TESTING THE WHISTLES REPERTOIRE OF THE STRIPED DOLPHIN IN THE WESTERN MEDITERRANEAN SEA

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INTRODUCTION

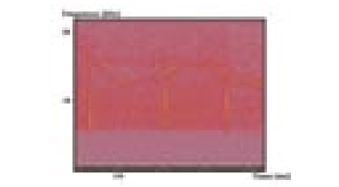
The striped dolphin *(Stenella coeruleoalba)* is the most abundant dolphin in the Mediterranean Sea and can be easily detected with acoustics, depending on behavioral context (Gannier, 2001). Reliability of the whistle repertoire as a tool to determine species identity was tested.

MATERIAL AND METHODS

Recordings made in the Western Mediterranean Sea from sailboat survey data during 1990-1994 period were processed. We used 200-20kHz hydrophones, either simple or towed array, and analog recording devices.

All vocalizations were listened in 90 secondes sequences and filled an Access data base including time and geographic variables. The good quality bins were digitized at 32 to 44kHz-16 bits using *Cool Edit* software. Every whistle provided one sample for which a FFT-spectrogram (Figure 1) was produced and the following variables (Oswald et al., 2003) extracted (Figure 2):

- -duration *D*
- -beginning *Fb* and ending Fe frequencies
- -frequency range *Fr* (= *Fma-Fmi*)
- -number and type of frequency modulations



The purpose of the test was to determine if a first set of whistles (1990-92) would form a robust sample to represent the striped dolphin repertoire by comparison to a second and independent set (1994) of similar importance. The comparison was done with Chi-2 testing of the distribution of each of the above variable.

Figure 1: Example of whistle spectrogram of *Stenella coeruleoalba*.

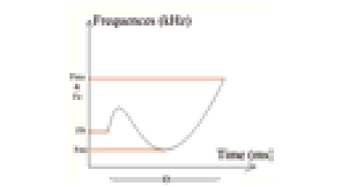


Figure 2: Determination of variables of a whistle.

RESULTS AND DISCUSSION

➡ A set of 336 signals coming from 5 different sightings made in 1990-92 (Table 1) gave a medium duration of 400ms, a frequency domain of 10.5kHz and an average frequency range of 4.2kHz. This repertoire was sorted into 19 categories according to visual caracteristics (general shape with number and type of modulation).

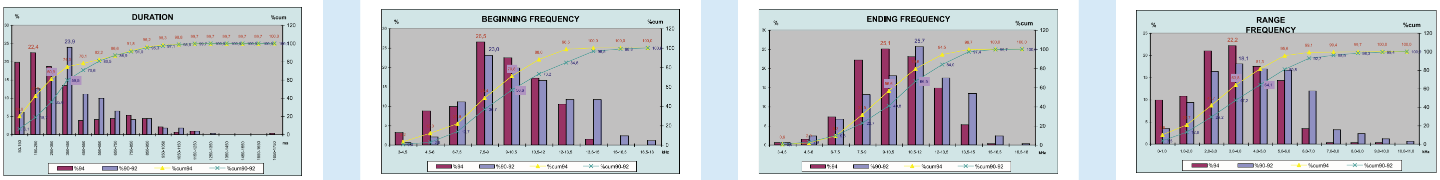
Table 1: Characteristics of 90-92 data set global distribution.

		D (ms)	Fb (kHz)	Fe (kHz)	Fr (kHz)
Range		50 to 1350	3 to 18	3 to 18	0 to 11
Length		1300	15	15	11
Mean		461.17	10.22	10.88	4.21
SD		245.32	2.59	2.42	2
CV		53.2%	25.34%	22.24%	47.51%
Mode	number	1 = 23.9%	1 = 23%	1 = 25.7%	/
	location	[350-450[	[7.5-9[	[10.5-12[	/
Median	location	[350-450[	[9-10.5[	[10.5-12[	[4-5[
Description (compared with mediant)		asymmetrical	asymmetrical	symmetrical	asymmetrical

➡ A second data set based on 343 whistles recorded from 9 sightings in 1994 was compared to the preliminary repertoire (Figures 3) and found to be statistically different based on distribution of patterns (Table 2 : Chi-2 test, · = 0.05).

Table 2: Statistical comparison of patterns between two data sets (1990-92 vs 1994).

VARIABLES	X^2(calculated)		X^2(theoritical)	Conclusions
D	181.85	>	15.5 (ddl=8)	Significative difference
Fb	162.46	>	11.1(ddl=5)	Significative difference
Fe	58	>	11.1(ddl=5)	Significative difference
Fr	89.45	>	9.49(ddl=4)	Significative difference



Figures 3: Comparison of parameters global distribution between 1990-92 and 94.

➡ At this stage, an extended repertoire was built with the same criteria by pooling both data set. This new data set included 22 categories. Its global distribution was described in Table 3.

Table 3: Characteristics of 1990-1994 global repertoire.

		D (ms)	Fb (kHz)	Fe (kHz)	Fr (kHz)
Range		50 à 1750	3 à 17	3 à 17	0 à 11
Length		1700	14	14	11
Mode	number	/	1 = 24.8%	1 = 24.3%	1 = 20.1%
	location	/	[7.5-9[	[10.5-12[	[3-4[
Median	location	[350-450[	[9-10.5[	[10.5-12[	[3-4[
Description		asymmetrical	asymmetrical	symmetrical	symmetrical

We could observe in this new repertoire the discrimination between two classes (Figures 4) of whistles : those with simple frequency modulation and those with complex modulation.

Figures 4: Examples of spectrograms for the two classes of modulation: F[kHz]=f (t[ms]).

CONCLUSION

Our striped dolphin whistle repertoire included high variability, possibly based either on individuals, groups, behavioral context or region, the variance on Fb, Fe, Fr and D were high. It is not known yet if some classes of whistles could be attributed to behavioral context while other assigned to signature vocalizations. One might presume that the latter hypothesis would be consistent with a higher degree of whistle variability in larger schools of dolphins.

So it would be interesting to compare this repertoire with other coming from striped dolphin sightings from eastern Mediterranean Sea and also to test the robustness of our description with common dolphin whistles from western Mediterranean Sea.

REFERENCES

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