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*, provides a simple means of studying maternal investment in embryonic nourishment through a visible external yolk sac and then through histotroph secretions. Understanding these reproductive functions is crucial to the long-term conservation of elasmobranchs as while it is assumed that these species invest the greatest of all elasmobranchs, this is not currently quantified.

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 2 – *H. Sabinus* Embryo

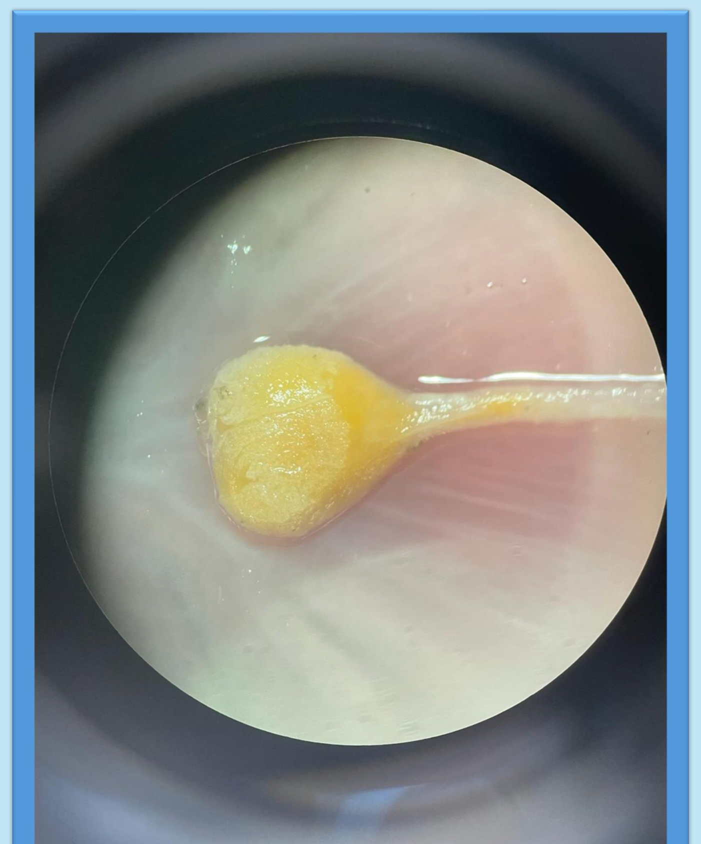

Figure 3 – External Yolk Sac

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°C 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 °C to 550 °C and dwelled at 550 °C 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.

SPECIES ID	Sample ID	WET WT (g)	T1 in Dryer	Date	T2 out Dryer	PL2 DW (g	T2 in Dryer	Date
23VI23A2C	EM1 B	14.5626	NA	10/10/23	NA	NA	NA	10/12/23
23VI23A2C	EM1 EYS	0.0090	15:00	10/10/23	10:33	0.0002	10:35	10/12/23
23VI23A2C	EM1 IYS	NA	NA	10/10/23	NA	NA	NA	10/12/23
23VI23A2C	EM1 LV	0.507	15:16	10/10/23	10:33	0.2254	10:33	10/12/23
23VI23A2C	EM1 DT	1.1755	15:29	10/10/23	10:33	0.2778	10:34	10/12/23
23VI23A2C	EM1 EVB	11.4748	15:16	10/10/23	10:33	1.3472	10:34	10/12/23
23VI23A2C	EM2 B	10.7103	NA	10/10/20223	NA	NA	NA	10/12/23
23VI23A2C	EM2 EYS	0.0044	15:28	10/10/23	10:35	0.0302	10:38	10/12/23
23VI23A2C	EM2 IYS	NA	NA	10/10/23	NA	NA	NA	10/12/23
23VI23A2C	EM2 LV	0.1700	15:47	10/10/23	10:35	0.0552	10:37	10/12/23
23VI23A2C	EM2 DT	0.6706	15:52	10/10/23	10:35	0.1184	10:36	10/12/23
23VI23A2C	EM2 EVB	8.5920	15:48	10/10/23	10:35	1.0135	10:36	10/12/23

Figure 1 – Embryo Drying Table

Figure 1 shows data from two separate embryos retrieved from the same specimen. It includes the dates, times, and recorded weights of these embryos after different periods of being dried, showing the removal of water content over time.

Conclusion

Due to the large amount of nutrients invested into the matrotrophic histotrophs produced by gravid female stingrays, it appears providing a sustainable food source and a stress-free environment may be the most effective means to ensure a successful live birth for Atlantic stingrays, and perhaps other ray species as well.

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. We will do this through respirometry trials that are set to take place within the next three months.

Results

Though this study is not yet complete, there are outcomes that are expected due to current data.

Based on acquired information, it appears likely that gravid female stingrays invest a large portion of the nutrients they collect into production of intrauterine fluids.

References

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

2) Johnson, M. R. 1992. Reproductive life history of the Atlantic stingray, Dasyatis sabina (Pisces, Dasyatidae), in the St. Johns River, Florida. M.S. Thesis, University of Central Florida, Orlando, Florida. 85p.

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