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## SUMMARY

This output reports on the first estimates of routine metabolic rate (RMR) in Atlantic bluefin tuna (*Thunnus thynnus*) larvae, which is essential to understand how larvae balance their high growth and other physiological functions. The results can help improve larviculture protocols, such as improved feeding schemes that result in lower mortalities and faster larval growth.

## KNOWLEDGE NEED

Atlantic bluefin tuna is an iconic species with a high commercial and ecological value. Despite this, many physiological aspects during the larval stages are still unknown, creating a bottleneck for upscaling production. The mechanisms of how fish larvae balance growth and activity are of great interest, as metabolic costs are very high compared to juveniles and adults. However, there is a lack of information about energy demands in bluefin tuna larvae. Gaining reliable estimates of metabolic costs in these larvae can help to:

- (1) identify vulnerabilities during ontogeny related to increased requirements (e.g. tail flexion, start of piscivory)
- (2) improve larviculture protocols to optimize daily nutritional needs.



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## POTENTIAL IMPACT

- Improvement of larviculture protocols for bluefin tuna, to allow for an adequate feeding scheme that considers changes in the metabolic demands during larval ontogeny.
- Improved health and welfare for bluefin tuna larvae.
- Increased sustainability of the bluefin tuna industry due to lower mortalities and faster growth of the larvae as a result of food optimisation procedures.

**EATiP - Strategic Research and Innovation Agenda (SRIA)** Thematic Area 3 – Managing the Biological Lifecycle: Goal 1 and 4. Thematic Area 4 – Sustainable Feed Production: Goal 2 and 5. Thematic Area 7 – Aquatic Animal Health and Welfare: Goal 4. To see the full list and descriptions of the thematic areas and goals, please visit: [bit.ly/3hBDpGH](https://bit.ly/3hBDpGH)

## UNDERLYING SCIENCE

Atlantic bluefin tuna eggs were collected from the wild and reared in the laboratory. Larvae were reared *ad libitum* (algae, enriched rotifers and artemia, and seabream yolk sac larvae), first in 5000 L and then in 1500 L tanks at 26 °C. Routine metabolic rate was measured at 26 °C using closed respirometry in 20 and 100 ml glass containers. Measurements were done in light and darkness to compare activity levels, and typically lasted less than 1 hour. After the recording of routine metabolic rate, larvae were measured and preserved. A biochemical nutrition index (the RNA:DNA ratio) was measured in all larvae to test whether inter-individual differences in energy requirements were related to differences in larval nutritional condition.

## RESULTS

- Routine metabolic rate scaled nearly isometrically (proportionally) with body size ( $b = 0.99$ ) at 26 °C in Atlantic bluefin tuna larvae. These results highlight the high energy demands of tuna larvae throughout ontogeny, as most larval fish display allometric scaling, where metabolism does not increase proportionally to body size.
- Size (and not nutritional condition) explained most of the variability among individuals in routine metabolic rate in the bluefin tuna larvae, however all larvae were well fed, so further research is needed to disentangle the potential effects of different diets (quantity and quality) on larval energetics.
- No significant differences in routine metabolic rate were detected under light and darkness. One would expect tuna larvae to be less active (and thus have lower energy demands) in darkness as they are visual predators, but our results suggest similar activity levels in both conditions (during our short-term measurements).
- This study also highlights the complications of estimating metabolic rates in larvae of Scombrid fish (e.g. tunas, bonitos, billfish) which are highly sensitive to handling and confinement.

## END-USERS & POTENTIAL APPLICATIONS

### END-USER 1: Atlantic bluefin tuna farmers

**APPLICATION:** 1) Calculate energy needs for different sized tuna larvae using the estimated routine metabolic rate. 2) Establish predictability and improve output during early larval stages of the lifecycle.

### END-USER 2: Atlantic bluefin tuna feed producers

**APPLICATION:** Establish optimal larviculture diets for bluefin tuna based on their energy requirements.

### END-USER 3: Ecophysiologicals & ecologists

**APPLICATION:** Generate new data on the metabolic demands of Scombridae larvae to improve the quality of comparative analysis, exploring general trends in body size scaling of metabolic rates across marine fish taxa.

## STATUS

### Technology Readiness Level (TRL) 1 - basic principles observed

- This work is published in the *Journal of Fish Biology*: [doi.org/10.1111/jfb.14473](https://doi.org/10.1111/jfb.14473)
- Further research is needed to disentangle the potential effects of different diets (quantity and quality) on larval energetics.
- The same methodology has been used with Atlantic bonito (*Sarda sarda*) larvae and the results are currently (autumn 2020) being analysed.

AT A  
GLANCE

**TITLE:** First estimates of metabolic rate in Atlantic bluefin tuna larvae

**KNOWLEDGE TYPE:** Scientific publication

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**TNA FACILITY USED:** Instituto Español de Oceanografía - Marine Aquaculture Plant (Murcia, IEO-ICRA and IEO-MAP)

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**PATENTS OR OTHER IPR EXPLOITATIONS:** No

