

Distribution of cetaceans in the offshore Gulf of Mexico

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ABSTRACT

In order to comprehend better the distribution of Gulf of Mexico cetaceans, all available records of whales and dolphins in the offshore Gulf were assembled and analysed. This included sightings, strandings and captures of all species, except the Bottlenose Dolphin *Tursiops truncatus*, from all sources, except the recently completed GulfCet project. An attempt was made to confirm species identification for each of the records. A total of 1223 records was available for analysis. Twenty-seven species of cetaceans have been confirmed to occur in the offshore Gulf of Mexico. All of the baleen whales, with the possible exception of the Bryde's Whale *Balaenoptera edeni* appear to be extralimital in the Gulf. The Sperm Whale *Physeter macrocephalus* is, by far, the most common great whale in this body of water. All previous records of Common Dolphins *Delphinus* spp. in the Gulf are rejected as either incorrect or unreliable, and there is currently no convincing evidence that dolphins of the genus *Delphinus* occur in the Gulf. The Atlantic Spotted Dolphin *Stenella frontalis* is the only species, other than the Bottlenose Dolphin, that regularly occurs over the continental shelf. The Pantropical Spotted Dolphin *Stenella attenuata* is the most common species of small cetacean in oceanic waters of the Gulf, but many other species also occur there in significant numbers.

INTRODUCTION

The Gulf of Mexico has become a major source of oil and gas in the past few decades. However, despite the importance of these waters to the oil industry, there has been little effort to study the marine mammals of the area, and the effects of oil and gas exploration and production activities on them. For species other than the Bottlenose Dolphin *Tursiops truncatus*, what is known of their natural history in the Gulf comes mostly from occasional strandings or opportunistic sightings, and for at least one species (the Sperm Whale *Physeter macrocephalus*), old whaling records. The first large-scale vessel surveys to assess marine mammal distribution and abundance in the Gulf only began in 1990, and now there is a major effort to understand the cetaceans of the offshore Gulf of Mexico, largely as a result of the need for information to assess the impacts of offshore oil and gas activities (Jefferson, in press).

Two reports have previously summarized information on historical records of cetaceans in the Gulf of Mexico. Schmidly (1981) presented distribution maps for all species of cetaceans known to occur in the Gulf of Mexico, up until 1979. His analysis has continued to be useful, but it is now somewhat out-of-date. In addition, because he was not able to verify species identification for many records, there are many incorrect identifications in his maps. Recently, Jefferson *et al.* (1992) updated Schmidly's (1981) maps for a field guide to cetaceans of the Gulf of Mexico. This report provided more recent information, but suffered from similar identification problems, because the short period for production of the guide did not allow for proper verification of species identification in

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many cases. We thus suggest that the maps in Schmidly (1981) and Jefferson *et al.* (1992) not be cited, and that those in this document be used instead.

The present paper reviews and summarizes what is known of the distribution and seasonal occurrence of offshore cetaceans in the Gulf of Mexico. Offshore cetaceans are defined here to include all those members of the order Cetacea found in the Gulf of Mexico, with the exception of the Bottlenose Dolphin. This species is not included because it is primarily a coastal species (although there are an increasing number of outer continental shelf and slope records), and its distribution in the Gulf has been comparatively well-studied (Leatherwood *et al.*, 1978; Barham *et al.*, 1980; Odell & Reynolds, 1980; Leatherwood & Reeves, 1983; Scott *et al.*, 1989; Mullin *et al.*, 1990). Records resulting from the GulfCet programme, which form a continuous, homogeneous database based on systematic surveys, will be presented elsewhere. The analyses in this paper are based on all other available records, published and unpublished.

MATERIALS AND METHODS

Area of coverage

The Gulf of Mexico (Fig. 1) is a small oceanic basin almost completely enclosed by land on all four sides by the southern United States, Mexico, and Cuba (see Uchupi, 1975). The only openings are to the south-western North Atlantic, via the Straits of Florida (between Florida and Cuba), and to the Caribbean Sea, via the Yucatan Channel (between the Yucatan Peninsula and Cuba). For the purposes of this paper, the study area boundaries were defined to be the shortest line from the tip of the Yucatan Peninsula to Cabo San Antonio, Cuba, and a line from the southern tip of Florida to the Cuban coast, running along longitude 80°30'W (Fig. 1).

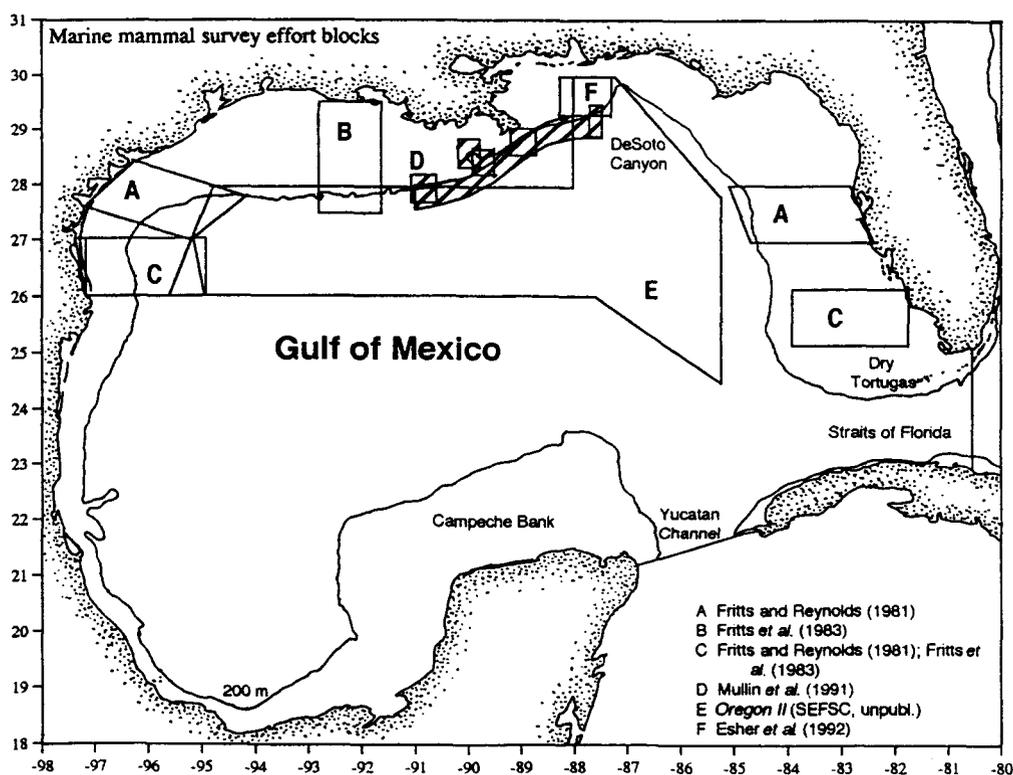


Fig. 1. Map of the study area, showing locations of survey blocks from various studies.

Sources of data

All available records of strandings, sightings and captures of cetaceans from the waters of the Gulf of Mexico were compiled. The records from the GulfCet project are not analysed here, except for those that have previously been published: Fraser's Dolphins (*Lagenodelphis hosei*; Leatherwood *et al.*, 1993), Melon-headed Whales (*Peponocephala electra*; Mullin *et al.*, 1994a), and Clymene Dolphins (*Stenella clymene*; Mullin *et al.*, 1994b). A total of 1223 records were available for this analysis from the sources listed below.

Published and unpublished literature. There is a moderately extensive literature on cetaceans of the Gulf of Mexico. Most of the published papers report strandings or opportunistic sightings, but there are a few reports of live-captures, specimens collected for research, and whaling catches (e.g. Cuni, 1918; Moore, 1953; Layne, 1965; Lowery, 1974; Schmidly & Melcher, 1974; Schmidly & Shane, 1978). In recent years, there have also been several projects that conducted repeated, systematic sighting surveys for cetaceans in offshore waters of the Gulf (Fritts & Reynolds, 1981; Fritts *et al.*, 1983; Mullin *et al.*, 1991, 1994c; see Fig. 1 for locations of survey blocks). Many of the identifications were inaccurate, and required verification.

South-eastern United States Marine Mammal Stranding Network (SEUS MMSN) database. The South-eastern US Stranding Network maintains a database of reported strandings from Gulf Coast states (Texas, Louisiana, Mississippi, Alabama and Florida; see Odell, 1991). Most records in this database are unpublished, and although species identifications are not always confirmed, most of the data were collected by experienced marine mammal biologists and are considered accurate. Data for the years 1977–91 were available, courtesy of D. K. Odell, Sea World of Florida.

Texas Marine Mammal Stranding Network (TMMSN) database. The marine mammal stranding network in Texas (Tarpley, 1987; Tarpley & Marwitz, 1986) is particularly well-organized and records from the inception of the programme in 1981, up until 1994, were available, courtesy of G. A. J. Worthy & E. Haubold, Texas A & M University at Galveston (TAMUG). Most records in this database are also in the SEUS MMSN database, and it was possible to verify species identification for many records by examining TMMSN data and photographic files.

J. G. Mead's Stranding and Historical Record Database. J. G. Mead, of the National Museum of Natural History, Smithsonian Institution, maintained a database in 1977 of marine mammal records from the US east and Gulf coasts. The majority of records in the database are of strandings, and most are from the published literature (see Mead, 1975). Not all identifications in this database have been verified.

D. J. Schmidly's Gulf of Mexico Marine Mammal Files. Files compiled by D. J. Schmidly, TAMUG, mostly during preparation of Schmidly (1981), were searched. Information consisted mostly of previously unpublished strandings, and newspaper clippings. Often, photos or other information were available to verify species identifications.

W. F. Perrin's Compilation Files of Data on Dolphins of the Genus Stenella. Several binders of data on dolphins of the genus *Stenella*, collected by D. K. & M. C. Caldwell, G. H. Lowery, and D. J. Schmidly, are in the possession of W. F. Perrin, South-west Fisheries Science Centre, NMFS. These binders were searched for records of dolphins in the Gulf of Mexico. Photos, drawings or subsequent examination of skeletal material allowed verification of most of these records.

Museum holdings. Holdings of several museums with specimens from the Gulf of Mexico were examined. The entire cetacean osteological collections of the following museums were examined: the Texas Cooperative Wildlife Collection (TCWC), Houston Museum of Natural Science (HMNS), University of South-western Louisiana (USWL), and Louisiana State University Museum of Zoology (LSUMZ). A portion, primarily *Stenella* specimens, of the Florida Museum of Natural History (UF), and National Museum of Natural History (USNM) collections were also examined.

National Oceanic and Atmospheric Administration (NOAA) vessel bridge logs. NOAA vessels stationed at the South-east Fisheries Science Centre (SEFSC), Pascagoula Laboratory (*Oregon*, *Oregon II*, *Researcher* and *Chapman*) often kept logs of opportunistic sightings of marine mammals in the Gulf of Mexico during cruises dedicated to other types of research. These data were provided courtesy of K. D. Mullin, K. Rademacher and W. L. Perryman; some records from the *Oregon* and *Oregon II* were previously plotted in Lowery (1974). These records cover the years 1950–92. The data were collected by many different people, with widely different abilities to identify marine mammals, and many of the identifications could not be verified (and were thus not used).

Oregon II Pre-GulfCet marine mammal surveys. Two marine mammal surveys were conducted by the SEFSC using the NOAA Ship *Oregon II*, during the spring seasons of 1990 and 1991 (Fig. 1). These were intensive marine mammal surveys, with systematic sighting effort, and using highly trained observers (thus all identifications are considered to be confirmed). Unpublished data from these surveys were provided by K. D. Mullin & L. J. Hansen, SEFSC.

Several surveys for marine mammals have been conducted in the Gulf of Mexico, which provided no data that could be used in this paper. Esher *et al.* (1992) sighted several large herds of dolphins that they identified as either Atlantic Spotted Dolphins *Stenella frontalis* or Pantropical Spotted Dolphins *S. attenuata*, and groups of unidentified whales and dolphins (see Fig. 1 for survey block). They also stated that they detected Pilot Whales *Globicephala macrorhynchus* and Common Dolphins *Delphinus* sp. by acoustic methods (sonobuoy drops from the survey aircraft), but these detections are rejected as unreliable because of the lack of visual confirmation. Their acoustic detections of Sperm Whales are considered reliable, because of the species-specific characteristics of the vocalizations of this species. However, the Sperm Whale records are not plotted in this paper, because Esher *et al.* (1992) did not plot them or provide positions in their report.

Scott *et al.* (1989; see also Carter & Derman, 1986) conducted aerial surveys in Gulf waters out to 9.3 km beyond the 183-m contour. However, they sighted very few animals other than Bottlenose Dolphins, and data on these other species were not presented in their report. Similarly, Mullin *et al.* (1990) surveyed coastal and offshore waters (within 37 km of shore), but reported no sightings other than Bottlenose Dolphins. There have been several other surveys for Bottlenose Dolphins in coastal waters, but they have provided no data on offshore species of cetaceans (Leatherwood *et al.*, 1978; Barham *et al.*, 1980; Odell & Reynolds, 1980; Leatherwood & Reeves, 1983; Scott *et al.*, 1989; Mullin *et al.*, 1990).

Finally, the Galveston laboratory of the NMFS maintains a database of marine mammal sightings by observers in their Oil Platform Removal Observer Program. These unpublished data were provided by E. Klima, SEFSC. The database was checked, but because the observers are not trained in marine mammal identification, species identification was not available (although the vast majority of sightings were apparently of Bottlenose Dolphins).

Verification of species identification

It is important to ensure that species identification is accurate for records used to delineate distribution. There are many errors in species identification for the older records, and even some for recent records from stranding networks. In addition, the taxonomy of some groups (such as *Kogia* and *Stenella*) has only recently been clarified. Thus, for each record, the species identification was questioned and an attempt made to verify it. Verification could come in one of several ways: location of photographs, drawings or detailed descriptions of the animals demonstrating diagnostic features; examination of voucher materials, such as skulls collected from specimens stranded or captured; identifications made by highly trained observers; or identifications made by relatively inexperienced observers, but of highly distinctive species (such as Sperm Whales or Killer Whales *Orcinus orca*). The ease of identifying each species was kept in mind when judging the amount of identification experience required of an observer.

For many records, it was not possible to verify the species identification. Unless there was strong reason to believe that the identification was in error, these records were included in plots, using a unique symbol (X) indicating questionable accuracy. For many other records, the genus could be verified, but not the species. Such records are not plotted. Despite this treatment, there are probably still some errors in some of the records that have been considered verified. These are pointed-out in the text where applicable. Of the total of 1223 records, 1044 were considered to be verified, 104 were questionable, and 75 could only be identified to genus.

Plotting of distribution maps

After species verification, records were plotted for each species represented by at least two verified records. It should be cautioned that it was not always possible to obtain an exact position for each record. In cases where a record could be localized to a small area (such as a county or a region of less than about 50 ↔ 50 km), a position in the middle of that area was chosen for plotting. Thus, a small number of records on the maps may appear some distance from their true location. For records in which only a very general region (such as 'the north-western Gulf of Mexico') was available, the record was not plotted.

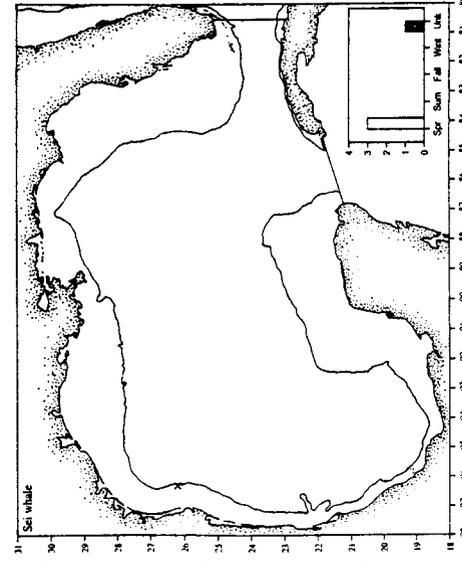
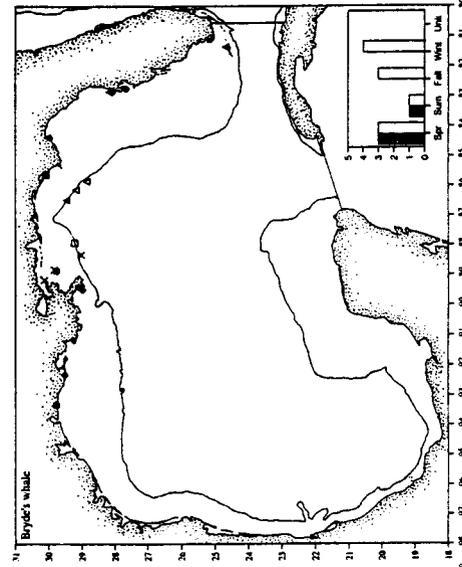
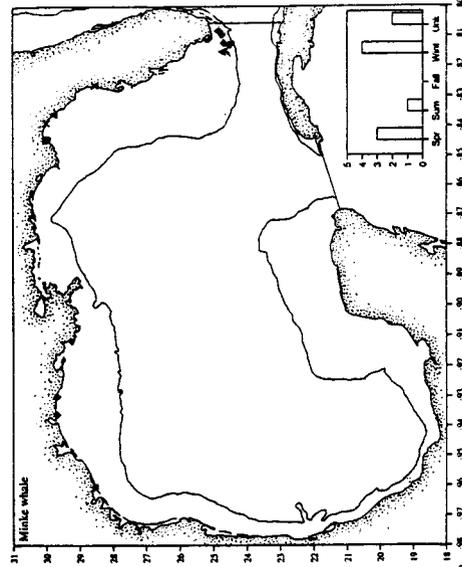
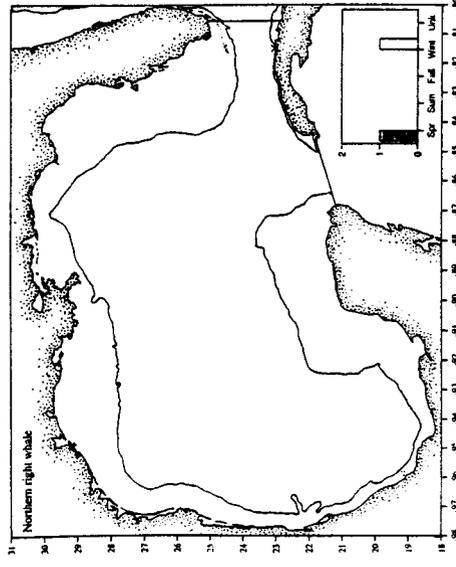
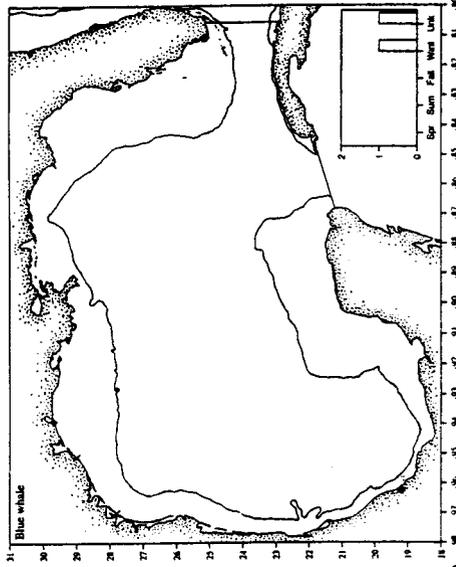
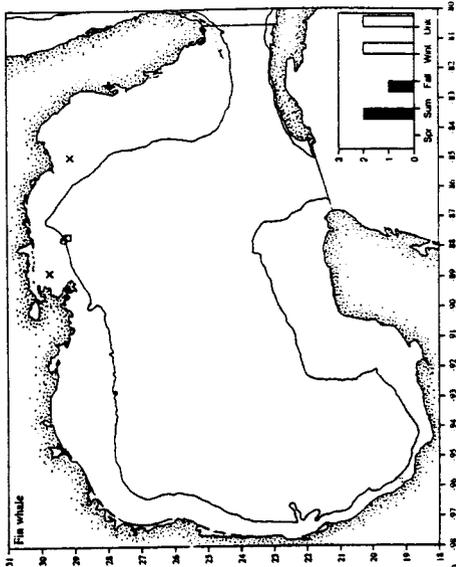
A bar graph of the seasonal distribution of the verified records is overlain in the lower right-hand corner of the map for each species. Questionable records are not included on these graphs.

SPECIES ACCOUNTS

Northern Right Whale *Eubalaena glacialis*

Northern Right Whales are found in both the North Atlantic and North Pacific oceans (Cummings, 1985a). There are only two confirmed records of northern Right Whales in the Gulf of Mexico, a spring sighting off Florida (Moore & Clark, 1963) and a winter stranding in Texas (Schmidly *et al.*, 1972a). In addition, there are three questionable records (Fig. 2). Townsend (1935), in his report on nineteenth-century whaling grounds and whaling catch records, did not show any catches in the Gulf of Mexico. However, Clark (1884) did identify the central Gulf of Mexico as a whaling ground for Right Whales, but did not present any specific records of their occurrence there, and we know of no other information that documents right whaling in the Gulf.

From the above information, it is concluded that the Northern Right Whale is not a normal inhabitant of the Gulf of Mexico. The records that do exist are probably those of extralimital strays from the wintering grounds of this species off the south-eastern US coast, from Georgia to north-eastern Florida (see Mead, 1986; Kraus *et al.*, 1987).



Rorquals *Balaenoptera* spp.

There are five species in the genus *Balaenoptera*, and they are all cosmopolitan, occurring in all oceans and major seas (see chapters in Ridgway & Harrison, 1985). All five have been reported from the Gulf of Mexico. In addition to the records summarized below, which are probably correctly identified to species, there are 14 other records that are not supported by enough evidence, or were collected by inexperienced observers, and thus can not be confidently assigned to any particular species.

There are only two reliable records of Blue Whales *B. musculus* in the Gulf, both of strandings (Lowery, 1974; J. G. Mead, unpublished data), and two additional questionable reports (Fig. 3). It is possible that some of the records of unidentified balaenopterids are of this species, but despite this possibility, there appears to be little justification for considering the Blue Whale to be a regular inhabitant of the Gulf.

Seven reports of Fin Whales *B. physalus* in the Gulf of Mexico are considered reliable, and four others are of questionable accuracy (Fig. 4). It is apparent that Fin Whales are not abundant in the Gulf of Mexico, but it is possible that the Gulf represents a part of the range of a low-latitude population in the western Atlantic (or some subarea), or that a small relict population is resident in this area. Alternatively, the records may be extralimital, and this is considered more likely. Records of Fin Whale occurrence in the Gulf are all from summer, autumn and winter, but are too few for any meaningful seasonal analysis.

Sei Whales *B. borealis* occur primarily in temperate waters, with lower densities in the tropics and near the poles (see Gambell, 1985). They are represented in the Gulf by only four reliable records, and one questionable one (Fig. 5). This species should be considered to be most likely of accidental occurrence in the Gulf, although it is worth noting that three of the four reliable records are from strandings in eastern Louisiana.

Although probably not common in the Gulf of Mexico, the Bryde's Whale *B. edeni* is nevertheless represented by more records than any other species of baleen whale (15 verified records, and three questionable; Fig. 6). The frequency with which Bryde's Whales have been identified in recent years suggests that many of the older records of unidentified balaenopterids were of this species. It is interesting that all the sightings are from the shelf edge near De Soto Canyon.

Bryde's Whales are known to be year-round inhabitants of tropical and subtropical waters (see Cummings, 1985b). Stranding records for the Gulf of Mexico are scattered throughout the year; the three spring sightings all resulted from the spring *Oregon II* surveys. It is likely that the Gulf of Mexico represents at least a portion of the range of a dispersed, resident population of Bryde's Whales (see Mead, 1977), and this appears to be the most common species of baleen whale in Gulf waters.

Although there are 10 reliable, and two questionable, records of Minke Whales *B. acutorostrata* in the Gulf of Mexico, all are of strandings, and seven of eight in which the season is known are from winter or spring (Fig. 7). Either Minke Whales migrate into the Gulf regularly, but in small numbers, in winter, or these records represent strays from low-latitude breeding grounds elsewhere in the western North Atlantic. The latter explanation was proposed by Mitchell (1991), and it is considered the more likely of the two.

Key for species maps, Figs 2–27:

Solid symbols, strandings; hollow symbols, identified sightings. Triangles, spring (March–May); squares, summer (June–August); circles, autumn (September–November); diamonds, winter (December–February). Open crosses, unknown sightings; and X, questionable identification sightings.

Fig. 2. Records of Northern Right Whales in the Gulf of Mexico. **Fig. 3.** Records of Blue Whales in the Gulf of Mexico. **Fig. 4.** Records of Fin Whales in the Gulf of Mexico. **Fig. 5.** Records of Sei Whales in the Gulf of Mexico. **Fig. 6.** Records of Bryde's Whales in the Gulf of Mexico. **Fig. 7.** Records of Minke Whales in the Gulf of Mexico.

Humpback Whale *Megaptera novaeangliae*

The distribution of the Humpback Whale is cosmopolitan (Winn & Reichley, 1985). There are seven records of Humpback Whales from the Gulf of Mexico that have been considered reliable (plus two questionable ones), either because they are supported by photographic or written evidence, or because they were sightings made by observers with enough experience to recognize this highly distinctive species (Fig. 8). The records are all of sightings, several of which have been noted to be of small animals (see Weller *et al.*, 1996). All except one (Aguayo, 1954) of these sightings were in shallow, nearshore waters.

The breeding grounds of the western North Atlantic stock of Humpbacks in the West Indies are well-known (see Katona & Beard, 1991). Although most of the population in winter is located at Silver and Navidad banks, north of the Dominican Republic, some whales venture as far south of the normal breeding grounds as the coast of Venezuela (Katona & Beard, 1991). It seems likely that some Humpbacks stray into the Gulf of Mexico during the breeding season or on their return migration northward. The time of year of the records in which the season is known (all six in winter and spring), and the small size of the animals involved in many sightings (most likely inexperienced yearlings on their first return migration) support this hypothesis. Humpbacks in the Gulf of Mexico are probably best considered strays.

Sperm Whale *Physeter macrocephalus*

Sperm Whales have an extensive distribution, ranging from the tropics to ice edges in deep waters of both hemispheres (Rice, 1989). There are numerous records of Sperm Whales in the Gulf of Mexico (189 reliable records and two questionable ones), more than for any other species of offshore cetacean, except the Atlantic Spotted Dolphin (Fig. 9). Townsend (1935) identified the Gulf of Mexico as a significant sperm whaling ground for nineteenth-century Yankee whalers. Although the exact dates were not reported by Townsend, most of the catches were made from spring to summer in the area between the Straits of Florida and the Mississippi River delta.

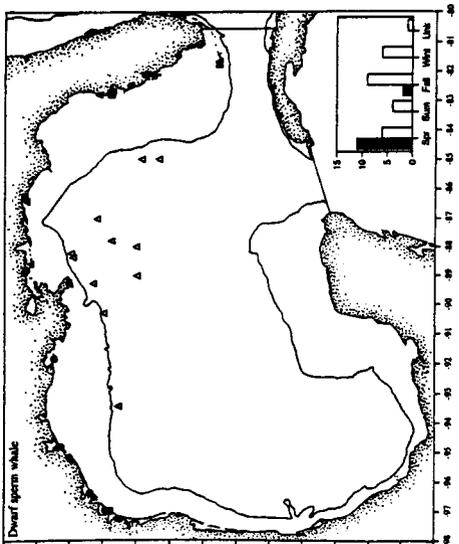
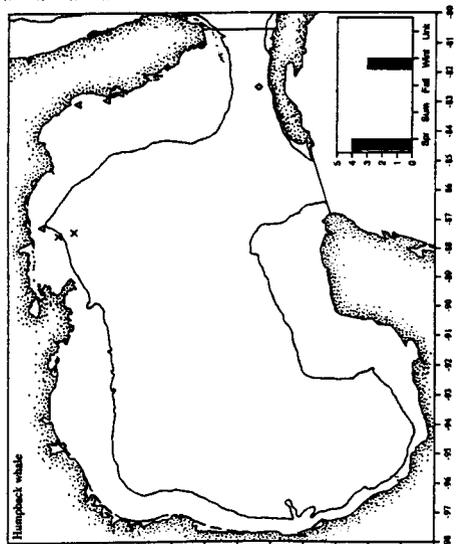
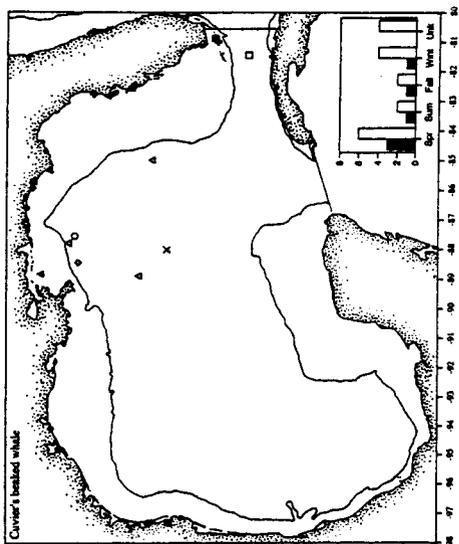
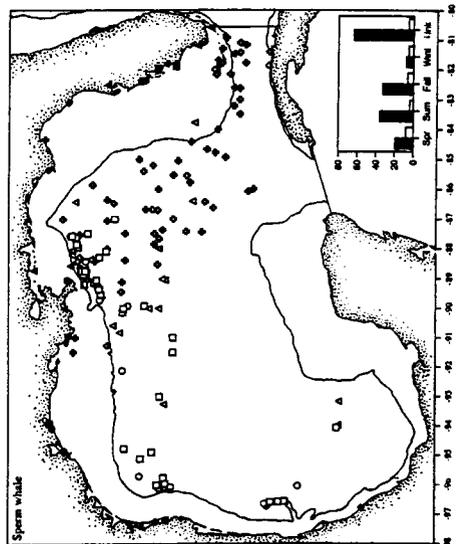
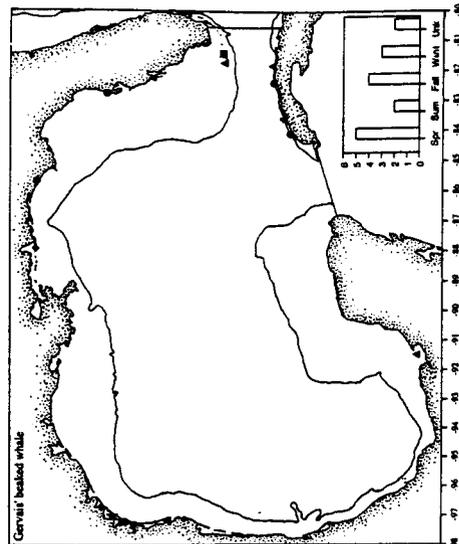
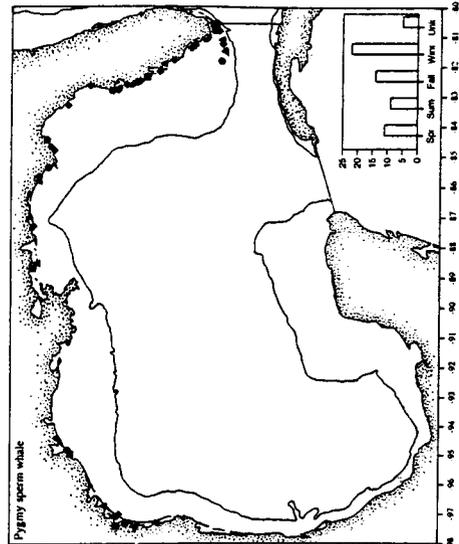
The historical records show no strong seasonal pattern (Fig. 9). The low number of sightings in winter probably results from decreased offshore human activity and poorer sighting conditions during that time of year. Sperm Whales are found primarily in deep waters beyond the edge of the continental shelf (although there are a few records from over the shelf). In the Gulf of Mexico, this generally puts their distribution offshore several tens to hundreds of kilometres. However, in some areas where the continental shelf is narrow (such as off the Mississippi River delta), they may be seen close to shore.

It appears likely that there is a resident population of Sperm Whales in the Gulf of Mexico, but only repeated identification and/or long-term tracking of individual whales will tell us how much interchange there is with surrounding bodies of water. There is no doubt, however, that Sperm Whales are, by far, the most common large whales in the Gulf, and that they can be found there at any time of year.

Pygmy and Dwarf Sperm Whales *Kogia* spp.

Two species of *Kogia* are currently known, although it was not until Handley's (1966) study that the Dwarf Sperm Whale *K. simus* was widely recognized as valid. Both species of the genus *Kogia* occur in tropical to temperate waters of the world (Caldwell & Caldwell, 1989). Because of these taxonomic problems and the continuing difficulty of many observers in identifying these animals to

Fig. 8. Records of Humpback Whales in the Gulf of Mexico. Fig. 9. Records of Sperm Whales in the Gulf of Mexico. Fig. 10. Records of Pygmy Sperm Whales in the Gulf of Mexico. Fig. 11. Records of Dwarf Sperm Whales in the Gulf of Mexico. Fig. 12. Records of Cuvier's Beaked Whales in the Gulf of Mexico. Fig. 13. Records of Gervais' Beaked Whales in the Gulf of Mexico.



species (especially, but not only, in sightings at sea), there are many (48) remaining records that cannot be confidently assigned to either species. In addition, it is likely that a few of the records assigned to one or the other species are, in fact, misidentifications.

Historical records of Pygmy Sperm Whales *K. breviceps* in the Gulf of Mexico are exclusively of strandings or presumed strandings (61 reliable records, and two questionable ones) (Fig. 10). This species was previously considered to be rare (see Schmidly, 1981), but the number of records would indicate otherwise. The absence of sightings probably has to do with the cryptic behaviour and difficulty in positively identifying this species at sea, and many of the sighting records identified as *Kogia* sp. on recent cruises and aerial surveys are probably of this species.

The Dwarf Sperm Whale, like its congener, was previously thought to be rare in the Gulf of Mexico. However, there are numerous records (39 reliable ones) from this body of water, many of them strandings (Fig. 11). In recent years, the first reliable sightings of this species at sea in the Gulf have been recorded (*Oregon II*, SEFSC, unpublished data). There are stranding records from all four seasons. The peak in spring sightings is not necessarily real, but probably reflects the increased sighting effort associated with the *Oregon II* surveys. There is no compelling evidence for seasonal differences in abundance at this time.

Cuvier's Beaked Whale *Ziphius cavirostris*

Cuvier's Beaked Whale is the most cosmopolitan of all the beaked whales (Heyning, 1989). It has been reported at least 24 times from the Gulf of Mexico (with one additional questionable record), and is probably the most common beaked whale in these waters. Most of the records are of strandings, and they are scattered more-or-less equally throughout the four seasons (Fig. 12). There is a slight peak in the spring, but whether this is real or some artefact of the data remains to be tested with larger sample sizes and more systematic effort.

Mesoplodonts *Mesoplodon* spp.

Three of the 13 species in the genus *Mesoplodon* have been reliably reported from the Gulf of Mexico. This is a problematic group, because the taxonomy is still in a state of flux, and because identification presents major challenges, due to poor documentation of diagnostic characters (Moore, 1966). One species was described only in 1991 (Reyes *et al.*, 1991), and there is discussion of merging two others into a single species (Mead, 1989). Only rarely have at-sea sightings been identified to species (although the frequency of such identifications is increasing as our knowledge grows), and even specimens 'in hand' often can not be identified without museum preparation. Because of this situation, any assessments of mesoplodont distribution in the Gulf must be considered tentative. Other species not yet confirmed, such as True's Beaked Whale *M. mirus*, which is known from the nearby Bahamas (Mead, 1989), may occur there. A beaked whale tentatively identified as a True's Beaked Whale stranded on the Gulf coast of Florida in April 1993 (SEUS MMSN, unpublished data).

Gervais' Beaked Whale *M. europaeus* appears to be endemic to the Atlantic Ocean (Mead, 1989). It is the most common mesoplodont stranded along the Atlantic coast of the United States, and most records of its occurrence are from the western North Atlantic (Mead, 1989). There are more records for Gervais' Beaked Whale in the Gulf of Mexico than for any other species of *Mesoplodon* (Fig. 13). There are 16 reliable records (all strandings), plus another questionable one. This species is probably the most common mesoplodont in these waters; however, this conclusion must be considered tentative, as the sample sizes are still small and many *Mesoplodon* records remain unidentified to species. The small sample does not indicate any obvious seasonality (Fig. 13).

There are only three confirmed records of Blainville's Beaked Whale *M. densirostris* from the Gulf, plus one questionable record (Fig. 14). This species has the widest distribution of all the mesoplodonts occurring in tropical to warm temperate waters of the world (Mead, 1989). All of the

Gulf records are of strandings, and all the reliable records are from December and January. However, it is too early to tell if this is an indication of a real seasonal difference.

Sowerby's Beaked Whale *M. bidens* is represented in the Gulf of Mexico by only a single record, a stranding in Florida (Bonde & O'Shea, 1989). This species normally occurs much further north in cool temperate waters of the North Atlantic (Mead, 1989), and this record is thus considered extralimital.

Killer Whale *Orcinus orca*

Killer Whales are found in all oceans and seas, and probably have the most extensive distribution of any cetacean (see Heyning & Dahlheim, 1988). There are 15 reliable records of Killer Whales in the Gulf of Mexico (plus two others that are questionable), mostly of sightings at sea (Fig. 15). There are some records for all four seasons, although there is an apparent spring/summer peak. This may be due to increased survey effort and boating activity offshore during that part of the year. In recent years (since 1989) there have been at least nine sightings (mostly resulting from SEFSC GulfCet cruises and aerial surveys, thus not summarized in this paper), and some have involved resightings of previously seen pods or individuals (Roden *et al.*, 1993). Most of these sightings have been in offshore waters greater than 200 m deep (Roden *et al.*, 1993), although there are other sightings from over the continental shelf.

Katona *et al.* (1988) could locate records of only four sightings, four strandings, and two fishery catches from the Gulf of Mexico. They stated that Killer Whale use of the Gulf was unclear, but considered Killer Whales uncommon there. Based on the above information, it seems likely that there are a small number of pods that use the offshore waters of the Gulf of Mexico as all or part of their normal range.

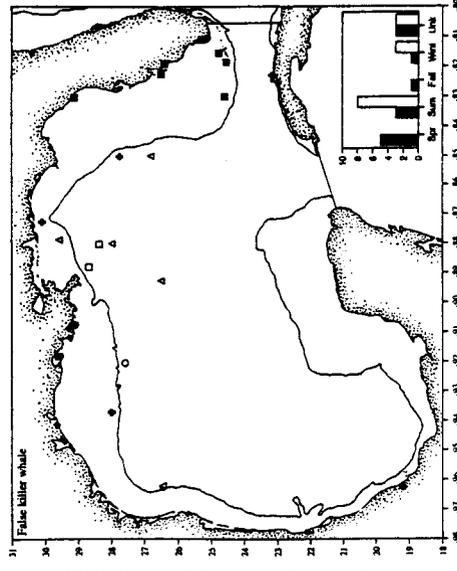
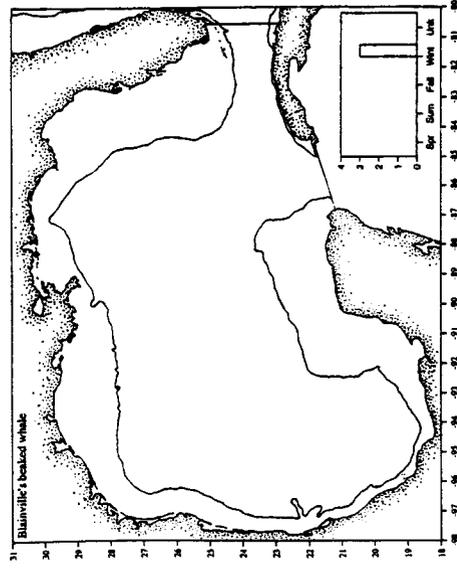
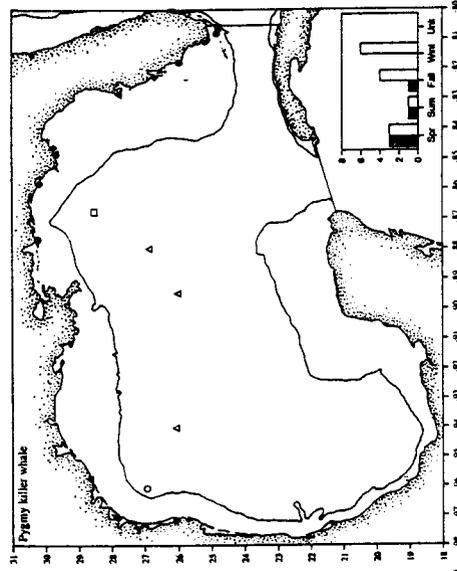
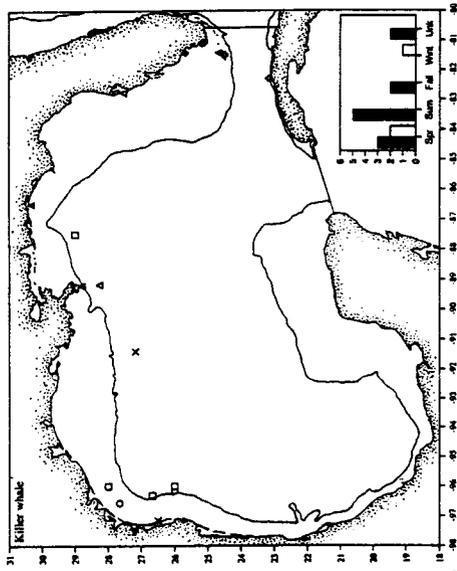
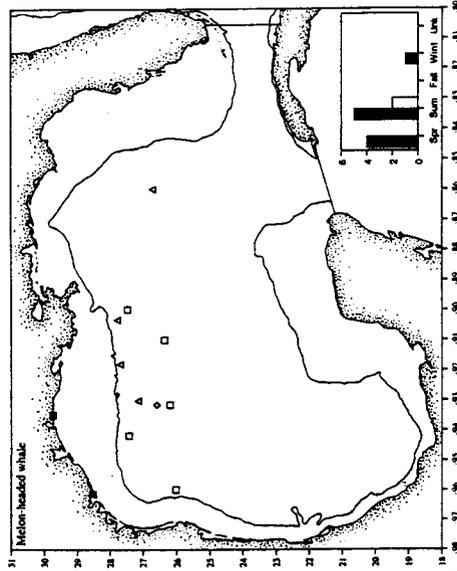
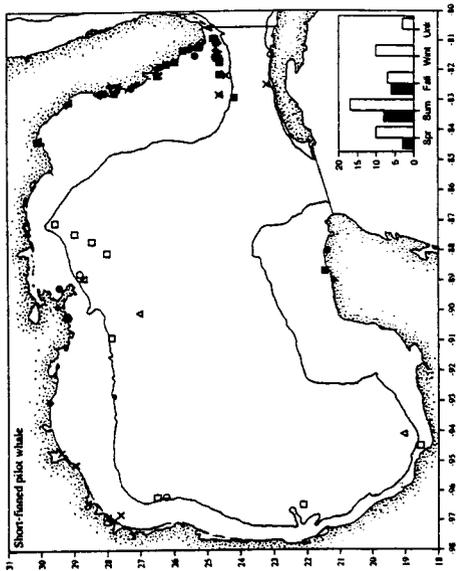
Short-finned Pilot Whale *Globicephala macrorhynchus*

Pilot Whales of the genus *Globicephala* are found in all major oceans and seas (Bernard & Reilly, in press). There are two species of Pilot Whale currently recognized, the Long-finned Pilot Whale *Globicephala melas* and the Short-finned Pilot Whale. The taxonomy of this genus is still somewhat controversial, and all of the Pilot Whale records from the Gulf are assumed in this paper to be *G. macrorhynchus*, the more tropical of the two. This is based on the currently known distributions of the two species, and their habitat preferences (see Bernard & Reilly, in press). However, it should be kept in mind that the identifications of many specimen records, and most or all sightings, have not been unequivocally shown to be of the short-finned species.

Based on historical records, the Short-finned Pilot Whale would be considered to be one of the most common offshore cetaceans in the Gulf of Mexico, with more records than any species, except the Sperm Whale, Risso's, Pantropical Spotted, and Atlantic Spotted Dolphins. A total of 64 records were accepted as reliable, and an additional 17 were considered questionable (Fig. 16). However, recent aerial and shipboard surveys in the northern Gulf of Mexico have not borne out the conclusion that Pilot Whales are common in the Gulf; they have only occasionally been sighted (Jefferson, in press).

One potential explanation for the preponderance of Pilot Whales in the older records, and their surprising rarity in recent surveys, is that many of the old records were misidentifications of other 'blackfish'* (most likely False Killer Whales, *Pseudorca crassidens*). This is a possibility, but many of the older records are supported by photographs or voucher specimens (skulls) that were collected from stranding sites. A more likely explanation is that the abundance or distribution patterns of Pilot Whales in the Gulf have changed over the past few decades. This is further explored in the Discussion.

* The term 'blackfish' is used variously to refer to several species of large, dark delphinid (pilot, killer, false killer, pygmy killer, and melon-headed whales, and sometimes Risso's dolphins).



False Killer Whale *Pseudorca crassidens*

False Killer Whales are found in tropical to warm temperate waters of the world (Stacey *et al.*, 1994). There are 27 reliable records from the Gulf of Mexico (Fig. 17). Several sightings have occurred over the continental shelf, although the majority appear to be in slope and oceanic waters. Stacey *et al.* (1994) mentioned that inshore movements associated with movements of prey and warm-water currents have been documented. There is a large peak in Gulf of Mexico strandings in the summer, but sample size is too small to tell if this peak results from a real difference.

Pygmy Killer Whale *Feresa attenuata*

Pygmy Killer Whales occur around the world in tropical and subtropical waters (Ross & Leatherwood, 1994). These animals do not appear to be very common in the Gulf of Mexico; there are only 19 reliable records, most of them strandings (Fig. 18). The apparent stranding peak in the winter may or may not be real, but the peak in sightings from the spring months results from the effort associated with the spring *Oregon II* surveys.

Melon-headed Whale *Peponocephala electra*

Melon-headed Whales occur throughout the tropical and subtropical waters of the world (Perryman *et al.*, 1994). The first records of this species from the Gulf of Mexico were only obtained recently. These consisted of two strandings, one in Texas in 1990, the other in Louisiana in 1991 (Barron & Jefferson, 1993). There have been a number of recent sightings associated with the GulfCet programme (Mullin *et al.*, 1994a), bringing the total number of reliable Gulf records to 12 (Fig. 19). Most of the sightings have been in deep waters, well beyond the edge of the continental shelf. The sample size is small, and the peak in spring and summer records does not necessarily reflect a real seasonal pattern, but rather an increase in survey effort and beachgoer activities at this time of year.

Risso's Dolphin *Grampus griseus*

This species is found in all major oceans in tropical to warm temperate waters (Kruse *et al.* in press). Although the first record for the Gulf of Mexico only came in 1966 (Paul, 1968), and Risso's Dolphins were previously considered to be rare in the Gulf, there are now numerous records (Fig. 20). A total of 97 reliable records were located, the vast majority sightings, and most from Mullin *et al.* (1991, 1994c). There is a large peak in sightings during the spring months, and this is perhaps indicative of increased abundance on the upper slope in this season.

The number of Risso's Dolphin sightings has dramatically increased in recent years. In fact, this was the most commonly sighted species in the surveys by Mullin *et al.* (1991, 1994c). The area of these surveys, the upper continental slope off Alabama, Mississippi, and eastern Louisiana, may be an area of concentration for these animals, or alternatively, there may have been an influx of Risso's Dolphins into this area during the time period of their surveys. The possible relationship between the abundance of this species and that of the Short-finned Pilot Whale is examined further in the Discussion. Whatever the reason for the change in frequency of records, it is clear that this species is not rare in the Gulf.

Rough-toothed Dolphin *Steno bredanensis*

Rough-toothed Dolphins are found in tropical to warm temperate waters of the world (Miyazaki & Perrin, 1994). Although not very common, the historical records none the less indicate that the

Fig. 14. Records of Blainville's Beaked Whales in the Gulf of Mexico. Fig. 15. Records of Killer Whales in the Gulf of Mexico. Fig. 16. Records of Short-finned Pilot Whales in the Gulf of Mexico. Fig. 17. Records of False Killer Whales in the Gulf of Mexico. Fig. 18. Records of Pygmy Killer Whales in the Gulf of Mexico. Fig. 19. Records of Melon-headed Whales in the Gulf of Mexico.

Rough-toothed Dolphin occurs in the Gulf of Mexico at any time of the year (Fig. 21). The 21 verified records (plus one additional questionable record) occur from throughout all four seasons. The apparent peak in spring sightings most likely results from the effort associated with the *Oregon II* surveys.

Fraser's Dolphin *Lagenodelphis hosei*

This is a tropical species, found world-wide on the high seas, and nearshore in some areas where deep water approaches the coast (Perrin *et al.*, 1994a). There are very few records from the Atlantic Ocean (see Leatherwood *et al.*, 1993), and until 1992, only a single record from the Gulf of Mexico, a mass stranding in the Florida Keys (Hersh & Odell, 1986). The first sightings in the Gulf were made in 1992, and since then there have been a number of others, associated with the GulfCet programme (Leatherwood *et al.*, 1993). The seven verified records come from all four seasons (Fig. 22). The recent spring and summer sightings reflect the bias in sighting effort during this time of year, and the three strandings occurred one each in spring, autumn and winter.

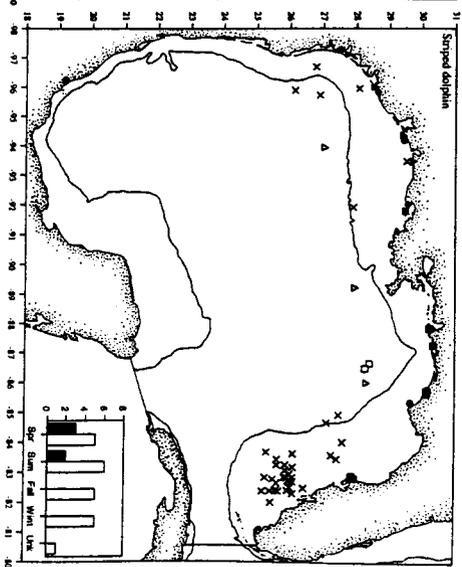
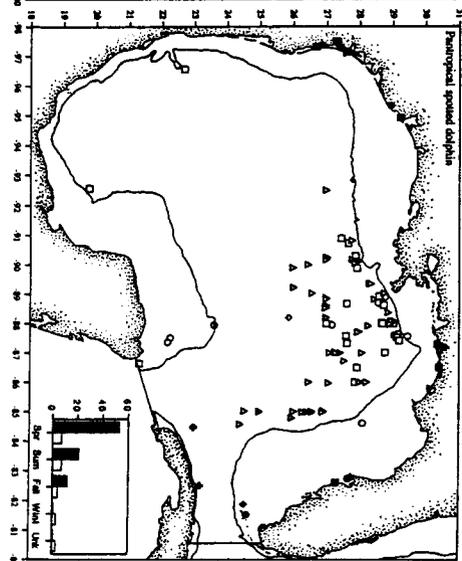
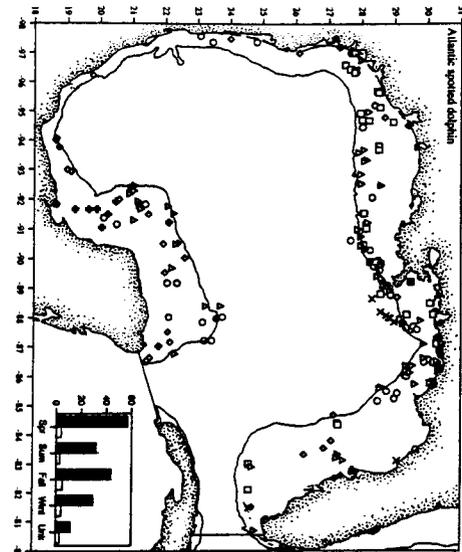
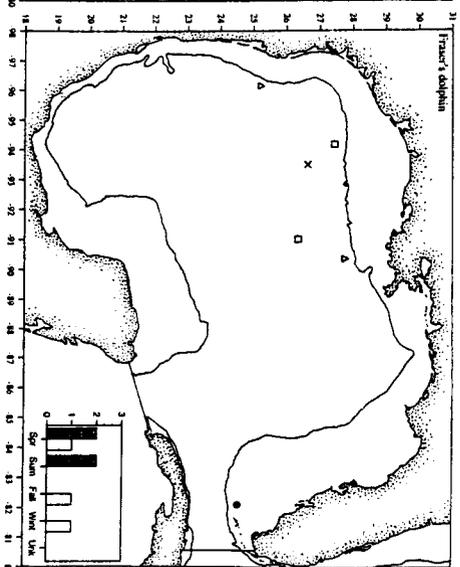
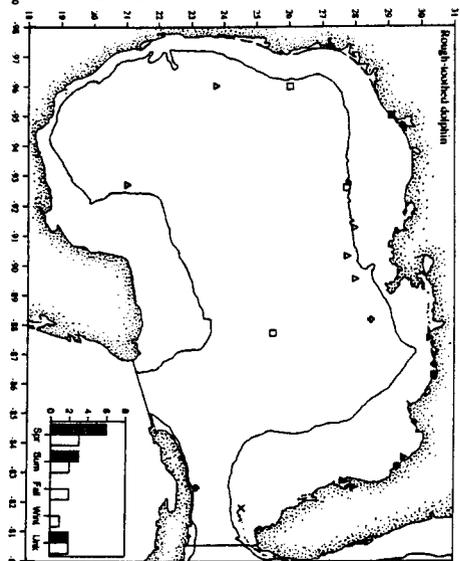
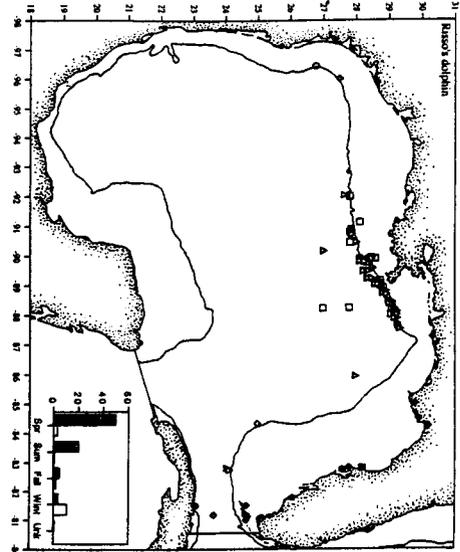
Common Dolphins *Delphinus* spp.

Common Dolphins occur in tropical to warm temperate waters of all three major oceans (Evans, 1994). Although long-beaked and short-beaked varieties of Common Dolphins have long been recognized, they were classified as one species (*D. delphis*) by most biologists until recently. However, Heyning & Perrin (1994) showed that the two types represent separate species in the eastern North Pacific. These are the Short-beaked Common Dolphin *D. delphis* and the Long-beaked Common Dolphin *D. capensis*, and these differences appear to apply to other ocean basins as well. Short-beaked Common Dolphins are known from the east coast of Florida, while the nearest occurrence of the long-beaked species is from Venezuelan waters (Heyning & Perrin, 1994).

Only three alleged specimen records of Common Dolphins from the Gulf of Mexico have been located. These consist of a live-capture of two specimens from near St Petersburg, Florida, in the spring of 1965 (R-G-1-SLS), which was mentioned by Caldwell & Caldwell (1973). These animals were later re-identified as 'Short-snouted Spinner Dolphins' (Caldwell & Caldwell, 1975), and photographs published therein leave no doubt that these animals were indeed *Stenella clymene*. A stranding at Sabine Pass, Texas, on 16 May 1974 (TCWC 28286) was identified at the time as a Common Dolphin, but was later re-identified as a Spinner Dolphin by Schmidly & Shane (1978). Finally, a live-stranding of a Common Dolphin in Galveston, Texas, on 30 March 1979 (TCWC 50849), was briefly mentioned in Schmidly (1981). We have examined the skulls of the latter two specimens, and the identifications have been confirmed as *S. longirostris* (TCWC 28286) and *Stenella clymene* (TCWC 50849) (Jefferson *et al.*, 1995). Thus, there are no valid specimen records of the genus *Delphinus* from the Gulf.

There have also been several reported sightings of Common Dolphins in Gulf of Mexico waters (Cuni, 1918; Caldwell, 1955; Springer, 1967; Caldwell & Caldwell, 1973; Lowery, 1974; Fritts & Reynolds, 1981; Dorf, 1982). However, none of these was accompanied by photographs, sketches or detailed descriptions of diagnostic characters used in identification. Most of the records were by untrained observers, and were made at a time when the taxonomy and diagnostic features of the long-snouted tropical dolphins (*Delphinus* and *Stenella*) were poorly known. All of these sightings occurred prior to 1981, when the redescription of the similar-appearing Clymene Dolphin was pub-

Fig. 20. Records of Risso's Dolphins in the Gulf of Mexico. Fig. 21. Records of Rough-toothed Dolphins in the Gulf of Mexico. Fig. 22. Records of Fraser's Dolphins in the Gulf of Mexico. Fig. 23. Records of Atlantic Spotted Dolphins in the Gulf of Mexico. Fig. 24. Records of Pantropical Spotted Dolphins in the Gulf of Mexico. Fig. 25. Records of Striped Dolphins in the Gulf of Mexico.



lished (Perrin *et al.*, 1981). Further, the sightings by Fritts & Reynolds (1981) and Dorf (1982) were made from aircraft, a platform from which identification is notoriously difficult (see Mullin *et al.*, 1991).

Even more questionable are the reported identifications of *Delphinus*, based only on recorded vocalizations, with no visual confirmation (Esher *et al.*, 1992). It is likely that most, if not all, of the reported *Delphinus* sightings were actually of groups of *Stenella clymene*, or possibly other species of *Stenella*. Evans (1994) also considered the presence of *Delphinus* in the Gulf of Mexico to be suspect; he suggested that the most likely explanation for most of the old sighting records was misidentification of *Stenella clymene*.

In conclusion, all reported records of *Delphinus* from the Gulf of Mexico are rejected as either incorrect or unreliable. Common Dolphins should not, at this time, be considered a species known to occur in the Gulf of Mexico. However, because of their known distribution in similar latitudes in other places in the world, they may be found there at some point in the future.

Atlantic Spotted Dolphin *Stenella frontalis*

Atlantic Spotted Dolphins are endemic to the tropical to warm temperate Atlantic Ocean (Perrin *et al.*, 1987, 1994b). Although they have been recorded from around oceanic islands and far offshore, they occur in the Gulf almost exclusively over the continental shelf (Fig. 23). The animals from offshore and around oceanic islands are smaller and more lightly spotted, and may represent a different form than the coastal animals (Perrin *et al.*, 1994b).

There are more Gulf records of Atlantic Spotted Dolphins than there are for any other species of offshore cetacean (Fig. 23). There are 194 records that are considered reliable, and an additional seven that are questionable. This is the only species, other than the Bottlenose Dolphin, that commonly occurs over the continental shelf. It is also the only species for which there is adequate information to assess its distribution in Mexican waters, which is also primarily over the continental shelf (Fig. 23). The apparent peak in sightings for the spring months may be real, as sightings per unit effort also increase in the spring (Mills *et al.*, 1993). One interesting feature is the low number of strandings; almost all records are of sightings or captures. It is unclear why a species as common as this one is so poorly represented in the stranding record.

Pantropical Spotted Dolphin *Stenella attenuata*

This is a tropical species, known from the Pacific, Indian and Atlantic oceans (Perrin & Hohn, 1994). In the Gulf of Mexico, it occurs almost exclusively in oceanic waters (Fig. 24). Most recent evidence indicates that this species is the most common and abundant delphinid in the oceanic (deeper than 200 m) waters of the Gulf of Mexico (Johnson *et al.*, 1991; Jefferson & Lynn, 1994). A total of 112 records have been located, mostly of sightings. Many of these sightings have come as the result of recent deep-water surveys in the northern Gulf (Mullin *et al.*, 1991, 1994c; SEFSC, unpublished data). The previous conclusion that this species was uncommon (see Schmidly, 1981) was probably mostly a result of its confused taxonomic status. Many older records of *Stenella* that could not be identified to species were probably of this species. Since its redescription (Perrin *et al.*, 1987), there have been numerous reports of this species in the Gulf.

The sightings reported from the mid-continental shelf area off the Yucatan Peninsula by Fuentes *et al.* (1986) do not agree with what is known of the preferred oceanic habitat of this species. They may be misidentifications of Atlantic Spotted Dolphins.

Striped Dolphin *Stenella coeruleoalba*

Striped Dolphins occur from tropical to warm temperate waters in all three major ocean basins (Wilson *et al.*, 1987; Perrin *et al.*, 1994c). There are relatively few verified records (27), but many

questionable ones (41) (Fig. 25). Many of the questionable records are from aerial surveys by Fritts *et al.* (1983). There is little evidence for seasonal differences; the spring sightings result from the *Oregon II* marine mammal surveys.

In most areas of the world, the primary habitat of Striped Dolphins appears to be deep water (> 200 m). Thus there is reason to question the accuracy of the many sightings reported from the west Florida shelf by Fritts *et al.* (1983). These were made from aircraft, from which species identification can be difficult (see Mullin *et al.*, 1991), and were collected mainly by inexperienced observers. It is likely that many, if not all, of these sightings were misidentifications of Atlantic Spotted Dolphins. Groups of young spotted dolphins, which are not heavily spotted, may be easily mistaken for Striped Dolphins (especially from the air), since both have prominent spinal blazes.

Spinner Dolphin *Stenella longirostris*

Spinner Dolphins are pantropical in distribution (Perrin & Gilpatrick, 1994). In the Gulf of Mexico, only 19 verified records, and 10 others that are questionable, were found (Fig. 26). This is fewer than for any other species of *Stenella*. There are records from all four seasons, although there are more strandings from summer. However, the small sample size precludes any conclusions about seasonality.

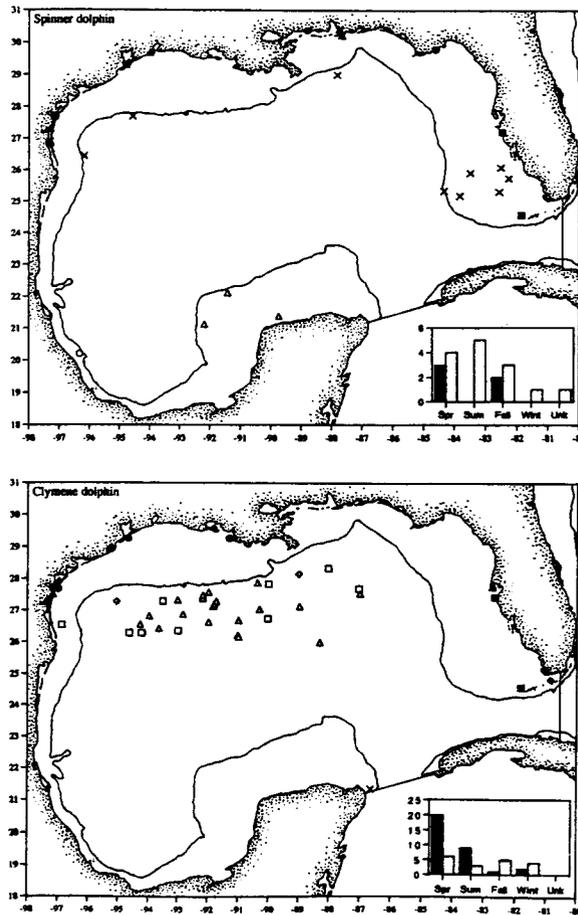


Fig. 26. Records of Spinner Dolphins in the Gulf of Mexico. Fig. 27. Records of Clymene Dolphins in the Gulf of Mexico.

Although Spinners occur in nearshore, shallow waters in some areas, their distribution in the tropical Atlantic appears to be primarily oceanic, with the exception of movements into shallow waters, such as around the island of Fernando de Noronha off Brazil (Lodi & Fiori, 1987). Thus, the continental shelf sightings reported for the west coast of Florida (Fritts *et al.*, 1983) and the Campeche Bank, north-west of the Yucatan Peninsula (Urban & Aguayo, 1983) may be misidentifications.

Clymene Dolphin *Stenella clymene*

The Clymene Dolphin is an Atlantic endemic, found in tropical and subtropical waters (Perrin *et al.*, 1981; Perrin & Mead, 1994). There are 50 verified records from the Gulf of Mexico (plus one questionable one from the southern Gulf), indicating that this species is not rare in this body of water (Fig. 27). The rarity of records in the past (see Schmidly, 1981) was probably only a result of its recently clarified taxonomic status and the tendency of observers to confuse it with other species (see Perrin *et al.*, 1981). There is no compelling evidence for seasonal differences. Strandings have occurred with relatively equal frequency throughout the year (Jefferson *et al.*, 1995), and the large spring sighting peak is due to the seasonal bias in survey effort of the *Oregon II* and GulfCet surveys (Mullin *et al.*, 1994b).

DISCUSSION

Distribution records of cetaceans are of several types. It is important to remember that what a particular record tells one about the distribution of the species depends on the record type. Sightings (with few exceptions) can be assumed to indicate the true location and movement of the animals. In other words, the animals are there because they swam there of their own motivation. Not all sightings are indicative of the normal range of the species, however, as animals get lost or occasionally venture to distant areas during unusual circumstances.

Similarly, most direct captures (incidental captures in fishing gear are rare in the Gulf) involve first a sighting of a group of animals, and can generally be safely assumed to represent a true location. The major exception involving some of the Gulf records is when an animal is captured outside its normal habitat, usually very near shore, probably in the process of stranding.

Finally, strandings should not be assumed to indicate anything more than a general region of occurrence and nothing at all of the habitat preference of a species. The reasons for this are that strandings often involve sick or injured animals that are behaving abnormally, swimming or being carried (sometimes after death) by currents many hundreds of kilometres from their normal range. One need only to look at the numerous stranding records for high-seas, offshore species such as Sperm Whales and beaked whales to understand the significance of this.

Strandings involve at least one other major bias: they are highly dependent on physical features that bring the animals to shore. Currents and weather patterns will affect when and where (and even if) an animal strands. Because of the current systems of the Gulf, for example, a dolphin that dies off the coast of Louisiana may wash up on a beach in southern Texas. There are also many reports of cetacean strandings in the Gulf of Mexico coinciding with the passage of hurricanes or other large oceanic storms (e.g. Lowery, 1943, 1974; Gunter, 1955; Waldo, 1957; Caldwell & Caldwell, 1969; Schmidly *et al.*, 1972b; Schmidly & Melcher, 1974; Schmidly & Shane, 1978; Davis, 1978; Gruber, 1981; Harris, 1986). Thus, it should not be assumed that the stranding of a cetacean in a certain area at a certain time means that the species naturally occurs in that area at that time.

It also should be remembered that there are often strong geographical and seasonal biases in sighting and stranding recovery efforts. For essentially all types of records, for instance, there has been almost no work in the southern Gulf of Mexico. Thus, distribution maps showing only, or primarily, records from the northern Gulf of Mexico do not, in any way, imply that these species do

not occur in the southern Gulf. On the contrary, there is no reason to believe that any species known from the northern Gulf does not also occur in the southern part of the study area.

Likewise, seasonal graphs must be viewed with several important biases kept in mind. For the most part, effort to document strandings since the inception of the SEUS MMSN in 1977, has been relatively even throughout the year. However, because stranding recoveries depend heavily on reports from the general public, the summer season (when more people are at the beach) would be expected to produce more stranding records than other seasons would. This is probably even more true of older stranding records, from before the establishment of systematic data collection. Finally, opportunistic sightings tend to be biased towards the time of year when the weather is good and more people are venturing offshore (primarily summer). In addition, one of the major sources of high-quality data for this analysis, the *Oregon II* surveys (SEFSC, unpublished data), have occurred almost exclusively in the spring. Thus, the apparent spring and/or summer peaks in sightings for many species are not necessarily real trends.

For most species, either the data do not provide enough high-quality information, or there are simply too few records to make solid conclusions about geographical distribution or seasonal movements in the offshore Gulf of Mexico at this time. In general, however, baleen whales appear not to occur in the Gulf of Mexico with any regularity (the Bryde's Whale may be an exception). None of the many species of toothed whales (Sperm and beaked whales, dolphins, and larger delphinids) that occur in the Gulf shows any convincing evidence for seasonal movements into or out of the Gulf (although seasonal shifts in abundance may be present). Although certain species inhabit shallower waters, and others are found mostly or exclusively in deeper waters, the present analysis did not turn-up any solid evidence of localized distributions within certain sections of the Gulf. The relative uniformity of the offshore cetacean habitat in the Gulf of Mexico may explain this.

Schmidly & Scarbrough (1990) previously noted an apparent decline in the number of Pilot Whale records in recent years. It was mentioned above that this decreasing trend in Pilot Whale records may have been due to a tendency to misidentify other blackfish species as Pilot Whales in the older literature. There is another potential explanation that may also shed light on the apparent great increase in Risso's Dolphins records within the last 10 years. Shane (1994) outlined a scenario in which Pilot Whale numbers in the southern California Bight dramatically declined following a major El Niño event, and Risso's Dolphin abundance increased immediately thereafter. She suggested that Risso's Dolphins moved in to fill the medium-sized teuthophage niche vacated by the Pilot Whales. There is also some evidence that a more tropical species of squid than the normally occurring *Loligo opalescens* invaded the area at about this time (W. E. Evans, personal communication). Unfortunately, data on oceanographic conditions in the Gulf correlated with cetacean abundance have not been available in the past, and even the cetacean data are non-systematic and highly variable in quality. However, it is tempting to imagine a similar scenario for the Pilot Whale/Risso's Dolphin situation in the Gulf of Mexico.

The apparent absence of Common Dolphins in the Gulf of Mexico is interesting, and is worthy of examination. Schmidly & Scarbrough (1990) noted that Common Dolphins had not been documented from the Gulf in the past decade, but apparently they did not doubt the accuracy of the older records. Common Dolphins appear to occur in most tropical to warm temperate waters of the world (Evans, 1994; Heyning & Perrin, 1994), and appear to favour cool, upwelling-modified waters in at least some areas (Reilly, 1990; Reilly & Fiedler, 1994). Their status in north-eastern Florida (the nearest area to the Gulf with confirmed records) was discussed by Caldwell & Caldwell (1978). They were once common along this coast, but in the past few decades have disappeared from these waters. The last known sightings and strandings were in 1958 and 1960, respectively (Caldwell & Caldwell, 1978). The disappearance of Common Dolphins from north-eastern Florida is probably

the result of natural fluctuations in numbers or distribution (probably associated with oceanographic changes), as there have been no known fishery interactions or other human-caused mortality events involving Common Dolphins from the south-eastern United States.

Because of the known occurrence, and then disappearance, of Common Dolphins off north-eastern Florida in recent decades, it must be considered possible that at least some of the older *Delphinus* records from the Gulf of Mexico were valid, and that the animals have left these waters as well. Regardless of the explanation, there is strong reason to believe that Common Dolphins presently do not occur in the Gulf of Mexico, or at least the northern half, from where there is now an adequate database to make conclusions.

There are potential sources of data on historical records in addition to those that have been examined in this paper. Some of the most valuable are old, nineteenth-century whaling logbook records. Townsend (1935) extracted records of the large whales that were the whaler's targets (Sperm, Humpback and Right Whales) from many logbooks of Yankee whalers. However, there are probably many more logbooks that have not been examined, and there is likely to be much other information in those that were examined by Townsend (1935). For instance, other large whales that were too quick to be primary targets of Yankee whalers (rorquals) and other species of small cetaceans were often mentioned in old whalers' logbooks. Although species identification would be very difficult to verify for many of these records, there may be a number of records of highly distinctive species (such as Killer Whales) that could be extracted. Thus, these whaling logbooks represent a potentially valuable untapped source of data for analyses such as this.

Recent increases in funding for studies of offshore cetaceans of the Gulf of Mexico have allowed us to add greatly to the efforts of those early workers who painstakingly documented strandings and occasional sightings of these relatively poorly known animals. Only with continued funding and dedicated study can we provide the information on the biology of these animals that is needed to protect them from human-caused threats, and thus ensure their continued existence in the Gulf of Mexico.

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