Application for Incidental Take Authorization (LOA) for Texas Parks and Wildlife Department, April 24, 2015

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The purpose of this Incidental Take Authorization (LOA) is to comply with statutory requirements to use the best scientific information available when assessing the risk posed to listed species by proposed Texas Parks and Wildlife Department (TPWD) actions; specifically incidental take of bottlenose dolphins (dolphin or dolphins) by seasonal gill net sampling.

1) Description of the Specific Activity:

TPWD conducts a long-term standardized fishery-independent monitoring program to assess the relative abundance and size of finfish and shellfish in Texas bays. TPWD is mandated by the Texas Legislature to conduct continuous research and study of the supply, economic value, environment, and breeding habits of the various species of finfish, shrimp and oysters under Parks and Wildlife Code §66.217, §76.302 and §77.004. Results from this program are primarily used by the agency to manage Texas' marine finfish and shellfish resources. Data are also used by other state and federal agencies (e.g., NOAA, USFWS, Gulf of Mexico Fishery Management Council, Gulf States Marine Fisheries Commission, Texas Water Development Board, and Texas Commission on Environmental Quality), Universities, NGO's and the private sector.

The utility of this program data is dependent upon its consistency, comparability, and reliability. The current protocol began in the spring of 1983 for seven of the ten bay systems. TPWD began collecting gill net data in Sabine Lake in 1986. The number of gill nets set was standardized in 1985. Cedar Lakes is a fairly isolated and small system; gill net sampling began there in 1996. For the first 4 years in Cedar Lakes 40 nets per season were set, and then in 2000 it was reduced to 20 nets per season (Table 1). Despite the differences in the numbers of nets set (these are standardized by using CPUE) for these 3 bay systems, all other parameters have remained constant since 1983.

The monitoring program utilizes a stratified random sample design, with each bay system as an independent stratum. Gill net sample locations are randomly selected from grids (1 minute latitude by 1 minute longitude) containing >15.2 m of shoreline, with each selected grid further subdivided into 144 5-second "gridlets". Sample sites are then randomly selected from gridlets containing >15.2 m of shoreline. If it is determined in the field that the randomly selected section cannot or should not be sampled, the nearest 15.2-m section that can be safely sampled is designated as an alternate.

Gill nets (monofilament, 183 m long; 1.2 m deep with separate 45.7-m sections of 7.6-, 10.2-, 12.7- and 15.2-cm stretched mesh tied together in ascending mesh size) are set overnight during each spring and fall season. Gill nets are set overnight to eliminate day-use disturbances (boaters running the shoreline) that can alter normal fish behavior and movement patterns, reduce the amount of disturbance by and to anglers and boaters (user conflicts), and increases boater safety (reduced likelihood of striking nets).

The spring season begins with the second full week in April and extends for 10 weeks. The fall season begins with the second full week in September and extends for 10 weeks. Gill nets are set perpendicular to shore with the smallest mesh shoreward. Nets are set within 1 h before sunset and retrieved within 4 h after the following sunrise. Total fishing time is recorded (nearest 0.1 h), typically between 12 and 14 h. All gill net samples coastwide are set in water depths ranging from 0.0-1.1 m on the shallow end of the net and from 0.1-4.6 m on the deep end of the net.

Only new or fully repaired nets are used in sampling. Table 2 shows the number of gill nets set per sample period. No more than one gill net is set in the same grid on 1 night, nor set more than two times in the same grid in a season. Gill nets set on the same night must be at least 1 km apart in all directions. If setting adjacent grids, one of the grids is chosen at random and then a gridlet is selected. The gridlet in the adjacent grid is chosen from all gridlets that are 1 km from initial selected site.

Gill net surveys are essential for effectively managing fisheries in Texas bays. Consequently, they were selected as the primary sampling gear to collect fishery-independent data on relative abundance, diversity, and age and size distributions of adult and subadult finfish in Texas waters. These samples also provide data for genetic, life history and age and growth analyses. In addition, because of their size selectivity, different mesh sizes allow capture of different sizes of fish including pre-recruits and fish fully recruited into the fishery and the combined results provide data on the size and age structure of the finfish population.

Statistically, gill nets are our most precise gear which exhibits the lowest variability of all our sample gears. They provide our best fishery-independent measure of adult and subadult finfish abundance with a low coefficient of variation for most species requiring a low sample size. Standardized sampling methods have low operational bias allowing comparison between and among bay systems and years.

Fishery-dependent data cannot be relied on solely for monitoring as they are based on non-random, non-uniform fishing, are subject to economic or regulatory constraints, and they provide no data on species that are not harvested.

The current gill net sampling protocols developed in 1983 are important for the integrity of the program and safety of staff and citizenry. Stratified random sampling provides the most precise data on relative abundance. Seasonal sampling addresses seasonal differences in fish behavior, diversity and relative abundance. Night sampling eliminates day-use disturbances that can alter normal fish behavior and movement patterns, reduces the amount of disturbance by and to anglers and boaters, and increases boater safety. Gill nets are not attended by staff for critical safety and security reasons (our vessels are shallow running bay skiffs and are not equipped for overnight stays), as well as reducing overall operational costs. There are 2-3 nets on two separate nights for each bay system, separated by at least 1 km and usually miles apart. Monitoring this number of nets (needed for statistical robustness) would exceed manpower and equipment capabilities of TPWD.

Hydrological data, vegetative identification and density data are recorded in addition to species data. Salinity (‰), water temperature (^{o}C), dissolved oxygen (ppm) and turbidity (Nephelometric Turbidity Units) are measured at the set and pickup for each gill net. All organisms greater than 5 mm in length are

identified as to genus, species or the lowest phylogenic unit. Length is recorded for the first 19 randomly selected individuals of each species in each mesh size, with the remainder counted. Catch rates are calculated by dividing total number captured by total effort. Catch rates for each bay system can be calculated by year or season. Coastwide estimates are calculated by weighting each stratum by its total shoreline for gill nets.

Any marine mammal take is taken seriously by TPWD staff. Any individual marine mammal found dead in TPWD gill nets is documented following the NMFS Protocol for Dead Entangled Small Cetaceans (from SERO letter sent to Robin Riechers dated 9/23/11, Appendix A). Gill nets are examined prior to retrieval and if a live dolphin is encountered it is quickly and safely released. If measurement and visual inspection is possible, the data will be collected and reported. TPWD closely monitors our sampling routine and will not knowingly endanger or entangle any marine mammal. TPWD has been fully supportive and cooperative in marine mammal protection. TPWD is a partner with the Marine Mammal Stranding Network (TMMSN). Staff responds to and documents strandings, and assists with cooperative data and tissue sample collection (Appendix 2).

2) The date(s) and duration of such activity and the specific geographical region where it will occur.

It is anticipated 780 gill net samples, split evenly between the spring and fall seasons, will be taken annually during the 2015-2020 sampling seasons. Gill nets are set overnight during each spring and fall season. The spring season begins with the second full week in April and extends for 10 weeks. The fall season begins with the second full week in September and extends for 10 weeks.

Gill will be used in each of the ten major Texas bay systems: Sabine Lake, Galveston, Cedar Lakes, East Matagorda, Matagorda, San Antonio, Aransas, Corpus Christi, upper Laguna Madre and lower Laguna Madre. Gill nets are not used anywhere along the Gulf beaches of the Texas coast (Figure 1).

3) Affected marine mammal species.

Bottlenose dolphin, *Tursiops truncatus truncatus*, from seven different stocks (NMFS definition of a stock). This may include individuals from the Laguna Madre (B51), Nueces Bay/Corpus Christi Bay (B52), Copano Bay/Aransas Bay/ San Antonio Bay/Redfish Bay/Espiritu Santo Bay (B50), Matagorda Bay/Tres Palacious Bay/ Lavaca Bay (B54), West Bay (B55), Galveston Bay/East Bay/Trinity Bay (B56), and Sabine Lake (B57) stocks (NOAA 2012).

4) Status and distribution of affected marine mammal species.

Although the status of the bay, sound, and estuarine bottlenose dolphins within the study area are unknown and are neither threatened or endangered (NOAA 2012), all stocks inhabiting the study area are considered strategic under the Marine Mammal Protection Act.

Blaylock and Hoggard (1994) as cited by Waring et al. (2001) estimated the abundance of the western Gulf of Mexico coastal bottlenose dolphin stock to be between 2,938 and 3,499 individuals based on an aerial transect survey conducted in 1992.

The stock assessment report for bottlenose dolphin bay, sound and estuary stocks in the Northern Gulf of Mexico (NOAA 2012) report population size estimates for the gulf are greater than 8 years old, and are therefore considered unknown. The report further stated that data were insufficient to conduct a statistical trend analysis. A table of data was published using estimated data from line-transect data collected in aerial surveys in Texas in September and October of 1992. The analyses state there were the following bottlenose dolphin abundance best (Nbest) estimates for these Texas bay systems: Laguna Madre Nbest = 80, CV=1.57, Nueces and Corpus Christi Nbest=58, CV=0.61, Copano, Aransas, San Antonio, Redfish and Espiritu Santo Nbest=55, CV=0.82, Matagorda, Tres Palacios and Lavaca Nbest=61, CV=0.45, West Bay Nbest=32, CV=0.15, Galveston, East and Trinity Nbest=152, CV=0.43, and Sabine Lake Nbest=0.

Figure 2 shows the distribution of the possibly affected stocks.

5) Type of incidental take authorization being requested.

Requesting incidental take authorization for research gill nets that may potentially result in death of a bottlenose dolphin.

6) The number of marine mammals that may be taken.

In 32 years of TPWD gill net sampling (1983-2014), and with 24,507 gill nets sets, there have been 28 encounters for an average of 0.88 dolphin captured per year. In 15 of the 32 years (47%) there were zero dolphins taken (Table 3). During these 32 years, there were 12 dolphins release alive, 7 recorded as dead, and 9 where the condition was not recorded. If you assume that the ratio of dead to alive (7:12) for individuals where release condition was noted applies to the not-recorded individuals and expand out to the total number of dolphins encountered, there were 16 released alive and 12 fatalities, or 0.375 fatalities per year. However, consensus among staff is that in encounters where release condition was not noted the dolphin was probably released alive, or escaped before staff reached the dolphin.

<u>* Of note is that no dolphins have been taken since April of 2011 and no encounters since October of 2012.</u>

TPWD anticipates overall take of no more than 1 dolphin in any one year as a result of this proposed action, with no more than 1 bottlenose dolphins from any one stock in any given year. Overall take for the 5 year duration of this permit is expected to be ≤ 2 dolphins. Table 4 shows the estimated annual take for each stock based on the expanded fatalities proportionally distributed among stocks with recorded takes.

7) Anticipated impact of the activity upon the species or stock.

Based on the 32 years of gill net data collected by TPWD we expect less than two dolphins (≈ 1.25) to be taken over the next 5 years. From our data, we can assume that if a dolphin is taken during the next 5 years it will probably come from the Copano Bay/Aransas Bay/ San Antonio Bay/Redfish Bay/Espiritu Santo Bay stock (estimated take from this stock is one dolphin every 4.3 years). Since the status of this stock is unknown, or undetermined, it is difficult to determine what impact this take will have and would

depend on the sex of the dolphin taken. Overall we believe the impact of our activity to be negligible for all seven bay, sound, and estuary stocks found in Texas.

8) The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

No subsistence use of bottlenose dolphin occurs in Texas waters.

9) The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

No impact on habitat is anticipated.

10) The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

No loss or modification of habitat is anticipated.

11) The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of affecting the least practicable adverse impact upon the affected species or stocks, their habitat, or their availability.

TPWD determined that setting our research gill nets at night would prevent user conflicts, result in less fishing mortality (cooler water temperatures at night allow for more of the catch to be released alive), and protect our staff and equipment. While tending gill nets overnight might be an effective means of avoiding take, it has been determined to be impractical and unsafe for our gill net sampling program and staff. None of our vessels (shallow running flats boats) used to set gill nets are equipped to provide safe overnight accommodations for staff. Additionally, given that up to three gill nets may be set in a bay system on any given night, and the nets may be separated by miles the manpower requirements needed to monitor nets overnight far exceeds staffing levels. Given these concerns we believe that the below listed measures are best practices for this sampling.

Preventative measures used for gill net sampling:

- Only new or fully repaired gill nets will be used.
- Gill nets will be set with minimal slack and a very short marker buoy attached to the deep end of the net.
- Prior to setting nets, scan 360 degrees around the sample site to determine if dolphins are within view of the proposed site.
- If dolphin are present, use appropriate techniques (raising and lower lead line) to encourage the animals to leave the site.
- If bottlenose dolphins are still within view of the sample site; select an alternate site.
- Staff will immediately respond to net disturbances when setting and retrieving nets to determine if a dolphin is entangled, and if so release the dolphin immediately.

- "Hot spots" where bottlenose dolphins were more frequently encountered in TPWD routine gill net sampling have been identified. The sampling protocol can be revised in order to minimize the probability of encounter by:
    - Setting only one net in these identified "hot spot" grids per night; AND
    - Minimizing soak time by utilizing the "last out/first in" strategy for gill nets set in these identified so that the nets set are deployed last (at or after sunset) and retrieved first (at or before sunrise).

12) Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and /or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must either submit either a plan of cooperation or information that identifies what measures have been taken to minimize any adverse effects.

N/A

13) The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity.

- *Necessary monitoring and reporting...*
    - Report takes according to NOAA protocols
    - Determine sex of captured animals
    - Photograph individuals
    - Obtain necropsy samples when necessary
    - Take samples to stranding network point of contact
- *Level of taking or impacts...*
    - Keep logs of each take
    - Record condition of animal in a user defined data field on our resource monitoring data sheets
    - Routinely analyze take data to determine level of impacts
- *Suggested means of minimizing reporting burdens...*
    - Utilize standardized data entry sheets to document pertinent data for each take
    - Report each take by phone and/or e-mail to MMSN and NOAA (Stacey.Horstman@noaa.gov and/or HWhitehead@tmmsn.org and/or Blair.Mase@NOAA.gov and/or Rosie.Roegner@tpwd.state.tx.us)
- *Monitoring plans...*
    - Take field notes of presence/absence of bottlenose dolphin in the area
    - Estimate numbers and sizes of individuals
    - Determine activities of the bottlenose dolphin (feeding, moving through, etc.).
    - Take photos of the bottlenose dolphin if they are within range and compare with previous photos taken during the activity.

14) Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

- Cooperate with NOAA or universities to evaluate the efficacy of various techniques to reduce or eliminate dolphin takes.
- Cooperate with NOAA or universities to obtain better population data for bay stocks in Texas

Literature Cited

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

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Kastelein RA, Au WWL, de Haan D (2000) Detection distances of bottom-set gillnets by harbor porpoises (*Phocoena phocoena*) and bottlenose dolphins (*Tursiops truncatus*). Marine Environmental Research, 49: 359-375.

NOAA. 2012. Bottlenose Dolphins (*Tursiops truncatus truncatus*): Northern Gulf of Mexico Bay, Sound and Estuary Stocks. Marine Mammal Stock Assessment Reports. December 2012, pp 183-197. http://www.nmfs.noaa.gov/pr/pdfs/sars/ao2012dobn-gmxb.pdf.

Read AJ, Waples DM, Urian KW, Swanner D (2003) Fine-scale behavior of bottlenose dolphins around gillnets. Proceedings of the Royal Society of London, 270: S90-S92.

Waring, G. T., J. M. Quintal, and S. L Swartz (Eds.). 2001. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2001. NOAA Technical Memorandum NMFS-NE-168. Northeast Fisheries Science Center, Woods Hole, MA. 307 pp.

Figure 1. Distribution of gill net samples for the TPWD fishery-independent monitoring program.

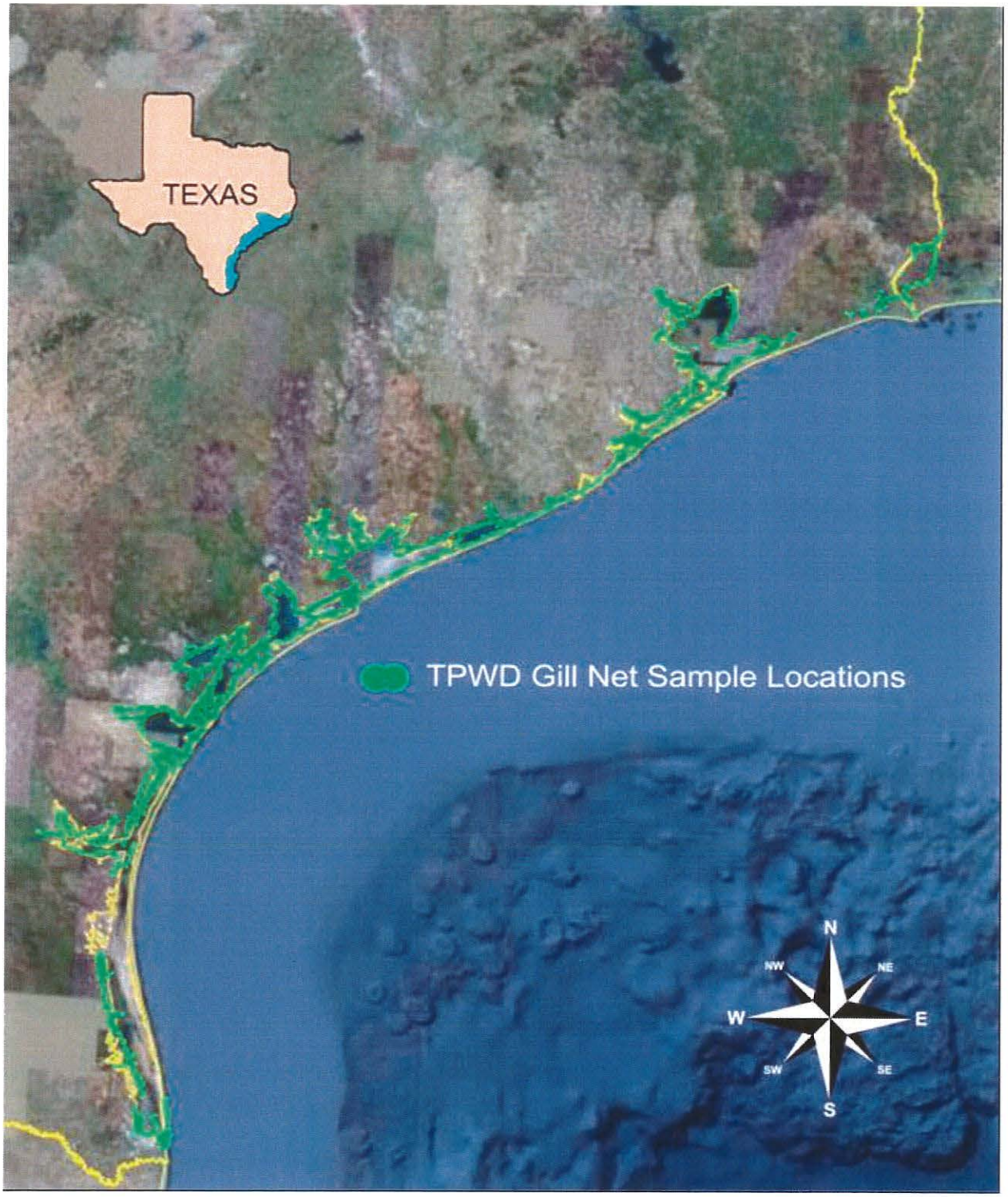


Figure 2. Distribution of Bottlenose Dolphin Stocks in Texas (Block 50 = Copano Bay/Aransas Bay/San Antonio Bay/Redfish Bay/Espiritu Santo Bay stock, Block 51 = Laguna Madre stock, Block 52 = Nueces Bay/Corpus Christi Bay stock, Block 54 = Matagorda Bay/Tres Placious Bay/Lavaca Bay stock, Block 55 = West Bay stock, Block 56 = Galveston Bay/East Bay/Trinity Bay stock, Block 57 = Sabine Lake stock).

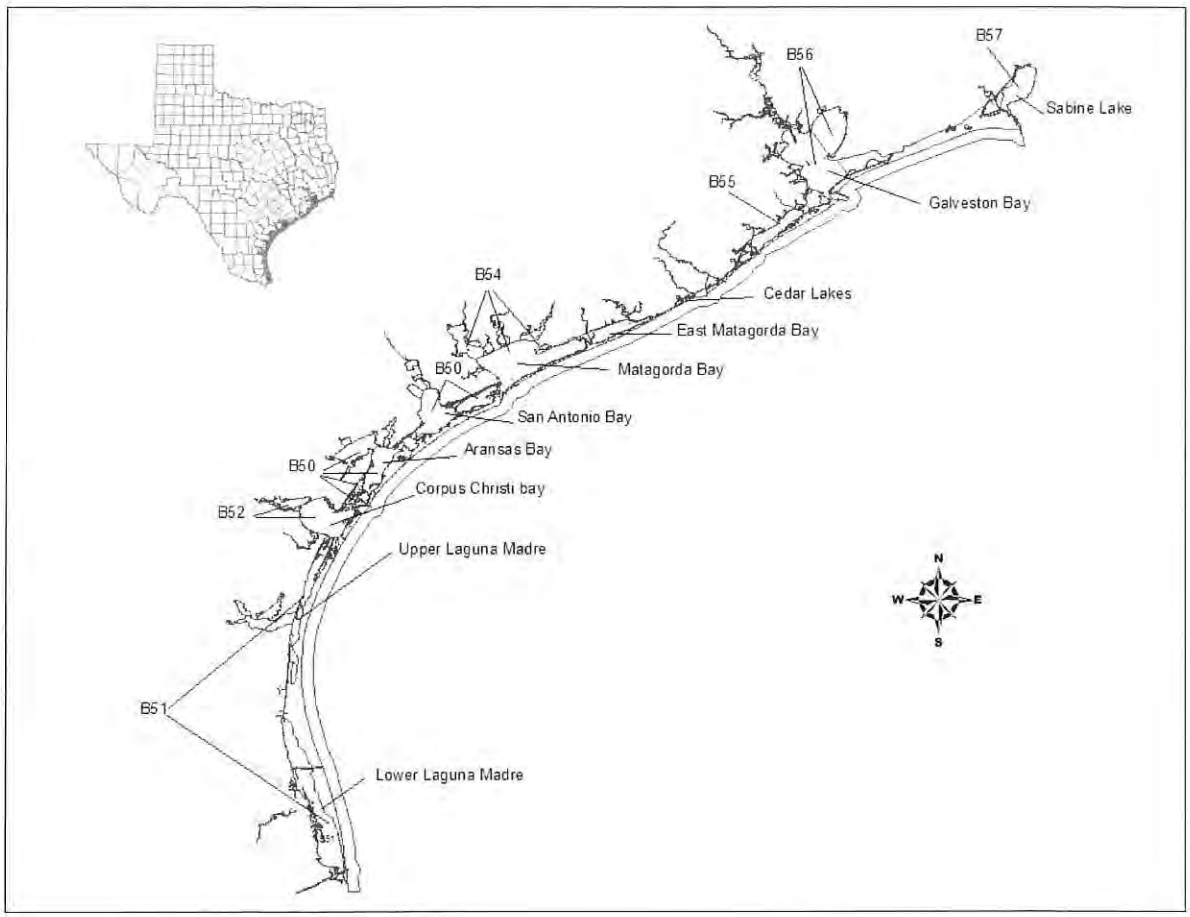


Table 1. Number of TPWD gill net samples from 1983-2014, by bay system and year (SL=Sabine Lake, GB=Galveston Bay, CL=Cedar Lakes, EM=East Matagorda Bay, MB=Matagorda Bay, SA=San Antonio Bay, AB=Aransas Bay, CC=Corpus Christi Bay, ULM=upper Laguna Madre, LLM=lower Laguna Madre).

Year	SL	GB	CL	EM	MB	SA	AB	CC	ULM	LLM	Total
1983	0	90	0	36	90	90	90	90	90	90	666
1984	0	90	0	41	90	90	90	90	90	90	671
1985	0	90	0	40	90	90	90	90	90	90	670
1986	90	90	0	40	90	90	90	90	90	90	760
1987	90	90	0	40	90	90	90	90	90	90	760
1988	90	90	0	40	90	90	90	90	90	90	760
1989	90	90	0	40	90	90	90	90	90	90	760
1990	90	90	0	40	90	90	90	90	90	90	760
1991	90	90	0	40	90	90	90	90	90	90	760
1992	90	90	0	40	90	90	90	90	90	90	760
1993	90	90	0	40	90	90	90	90	90	90	760
1994	90	90	0	40	90	90	90	90	90	90	760
1995	90	90	0	40	90	90	90	90	90	90	760
1996	90	90	40	40	90	90	90	90	90	90	800
1997	90	90	40	40	90	90	90	90	90	90	800
1998	90	90	40	40	90	90	90	90	90	90	800
1999	90	90	40	40	90	90	90	90	90	90	800
2000	90	90	20	40	90	90	90	90	90	90	780
2001	90	90	20	40	90	90	90	90	90	90	780
2002	90	90	20	40	90	90	90	90	90	90	780
2003	90	90	20	40	90	90	90	90	90	90	780
2004	90	90	20	40	90	90	90	90	90	90	780
2005	90	90	20	40	90	90	90	90	90	90	780
2006	90	90	20	40	90	90	90	90	90	90	780
2007	90	90	20	40	90	90	90	90	90	90	780
2008	90	90	20	40	90	90	90	90	90	90	780
2009	90	90	20	40	90	90	90	90	90	90	780
2010	90	90	20	40	90	90	90	90	90	90	780
2011	90	90	20	40	90	90	90	90	90	90	780
2012	90	90	20	40	90	90	90	90	90	90	780
2013	90	90	20	40	90	90	90	90	90	90	780
2014	90	90	20	40	90	90	90	90	90	90	780
Total	2,610	2,880	460	1,277	2,880	2,880	2,880	2,880	2,880	2,880	24,507

Table 2. Number of samples per sample period by sample area (A = no less than three or more than five nets are set each week and on no more than 6 nights during the 10 weeks can three nets be set in one night, B = one net per week, C = two nets per week).

Area	Week	Season	Year
Sabine Lake	A	45	90
Galveston Bay	A	45	90
Cedar Lakes	B	10	20
East Matagorda Bay	C	20	40
West Matagorda Bay	A	45	90
San Antonio Bay	A	45	90
Aransas Bay	A	45	90
Corpus Christi Bay	A	45	90
Upper Laguna Madre	A	45	90
Lower Laguna Madre	A	45	90
Total		390	780

Table 3. All bottlenose dolphins encountered in TPWD gill nets from 1983 – 2014 (Block 50 = Copano Bay/Aransas Bay/San Antonio Bay/Redfish Bay/Espiritu Santo Bay stock, Block 51 = Laguna Madre stock, Block 52 = Nueces Bay/Corpus Christi Bay stock, Block 54 = Matagorda Bay/Tres Placious Bay/Lavaca Bay stock, Block 55 = West Bay stock, Block 56 = Galveston Bay/East Bay/Trinity Bay stock, Block 57 = Sabine Lake stock).

Date	Bay System	Block	Station Number	Water Depth (m)	Length (mm)	Condition
04/18/1984	San Antonio Bay	B50	113	0.9	--	Not Recorded
05/30/1985	Matagorda Bay	B54	276	0.6	2134	Not Recorded
09/13/1988	Lower Laguna Madre	B51	47	1.2	--	Dead
09/13/1988	Lower Laguna Madre	B51	47	1.2	--	Not Recorded
05/31/1989	Lower Laguna Madre	B51	318	0.7	2000	Alive
10/17/1989	San Antonio Bay	B50	259	1.2	--	Not Recorded
05/22/1990	Matagorda Bay	B54	58	1.3	1948	Not Recorded
10/03/1990	Aransas Bay	B50	291	1.2	1885	Not Recorded
10/05/1993	San Antonio Bay	B50	183	1.1		Not Recorded
10/05/1994	Lower Laguna Madre	B51	319	1.4	1880	Alive
09/12/1995	Aransas Bay	B50	301	1.4	2134	Not Recorded
06/05/1996	Corpus Christi Bay	B52	132	2.5	1820	Alive
06/05/1996	Corpus Christi Bay	B52	132	2.5	2510	Not Recorded
09/24/1996	Aransas Bay	B50	280	1.2	--	Dead
04/15/1997	Aransas Bay	B50	280	1.5	--	Dead
10/15/1997	San Antonio Bay	B50	96	1.1	--	Alive
09/23/1999	Corpus Christi Bay	B52	61	3.4	2360	Alive
04/23/2003	Aransas Bay	B50	290	1.1	1323	Dead
10/27/2004	Aransas Bay	B50	280	1.2	2020	Dead
10/25/2007	Matagorda Bay	B54	294	0.9	1762	Dead
05/11/2010	San Antonio Bay	B50	278	0.9	--	Alive
09/13/2010	Aransas Bay	B50	171	1.4	--	Alive
04/21/2011	Aransas Bay	B50	255	1.3	1230	Dead
09/27/2011	Aransas Bay	B50	308	2.3	2286	Alive
04/19/2012	Corpus Christi Bay	B52	8	1.4	--	Alive
05/08/2012	Corpus Christi Bay	B52	63	1.0	2130	Alive
05/30/2012	San Antonio Bay	B50	198	0.9	--	Alive
10/03/2012	Lower Laguna Madre	B51	88	1.5	1524	Alive

*Data for this table was compiled from the TPWD Coastal Fisheries data base, and from encounter reports submitted to NMFS. There were two instances where the same individual was reported twice (10/31/1990 and 9/12/1995) to NMFS. There was also an erroneously recorded encounter within NMFS records (9/30/2008). There is no record of this encounter within our data base and the reported Matagorda Bay grid 361 where this encounter was reported to occur is on dry land.

Table 4. Annual expected take by block based on expanded data from TPWD fisheries independent sampling program gill nets (Block 50 = Copano Bay/Aransas Bay/San Antonio Bay/Redfish Bay/Espiritu Santo Bay stock, Block 51 = Laguna Madre stock, Block 52 = Nueces Bay/Corpus Christi Bay stock, Block 54 = Matagorda Bay/Tres Placious Bay/Lavaca Bay stock, Block 55 = West Bay stock, Block 56 = Galveston Bay/East Bay/Trinity Bay stock, Block 57 = Sabine Lake stock) .

Block	**# of Dolphins**
B51	0.046875
B52	0.046875
B50	0.234375
B54	0.046875
B55	0
B56	0
B57	0

Appendix 1 TPWD Marine Mammal Encounter Data Collection Form

Encounter Number	Major Bay System (from drop-down list)	Date	Gear Code [1]	Mesh Size [2] (in)	Depth where found (ft)	Time taken to Release (min)	Photos Taken (Y or N)	GN Set Start Time (h:min)	GN Set End Time (h:min)	Total Soak Time [3] (h) Field Auto-Calculates	Start Temp (°C)	End Temp [4] (°C)	TPWD Station [5] (X-YYY-ZZZ)	Latitude (N XX-YY-ZZ)	Longitude (W XX-YY-ZZ)	Species Name (from drop-down list)	Length [6] (mm)	Condition (RA=Released Alive); (D=Dead)
													NOTE: Fields will Auto-Format--do not enter dashes or letters					
EXAMPLES==>	Aransas	06/30/11	1	6	3	5	Y	18:25	6:03	11.63	25.0	18.0	XYYYZZZ	XXYYZZ	XXYYZZ	Species Name	XXXX	RA
1										0.00								
2										0.00								
3										0.00								
4										0.00								
5										0.00								
6										0.00								
7										0.00								
8										0.00								
9										0.00								
10										0.00								

ENTER ANY ADDITIONAL INFORMATION REGARDING EACH ENCOUNTER

Encounter Number	EXAMPLE==>Dolphin active; no noticible injuries; released unharmed; swam away without noticible disorientation or hesitation.
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

HEADER EXPLANATIONS

[1]	GEAR CODE:	*1 = GILL NET; 5 = SHRIMP TRAWL; 7 = BAG SEINE; 29 = LONGLINE*
[2]	MESH SIZE:	*NOT REPORTED FOR SHRIMP TRAWLS, BAG SEINES & LONG LINES*
[3]	SOAK TIMES:	*NOT REPORTED FOR SHRIMP TRAWL AND BAG SEINE SAMPLES*
[4]	END TEMP:	*NOT REPORTED FOR SHRIIMP TRAWL AND BAG SEINE SAMPLES*
[5]	TPWD STATION:	*RECORDED AS MAJOR BAY-MINOR BAY-GRID--- (NOTE:Minor bay and grid code numbers MUST be 3 digits; if not, preceed with zeros to make 3 digits)*
[6]	LENGTH:	*DOLPHINS = STANDARD LENGTH (STRAIGHT-LINE FROM NOSE TO NOTCH IN TAIL FLUKES)*

Appendix 2

TPWD Technical Memorandum

Description of Encounters with Bottlenose Dolphins (*Tursiops truncatus*) During the Course of Coastal Fisheries Routine Monitoring

Coastal Fisheries Division, Texas Parks and Wildlife

Executive Summary

The following data were compiled in an effort to summarize encounters with marine mammals in the sampling gear of the Texas Parks and Wildlife Coastal Fisheries Division (hereafter TPWD-CF). The data represent 37 years of TPWD-CF monitoring data, collected using TPWD-CF systematic routine monitoring protocol spanning the years 1976 – 2012. Over this time period, a single species, the bottlenose dolphin (*Tursiops truncatus*), has accounted for all marine mammal encounters. Encounters with bottlenose dolphins (hereafter, "dolphins") occurred on 28 independent occasions, all of which involved gill net sampling gear. Dolphins encountered by gill nets were typically adults or sub-adults, ranging in size from 1230 mm to 2510 mm total length. There was not a statistical trend, either positive or negative, that would suggest a change in the frequency of encounters over the sampled period.

The central coast and southern coast are more disposed to encounters with dolphins than the northern coast, with none of the reported encounters occurring north of Matagorda Bay. Within bays, the geographic distribution of dolphin encounters was not entirely random. For instance, while a vast majority of TPWD-CF grids did not have a single encounter, 3 grids saw repeated encounters (2+ individuals) over the sampled period, suggesting that some grids are more frequently utilized by dolphins.

The data were also used to explore relationships between water characteristics (temperature, salinity, depth) and frequency of dolphin encounters. While temperature and salinity had no effect on encounters, depth was a major factor in nets that intercepted dolphins, with deeper nets (> 2.0 m) intercepting dolphins at a higher than expected rate. The mesh size of sampling gear is also important, with the largest mesh (152 mm) intercepting over half of the dolphins encountered in the sampling period, although mesh size and depth are interacting variables. These data suggest that latitude, within-bay habitat variability, and water depth are the most important factors in determining the probability of dolphin encounters in TPWD-CF sampling gear.

Data Analysis

Timing of encounters.—Encounters with dolphins were rare in TPWD-CF sampling gear over the reported period (1976 – 2012). Dolphins were intercepted by approximately 0.1% of TPWD-CF gill nets deployed, and there was no evidence that the rate of encounters has changed since

the initial encounter (Fig. 1). Regression analysis of the number of encounters per year over the span of 1984 – 2012 resulted in a flat, and non-significant correlation ($r^2 = 0.011$, $p = 0.592$). Although the last three years (2010 – 2012) of the reported period have each been above average (8 dolphins across the 3-year span), other three-year spans in the reported period have produced similar overall encounters (1988 – 1990 overall six encounters; 1995 – 1997 overall six encounters). Encounters were slightly more frequent during the fall gill net season (September – November, $n = 15$) than in the spring gill net season (April – June, $n = 13$). Monthly encounters are highest in September and October ($n = 7$, and $n = 8$, respectively) followed by May ($n = 6$), April ($n = 5$) and June ($n = 2$). Due to the small sample numbers of dolphins encountered within any given month, and due to the fact that gill net sampling intensity is not equal across all months, no statistical analysis was performed to determine whether the probability of encounter was variable across months. More data are needed to examine this possibility.

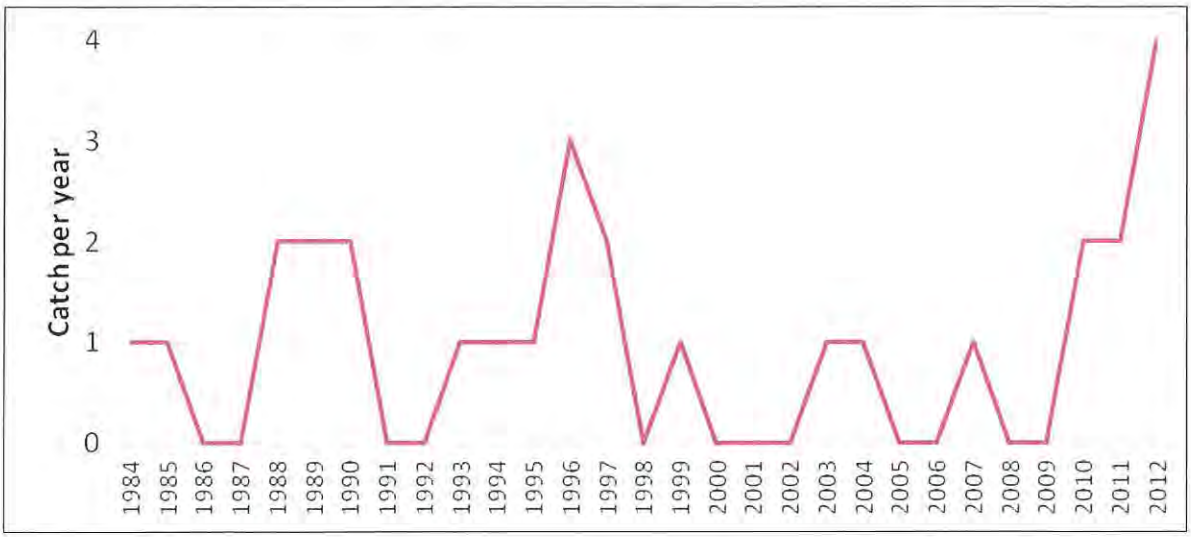


Figure 1. Total number of bottlenose dolphin (*Tursiops truncatus*) encounters in TPWD-CF sampling gear, by year, all bays combined.

Geographic variability of encounters.— Encounters with dolphins were not equally distributed across all TPWD-CF sampling areas. Of the ten sampling areas covered by TPWD-CF gill net surveys, five have not had dolphin encounters (Sabine Lake, Galveston Bay, East Matagorda Bay, Upper Laguna Madre, and Cedar Lakes). A majority of encounters occurred in the central coast area, with 23 of 28 encounters occurring between West Matagorda Bay and Corpus Christi Bay (Fig. 2). In particular, Aransas Bay is the most highly susceptible area for dolphin encounters, with 9 of the 28 encounters overall occurring within the Aransas sampling area.

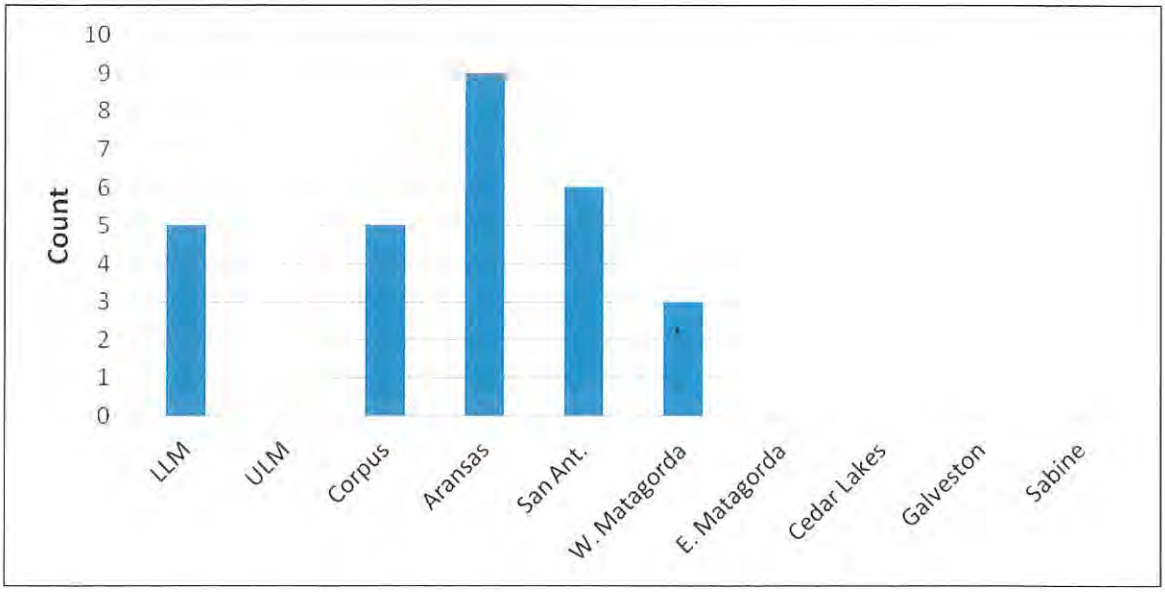


Figure 2. Number of encounters of bottlenose dolphins by TPWD-CF sampling gear, broken down by bay.

Within sampling areas, there also appeared to be a non-random distribution of sample grids that had encounters, resulting in dolphin encounter "hot spots". Here, a dolphin hot spot is defined as an area where:

1) there have been multiple (repeated) dolphin encounters in a single TPWD-CF sampling grid through the reported period, OR

2) multiple adjacent grids have had at least one dolphin encounter over the reported period.

Note the difference here with the current TPWD-CF criteria for marine turtle hot spots. In the case of marine turtles, both criteria must be met in order for an area to be considered a hot spot. Encounters with marine turtles are generally much more common than those with dolphins. Thus, TPWD-CF grids must only meet one of two criteria to be considered dolphin hot spots. Using these guidelines, there are three TPWD-CF sampling areas that can be considered dolphin hot spots. They are, (1) Aransas Bay, just south of Allyn's Bight (grid #'s 280, 290, 291, 301, Fig.3), which satisfies both criteria, (2) Corpus Christi Bay, south of Ingleside shoreline (CC grid # 132, Fig. 4), which satisifies criterion #1, and (3) Lower Laguna Madre, in Redfish Bay (LLM grid # 47, Fig 5), which satisifies criterion #1. These hot spots account for 10 of the 27 reported encounters with dolphins over the reported period.

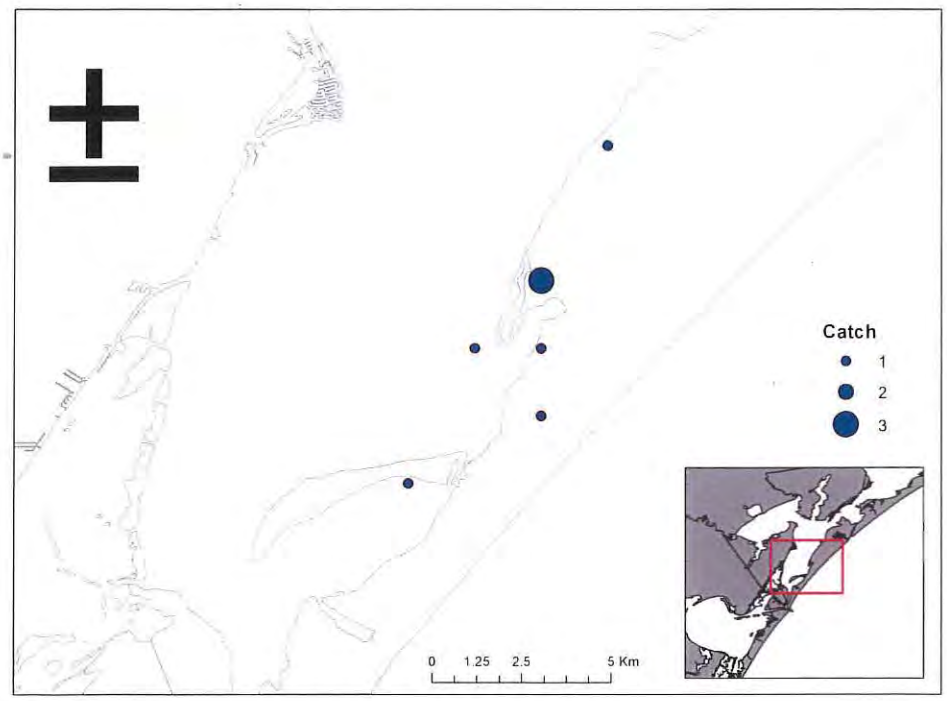


Figure 3. Bottlenose dolphin hot spot #1 on the Texas coast, in Aransas Bay near Allyn's Bight. The red box in the inset is the extent of the area represented in the larger map.

Figure 4. Bottlenose dolphin hot spot #2 on the Texas coast, in northern Corpus Christi Bay on the south shoreline of Ingleside. The red box in the inset is the extent of the area represented in the larger map.

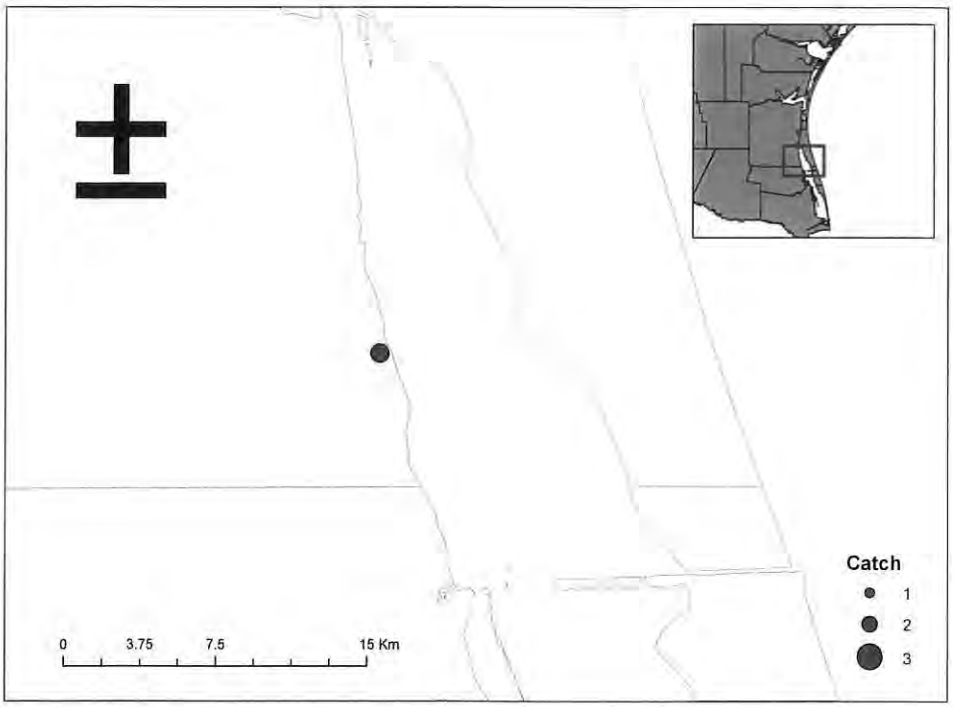


Figure 5. Bottlenose dolphin hot spot #3 on the Texas coast, in northern Lower Laguna Madre in the Redfish Bay area. The red box in the inset is the extent of the area represented in the larger map.

Environmental variability of encounters.— The range of water temperatures in which dolphin encounters occurred was from 18.0 °C to 32.6 °C, with an average temperature of encounter of 27.6 °C. Encounters usually occurred in water temperatures greater than 24 °C. However, it is unlikely that warmer water temperatures are predictive of dolphin encounters, as temperatures less than 24 °C are generally uncommon in the months of TPWD-CF routine monitoring gill net sets (Fig. 6). The overall distribution of temperature categories between gill net sets that encountered dolphins and those that did not were compared using a Kolmogorov-Smirnov test of homogeneity. There was a statistically significant difference between water temperatures of dolphin-positive and dolphin-negative net sets ($d = 0.471$, $p = 0.031$). However, the significance of this test is likely driven by lower than expected encounters at a single data point (22 °C, $n = 0$), and higher than expected encounters at the mean temperature (28 °C, $n = 12$), and thus may be indicative of small sample sizes, rather than entirely a biological effect. The distribution of various water salinities over all dolphin encounters was also explored, although no statistical relationship was found (data not shown).

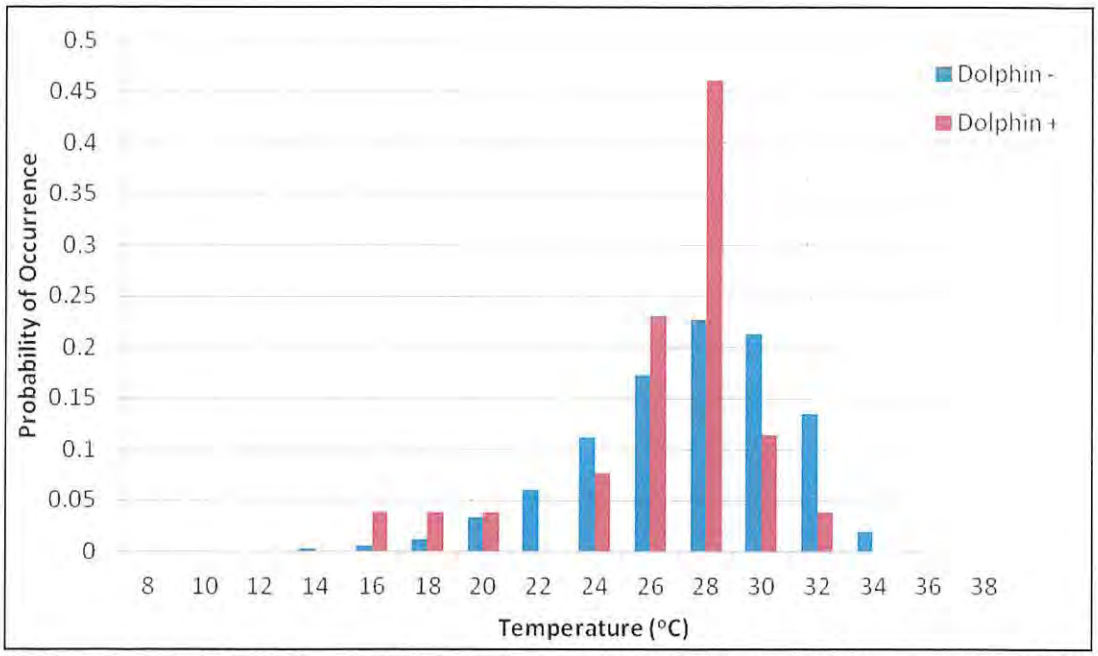


Figure 6. Temperature distribution of gill net sets that resulted in bottlenose dolphin encounters (dolphin +, red bars) and all other gill nets (dolphin -, blue bars) throughout the sampling period in TPWD-CF gill net sampling gear.

Water depth and mesh size.— There is strong evidence that water depth is a major factor involved with dolphin encounters. Four of the 28 encounters (14%) occurred in water depth of 2.1 m or greater. Although this is not necessarily a large proportion, it is large compared to the frequency of nets set at this depth. Because TPWD-CF gill net sets are generally adjacent to shorelines, the frequency of occurrence of a deep-water depth of 2.1 m or greater is approximately 3%. In order to quantify the effect of depth on dolphin encounters, the ratio of observed encounters versus the number of encounters predicted by the frequency of occurrence of each depth category was plotted. Dolphin encounters at the highest depth category (2.1 m and higher) occur at approximately 5 times the expected rate based upon an equal-depth model (Fig. 8). A majority of dolphin encounters (16 out of 28, or 57%) over the sampled period occurred in a depth of 1.1 – 2.0 m of water, which is slightly higher than the expected frequency of 45%. The remainder of encounters (8 out of 28, or 29%) occurred in 0 – 1.0 m of water, a deep water depth that occurs 51% of the time. From these numbers, it would appear that unusually deep gill net intercept dolphins at a much higher rate than those set in shallow areas.

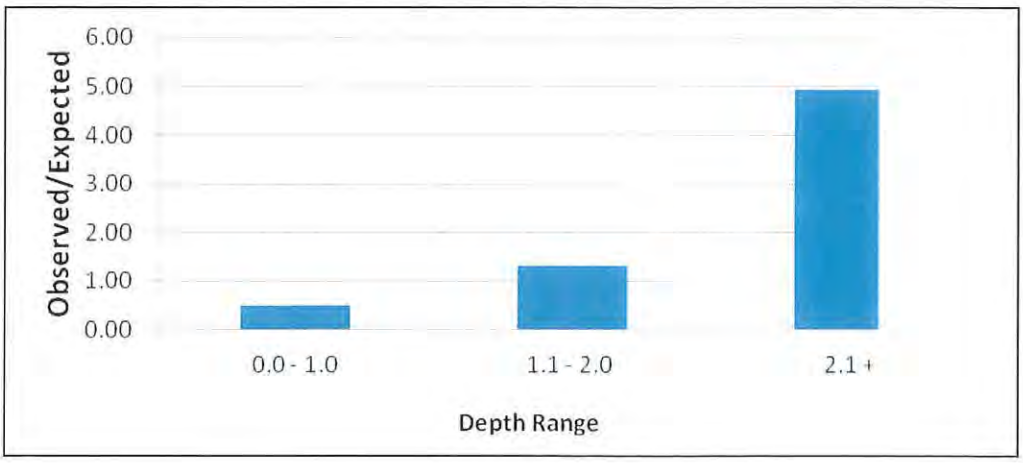


Figure 8. The ratio (observed/expected) of capture of various depth categories observed over the sampling period of bottlenose dolphins encountered in TPWD-CF gill net sets. The expected number of dolphins at each depth category was calculated as the total number of observed dolphins (28) multiplied by the frequency of each depth category. For instance, the expected number of dolphins at the 0.0 – 1.0 depth category was calculated as (28 * 0.51 = 14), with 0.51 being the frequency of overall net sets that were completed at this depth.

A second indication that depth is a major factor in gill net sets which intercept dolphins is the distribution of mesh sizes in which encounters occurred. Dolphins were encountered more frequently in larger mesh sizes than in smaller mesh (Fig. 7). The largest gill net mesh size, 152 mm, accounted for 16 of the 28 dolphin encounters in the study (57%). The 127 mm mesh accounted for 8 encounters (29%) while the 102 mm mesh accounted for the remaining 4 encounters (14%). There were no encounters in the 76 mm mesh size.

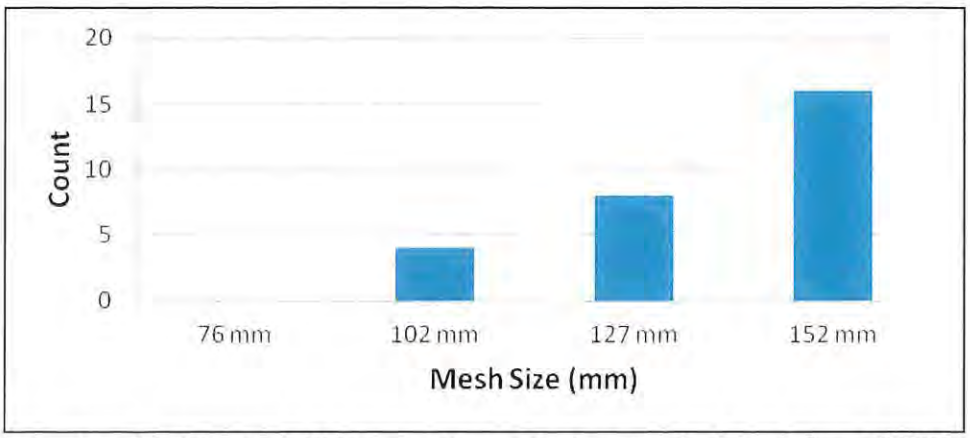


Figure 7. The number of bottlenose dolphin encounters at the four standard mesh sizes of TPWD-CF gill net sampling gear.

There are two general hypotheses regarding why larger mesh sizes encounter more dolphins. The first is that dolphins are more likely to be physically entangled in larger mesh sizes. One expectation of this hypothesis is that the average size of dolphins entangled will increase with increasing mesh size. To explore this, the average length of dolphins entangled in the two largest mesh sizes (127 mm and 152 mm) were calculated (the 102 mm mesh was not included because only one dolphin in this mesh was measured for length). Contrary to expectations, average size

decreased from 2028 mm in the smaller mesh to 1819 mm in the larger mesh. Thus it is unlikely that dolphins cannot be intercepted by smaller mesh sizes.

A second hypothesis regarding mesh size is that the mesh size variable is confounded by depth, which is highly predictive of dolphin encounters. The largest mesh, 152 mm, is always located on the bayward end of a TPWD-CF gill net, and therefore is located in deeper water most of the time. Due to small sample sizes at deeper net sets, an analysis of the interaction between depth and mesh size was not performed. However, given that a majority (86%) of gill net sets occur at a deep-end depth of 1.5 m or lower, it is likely that the 152 mm mesh is usually the only mesh in water that is deep enough for dolphins to pass.

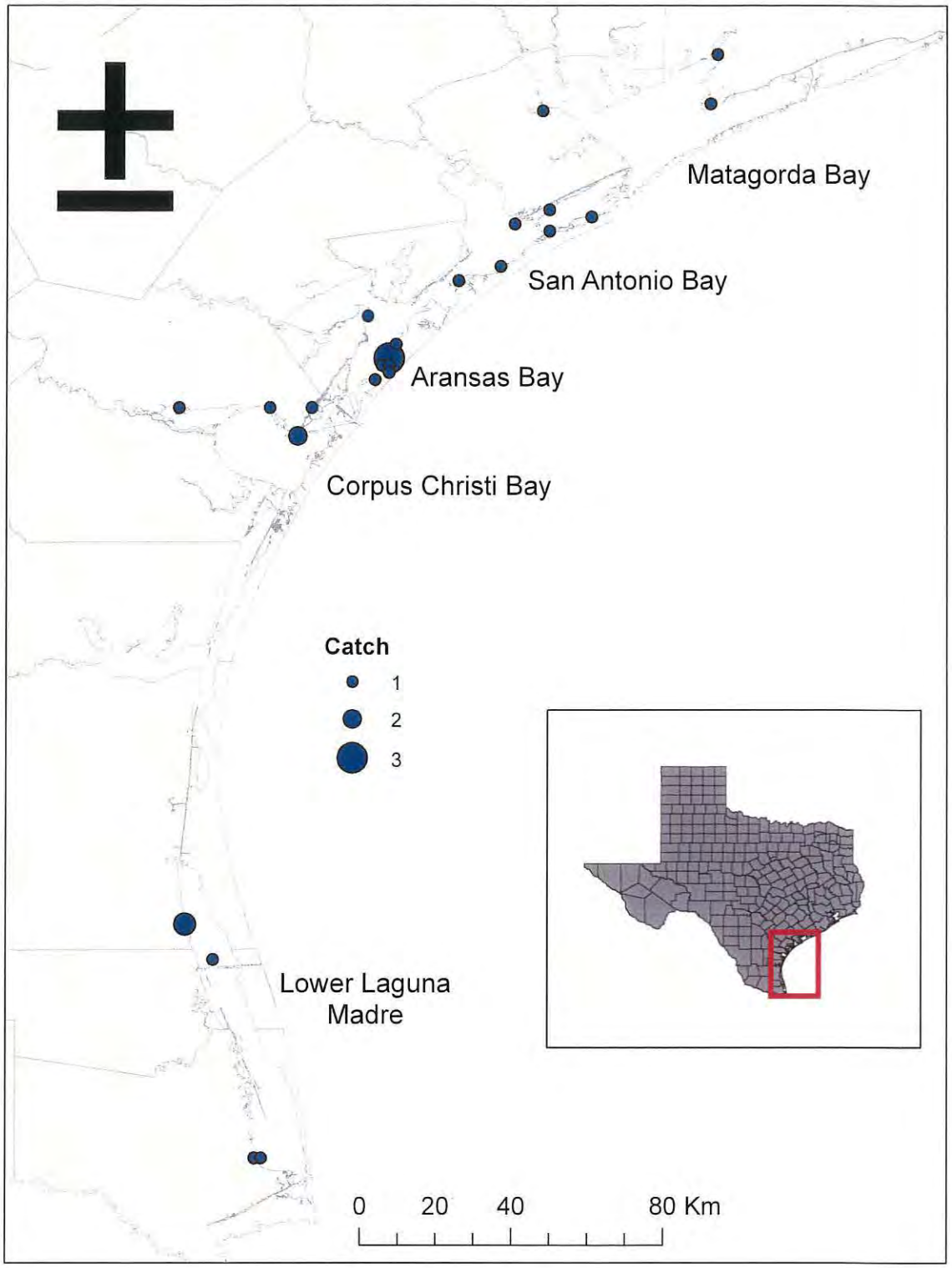
Discussion and Future Considerations

There are aspects of the available data on dolphin encounters that suggest that encounters with TPWD-CF gill net sets are not entirely random occurrences. Spatially, encounters occur entirely within central and southern Texas inshore areas, suggesting either that dolphins are more numerous in these areas, or that they are more likely to use shoreline habitat in the central and southern coast than they are in East Matagorda, Cedar Lakes, Galveston Bay or Sabine Lake. Within bays, encounters have in some cases been centralized in dolphin hot spot areas. In particular, the hot spot area in Aransas Bay south of Allyn's Bight has seen a total of six encounters across the span of four adjacent grids, including a single grid where dolphins were encountered in three independent gill net sets. Similar repeat-occurrence grids occur in the Lower Laguna Madre and Corpus Christi bay, and all of these areas (inclusive) account for 10 of 28 (36%) dolphin encounters. Determining which habitat factors or environmental cues are being commonly utilized by dolphins in these areas would improve the ability to predict and avoid future encounters.

Statistical modeling of these data are otherwise complicated by the extremely rare occurrence of dolphin encounters by TPWD-CF sampling gear. Dolphins are intercepted by approximately 0.1% of TPWD-CF gill nets deployed. Given a sample of only 28 individuals, it would be difficult to draw robust conclusions regarding the environmental or sampling factors that may predispose sampling gear to dolphin encounters. However, a number of general conclusions can be drawn from the data as it currently stands. First, the chronological trend in dolphin encounters with TPWD-CF sampling gear tends to be flat and non-significant, suggesting that encounters over the sampled period have occurred at a rate that is not statistically changing, either positively or negatively. Second, gill net sets that occur at depths greater than 2.0 m of water are 5 times more likely to encounter dolphins than the rate that would be expected under the assumption that encounters occur independent of depth. Third, larger meshes are more likely to intercept dolphins than smaller meshes, although mesh size and depth are confounding variables. It is likely that depth is more predictive of encounter than mesh size, given all other factors equal. Fourth, water characteristics such as temperature and salinity (data not shown) likely play little role in the probability of encounter between dolphins and TPWD-CF sampling

gear. Finally, there seems to be little correlation between encounters and the month in which gill nets are set, although no dolphins have ever been encountered in November sets. Encounters have occurred in all other months that are sampled by TPWD-CF.

Appendix 1. Description of all bottlenose dolphin encounters with TPWD-CF sampling gear, organized by bay.

Bay	Station	Year	Month	Salinity	Temperature	D.O.	Depth	Mesh	Length
Aransas	291	1990	10	33	29.4	12	1.2	127	1885
Aransas	301	1995	9	32	31.1	6.4	1.4	127	2134
Aransas	280	1996	9	35	30.9	5.6	1.2	127	-
Aransas	280	1997	4	17	18	9.6	1.5	127	-
Aransas	290	2003	4	20.9	24.2	7.9	1.1	152	1323
Aransas	280	2004	10	20.9	27.7	7.5	1.2	152	2020
Aransas	171	2010	9	16	32.6	9.1	1.4	152	-
Aransas	255	2011	4	26	27	8.1	1.3	152	1230
Aransas	308	2011	9	36.9	29.2	7.4	2.3	152	-
Corpus Christi	132	1996	6	32	29.1	6.3	2.5	152	1820
Corpus Christi	132	1996	6	32	29.1	6.3	2.5	152	2510
Corpus Christi	61	1999	9	31.2	27.7	8	3.4	127	2360
Corpus Christi	8	2012	4	33.8	26.6	8.8	1.4	152	-
Corpus Christi	63	2012	5	34.9	29.3	10.3	1	152	-
Lower Laguna	47	1988	9	40	29.7	7.2	1.2	127	-
Lower Laguna	47	1988	9	40	29.7	7.2	1.2	152	-
Lower Laguna	318	1989	5	40	28.1	4.3	0.7	127	2000
Lower Laguna	319	1994	10	34	29.1	7.1	1.4	152	1880
Lower Laguna	82	2012	10	-	27.5	-	0.9	152	1524
Matagorda	276	1985	5	20	28.5	8	0.6	102	2134
Matagorda	58	1990	5	16	29.5	6.5	1.3	152	1948
Matagorda	294	2007	10	10.4	20	6.7	0.9	127	1762
San Antonio	113	1984	4	33.3	25	10	0.9	102	-
San Antonio	259	1989	10	30	26.8	7.8	1.2	152	-
San Antonio	183	1993	10	24	27.9	6	1.1	102	-
San Antonio	96	1997	10	21	21.6	8.2	1.1	152	-
San Antonio	278	2010	5	27.7	27.7	7.5	0.9	152	-
San Antonio	198	2012	5	21.9	30.8	7.6	0.9	102	-

Appendix 2. Map of all bottlenose dolphin encounters with TPWD-CF sampling gear. Bays north and east of Matagorda Bay did not encounter dolphins throughout the sampling period.