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A PRELIMINARY NOTE ON THE VOCAL REPERTOIRE OF A RESIDENT POPULATION OF COMMON BOTTLENOSE DOLPHINS, *TURSIOPS TRUNCATUS*, IN CHILE

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ABSTRACT

Acoustic records were made from the sailboat "Leviathan II", in the area southwest of the "Choros" coastal island in the central-north of Chile, to test the feasibility of developing studies on the underwater sound production of the resident pod of bottlenose dolphins, *Tursiops truncatus*. While drifting and having the dolphins under visual contact, the recordings were made using the Ca20 wired hydrophone. A preliminary vocal repertoire was assessed to base further studies. The use of protocols for approaching the dolphins, register and analyze the information resulted in 296 whistles individualized by their spectrographic signal and general acoustic characteristics using the SDP software SpectraLAB-plus. The frequency and duration ranges, were 86.13 Hz to 17323.08 Hz. and from 0.01 to 7.96 sec. 67.5% of the signals were distributed in a steno-band [119 Hz to 4214 Hz; Δ 4096 Hz] while 32.5% of the signals were distributed in a broader bandwidth [5222 Hz to 15558 Hz; Δ 10336 Hz]. The reason that the in between bandwith was not used, is unknown. The rate to obtain new vocalizations was 0.99 per minute. We developed an effort marker based on the efficiency of the method to obtain identifiable signals as a replacement of the effort measurement through the register time. We estimated the obtained preliminary vocal repertoire, to be an initial step in relation to the vocal diversity potential of this dolphin pod, based on the effort estimate and the low occurrence of repetitions of known vocalizations.

Key words: Bottlenose dolphin, *Tursiops truncatus*,Vocalizations, Bioacoustics, Vocal repertoire.

RESUMEN

Nota preliminar sobre el repertorio vocal de una población residente de delfín nariz de botella, *Tursiops truncatus,* en Chile. Se desarrollaron estudios acústicos en la población residente de delfines nariz de botella *Tursiops truncatus*, en la IV Región de Chile, se determinó preliminarmente su repertorio vocal como base para futuros estudios, se realizaron registros acústicos pasivos en el sector suroeste de la isla Choros, con un hidrófono Cetacean Research Ca20 desde el velero "Leviathan II", durante contacto visual con los delfines y en deriva. La aplicación de los protocolos de acercamiento, registro, procesamiento y análisis, resultó en la obtención de 296 vocalizaciones individualizadas según su análisis espectrográfico con el programa SpectraLAB-plus y características acústicas generales. Los rangos de frecuencia y duración, fueron de 86.13 Hz a 17323.08 Hz. y desde 0.01 hasta 7.96 segundos. El 67.5% de las señales se agruparon en una estenobanda [119 Hz a 4214 Hz; Δ 4096 Hz] mientras el 32.5% se distribuyó en rango más amplio de frecuencias [5222 Hz a 15558 Hz; Δ 10336 Hz]. Se desconoce la razón de evitar el uso de la banda de frecuencias intermedia. Se estimó una eficiencia de obtención de vocalizaciones individualizadas de 0.99 por minuto. Se desarrolló un estimador del esfuerzo en base a la eficiencia de obtención de espectros identificables como reemplazo a los estimadores por tiempo de registro. En base al esfuerzo estimado y la baja proporción de espectros como repetición de señales conocidas, estimamos que el repertorio corresponde a una etapa aún muy preliminar en relación a la diversidad vocal potencial.

Palabras clave: Delfín nariz de botella, *Tursiops truncatus*, Vocalizaciones, Bioacústica, Repertorio vocal.

INTRODUCTION

The ocean is a medium where the sound travel almost five times faster than in the air, allowing the sound to travel greater distances (Payne, 1995). Due to these characteristics, the acoustic communication plays an important role into the social communications of dolphins (Acevedo-Gutiérrez and Stienessen, 2004), mainly in those who lives in zones with poor light conditions (i.e., highly productive ecosystems).

Common bottlenose dolphin, *Tursiops truncatus,* vocalizations have been studied in greater detail than any other delphinid (Shane *et al.,* 1986; Schultz *et al.,* 1995), and they have been classified within two categories: i) high frequency pulsed sounds, used in echolocation (Richardson *et al.,* 1995; Berta and Sumich, 1999) and ii) continuous sounds with moderate frequencies called vocalizations, used in communication and cohesion (Jacobs *et al.,* 1993; Richardson *et al.,* 1995; Janik and Slater, 1998), and individual recognition (Caldwell *et al.,* 1990; Tyack, 1997; Janik and Slater, 1998; McCowan and Reiss, 2001).

In Chile, the bottlenose dolphin ranges from the northern national limit with Peru, to the 42º S as the southernmost limit (Sanino *et al.,* 2005). Recently, two distinct ecotypes of the species have been documented in Chilean waters based on mtDNA analysis (Sanino *et al.,* 2005), supporting previous studies based on video-identification analysis (Sanino and Yáñez, 2001a). The bottlenose dolphin inshore ecotype is represented in Chile by a single pod, known as pod-R. Sanino and Yáñez (2001a), using a technique based on digital video, produced an individual catalogue of 28 individuals, and estimated the population size to be 31 (±3) individuals, distributed in the vicinity of the coastal islands of Chañaral, Damas and Choros. For longtime, some Chilean Authorities and decision makers considered the pod-R originated from a single funding event from coastal bottlenose dolphins from Perú, during an ENSO event, and, therefore new individuals could join them the same way. However, there were no studies supporting it. Sanino *et al.* (2005) presented a comparative analysis of samples from inshore and offshore individuals from Chile and Peru, demonstrating a lower net interpopulational distance of the pod-R with the Chilean offshore bottlenose schools (0.87%) than with the inshore Peruvian dolphin schools (3,41%). Consistent with intensive field observation, the pod-R presents a low nucleotide diversity (0.00691), suggesting that the group is highly endogamic and therefore, it may be reproductively isolated. Considering the maternal heritage of the mtDNA, a study using nuclear DNA markers is being conducted by the same authors, to verify the pod-R isolation, using the same samples to prevent exposing the dolphins to the effects of an unnecessary sampling replica (PS).

Direct and accidental cetacean takes, including bottlenose dolphins, *Tursiops truncatus*, long-finned pilot whales, *Globicephala melas*, and Burmeister's porpoise, *Phocoena spinipinnis,* have risen management and conservation concerns in the area (Van Waerebeek *et al.,* 1999; Sanino and Yáñez, 2000; 2001a; 2001b). As well as the negative impacts of the non regulated whalewatching operations over the pod-R and other cetaceans in the vicinity of the coastal islands of the centra-north of Chile (Sanino and Yáñez, 2000; Van Waerebeek *et al.,* 2006).

Considering the small populational size of the pod-R and the threats that cetaceans are facing in the area of study, systematic studies using non invasive methods are needed. Being no previous local studies of *T. truncatus* based on signal analysis, this contribution's objectives are: i) to test if the area nearby Choros Island is suitable for passive acoustic studies by checking if vocalizations can be retrieved from underwater recordings with the presence of the resident bottlenose dolphin pod (pod-R); ii) if so, to characterize the vocal production of the pod-R; and iii) to develop a preliminary vocal repertoire of the pod-R to be the base for further comparative studies.

MATERIALS AND METHODS

Area of study

The study was carry out in the southernmost limit of Choros Island (29º16' S; 71º32' W). The area where the recordings were developed was inside the triangle of marine area delimited by one kilometer in longitudinal sense by two kilometers in latitudinal sense.

Data collection

Acoustical data were collected during two weeks between January and February 1999, from the research sailboat "Leviathan II" (for details see Sanino and Yáñez, 2001a). Based on information about the pod-R movements (Sanino and Yáñez, 2000; 2001a), the vessel was located in the area of study every day at 10:00 a.m. before the arrival of pod-R, as well as the tourism boats. This was needed to attempt to register the vocalizations of the dolphins when no boat is chasing them, and therefore closer to their natural status. So, the effects of the presence of our sailboat, over the dolphins, were reduced to a drifting silent boat. After the first recording of the day, needing to relocate the sailboat depending on the dolphin school's position or under the presence of tourism boats, the sailboat was approached to the dolphins by sailing on sails following the method with stop described on Sanino and Yáñez (2000). However, the radio of closest active approach was increased to 100 meters. The drift caused by the wind was limited by using a three meters diameter underwater parachute at the end of a 15 meters mooring line.

Choros Island is at 2.5 nm of Gaviota Island, 0.8 nm of Damas Island and 3.5 nm from the coastline. The island presents oceanic waves from south-southwest hitting against its rocky shore, producing noise and white foam. The area is highly productive and the abundant crustaceans are the main source of the underwater noise. To avoid the excess of noise or getting too close to the rocks, we decided to deploy a hard wired hydrophone (Cetacean Research Ca20; 0.01-35kHz), at 20 meters deep, in locations where the depth was at least 40 meters. The depth was checked constantly using the fishfinder Interface SeaScout, with depth alarm activated. The underwater parachute located the sailboat's bow against the waves in the most safe position, and allowing to operate the hydrophone from the back of the sailboat, in direction to the island and preventing entanglement with the sailboat structures.

To diminish the noise (undesired sound) produced by the ocean making the sailboat to pull up the hydrophone with every wave, a series of modifications were used in the hydrophone: i) a plastic mesh was located one meter before and after the acoustic sensor, around the hydrophone wire; ii) over the upper mesh section, an elastic band was used on a 80 cm section length of uncovered wire forming a loop section, as a shock absorber.

The acoustics records were restricted to wind conditions lower than four knots, measured with a hand held anemometer, and by the pod-R activity. The identification of the pod-R was done using the individual identification catalogue on Sanino and Yáñez (2001a). The acoustic recordings were made continuously while having visual contact with the pod-R members and no dolphin displayed behaviors of rejection (Sanino and Yáñez, 2000).

An analogous recorder (Sony TCM-453V; 0.02 to 20 kHz), produced the acoustic material in cassettes that later, were digitalized on a desktop computer (Intel Pentium III), provided with a sound board (Creative SoundBlaster 128), sampling at 44.1 kHz and 16 bits. The material was stored as audio CDs for further analysis.

Data analysis

In a desktop computer, previously described, the CDs were played with a CD player application. We used the signal processing software *SpectraLab 4.32.13* (sampling rate: 44.1 kHz; analysis bandwidth was 21.83 kHz; the dynamic range was –70 dB; Full Color screen; and both channels crossed in mono), to visually examine the dolphin signals (spectrograms). The simultaneous visual and aural monitoring allowed for a more complete analysis of the recordings; fainting sounds could be categorized by their spectrum images and faint images by their aural inputs (Acevedo-Gutiérrez and Stienessen, 2004). Based on the obtained spectrograms, the following acoustic parameters were obtained for each vocalization: a) minimum frequency, b) maximum frequency, c) duration and d) number of inflection points (Figure 1). Also, each vocalization was stored as image and acoustic file in was format.

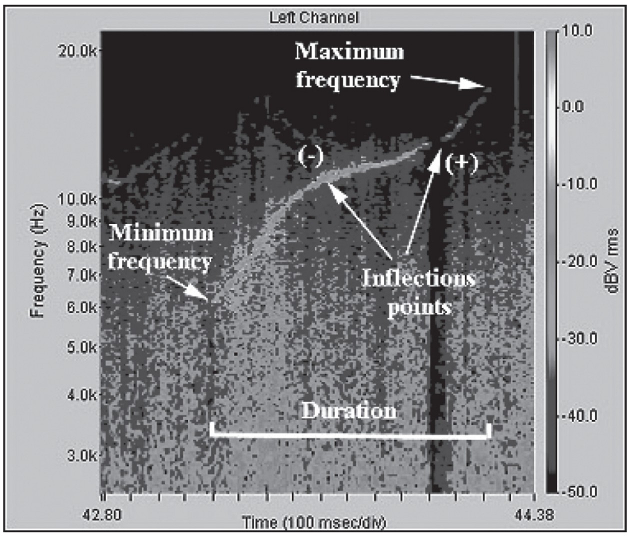

FIGURE 1. Spectrogram of a whistle produced by an individual member of the pod-R bottlenose dolphin school in Choros Island, Chile.

To evaluate the effort to obtain a vocalization, as their number per time unit, with this methodology and from the pod-R, an "ovoc" index, where "voc" is the total number of vocalizations including their repetitions and T is the total recording time, was calculated as follows:

$$ovoc = \frac{voc}{T}$$

To evaluate the effort to obtain a new vocalization with this methodology and from the pod-R, an "onvoc" index, where "repvoc" is the number of identified individual vocalizations conforming the vocal repertoire and T is the total recording time, was calculated as follows:

$$onvoc = \frac{repvoc}{T}$$

We expect that initially most signals will correspond to new or uncatalogued vocalizations. Then, as the vocal repertoir is assessed or completed, higher efforts would be needed to record new individual vocalizations for the catalogue while the number of repetitions increases. Therefore the proportion "Pr" of individual identified vocalizations over the total number of recorded vocalizations, helps to evaluate the rate of new vocalization retrieval as was calculates as follows:

$$Pr = \frac{repvoc}{voc}$$

The vocal repertoire would be completely assessed when all vocalizations used by the pod-R are identified and included into the catalogue. On this ideal case, the “Pr” index will trend to the value “0”, while in initial steps it would trend to the value “1”.

RESULTS

The acoustic recording material consisted in 300 minutes. From a total of 339 signals (voc), 296 were individually identified (repvoc) based their aural shape, frequencies, duration and inflection number properties. Table 1 presents the general properties of the measured variables characterizing the acoustic material analyzed on this note.

TABLE 1: General properties of the acoustic material recorded in presence of members of bottlenose dolphins, *T. truncatus*, pod-R in the vicinity of Choros Island, Chile.

	Maximum Frequency (Hz)	Minimum Frequency (Hz)	Duration (sec.)	Inflection Points (Nº)
Max. value	17323	13793	7.96	11
Min. value	151	86	0.01	0
Delta	17172	13707	7.95	11
Mean	5305	3091	0.38	0.95
Mode	283	86	0.01	0

The values for the indices “ovoc”, “onvoc” and “Pr”, 1.23, 0.99 and 0.8 respectively. The minimum and máximum frequencies of the signals, distributed together in two main groups (see Figure 2). A group that lodged most of the vocalizations (67.5 %) represented by a short range of frequencies [119 Hz to 4214 Hz; Δ 4096 Hz] and a second group less abundant (32.5 %) represented by a wider range of frequencies [5222 Hz to 15558 Hz; Δ 10336 Hz].

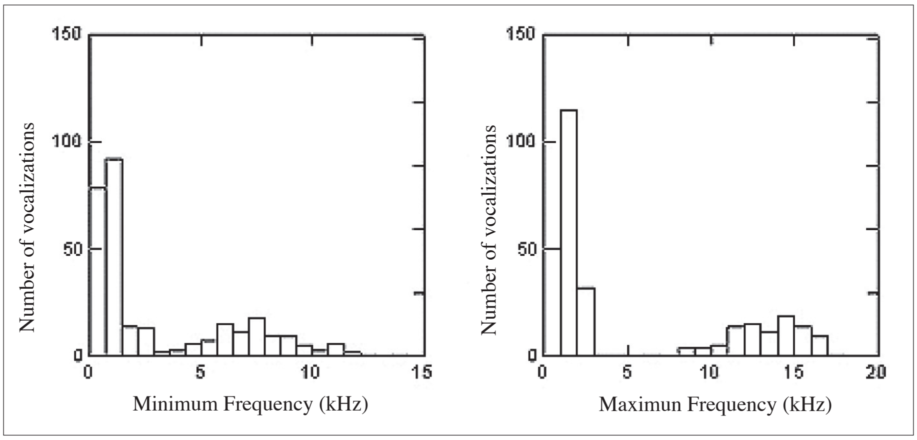

FIGURE 2: Histograms of minimum (left) and maximum (right) signal frequencies of bottlenose dolphins, *T. truncatus*, members of the pod-R at Choros Island.

CONCLUSIONS

The area of distribution of the bottlenose dolphin pod-R, included originally the area around Chañaral Island (Sanino and Yáñez, 2000). However, the home range has increased since 1995 caused by an increasing anthropic pressure (Sanino and Yáñez, 2000; 2001a; 2001b). The area and specifically the pod-R is the target of a non regulated whalewatching tourism activity. Significant negative effects have been documented (Sanino and Yáñez, 2000), but the effects of the underwater noise over the free ranging cetacean populations in the area is still unknown. Actually, the dolphins distribute in small groups in the vicinity of at least three of the five coastal islands in the central-north of Chile, with 20 nautical miles of length (in latitude direction). All this area is affected by south-southwest winds and oceanic waves hitting the islands shore where the dolphins use to spend most of their daily time and adding difficulties during underwater acoustic recording events. The highly productive waters including areas with upwellings (Acuña *et al.,* 1989), support a rich biodiversity contributing with the noise in the underwater environment. Specifically caused by shrimps, there is a constant and intense underwater background noise. The area is also the site for Chilean navy submarine trainings, and diverse fishing operations. The presence of a high diversity of wildlife as well as private small boats, local fishermen vessels, industrial fisheries, and large carriers as well as the local oceanographic conditions made uncertain the possibility to develop underwater acoustic studies in the area. Maybe the most important conclusion of this note is that despite of the noise in the underwater environment, the area is suitable for passive acoustic studies. The dolphins members of the pod-R, despite of their small number and behavior of getting close to the islands' shore, they are very vocal and their vocalizations are able to be recorded and retrieved from the background noise even during tourism operations.

Being this only a preliminary study, and the first attempt to classify the bottlenose dolphins vocalizations in Chile, with the collected information from 300 minutes, we were able characterize the generalities of the vocal production of the pod-R, as well as to elaborate a preliminary 296 signal catalogue of their vocal repertoire to be the base for further comparative studies.

For this dolphin pod, and restricted to the used methodology during the summer season, we retrieved more than one vocalizations per minute (ovoc: 1,23) and almost one new was added to the vocal repertoire per minute (onvoc: 0.99). Thus the number of repetitions was low (Pr: 0.8), these results suggest that the 296 distinct signals, mostly whistles, are far from being the complete vocal repertoire of these dolphins and further studies are needed. We propose the use of the rate of vocalization per unite of time as an indicator of the the effort rather than the recording time. Considering that the dolphins may have places and/or circumstances where they are vocally more active (Miller and Brain, 2000; Schultz and Corkeron, 1994), the use of the recording time as measure of the effort, indicates the effort to register but not the efficiency to retrieve signals.

The study of dolphin vocalizations has included the categorization of signal shapes or contours into classes (Jacobs *et al*., 1993; Janik and Slater, 1998; Mc Cowan and Reiss, 1995; 2001; Acevedo-Gutierrez and Stienessen, 2004; Erber and Sim□o, 2004; among others) and/or the classification through the extraction of acoustic parameters from the signals (Lilly and Miller, 1961; Lilly, 1962; Schultz *et al*., 1995; Smolker and Pepper, 1999; Yin, 1999; Lammers and Au, 2003; Barzúa-Durán, 2004). The first method presents several restriction and biases due to the lack of a standardized criteria to define these categories (Janik and Slater, 1998). Also, the measurement errors by the observer, have not been fully quantified (McCowan and Reiss, 1995; Jones and Sayigh, 2002).

On the other hand, the extraction of acoustic parameters from each signal contour, helps to get individual vocalization identifications, an therefore to retrieve more biological information from comparative studies. In this note, we used the second techniques, although it demands a greater time of analysis.

To the techniques used to study this dolphin school, as photography, video, and indirect skin sampling, the spectrographic analysis of the signals from their underwater vocalizations recorded with passive hydrophones can and should be included. In a next contribution, looking for we will analyze the possible differences on the vocal production of the pod-R dolphin members, with and without the presence of tourism boats.

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REFERENCES

ACEVEDO-GUTIÉRREZ, A. and STIENESSEN, S.C.
2004 Bottlenose dolphins (*Tursiops truncatus*) increase number of whistles when feeding. Aquatic Mammals 30: 357-362.

ACUÑA, E., MORAGA, J. y URIBE, E.
1989 La zona de Coquimbo: Un sistema nerítico de surgencia de alta productividad. CPPS, Revista del Pacífico Sur (número especial) p. 45-157.

BARZÚA-DURÁN, C.
2004 Differences in the whistle characteristics and repertoire of bottlenose and spinner dolphins. Annals of the Brazilian Academy of Sciences 76(2): 386-392.

BERTA, A. and SUMICH, J. L.
1999 Marine Mammals, evolutionary biology. Academic Press. USA. 494 p.

CALDWELL, M.C., CALDWELL, D.K. and TYACK, P.L.
1990 Review of the Signature-Whistle Hypothesis for the Atlantic Bottlenose Dolphin. Pages 199-234 in: The Bottlenose Dolphin. Leatherwood, S., and R.R. Reeves (eds). Academic Press, San Diego, CA.

ERBER, C. and SIMÃO, S.M.
2004 Analysis of whistles produced by the tucuxi dolphin *Sotalia fluviatilis* from Sepetiba Bay, Brazil. An. Acad. Bras. Cienc. 76: 381-385.

TYACK, P.L.
1997 Development and Social Functions of Signature Whistles in Bottlenose Dolphins *Tursiops truncatus*. Bioacoustics 8: 21-46.

JACOBS, M., NOWACEK, D.P., GERHART, D.J., CANNON, G., NOWICKI, S. and FORWARD, R.B., JR.
1993 Seasonal changes in vocalizations during behavior of the Atlantic bottlenose dolphin. Estuaries 16(2): 241-246.

JANIK, V. and SLATER, P.
1998 Context-specific use suggests that bottlenose dolphin signature whistles are cohesion calls. Animal Behaviour 56: 829-838.

JONES, G.J. and SAYIGH, L.S.
2002 Geographic variation in rates of vocal production of free-ranging bottlenose dolphins. Marine Mammal Science 18: 374-393.

LAMMERS, M.O. and AU, W.W.L.
2003 Directionality in the whistles of Hawaiian spinner dolphins (*Stenella longirostris*): A signal feature to cue direction of movement? Marine Mammal Science 19: 249-264.
LILLY, J.C. and MILLER, A.M.
1961 Sounds Emitted by the Bottlenose Dolphin. Science 133: 1689-1693.
LILLY, J.C.
1962 Vocal behavior of the bottlenose dolphin. Proceedings of the American Philosophical Society 106: 520-529.
MC COWAN, B. and REISS, D.
1995 Quantitative comparison of whistle repertoires from captive adult bottlenose dolphins (Delphinidae: *Tursiops truncatus*): A re-evaluation on the signature whistle hypothesis. Ethology 100(3): 194-209.
MC COWAN, B. and REISS, D.
2001 The Fallacy of "Signature Whistles" in bottlenose dolphins: a comparative perspective of "signature information" in animal vocalizations. Animal Behaviour 62: 1151-1162.
MILLER, P. and BAIN, D.
2000 Within-pod variation in the sound production of a pod of Killer Whale, *Orcinus orca*. Animal Behaviour 60: 617-628.
PAYNE, R.
1995 Among Whales. Scribner, New York (ISBN: 0684802104) 432 p.
RICHARDSON, W.J., GREENE, C.R., MALME, C. and THOMSON, D.
1995 Marine Mammals and Noise. Academic Press 576 p. U.S.A
SANINO, G.P. y YÁÑEZ, J.L
2000 Efectos del turismo de observación de cetáceos en Punta de Choros, IV Región, Chile. Revista Gestión Ambiental (Chile) 6: 41-53.
SANINO, G.P. y YÁÑEZ, J.L.
2001a Nueva técnica de video identificación y estimación de tamaño poblacional en cetáceos, aplicada en delfines nariz de botella, *Tursiops truncatus*, de isla Choros, IV Región de Chile.Boletín Museo Nacional de Historia Natural Chile 50: 37-63.
SANINO, G.P. y YÁÑEZ, J.L.
2001b Estudio de un ejemplar de *Globicephala melas* varado en la III Región y revisión de los registros del género para Chile. Boletín Museo Nacional de Historia Natural Chile 50: 21-36.
SANINO, G.P., VAN WAEREBEEK, K., VAN BRESSEN, M.F. and PASTENE, L.A.
2005 A preliminary note on population structure in eastern South Pacific common bottlenose dolphins, *Tursiops truncatus*. IWC Journal of Cetacean Research and Management 7(1): 65-70.
SCHULTZ, K.W. and CORKERON, P. J.
1994 Interspecific differences in whistles produced by inshore dolphins in Moreton Bay, Queensland (Australia). Canadian Journal of Zoology 72: 1061-1068.
SCHULTZ W., CATO, D.H., CORKERON, P.J. and BRYDEN, M.M.
1995 Low frecuency Narrow-Band sounds produced by Bottlenose Dolphins. Marine Mammal Science 11(4): 503-509.
SHANE, S., WELLS, R. and WÜRSIG, B.
1986 Ecology, Behavior and Social Organization of the Bottlenose Dolphin: A Review. Marine Mammal Science 2(1): 34-63.
SMOLKER, R. and PEPPER J.W.
1999 Whistle Convergence among Allied Male Bottlenose Dolphin (Delphinidae, *Tursiops* sp.). Ethology 105: 595-618.
TYACK, P.
1985 An optical telemetry device to identify which dolphin produces a sound. Journal of the Acoustical Society of America 78(5): 1892-1895.
VAN WAEREBEEK, K., VAN BRESSEM, M.F., ALFARO-SHIGUETO, J., SANINO, G.P., MONTES, D. and ONTON, K.
1999 A preliminary analysis of recent captures of small cetaceans in Peru and Chile. Paper SC/51/SM17, Scientific Committee International Whaling Commission, Grenada, May 1999.

VAN WAEREBEEK, K., BAKER, A.N., FÉLIX, F., IÑIGUEZ, M., SANINO, G.P., SECCHI, E., SLOCUM, G., SUTARIA, D., VAN HELDEN, A. and WANG, Y.
2006 Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, building a standardized database. SC/58/BC6, presented to the 58th Meeting of International Whaling Commission, St Kitts, May-June 2006.

YIN, S.
1999 Movement Patterns, Behaviors, and Whistle Sounds of Dolphin Groups Off KaiKoura, New Zealand. Submitted to the Office of Graduate Studies of Texas A&M University in partial fulfillment of the requirements for the degree of Master of Science.

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