ESTIMATED SIZE OF THE POPULATIONS OF PILOT WHALE *(GLOBICEPHALA MACRORHYNCHUS)* AND BOTTLENOSE DOLPHINS *(TURSIOPS TRUNCATUS)* IN THE SAC ES-7020017. TENERIFE

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INTRODUCTION The populations of bottlenose dolphins (*Tursiops truncatus*) and short finned pilot whales (*Globicephala macrorhynchus*) in the SW of Tenerife show a particular fidelity for such a reduced area. Their presence throughout the year is known, they live very close to the coast and their habitat coincides with one of the areas of highest tourist development in the Canaries. More than 30 whale watching boats visit them daily and it has been estimated that the number of passengers every year reaches a million.

In order to establish efficient polices that guarantee the viability of the populations of tropical pilot whales and bottlenose dolphins, in the SW of Tenerife, it is imperative to know exactly what the current situation is and the evolution in time of both populations. Quantifying the population abundance continuously and systematically is one of the procedures that makes it possible to assess in an efficient manner changes in the size of the populations (Gerrodette, 2000).

MATERIALS AND METHODS The design and execution of the pilot study established the minimum effort that should be employed to obtain an appropriate coefficient of variation (>900 nm). The pilot study provided valuable information for the execution of the main study and improved the design by adjusting better to the characteristics of the area of study and the populations.

Study Area The study carried out covered an area of 136-nm^2 (446km^2). We can not say that this is the real area of distribution of the populations in the SW of Tenerife. From previous photoID and genetic studies (Escorza *et al.*, 1992; Heimlich-Boran *et al.*, 1993; Carrillo *et al.*, 2000; Hildebrandt and Afonso, 2000) we can in fact conclude that without any doubt the SAC of Tenerife represents only a part of the distribution range of the populations of both species, and that the real area of distribution is larger than the sampling area.

Searching effort The abundance study was developed between December 2001 and September 2002 with the boat "Monachus". It is necessary to state the fact that the wind conditions in the southern limit (Pta. Rasca) and northern limit (Pta. Teno) of the area of study prevented us from sampling these areas correctly.

Nevertheless, as long as there is not a correlation between the wind conditions and the population density in these areas there is no bias in the estimate (Hammond, 1986).

Under good weather conditions we covered the area with line transects at 6 knots. When an individual or group of cetaceans was sighted, the distance to the group and the angle with the line transect was determined. The distance from the group to the line transect was determined from the centre of the group.

Analysis With the use of the distance data obtained it is possible to model mathematically the detection probability of the groups as a function of the distance from the groups of animals to the transect line. This probability function can be then transformed into an estimate of group density (of each species) in the study area. The group density can be transformed then into animal density and average number of animals in the study area (Buckland *et al.*, 1993).

Group Size To estimate animal density in the area it was necessary to estimate the average group size (E(S) for each species). Some factors can lead to bias in the determination of this variable. Therefore, several methods were used to achieve a reliable estimate for the average number of groups in the area.

* The estimate of group size used only the group size obtained by the best sightseer instead of the estimate of all the sightseers. It was accepted that the rest of the sightseers were in a position of their learning curve not close to the

asintote. If a correction factor was introduced for the estimates in order to use all the sightseers, the evolution in time of their estimates would lead to misleading results.

* It is well known that the group detection probability decreases with distance and may increase with increasing group size. Therefore, there could be a tendency to detect only larger groups at long distances. To avoid the overestimation of the average group size, the group size logarithm was regressed against the detection function (g(x)). If the regression was significant at 0,15 level, the group size estimate would have been used as E(S) (Buckland *et al.*, 1993). If the regression was not significant the arithmetic average would be used as a group size estimate.

RESULTS **Transects effort and sightings** Having selected 43 days of effort in good weather conditions that covered 1057.75 nm (1957 Km), the number of sightings per day of effort ranged from 0 to 12, with a total of 229 sightings during the sampling period.

The number of sightings of pilot whales per day ranged from 0 to 10, with a total of 166 sightings and an average of 3.86 sightings per day. The number of bottlenose dolphin sightings per day ranged from 0 to 4, with a total of 63 sightings and an average of 1.47 sightings per day.

Pilot whale population size (gm): Detection probability The probability function was adjusted with the use of a hazard-rate function and a polynomial expansion series. The detection probability for a transect width (AT) of 0.69 nm has been estimated in 0.34, with a CV of 17.46 (Table 1).

Encounter Rate The encounter rate of the groups (n/L) was 0.15 with a CV of 10.47(Table1).

Average Group size The regression test carried out upon the size of the groups of Gm was not significant at 0,15 level (r-p=0.28). The average group size was determined from the arithmetic average of the sizes of the groups sighted (E(S)= 8.39) (Table 2)

Density and Abundance The estimate group density of Gm in the study area was 0.32 with a CV of 20.36. The estimate animal density was 2.66 nm^2 (CV=20.93). This result multiplied by the study area led to an estimate of 362 animals (95% Confidence Interval 241-544) (Table 2).

Bottlenose dolphin population size (TT): Detection Probability The probability function was adjusted with the use of a uniform function and a cosine expansion series. The detection probability for a transect width (AT) of 0.89 nm has been estimated in 0.28, with a CV of 12.19 (Table 3).

Encounter Rate The encounter rate of the groups (n/L) was 0.60E-01 with a CV of 10.47 (Table 3).

Average Group size The regression test carried out upon the size of the groups of Tt was not significant at 0,15 level (r-p=0.30). The average group size was determined from the arithmetic average of the sizes of the groups sighted (E(S)= 7.43) (Table 4).

Density and Abundance The estimate group density of Tt in the study area was 0.12 with a CV of 17.79. The estimate animal density was 0,90 nm (CV=23.30). This result multiplied by the study area led to an estimate of 122 animals (95% Confidence Interval 78-193) (Table 4).

DISCUSSION Not knowing the real distribution of the tropical pilot whales and bottlenose dolphins in the SW of Tenerife (Heimlich-Boran *et al.*, 1993; Escorza *et al.*, 1992; Carrillo and Martín, 2000), these population estimates can be better understood as an estimate of average number of animals in the area during the period of study. The estimates are therefore referred only to the area searched, that is only a part of the real area of distribution of both species. These estimates can be a good indicator to assess the evolution of the populations, because indexes of abundance are more commonly used than abundance estimates to detect numerical trends (Evans, 1996).

In the Canary Islands, as well as in other regions of the world there seem to co-exist oceanic and coastal populations of bottlenose dolphins in the same area (Hansen, 1990). Around the SW coast of Tenerife it is possible that, at least seasonally, animals of different populations of bottlenose dolphins co-exist, as it is suggested by genetic studies of live animals (Hildebrandt and Afonso, 2000) and morphological studies of stranded animals (Martin and Carrillo, 1992). If this is the case, this study quantified average number of individuals of both populations in the area.

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Table 1. Detection probability and encounter ratio of pilot whale

	Estimate	%CV	df	Confidence Interval 95%	
Hazard/Polynomial					
P	0.34264	17.46	155	0.24334	0.48247
ESW	0.23553	17.46	155	0.16727	0.33164
n/L	0.14936	10.47	41	0.12095	0.18444

Table 2. Average group size, density and abundance of pilot whales

	Estimate	%CV	df	Confidence Interval 95%	
Average group size					
	8.3924	4.86	157	7.6242	9.2380
Hazard/Polynomial					
DS	0.31707	20.36	192	0.21308	0.47181
D	2.6610	20.93	214	1.7692	4.0021
N	362.00	20.93	214	241.00	544.00

Table 3. Detection probability and encounter rate of bottlenose dolphins

	Estimate	%CV	df	Confidence Interval 95%	
Uniform/Cosine					
P	0.27906	12.19	60	0.21886	0.35582
ESW	0.24568	12.19	60	0.19268	0.31326
n/L	0.59536E-01	12.95	41	0.45884E-01	0.77250E-01

Table 4. Average group size, density and abundance of bottlenose dolphins

	Estimate	%CV	df	Confidence Interval 95%	
Average group size					
	7.4286	15.05	62	5.5083	10.018
Uniform/Cosine					
DS	0.12117	17.79	95	0.85353E-01	0.17201
D	0.90010	23.30	157	0.57158	1.4174
N	122.00	23.30	157	78.000	193.00

Terms:

n - Number of groups sighted (or individuals).
L - Total length of the line transect (∑ of all the transect lines).
k - Number of transect lines (=days).
n/k - Group encounter rate.
AT - Transect width.
p.-. Detection probability in the area.
ESW.- Effective width strip.
m.-. Number of parameters in the model.
AIC.-. Akaike information criterion.
r-p.-. Probability of the regression test.
E(S).-. Average size of the groups.
DS.-. Estimated density of the groups.
D.- Estimated density of the individuals.
N.- Estimated number of individuals in the study area.
Nmin.-. Minimum population size.