

Multiple scattering for biomass assessment

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CONTEXT

In the 80's, the demonstration of multiple scattering phenomena for electromagnetic waves in media with an arbitrary scatterer distribution opened the door to the exploration of this phenomenon for other types of waves.

At the end of the 90's, publications emerged on the observation and use of this phenomenon in medical ultrasonics as well as at frequencies closer to those used in underwater acoustics.

The ability of the Seapix to process antenna signals as well as the possibility to observe multiple scattering phenomena in fish schools suggests the development of less empirical methods than the use of SV for school density estimation [1], [2].

In addition, the ability of Seapix to scan and recombine a volume provides the second term to the effective biomass estimation equation without fishing the school or handling [3].

REFERENCES

[1] B. Tallon, P. Roux, G. Matte, J. Guillard et S. E. Skipetrov, «[Mesoscopic wave physics in fish shoals](#)» *AIP Advances*, vol. 10, p. 055208, 2020.

[2] B. Tallon, P. Roux, G. Matte, J. Guillard, J. H. Page, and S. E. Skipetrov, "Ultra-Slow Acoustic Energy Transport in Dense Fish Aggregates", *Scientific Reports*, 11(1):17541, 2021

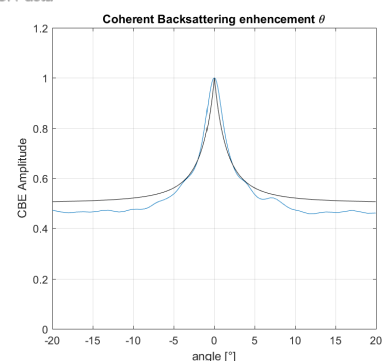
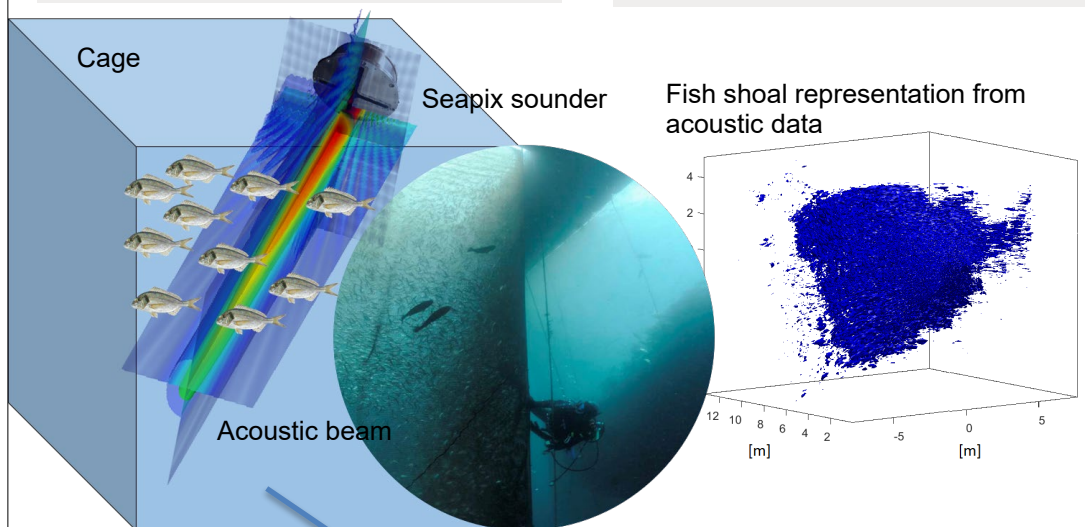
[3] B. Tallon, P. Roux, G. Matte, J. Guillard et S. E. Skipetrov, «[Acoustic density estimation of dense fish shoals](#)» *The Journal of the Acoustical Society of America*, vol. 148, pp. EL234-EL 239 2020

INTRODUCTION

Seapix is now installed on about 50 fishing vessels. The biomass analysis tool (GBA) is widely exploited by users, but still uses empirical data from volume backscatter or target echoes to sort schools or detections by species or size. Experiments were conducted in March 2017 and 2019 in Cannes Aquaculture sea cages to acquire volume imaging signals as well as multiple scattering measurements in order to be able to calculate the biomass by the product volume x density.

PROBLEMATICS

Despite advances in fish farming techniques, regular estimation of stocks by farmers remains imprecise and risky. Farmers use empirical grow-out models to avoid counting fish as much as possible, as this leads to high risks of injuries and infections in the stock. Recalibration of the grow-out models by these counts once a month at best can reveal unpleasant surprises, along with their economic impact.



CONCLUSION

The multiple scattering phenomenon has been well demonstrated experimentally in several cages of a marine aquaculture operation (Cannes aquaculture). It is the starting point of the exploitation of the mean free path measurement for the calculation of the density of a school, and by extension, a greater reliability on the calculations of biomasses.