21st conference of the european cetacean society
Donostia-San Sebastian, 2007 april 22-25

Long-finned pilot whales *(Globicephala melas)* in the Strait of Gibraltar: distribution and movements in relation to the tides

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Introduction:

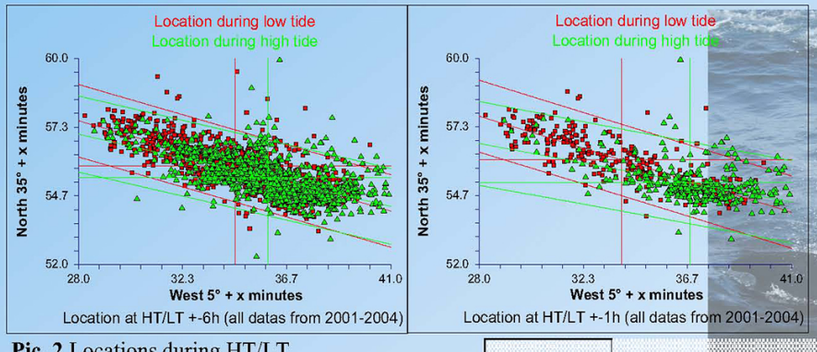
The Strait of Gibraltar is well known for its cetacean occurence, but also for strong surface currents wich are affected by the tidal changes. The Spanish foundation ***firmm®*** (foundation for information and research on marine mammals) has been studying cetacean abundance, distribution and behaviour in this area since 1998. 2064 recorded sightings between 2001 and 2004 indicate that the resident long-finned pilot whale population uses almost exclusively the southern part of the Strait, above the deeper zones (average depth ~700 m). Furthermore, there is strong evidence from our data for tidal influence on the local distribution of these animals. Whilst the dimension of the currents changes with the tides, the pilot whales move as well and show significant differences in their motional pattern. This information is important basic knowledge to study, among other topics, the potential impact the new commercial harbour close to Tangier is going to have on the resident pilot whale population, and by extrapolation, on all the other resident cetacean populations in the Strait of Gibraltar.

Methodology:

The observations of the long-finned pilot whales have all been taken from 2001 to 2004 between april and november on multiple daily boattrips which lasted 2h in the mean. The GPS datas and the time shedule of the tides were first used to do a mapping of the distribution (pic.1). To elaborate the motional pattern according to the tides the statistical softwares NCCS 2007 and SPSS were used. To work out the differences and the influence of the tides we used different timeframes (e.g. high tide +- 6h; high tide +- 1h) and considered also the coefficient of the tides (>0.75) which indicates the strength of the tidal currents .

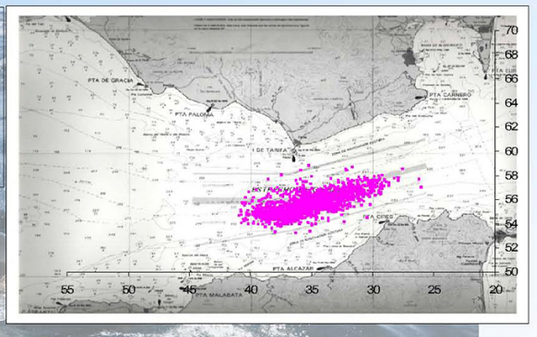
Results:

There are significant differences between the distribution of the pilot whale population during high tide (HT) compared to low tide (LT). During HT the animals are located more westerly than during LT (pic.2). There is also a obvious discrepancy on the North/South axis. The statsitical analyses show a high effect size when comparing the western coordinates in dependence to the tides (tab.1). The effect size is stronger, the smaller the time frame and/or the higher the coefficient is. Extrapolated on the whole population the distances between the locations (HT/LT) are calculated to be between 1.25 - 4 nautical miles.



Pic. 2 Locations during HT/LT

Pic. 1→ Distribution of the pilot whales in the Strait of Gibraltar



Tab.1

Paired Samples Test		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)	Effect size
				Lower	Upper				
Pair 1	WestLT/West HT +-1h	3.9485274	0.23471559	-3.34548693	-2.421453	**-12.28495**	**282**	**0.000**	**0.73**
Pair 2	WestLT/West HT+-6h	3.5575201	0.11381515	-1.7217211	-1.27501994	**-13.16495**	**976**	**0.000**	**0.421**
Pair 3	WestLT/West HT +-1h (c>0.75)	4.3751736	0.46376747	-3.95182018	-2.10853937	**-6.533834**	**88**	**0.000**	**0,692**

Discussion:

The distribution of the long-finned pilot whales in the Strait of Gibraltar is strongly influenced by the tides. The differences on the North/South axis is supposed to be caused by the topography of the ocean floor. The movements on the East/West axis are clearly depending on the tides or rather the currents, caused by the tides. These results show, that this population of flong-finned pilot whales moves with the tidal currents or furthermore is moved by them and that surface currents can have strong effects on the allocation of these animals on a daily base. These results should be considered for the planning of the gateways and regulations in the new harbour in Tangier.

Conclusion:

Statistical analysis shows highly significant differences between the distribution of the pilot whale population during high tide compared to low tide. It is obvious that the animals are locally influenced by and moving with the tides. These result may help to define adapted traffic rules in the Strait of Gibraltar.

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Acknowledgement:
We want to thank ***firmm®*** for the continous and ongoing data collection. Dr. Pierre Gallego for his helpfull advices and Marion Huber for the statistical analyses.