



Physiological status identification of fin whales (Northwest-Mediterranean) through analysis of reproductive hormones in blubber

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Introduction

We established in previous work (Tapie & al.2012) that Mediterranean fin whales are contaminated by PCBs at a significant rate. Given that such contamination is known to impact mammal reproduction we launch the current study to evaluate potential impact of POPs contamination on the pregnancy rate of the female fin whale. Its aim is to determine the physiological status of fin whales (*Balaenoptera physalus*) in the northwestern basin of the Mediterranean Sea (sexually active males and pregnant females) and to calculate the pregnancy rate of this population.



Fig. 1 Fin whales in the Pelagos Sanctuary

Material and methods

Campaigns at sea were organised by WWF-France for 6 weeks each summer between 2010 and 2013. Biopsies of 271 individuals were collected: 148 males and 123 females. Sex determination and genetic identity were carried out for each individual using eleven microsatellite loci. The rate of progesterone, testosterone, estradiol and androstenedione were measured in each sample by radioimmunoassay. Pregnant females are identified through their high level of progesterone during the first half of gestation and sexually active males through their level of androstenedione and testosterone (Thibault & al. 2001, Mansour & al. 2002).



Fig.2 Biopsy and sample processing

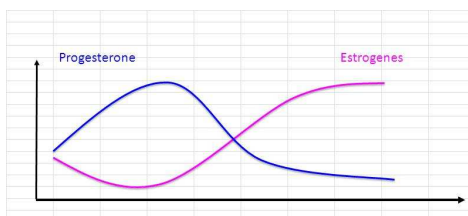


Fig.3 Hormonal changes during pregnancy in mammals

Results

The results have shown a very clear threshold between pregnant and non-pregnant females as well as between sexually active and juvenile males. When the progesterone rate is above 100 ng/ g fat, the female is unambiguously pregnant. For sexually active males, the rates of androstenedione or testosterone were greater than 6ng/ g fat.

Pregnant females

During the 4 years of research, 47 out of the 123 females sampled were pregnant, but rates have shown a significant difference from one year to another. In 2010 and 2011, steroid rates indicated that 52% and 42% of females were pregnant. In 2012 the proportion of pregnant females dropped to 11% and rose again in 2013 to 45%.

Active stallions

Of the 148 males biopsied, 129 were breeding males. Compare to females, the percentage of active stallions is more stable over the years with an average of 79% (max: 89 %, min: 60 %), even though 2011 appears uncommon, with 40% juveniles and only 60% active stallions.

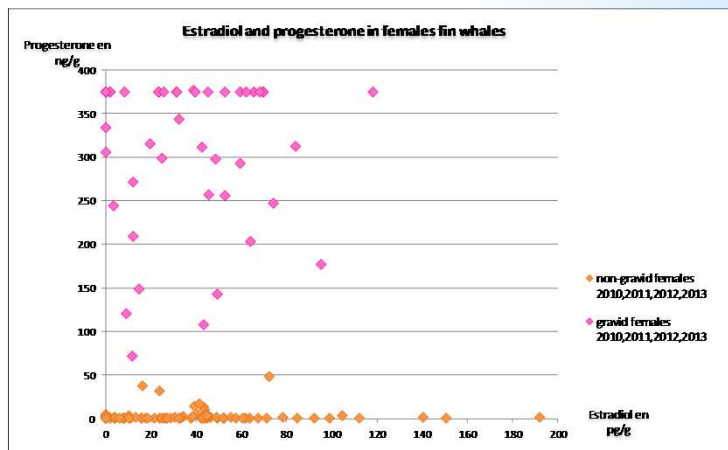


Fig.4.Estradiol and progesterone in females fin whales

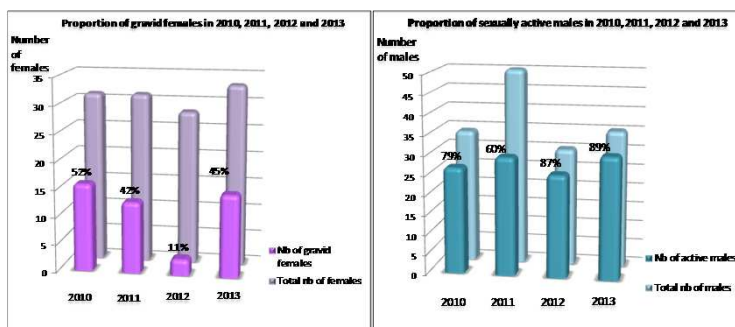


Fig 5. Proportion of gravid females and active males in 2010, 2011, 2012 and 2013

Discussion-Conclusion

The methodology that was used for the first time in fin whales in the Mediterranean appears to be an easy and simple way to evaluate their reproductive status and provides original information on demographic parameters.

According to these first results, the reproductive capacity of fin whales seems maintained despite a significant level of POP contamination (Tapie & al.2012).

At this stage, the fluctuation rate of pregnancy over years can be interpreted in two ways:
 -If we consider the drop to 11% in 2012 as an "accident" (related to bad environmental conditions for example), we can assume that each fin whale is giving birth every two years, which can also be found in the higher part of the range of other publication (36 and 47% (NOAA, 2010).
 -If we consider this low rate as a regular pattern, then the pregnancy rate (one calf each two or three years) falls into its lower part. Assuming this drop is a regular pattern would also suggest a synchronization of female pregnancy. This synchronization is well-known for wild mammal populations, but this is a new and original information for this fin whales' population.

The percentage of active stallions is nearly stable at about 80-90 %, except in 2011 when 40% of males were found to be juveniles. Could this result linked with the high level of pregnancy found in 2010 (52%) ? No satisfying explanation can be given at this stage, only long-term monitoring could answer this question.

With cautious precautions these results may also be interpreted to roughly estimate the juvenile mortality : in a theoretical world, where all the young grow up without any mortality, at an average pregnancy rate of 38% (present study) with fin whales reaching sexual maturity at age 8 (NOAA, 2010) we would expect a population of about 3 juveniles per adult. The average ratio we obtained for males in this study is approximately one juvenile per 4 adults. Related to the theoretical juvenile group expected under the previous assumptions, this ratio suggests that about two thirds of the juveniles are "missing". This rough extrapolation is not very far from the 77 % of mortality in the earlier stage of life given by Arrigoni & al, 2011 for the specie in the Mediterranean.

Measuring actual population trends and demographic parameters is very difficult with cetacean given the cost and difficulties of required protocols. On the contrary, this new methodology based on biopsy sampling appears to be a good tool to approach such parameters and to provide a good picture of population health. The juvenile mortality, more than the reproductive capacity, appears to be the limiting factor of Northwestern Mediterranean fin whale population restoration.

References

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