NATURE'S TRANSLATING CONE ROTATES

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ABSTRACT
Horn shark egg cases look very unusual. Shaped like a squat cone, they have a spiral vane vertically attached along the length of the cone's side. An explanation is given involving fluid dynamics and principles of biology. While sinking the egg should rotate and thereby maintain its initial direction. Among six or more eggs released in a bunch one by one into the water, initial angles of descent will be randomly distributed causing their end positions on the ocean's bottom to be widely separated. Such a means of dispersal tends to enhance the survival of the species.

Keywords: Horn Shark Eggs**,** Dispersal Mechanism

1. Introduction

Consider the egg case of the ocean's horn shark. It has a squat cone shape with a rigid spiral vane vertically attached along the length of the cone's side surface. A possible fluid dynamic reason for this configuration is given, which builds on a suggested biological purpose. My recent exposure to this type of shark egg did not lead to a sensible conclusion [1], probably because not all the available information was used.
Some facts about these shark eggs were made known to me during a visit to the aquarium and the biological collections of the Scripps Institution of Oceanography in La Jolla, CA. The egg case is slightly heavier than water and sinks slowly. Six or more eggs are released into the water one at a time. At first the flexible spiral vane lies flat against the surface of the cone and after several days in the water the vane becomes vertical and stiffens.

2. Proposed Explanation

Dispersal is the keyword. Given the conical egg shape, it is assumed that the blunt end of the cone will be lower in the water than the apex during sinking due to the mass distribution and center of gravity. Also the spiral form of the vane will cause rotation of the cone about its long axis while translating. Rotation has the

ability to stabilize the initial direction of translation because of a principle of physics: conservation of angular momentum. Among six or more eggs the initial directions are expected to be randomly distributed. Consequently at the ocean's bottom these eggs should end up being widely separated.

Another possible biological reason for the existence of the spiral vane on a cone occurs at the bottom, whether it be sand or some harder surface. If a current should give it a push, it will not go very far but rotate about the apex because of the conical shape. One is reminded of the elongated egg shapes produced by birds that lay them on narrow ledges of cliffs, in hopes that they will not roll off.

An underlying assumption is that if six or more shark eggs are hatched at the same time and place on the bottom, they might have a desire to eat each other. Dispersal is good for the survival of the species.

3. Discussion

Such a performance by the horn shark egg case is amazing, whether or not the above explanation is correct. But what nature so far has not invented first before humans did is the idea that if a solid cone without vanes somehow starts rotating about its long axis under water, it should begin to translate about that axis with the base leading and the apex trailing [2]. This is a theory which has not been verified yet.

Also clear is that the translating cone with a vane will rotate. If these two separate concepts can be combined in a constructive way such that the rotating and translating body makes an extended trip with no outside assistance, is not known at this point. Other configurations involving cones and vanes have been mentioned as possibilities but not the spiral vane of the horn shark egg case. For example, a solid cone with a lens bowing outward instead of a flat base and a couple of slanted vanes on the lens might work. Trial and error may waste time.

Given the translation, provided by gravity for the shark egg, the spiral vane creates the rotation. On the other hand, given the rotation a hollow cone without vane will increase (essentially double) the translation speed [3].

At first sight some may think that the horn shark egg is designed to screw itself through the water. In fact it unscrews its way. Evolution has taught fish to save energy by going blunt end first. Greatest thickness of the fish is closer to the mouth than the tail, and the horn shark egg also conforms to this rule. In the schools of naval architecture the wrong idea prevails.

4. Conclusions

Egg cases of horn sharks are cones with spiral vanes attached. They rotate when sinking, preserving their initial direction of descent, which is randomly distributed among a bunch of eggs released into the water. Therefore on the bottom the eggs will be widely scattered and stay in place rolling around their apexes. Dispersal aids the survival of this species.

References

[1] Kenyon, K. E. (2020) A Cone Rotating in a Fluid Translates. *Natural Science*, **12**, 39-41.

[2] Kenyon, K. E. (2020 Cone Rotating in a Fluid. *Natural Science*, **12**, 1-3.

[3] Kenyon, K. E. (2020) Hollow Cone Rotating under Water Translates, *European International Journal of Science and Technology*, **9**, No. 10.