

DOES SPRING BLOOM TIMING AND INTENSITY INFLUENCE FIN WHALE DISTRIBUTION IN THE LIGURIAN SEA?



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INTRODUCTION

Field hydrological studies in the Ligurian Sea (NW Mediterranean Sea) and satellite imagery underline a frontal area between 10 and 50 km from the mainland and from Corsican coasts. This region provides a high level of primary production, peaking in March-April. To obtain results on seasonal variation of cetacean population, monthly transects were conducted between French mainland and Corsica

between 2001 and 2003. The purpose of this study was to try to understand how fin whale (*Balaenoptera physalus*) year-round abundance could be affected by food availability in the area, using satellite remote sensed data. The food parameter was estimated by the Net Primary Production, considered as a good descriptor of food availability than surface chlorophyll pigment (Littaye *et al.*, 2004).

MATERIAL AND METHODS

Field survey

Seasonal variation of fin whale abundance was assessed by 29 dedicated surveys carried out between the « Cap d'Antibes » and the « Pointe de la Revellata » (Figure 1) from February 2001 to December 2003. Visual survey on the two parallel transect lines consisted of a continuous naked-eye observation by 3 observers (see Laran *et al.*, 2003 for more details on sampling protocol). Only efforts with Beaufort scale ≤ 3 were used. Survey transects were cut every 20nm (37km) until the end of the day (or bad weather) and the remaining distance was included in the pool of data. Encounter rate (number of fin whale/km) were computed on sample unit and averaged by trip. Effort by monthly trip ranged between 111 and 326km (mean: 250; SD: 71).

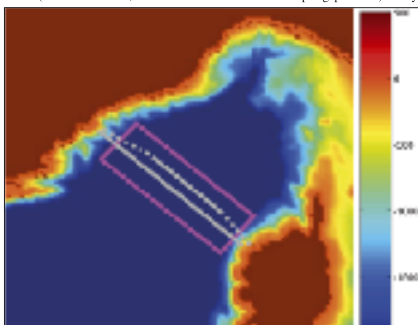


Figure 1: Study area (depth in metre). __ boundary lines of the strip; __ transect lines

Remote Sensing

Net primary production (NPP), in $\text{mgC.m}^{-2}.\text{d}^{-1}$, was computed using Wimsot v6.13 (Kharu, 2003). Inputs parameters were obtained from remote sensing data (with agreement of Goddard DAAC):

Input parameter	Source	Product	Resolution
Surface Chlorophyll pigment concentration	SeaWiFS	Level 3 NPP	4 km
Photosynthetically Active Radiation	PAR SeaWiFS	NASA Pathfinder	4 km
Sea Surface Temperature	SST AVHRR	NASA Pathfinder	4 km

Numerical data was extracted from a strip of $5,760 \text{ km}^2$ ($70 \times 24 \text{ nm}$) around both transect lines (Figure 1). This area was located on pelagic area (depth $\geq 2000\text{m}$, 17km from shore). Pixel measurements were temporally averaged by month.

As no SST data was already available from Nasa Pathfinder after June 2003, monthly averaged temperatures of 2002 were used with Chla of 2003 and PAR of 2003 to compute an indication of monthly NPP from July to December 2003.

NPP and mean encounter rate of whale were integrated over three periods: February to April as the Spring bloom period, May to August as the Summer period and September to December as the Autumn-Winter period. January was not included in those integrated periods.



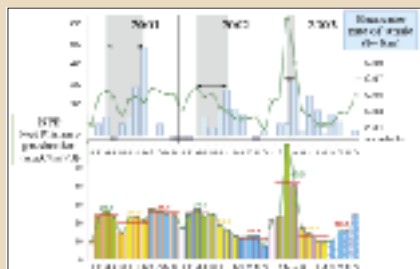
RESULTS AND DISCUSSION

Fin whale (Figure 2)

Fin whales occur year-round in the Ligurian Sea, with a maximum in summer. Whales were observed from February to October 2001, with a maximum encounter rate in August (0.109 whale/km). Then no sighting was recorded from December to February 2002, despite 744km of effort. In 2002, they peaked in July (0.057 whale/km). In 2003, the maximum encounter rate occurs in April (0.068 whale/km).

Net Primary production (Figure 2)

Figure 2: a- Net Primary Production (NPP) and whale encounter rate in 2001, 2002 and 2003. b- details on Spring (February to April), Summer (May to August) and Autumn-Winter (September to December) averaged value for the 3 years.



The best correlation between Primary production and whale encounter rate was found with one month of time lag (Pearson $r = 0.254$, $n = 29$). The Bloom situation of 2001 and 2002 were almost similar and for both years the whale maximum occurred in July-August, with a time lag of 4-5 months. Following the strong bloom intensity of 2003, the whale maximum occurred in April (time lag of one month) mainly spread in the central area instead of frontal distribution during spring 2001-02. A possible effect of a strong bloom intensity could be the early entrance of whales in the area which maybe attracted by aggregation of adult euphausiids remaining from the previous year. However, no direct effect appears on summer abundance of whales. Littaye *et al.* (2004) showed that whale distribu-

tion was well correlated with spring primary production from the end of June to mid-July, then with summer progressing short-term processes became more significant. This interpretation is coherent with our summer situation (Figure 3, in yellow) : high level of NPP in summer 2001 was followed by the maximum concentration of whales, in August 2001.

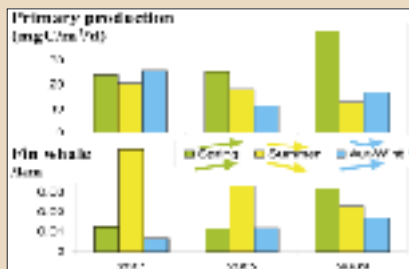


Figure 3: Mean primary production and fin whale encounter rate.

CONCLUSION

Spring bloom intensity seems to influence an early presence of fin whales in the Ligurian Sea. Moreover, an higher primary production level in summer may also favours a high relative abundance of whale in July and August.

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