Physiological Effects of Pregnancy on Atlantic Stingray

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Background Info

According to the most recent 2019 IUCN Red List [3], almost half of all rays are threatened or endangered. These species and other elasmobranchs fulfill important niches in their environments, yet little is known about their reproductive patterns or strategies.

Our model species, *Hypanus sabinus*, serves as an ideal representative to study the methods of embryonic nourishment and maternal investment strategies. Understanding these reproductive functions is crucial to the long-term conservation of elasmobranchs. While it is assumed that histotroph secreting species invest the greatest into their litter, it has not been quantified nor has the associated energetic costs been assessed.

Important Terms:

Elasmobranch – Term for cartilaginous fish (i.e. sharks, rays, skates, sawfish)

Viviparous – "Live-bearing", term for giving birth to live young.

Pups – Term for newborn sharks and rays.

Gravid – Term referring to pregnancy

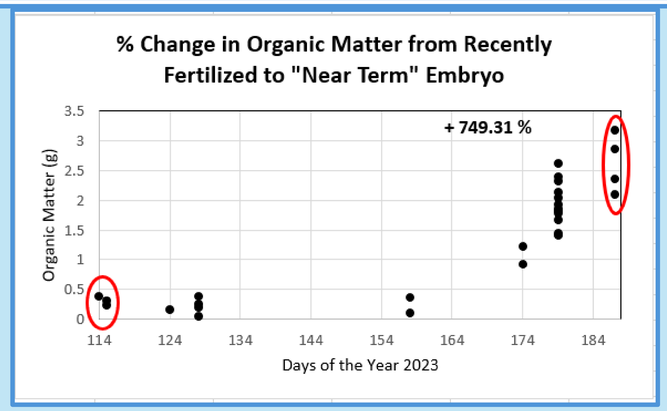

Figure 1 – % Change in Organic Matter

Figure 1 depicts the data utilized to determine the % change in organic mass across the different stages of embryonic growth. The averages of the data sets in red constitute the 'initial' and 'final' masses of organic matter. There was found to be a 749% increase in organic matter.

Methods

This study utilized a multi-step process to determine the percent change in mass (g) in water, inorganic matter, and organic matter from recently fertilized zygotes to full-term embryos.

1. Embryos at various developmental stages were weighed (g) alongside their accompanying external and internal yolk sac.
2. These embryos were then dried at 60℃ to remove water content. After stabilization, final weights were recorded to eventually determine mass of water content by subtracting dry weight (g) from initial weight (g).
3. Samples were removed from the oven and placed in a muffle furnace where temperatures were gradually increased from 90 ℃ to 550 ℃ and dwelled at 550 ℃ for 24 hours.
4. Samples were removed from the furnace, and organic matter mass (g) was calculated by subtracting ash weight (g) from dry weight (g).
5. After all data was collected, the percent change in mass between different embryonic stages was calculated using $\frac{Final\ (g) - initial\ (g)}{initial\ (g)}\ x\ 100$ for water mass, inorganic, and organic matter.

Figure 2 – *H. Sabinus* Embryo

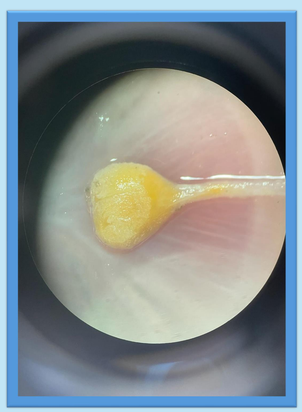

Figure 3 – External Yolk Sac

Results

From April to late July of 2023 (the 114th to 187th days of the year), the organic matter masses of embryos at various stages of development were collected. It was found that recently fertilized zygotes had an average organic matter mass of 0.3096 g. while near term embryos had an average organic matter mass of 2.62945. As such, it was determined that between these stages of development pups, on average, experience a 749.31% increase in organic matter.

Conclusion

The aforementioned results support the hypothesis that histotroph secreting species invest the greatest into their offspring, revealed through the extraordinarily large increase in organic matter during embryonic development.

As our study continues, we will investigate how reproductive stages contribute to elasmobranch fitness. Additionally, we will establish a link between negative physiological effects on gestation and its impact on a female and her litter's survival in the wild during their most vulnerable life stage. This will be accomplished through respirometry trials that are set to take place within the next three months.

References

1) Cotton, C. F., et al., 2015. Deep Sea Research Part II: Topical Studies in Oceanography. *115*, 41-54. 10.1016

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3) Marshall, A., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Pacoureau, N., Rigby, C.L., Romanov, E. & Sherley, R.B. 2022. Mobula alfredi (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2022