Use of advanced vitellogenic oocytes as a proxy for egg quality in sardine

Xènia Frigola-Tepe, Júlia Rotger-Triay, Judith Ollé-Vilanova, Jordi Viñas, Marta Muñoz

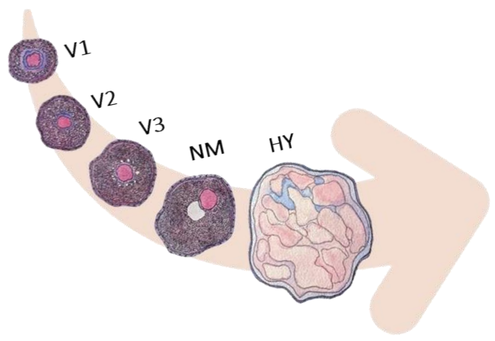
INTRODUCTION

Egg quality is the feasibility of an egg to be fertilized and develop into a healthy embryo (Bobe & Labbé 2010). Given the diversity of reproductive strategies, the method used to estimate fecundity must be adapted to each reproductive type. In contrast, methodologies for assessing spawning quality tend to be more standardized across species, although there is still limited consensus on the most reliable approaches.

In commercially important marine fish species, a common technique to assess egg quality is to measure the mean dry mass of hydrated oocytes obtained from the ovary (Ferrer-Maza et al. 2014, 2015; Serrat et al. 2019).

Handicap in *Sardina pilchardus*

- Short-term spawning aggregations at greater depths.
- Spawning peaks **6 and 7 p.m.**
- Sardines begin hydrating their eggs 9 hours earlier.
- Purse seines operate closer to the surface and during night.

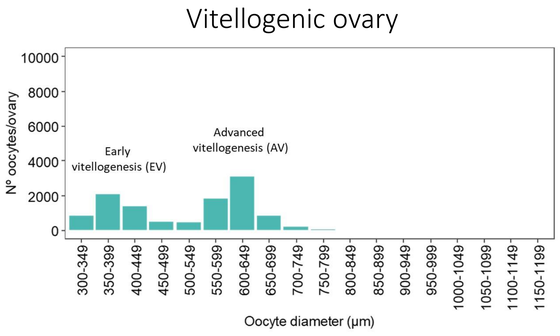


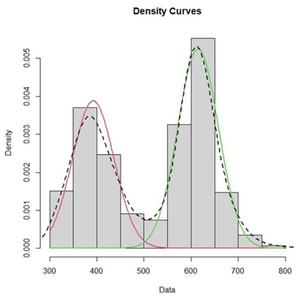
OBJECTIVE

Very few sardines (*Sardina pilchardus*) captured by purse seiners contain hydrated oocytes, even during the active spawning (AS) phase. The aim of this study was to evaluate whether oocytes in advanced vitellogenesis are suitable for estimating egg quality, by comparing the dry mass of different replicates of oocyte cohorts (previously identified through size frequency distribution plots).

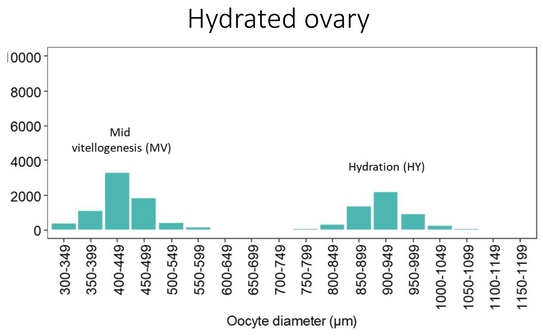
RESULTS

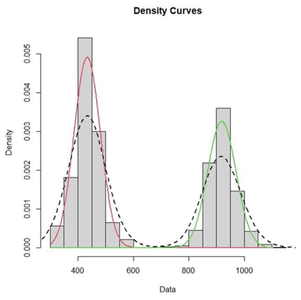
Vitellogenic ovary





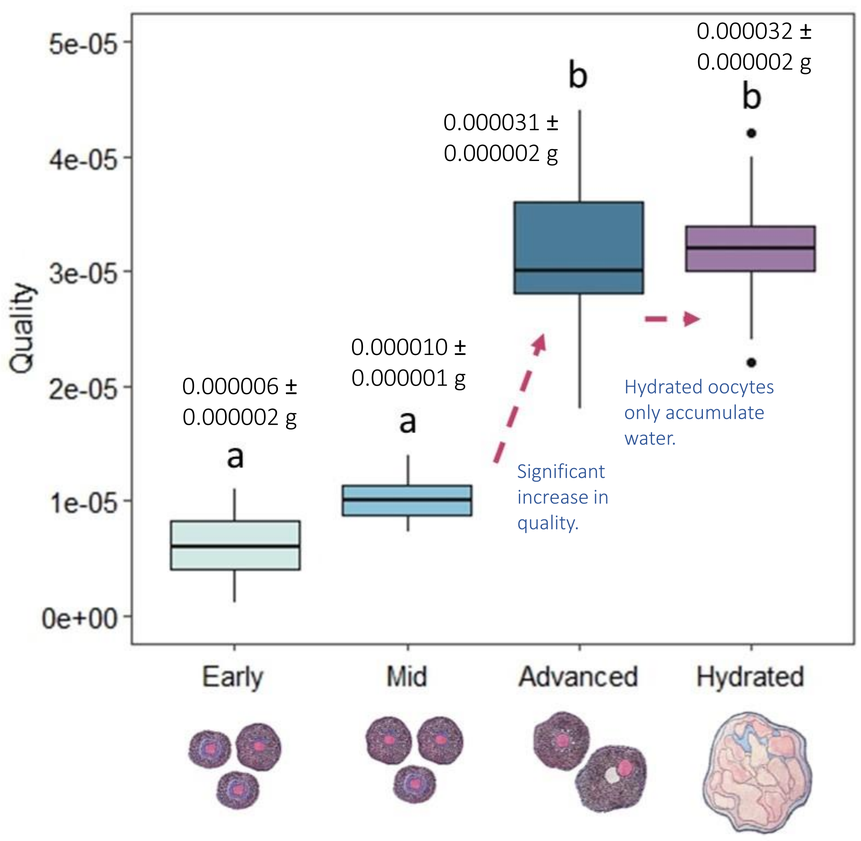
Hydrated ovary





Actively spawning sardine females (N=16) were collected on December 2023 and January 2024 from the southern Catalan coast (GSA 06) in the western Mediterranean.

Stops accumulating nutrients and quality is maintained.



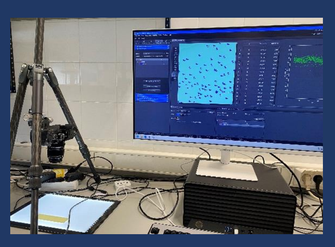
DISCUSSION

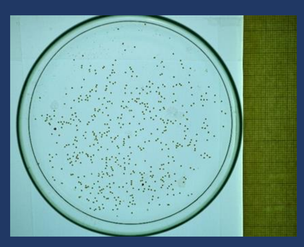
This study highlights that **advanced vitellogenic oocytes** in sardine no longer accumulate additional nutrients, and their dry mass does not differ significantly from that of hydrated oocytes. Only oocytes with a diameter of at least 500µm should be used, since dry mass differs between early–mid and advanced vitellogenic stages. This study provides new insights into the use of advanced vitellogenic oocytes as a proxy for egg quality, an important step for fisheries management.

METHODOLOGY

Oocyte size distribution plots

- Subsamples were sieved through seven meshes (900–300 µm) to separate oocytes by size.
- Image analysis software (Zeiss Zen Imaging) was used to generate size frequency distribution plots (OSFPs).
- When overlapping cohorts occurred, mixture analysis in R was applied to estimate the number of oocytes in the most advanced batch.
- Batch fecundity (BF) was estimated by identifying hydrated or advanced vitellogenic oocytes in whole ovarian mounts.





Validation of egg quality assessment using vitellogenic oocytes

- Egg quality was estimated by drying replicate samples of oocytes from each cohort at 110 °C for 24 h. Each replicate consisted of 50 oocytes from the most advanced cohort (hydrated or in advanced vitellogenesis) and 150 oocytes from the less advanced cohort.
- The total dry mass was measured and was divided by the number of oocytes per plate to calculate individual egg quality.

Bibliography

- Bobe J, Labbé C (2010). Egg and sperm quality in fish. Gen Comp Endocrinol or Gen Comp Endocrino 165(3): 535–548. https://doi.org/10.1016/j.ygcen.2009.02.011
- Ferrer-Maza D, Lloret J, Muñoz M, Faliex E, Vila S, Sasal P (2014) Parasitism, condition and reproduction of the European hake (Merluccius merluccius) in the northwestern Mediterranean Sea. ICES J Mar Sci 71(5), 1088–1099. https://doi.org/10.1093/icesjms/fst217
- Ferrer-Maza D, Muñoz M, Lloret J, Faliex E, Vila S, Sasal P. 2015. Health and reproduction of red mullet, Mullus barbatus, in the western Mediterranean Sea. Hydrobiologia, 753(1), 189–204. https://doi.org/10.1007/s10750-015-2205-5
- Serrat A, Lloret J, Frigola-Tepe X, Muñoz M (2019) Trade-offs between life-history traits in a coldwater fish in the Mediterranean Sea: The case of blue whiting Micromesistius poutassou. J Fish Biol, 95(2): 428–443. https://doi.org/10.1111/jfb.13993

Acknowledgment and Funding

Spanish Ministry of Science, Innovation and Universities TED2021-132521B-I00/MICIU/AEI/ 10.13039/501100011033, PDC2022-133800-I00/MICIU/AEI, the European Union NextGeneration EU/PRTR and the project MICIU/AEI/10.13039/501100011033/FEDER, UE.