspar, S. Ingram, C. Liret, S. Pribanic, A. J. Read, V. Ridoux, K. Schneider, K.W. Urian, R. S. Wells, C. Wood, P. M. Thompson and P. S. Hammond. 1999. Epidermal diseases in bottlenose dolphins: Impacts of natural and anthropogenic factors. Proceedings of the Royal Society of London B. 266(1423):1077-1083.

Würsig, B. and S.K. Lynn. 1996. Movements, site fidelity, and respiration patterns of bottlenose dolphins on the central Texas coast. NOAA Technical Memorandum. NMFS-SEFSC-383, 43 pp. + 10 Tables, 15 Figures, and 6 Appendices.

Relevant Presentations

Allen, J.B., S.D. Eide, E.A. Forys, and J.E. Reynolds. 1999. Changes in habitat use and population parameters for bottlenose dolphins (*Tursiops truncatus*) occupying Boca Ciega Bay, Florida. Proceedings of the 13th Biennial Conference on the Biology of Marine Mammals, Maui, Hawaii. 28 November – 3 December.

Allen, M.A., D.J. Wilkin, A.P. Cameron, J.H. Stewman, and J.E. Reynolds, III. 1995. DARWIN - Software to identify dolphins in digital images. Proceedings of the Eleventh Biennial Conference on the Biology of Marine Mammals, Orlando, Florida. 14-18 December.

Barros, N.B. and D.K. Odell. l993. Distinguishing parapatric populations of east Florida bottlenose dolphins using food habits data. Tenth Biennial Conference on the Biology of Marine Mammals. Galveston, Texas. 11-15 November.

Barros, N.B., D.K. Odell and G.W. Patton. 1989. Ingestion of plastic debris by marine mammals from Florida. Second International Conference on Marine Debris. Honolulu, HI. 2-7 April.

Barros, N.B. 1997. Bottlenose dolphin population differentiation in east Florida, USA, using fish otoliths from dietary studies. Second International Symposium on Fish Otolith Research and Application. Bergen, Norway. 20-25 June.

Barros, N.B. 1997. Prevalence of stomach flukes (*Braunina cordiformes*) in bottlenose dolphins from the southeastern United States. Twenty-second International Annual Meeting of the Mexican Society for Marine Mammalogy. Nuevo Vallarta, Mexico. 27 April- l May.

Barros, N.B., P.H. Ostrom and D.K. Odell. l995. Stable isotopes in muscle of east Florida bottlenose dolphins: implications for stock differentiation. Eleventh Biennial Conference on the Biology of Marine Mammals. Orlando, FL. 14-18 December.

Barros, N.B. and D.H. Adams. 1995. Fishery interactions with apex predators in the Indian River Lagoon system, Florida. Symposium on the Role of Marine Mammals on the Ecosystem. Dartmouth, NS, Canada. 6-8 September.

Caldwell, M.J., Weller, D.W., Defran, R.H., and Sandoval, A. 1990. Home range boundaries of Pacific coast bottlenose dolphins. Paper presented at the Fourth Biennial Conference of the American Cetacean Society, Monterey, California, November.

Doty, S.M., E.A. Forys, J.E. Reynolds, III, and R.S. Wells. 1998. Analysis using GIS of home range characteristics and habitat use by bottlenose dolphins, *Tursiops truncatus*, in Boca Ciega Bay, Florida, and surrounding waters. Proceedings of the Sixth Annual Atlantic Coastal Dolphin Conference, Sarasota, FL. 1-3 May.

Duffield, D.A. and E.O. Espinoza. 1999. Electrospray ionization mass spectrometric analysis of hemoglobin and myoglobin for differentiation of marine mammal species. Society for Marine Mammalogy. Maui, Hawaii. 28 November – 3 December.

Eide, S.D., M.E. Bolen, S. Carlson, S.M. Doty, E.A. Forys, J.M. Odell, K.A. Thoms, and J.E Reynolds, III. 1997. Assessment and habitat use of bottlenose dolphins, *Tursiops truncatus*, in Boca Ciega Bay, Florida. Proceedings of the 5th Annual Atlantic Coast Dolphin Conference, Wilmington, N.C. 4-6 April.

Eide, S.D. and J.E. Reynolds, III. 1998. Correlations between bottlenose dolphin (*Tursiops truncatus*) and presence of calves in Boca Ciega Bay, Florida and the Florida State ban on commercial netting. Proceedings of the World Mammal Science Conference, Monaco, 20-24 January.

Forys, E.A., E.L. Gallizzi, J.E. Reynolds, III, S.M. Doty, and S.D. Eide. 1998. Field use of technology to assist photo-identification research on bottlenose dolphins in the Tampa Bay area, Florida. Proceedings of the Sixth Annual Atlantic Coastal Dolphin Conference, Sarasota, Florida. 1-3 May.

Gailey, G., Würsig, B., Hillman, G., Kehtarnavaz, N., Drobyshevsky, A., and Weller, D.W. 1999. Computer-assisted photo-identification of bottlenose dolphins. Paper presented at the Thirteenth Biennial Conference on the Biology of Marine Mammals, Maui, Hawaii. 28 November – 3 December.

Hillman, G. R., Kreho, A., Kehtarnavaz, N., Tagare, H., Weller, D.W., and Würsig, B. 1998. Photographic identification of dolphins: comparison of affine invariant curve descriptors for recognition of individual dorsal fin profiles. Paper presented at The Annual Meeting of the Houston Society for Engineering in Medicine and Biology, Houston, Texas. April.

Hillman, G., Würsig, B., Kehtarnavaz, N., Weller, D., Kreho, A., Drobyshevsky, O., Elder, K., Araabi, B., McKinney, T., Gailey, G., and Tagare, H. (1999). Individual identification of dolphins in field photographs: a computer-based system. Paper presented at the Thirteenth Biennial Conference on the Biology of Marine Mammals, Maui, HI, December.

Irwin-Smith, L.J. New dorsal fin natural markings in a small populations of bottlenose dolphins, Poster presentation at the 13th Biennial Conference of the Biology of Marine Mammals, Maui, Hawaii., 28 November – 3 December.

Kostka, J., J. Jeffers, J. Odell, J. Hood, M. Bolen, L. Tomaselli, M. Allen, E. McMahon, J. Reynolds, and B. Weigle. 1995. Use of the Boca Ciega Bay, Florida, area by bottlenose dolphins, *Tursiops truncatus*. Proceedings of the Eleventh Biennial Conference on the Biology of Marine Mammals, Orlando, Florida. 14-18 December.

Kreho, A., Kehtarnavaz, N., Hillman, G., Würsig, B., and Weller, D.W. 1997. Computer assisted dolphin identification based on dorsal fin images. Paper presented at the International Conference on Parallel and Distributed Processing Techniques and Applications, Las Vegas, Nevada. June.

Kreho, A., Kehtarnavaz, N., Hillman, G., Würsig, B., and Weller, D. 1997. Automatic dolphin identification based on dorsal fin images. Paper presented at the Fifteenth Annual Houston Conference on Biomedical Engineering Research, Houston, Texas. February.

Maze, K., and L.J. Smith. 1999. Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site fidelity, and habitat use. Presentation at The State of the Bay Symposium IV, Galveston, Texas, January.

Maze, K., Würsig, B., and Weller, D.W. 1996. A review of recent and present research on bottlenose dolphins in Texas coastal waters. Paper presented at the Fourth Annual Atlantic Coastal Dolphin Conference, Charleston, S.C. March.

Roberts, Z.W., D.J. Wilkin, K.R. Debure, and J.E. Reynolds, III. 1999. Efficient correction of differences in perspective, orientation and scale in DARWIN: Digital Analysis to Recognize Whale Images on a Network. Proceedings of the 13th Biennial Conference on the Biology of Marine Mammals, Maui, Hawaii. 28 November – 3 December.

Stolen, M.K., A.C. Spellman, N.B. Barros and D.K. Odell. 1999. Human interactions with bottlenose dolphins from east Florida: evidence from strandings, 1993-1998. Seventh Annual Atlantic Coast Dolphin Conference. Virginia Beach, VA. 19-21 March.

Thoms, K.A., S.L. Carlson, M.E. Bolen, S.M. Doty, S.D. Eide, E.A. Forys, J.L. Odell, J.E. Reynolds, III, and J.B. Viezbicke. 1998. The use of Geographic Information Systems to relate behavior of bottlenose dolphins (*Tursiops truncatus*) and environmental parameters in Boca Ciega Bay, Florida. Proceedings of the World Mammal Science Conference, Monaco, 20-24 January.

Viezbicke, J.B., S.D. Eide, J.E. Reynolds, and E.A. Forys. 1999. Association patterns of bottlenose dolphins (*Tursiops truncatus*) in Boca Ciega Bay, Florida. Proceedings of the 13th Biennial Conference on the Biology of Marine Mammals, Maui, Hawaii. 28 November – 3 December.

Weller, D.W. 1997. Nearshore marine mammals in the Gulf of Mexico: a review of recent information on bottlenose dolphins, sperm whales, and manatees. Invited speaker symposium at the Seventy-Third Annual Meeting of the American Association for the Advancement of Science, Southwestern and Rocky Mountain Division, College Station, Texas. May.

Weller, D.W. 1998. Bottlenose dolphins of the Texas shoreline: An educational and biological re source. Invited speaker symposium at the Second Annual Coastal Issues Conference, Galveston, TX, March.

Weller, D.W. 1999. A Review of the Behavioral Ecology of Bottlenose Dolphins in Texas Coastal Waters. Paper presented at the Galveston Bay Estuary Program Conference, Galveston, Texas.

Weller, D.W., Acevedo, A., Würsig, B., Elsberry, W., Fortenberry, H., Defran, R.H., Constantine, R., Möller, L., Schiro, A., and Blackwood, D. 1998. Geographical variation in dorsal fin shape characteristics of the bottlenose dolphin (*Tursiops truncatus*). Paper presented at the Society for Marine Mammalogy and European Cetacean Society World Marine Mammal Science Conference, Monaco, January.

Wilkin, D.J., J.H. Stewman, M.C. Allen, E.L. Gallizzi, and J.E. Reynolds, III. 1998. DARWIN Software to identify dolphins in digital images. Proceedings of the World Mammal Science Conference, Monaco, 20-24 January.