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Abundance estimation of Commerson's dolphin in the eastern area of the Strait of Magallan-Chile

Estimación de abundancia de tunina overa en el sector oriental del Estrecho de Magallanes, Chile

ANNE-CATHERINE LESCRAUWAET[1], JORGE GIBBONS[2], LEONARDO GUZMAN[3] & ADRIAN SCHIAVINI[4]

[1]Fundación para el Desarrollo de Magallanes - [2]Instituto de la Patagonia Universidad de Magallanes, Punta Arenas, Chile, e-mail jgibbons@aoniken.fc.umag.cl
[3]Instituto de Fomento Pesquero, Punta Arenas, Chile. [4]Centro Austral de Investigaciones Científicas, Ushuaia, Argentina

ABSTRACT

Abundance of Commerson's dolphin, *Cephalorhynchus commersonii* (Lacépède 1804), in the eastern portion of the Strait of Magellan was estimated by means of aerial transects in autumn (June 1996). Using a helicopter at 100 m altitude and 129 km h^{-1}, 58 sightings representing 98 animals (average group size Es = 1.7, SD = 0.13) along 818.6 km of linear transects were recorded. Data analysis with "Distance" software gave a density estimation of 0.34 ind km^{-2} (CV = 0.27) and a population size of 1,206 (95% CI 711-2,049 individuals). Commerson's dolphin showed a habitat preference for the narrows, compared to open waters in the study area.

Key words: Commerson's dolphin, *Cephalorhynchus commersonii*, Strait of Magellan, Line transect sampling, habitat preference.

RESUMEN

Se presentan los resultados de un muestreo de transectos lineales de abundancia de tunina overa *Cephalorhynchus commersonii* (Lacepede 1804) en el sector oriental del Estrecho de Magallanes realizados durante el otoño de 1996. El área se sobrevoló en helicóptero a 100 m de altitud y 129 km h^{-1} a lo largo de 818,6 km, observándose un total de 98 animales en 58 avistamientos, con un tamaño grupal promedio de 1,7 (SD = 0,13). La densidad fue de 0,34 ind km^{-2} (CV = 0,27) y el tamaño poblacional de 1206 (95% c.i. 711 – 2049 individuos). Se observó que la tunina overa presenta mayor preferencia por las angosturas que por las aguas abiertas del área de estudio.

Palabras clave: Tunina overa, *Cephalorhynchus commersonii*, Estrecho de Magallanes, transecto linear, preferencia de hábitat.

INTRODUCTION

Commerson's dolphin has a restricted distribution in southern South America (Brown 1988, Goodall et al. 1988), Malvinas (Falkland) Islands (Brownell & Praderi 1985) and Kerguelen Islands (Angot 1954, Robineau 1985, De Buffrenil et al. 1989). The abundance of this species is poorly known. In chilean waters, surveys were performed only in the northeast of the eastern area of the Strait of Magellan in January-February 1984 (Leatherwood et al. 1988), April 1987 (Venegas & Atalah 1987), and December 1989 (Venegas 1996). In argentinian waters, surveys were reported for northern and central patagonian coast (Pedraza et al. 1996). The data presented in this article report on the fourth abundance estimation of the species' population in the eastern part of the Strait of Magellan.The urge to review the ocurrence of changes in the population size in comparison to previous studies in this area, is debt to the fact that according to some authors the species has been subjected to directed kills for bait in crab fisheries in Argentina and Chile (Goodall & Cameron 1980, Lescrauwaet & Gibbons 1994). Incidental mortality in passive fish-

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ing nets in the Atlantic coasts of Tierra del Fuego in Argentina was also reported (Goodall & Cameron 1980; Goodall et al. 1988; Goodall et al. 1994). Lack of direct evaluation of this mortality and the absence of information on basic population parameters and migratory habits does not permit a reliable assesment of conservation status. Currently the species is classified as insufficiently known by IUCN (Klinowska 1991).

MATERIAL AND METHODS

Study Area

Our study area covered approximately 3,600 km^2 between the Second Narrow and the Atlantic entrance to the Strait of Magellan (Fig. 1). This area was selected because includes those sampled in the three previous studies. The most important features of the study area are: a maximum depth of 70 m; close proximity (4-6 km) between the Island of Tierra del Fuego and the continent at the First Narrow; high tidal range towards the Atlantic Ocean (between 6 to 10 m); strong currents of 4.5 m/s at the First Narrow (Saggiomo et al. 1994); complete water mixing and limited development of phytoplancton (Magazzù et al. 1996).

Aerial survey

Severe currents and difficult field conditions favoured aerial surveys over boat surveys in this area. Line transects were flown using a helicopter "Twin star" between the continent and the island of Tierra del Fuego on 8, 22 and 29 June 1996 with waypoints randomly selected and set over land at 2nm and 4nm distance from shore. We planned the aerial survey on the basis of the distribution of known sightings for the species. Survey effort (km/ km^2) was 2.6 times higher in the narrows in order to account for the previously reported preference of this species for the narrows (Venegas & Atalah 1987, Leatherwood 1988). Waypoints for the transects, speed and height were entered in the GPS system and automatic pilot of the helicopter before the flight. Flight routes, transects and waypoints are shown in Figure 1.

Speed and height were kept constant (129 km h^{-1} and 100 m respectively) and all flights were made

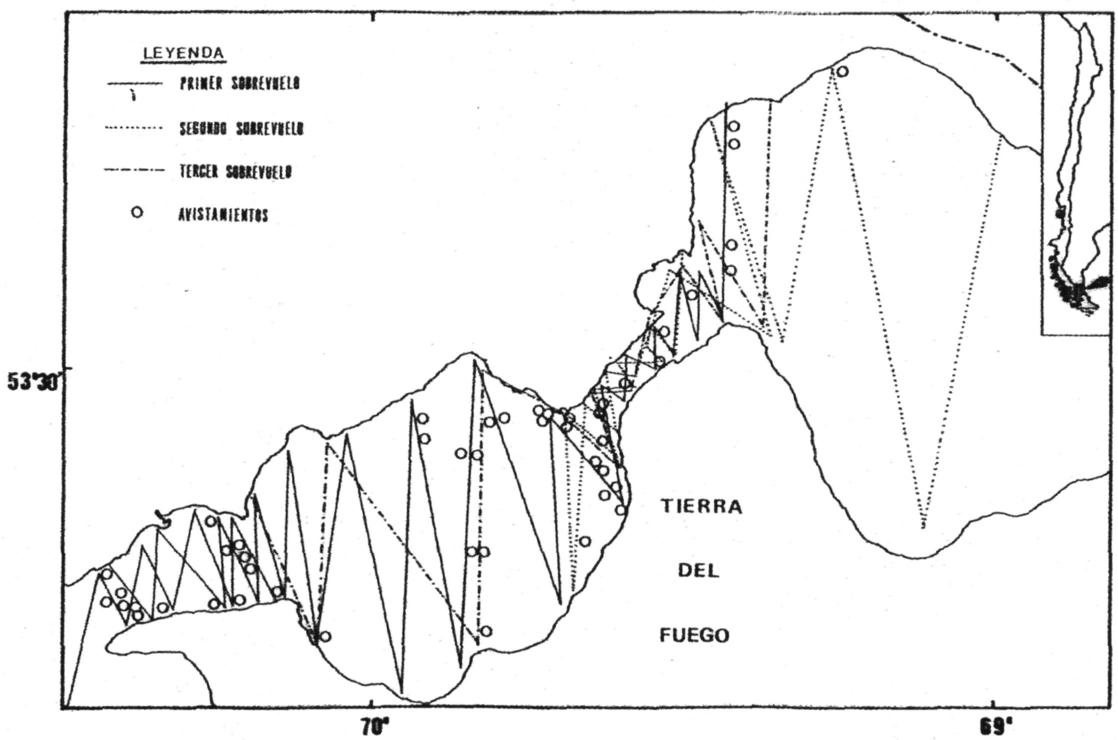

Fig. 1. Study Area in the Eastern Area of the Strait of Magellan. Different lines over the study area shows flight routes made on different days.

Area de Estudio en el Sector Este del Estrecho de Magallanes. Los distintos tipos de líneas sobre el área de estudio muestran el trayecto de sobrevuelos realizados en diferentes días.

TABLE 1

Sightings of Commerson's dolphins and data recorded within the respective transects

Avistamientos de tunina overa y datos registrados en los respectivos transectos

Flight number	Transect number	Area	Group Size	True angle of sighting (°) of sighting	Perpendicular distance (m)	Latitud	Longitud	Perpendicular distance (m) to coast	Water depht (m)
1	2	2ª angostura	5	37	68	52°44'06"	70°21'55"	1000	50 - 60
1	3	2ª angostura	1	26	44	52°44'30"	70°20'36"	1000	50 - 60
1	4	2ª angostura	3	28	48	52°44'17"	70°15'59"	300	0 - 35
1	5	2ª angostura	2	56	134	52°39'55"	70°16'16"	1100	0 - 5
1	10	Gregorio	2	52	116	52°45'18"	70°05'57"	1200	0 - 5
1	14	Gregorio	2	59	150	52°34'32"	69°55'33"	5100	15 - 20
1	14	Gregorio	3	66	202	52°35'07"	69°55'20"	6000	20 - 25
1	15	Gregorio	2	25	42	52°42'02"	69°50'15"	8300	30 - 40
1	15	Gregorio	4	74	313	52°42'02"	69°50'15"	8300	30 - 40
1	15	Gregorio	1	47	97	52°34'25"	69°50'00"	6000	10 - 15
1	15	Gregorio	1	38	71	52°34'25"	69°50'00"	6000	10 - 15
1	16	Gregorio	2	61	163	52°32'45"	69°47'50"	3000	10 - 20
1	16	Gregorio	1	63	177	52°33'17"	69°42'02"	1000	0 - 5
1	17	1ª angostura	1	43	84	52°33'17"	69°42'02"	1000	0 - 5
1	18	1ª angostura	1	48	100	52°33'45"	69°40'39"	1500	50 - 60
1	18	1ª angostura	2	46	94	52°33'12"	69°40'21"	1500	50 - 60
1	18	1ª angostura	3	45	90	52°33'12"	69°40'21"	1500	50 - 60
1	18	1ª angostura	1	49	104	52°33'33"	69°40'05"	1500	50 - 60
1	18	1ª angostura	1	42	81	52°35'25"	69°39'02"	5500	10 - 15
1	18	1ª angostura	1	53	120	52°35'55"	69°38'50"	2200	5 - 10
1	18	1ª angostura	1	31	54	52°37'00"	69°38'24"	2500	5 - 10
1	19	1ª angostura	1	67	212	52°38'33"	69°35'41"	50	0 - 5
1	19	1ª angostura	1	56	134	52°37'58"	69°35'37"	50	0 - 5
1	19	1ª angostura	1	56	134	52°37'58"	69°35'37"	50	0 - 5
1	19	1ª angostura	1	67	212	52°31'48"	69°37'27"	1000	50 - 70
1	22	1ª angostura	1	64	185	52°29'58"	69°32'21"	50	0 - 5
1	25	1ª angostura	3	33	59	52°29'01"	69°30'46"	1000	50 - 70
1	26	Posesión	1	62	170	52°26'49"	69°29'23"	3200	50 - 60
1	26	Posesión	1	46	94	52°28'17"	69°28'29"	800	0 - 5
1	27	Posesión	2	60	156	52°24'30"	69°28'30"	1500	0 - 5
1	28	Posesión	2	62	170	52°24'54"	69°25'08"	4000	45 - 60
1	28	Posesión	1	61	163	52°23'31"	69°25'13"	3500	30 - 50
1	28	Posesión	1	63	177	52°21'13"	69°25'05"	3800	0 - 5
1	28	Posesión	1	47	97	52°20'51"	69°25'07"	3500	0 - 5
1	28	Posesión	1	57	139	52°20'51"	69°25'07"	3500	0 - 5
1	29	2ª angostura	1	49	104	52°43'47"	70°11'50"	1000	50 - 60
1	30	2ª angostura	2	55	129	52°42'35"	70°13'22"	3500	50 - 60
1	30	2ª angostura	1	58	145	52°41'14"	70°13'53"	4500	40 - 60
1	30	2ª angostura	1	46	94	52°40'41"	70°14'08"	3000	45 - 55
1	31	2ª angostura	3	58	145	52°42'06"	70°15'37"	4200	45 - 55
1	32	2ª angostura	1	51	112	52°44'17"	70°17'14"	100	0 - 5
1	35	2ª angostura	2	58	145	52°43'60"	70°23'88"	3000	40 - 50
1	35	2ª angostura	1	65	193	52°44'46"	70°24'40"	2000	50 - 100
1	35	2ª angostura	1	69	234	52°44'46"	70°24'40"	2000	50 - 100
1	36	2ª angostura	3	49	104	52°44'08"	70°26'14"	3000	40 - 50
1	36	2ª angostura	4	54	124	52°42'52"	70°26'49"	1200	0 - 5
2	8	1ª angostura	2	28	48	52°34'26"	69°36'50"	50	0 - 5
2	10	1ª angostura	1	63	177	52°36'30"	69°38'06"	2200	5 - 10
2	18	Posesión	1	45	90	52°13'29"	69°13'32"	1200	0 - 5
2	20	Posesión	2	22	36	52°15'59"	69°01'55"	50	0 - 5
3	4	Gregorio	1	54	124	52°45'21"	69°48'23"	3100	0 - 5
3	4	Gregorio	2	38	71	52°43'20"	69°46'00"	6500	10 - 20
3	4	Gregorio	1	39	73	52°34'20"	69°49'43"	5500	10 - 20
3	5	1ª angostura	1	48	100	52°33'15"	69°41'42"	1200	0 - 5
3	6	1ª angostura	3	68	221	52°33'10"	69°37'25"	300	0 - 5
3	8	1ª angostura	1	45	90	52°30'76"	69°37'48"	400	50 - 60
3	8	1ª angostura	1	50	108	52°30'18"	69°32'09"	500	15 - 20
3	14	Posesión	2	58	145	52°27'33"	69°23'51"	2500	0 - 5

between 10:00 and 16:00 on clear days only to achieve comparable light conditions. One primary observer was located at each rear side of the helicopter. As secondary observers, the pilots did cover 45° in the front of the helicopter. Observers used unaided eyes with polarized sunglasses to enhance visibility and the support of 10x50 binoculars. Vertical angles to sightings were measured using a SUUNTO PM-5/360 clinometer. Data recorded on observation sheets by a secondary observer during the flights included: date, visibility, wind strength and sea state (Beaufort scale), transect number, time and position (GPS and left/right) of sighting, group size, presence of calves and angle of observation. All perpendicular distances were corrected for Earth curvature. The information on depth (strata) and distance from shore (ranges) at high tide for each observation was deduced from plottings on the nautical charts N°1,150 and 1,160 of the Hydrographic Service of the Chilean Navy (1:200,000).

The Helicopter used impeded visibility at an angle of 20° from the line on both sides under it. This represented a blind strip of 33 m at each side from the transect line. Following to Leatherwood (1984, 1988a) and Buckland et al. (1993), to make up for this lack of visibility, the perpendicular distances were rescaled, setting a distance of zero to the recorded distance of 33m from the line.

Density and abundance was estimated through DISTANCE 2.2 software, designed for distance sampling (Buckland et al. 1993, Laake et al. 1993), which estimates *f(0)*, the probability density function evaluated at distance equal to zero. Two detection models frequently used in cetacean surveys were compared in the analysis: Half Normal and Hazard rate. The final selection of the model was based on the comparison of the fit of the model to the data (Chi-square test), the coefficient of variation of the pooled estimated density and the effective strip width.

RESULTS

A total of 818.6 km were flown under favourable conditions (less than 3 Beaufort wind speed) distributed over 60 transects; 31 transects (246 km) were located in narrows and 29 (573 km) in open waters.

Density and Population Size Estimates

The Hazard Rate model for non-stratified left truncated data was the most appropriate model with the lowest coefficient of variation (CV = 27.1%), higher effective strip width (ESW = 165.8) and the lowest percentage contribution of the detection probability to the overall variance (10%). Based on this model, density and population size are estimated 0.34 ind km^{-2} (95% CI = 0.197 - 0.599) and 1,206 individuals (95% CI = 711 - 2,049 individuals) respectively, in the total area surveyed.

Group Size

Cluster size ranged from one to five individuals. Average was 1.7 ind group^{-1}($\pm$ SE = 0.13). Group size did not differ significatively between strata (1.6 ± 0.22 in narrows; 1.7 ± 0.17 in open waters). More than half of the sightings (58%) were of solitary animals and only one calf was observed.

Spatial distribution of sightings

Within the sampled area, the narrows showed a proportionately higher number of observations than the open waters (Test for Independent Proportions Z = 2.189, P = 0.01).

DISCUSSION

Population Estimate and Trends

Our results, with a survey effort of 818,6 km, present a lower CV (27.1%) in relation to previous studies done in the Strait of Magellan and to the survey in argentinian waters (Table 2). No relation is observed between CV's and the observation effort, when we compare the different surveys: Venegas & Atalah on may 1987 obtained a CV of 32% with the minor effort (577,2 km), while Venegas on December 1989, obtained a total CV of 60%, with a major effort (1320 km) and, in this case, also using a helicopter to perform the survey. It is not possible to detect a trend in the population size in comparison to previous population estimates, because our 95% CI overlaps with the lowest estimate of 2,043 individuals obtained by Leatherwood et al. (1984) and the estimated population size of 718 (SE ± 196) obtained by Venegas (1996). A fourth estimate (Venegas & Atalah 1987) has an inflated standard deviation, due to the small sample size (n = 21) and therefore is not comparable (Table 2).

Also, comparable population density values do not exist for this species from the Malvinas (Falkland) Islands and the Kerguelen Islands. The difference in density estimations obtained in the argentinian patagonian coast for the same area but with one year in difference (Table 2) , calls the attention on the potential for noticeable temporal and/or spatial variability: the estimates for 1994 and 1995 differs in one order of magnitude. The data available for the Strait of Magellan doesn't allow to assess this variability, although the variation detected in Atlantic waters should be considered in further surveys.

Group size

The proportion of single individuals is similar to that presented by Venegas & Atalah (1987: 85.7 % single individuals) and clearly higher than the one published by Leatherwood et al. (1984; 29.4 % single individuals). The low cluster size for Commerson's dolphins suggests that our abundance estimation should be taken as a lower limit of density, probably due to the effect of the high flight speed on overlooking submerged animals. The sighting of only one calf could be explained by the migration of females with calves towards more appropriate nursing conditions during the winter period.

Spatial distribution

Our results confirm the presence of Commerson's dolphin in the eastern sector of the Strait of Magellan. Observations from the central sector of the Strait of Magellan (Lescrauwaet 1996), Seno Almirantazgo, Seno Otway and Seno Skyring and patagonian channels (Sielfeld & Venegas 1978) suggest that *C.commersonii* is occasional or rare in Chilean waters west of the area between the Second Narrow and the eastern entrance of the Strait of Magellan. The proportionately higher number of observations in the narrows than the open waters coincide with the previously reported preference of this species for the narrows (Table 2).

The distribution documented here does not overlap with the *centolla* king crab (*Lithodes santolla*) fishing grounds. Then, we expect that directed catches for this species for bait will be found to be not as serious as previously feared. The restricted distribution of this species in Chilean waters allows to focus on their habitat preference and population trends on the Strait of Magellan.

Next steps in research in order to assess trends in number for the Commerson's dolphin, will

TABLE 2

Density estimated for this study and other information available for the same region. Included are data from the continental Patagonian coast in Argentina

Densidad estimada en este estudio y otra información disponible para la misma región. Se incluyen datos de la costa patagónica continental de Argentina

Period (in km^{-2})	Density	SE	CV (%)	n
June 1996 (This study)				
Total	0.340	0.0921	27.1	58
Open waters	0.264	0.0993	37.6	26
Narrows	0.441	0.1632	37.0	32
December 1989 (Venegas 1996)				
From First to Second Narrow	0.024	0.0147	62.0	6
Primer Bolsón	0.208	0.0429	21.0	53
First Narrow	0.473	0.5563	117.0	40
May 1987 (Venegas & Atalah 1987)				
Total Area	0.077	0.0241	32.0	21
First and Second Narrows	0.340	Not provided	-	8
Open waters	0.052	Not provided	-	13
January-February 1984 (Leatherwood et al. 1988)				
Total Area	2.199	0.741	34.0	46
First and Second Narrows	6.702	2.016	30.0	32
Open waters	0.658	0.050	8.0	14
Central Patagonia (Argentina) (Pedraza et al. 1996)				
November 1994	0.275	0.1023	37.21	-
December 1995	0.070	0.0275	39.23	-
Total	0.122	0.0344	28.23	-

focus in surveys in times of the year comparable with previous surveys (from december to april) and in the exploration of the sources of variation in numbers (spatial distribution, group size, searching methodology). Future research might also focus on the presence of calves in relation to reproductive seasonality and food availability.

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