PREDATION ON EGGS OF THE LITTLE SKATE (RAJA ERINACEA) IN THE GULF OF MAINE

David L. Cox and Thomas J. Koob

Mount Desert Island Biological Laboratory, Salsbury Cove, Maine 04672

Predation on large, energy rich eggs is common in terrestrial and freshwater communities and we might predict that predation on large eggs would also be widespread in marine communities. However, little information is available to test this prediction. Few records of predation on elasmobranch eggs by either invertebrates or vertebrates have reached the literature.We present new evidence for predation on the eggs of the little skate (Raja erinacea) in the Gulf of Maine based on examination of capsules held in museum collections, those collected from beaches, long-term incubations of caged egg capsules, SCUBA and aquarium observations. Our observations establish that gastropods (Buccinum undulatum) and sea urchins (Strongylocentrotus drobachiensis) are important egg predators.

Museum collections containing eggs of the little skate have been examined for the presence of bore-holes or other signs of predation. Presumed gastropod bore-holes are excavations of characteristic size, having distinctive detailed form (Carriker & Yochelson, *Contributions to Paleontology, Geological Survey Professional Papers* 593-B, 1968). Of six major North American collections studied to date only two collections contained specimens of Raja erinacea eggs from the Gulf of Maine with characteristic bore-holes: the American Museum of Natural History, New York, New York (AMNH No. 3092 from off Woods Hole), and the Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ No. 920 from Penikese, MA and an uncatalogued egg from off Nova Scotia).

Skate eggs collected from beach drift have been scored for presence of bore-holes. Only the following representative collections will be included in this report: Wonderland Beach, Mount Desert Island, Maine, August, 1987; and Biddeford Pool Beach, Maine, December, 1987. At Wonderland Beach, M.D.I., during August of 1987 we gathered 44 Raja erinacea capsules of which 35 had characteristic bore-holes (79.55%). There were 80 bore-holes in these 35 capsules, indicating that in this sample multiple boring into a single prey capsule was fairly frequent. Closed hatching slits were found on fourteen of the eggs; hatching slits of ten eggs were too mutilated to determine their condition. Twenty-two Raja erinacea egg capsules were collected at Biddeford Pool Beach, Maine, in December of 1987, although two of these could not be scored due to extreme damage. Nineteen of the remaining twenty capsules, or 95%, had bore-holes. Seven of these capsules retained closed hatching slits (37%).

Raja erinacea eggs incubated in Frenchman Bay for one year were also preyed upon. Freshly spawned eggs (n = 54) were collected and divided among four equal size compartments within a $1m^3$ cage. The cage was placed at a depth of 35-40 ft on a flat, unconsolidated silt substrate off Lab Point, Frenchman Bay, Mount Desert Island, Maine. Progress of the incubation was checked by SCUBA observation. After one year twelve of the 54 capsules placed in the four-chambered cage were perforated (22%). The frequency of boring activity, however, varied markedly between the upper and lower chambers. The upper left chamber contained 15 eggs, none of which were perforated, while one of the 15 eggs in the upper right chamber had a bore-hole (7%). Six of the 12 eggs in the lower left chamber had bore-holes (50%), and five of 12 capsules in the lower right chamber were perforated (42%). Eggs in the lower compartments were in contact with the silted substrate of the Bay, while those in the upper chambers were about 0.5m above.

During a routine SCUBA examination of the "one year cage" (13 August 1987), we encountered a snail actively boring through the dorsal body wall of a skate egg in about 20 ft. of water just off of the laboratory float. We observed this interaction for approximately 15 min as the gastropod continued its boring behavior. The predator was the wavy whelk, Buccinum undulatum.

Skate eggs were placed in flowing sea water aquaria (40L) with various freshly collected invertebrates (including Buccinum undulatum, Asterias vulgaris, Strongylocentrotus drobachiensis, Cancer irroratus, Hyas coarctatus, and Nereis virens) in an effort to identify additional potential egg predators. Within 15 min. a green sea urchin (Strongylocentrotus drobachiensis) was chewing through a just spawned skate egg. The urchin ate not only the egg contents, but it also chewed up tanned egg capsule material. Interestingly, sea urchins also attacked three year old eggs that were empty. Sea urchins preyed voraciously on freshly spawned skate eggs, as well as ones that had incubated 1 month or 3 years. Experiments underway in Frenchman Bay will help assess the extent of sea urchin and whelk predation on little skate eggs under more natural conditions.

Eggs of the little skate (Raja erinacea) in the Gulf of Maine are preyed upon by gastropods and sea urchins. The bore-holes we have observed are almost certainly of biological origin, whether or not they all result from gastropod or echinoderm activity. We do not know whether vertebrates prey on little skate eggs in the Gulf of Maine. Despite the paucity of specimens available from museums and field collections, it is clear that predation on these large, energy-rich eggs is common in the Gulf of Maine. We predict that sustained egg predation could have important life history consequences for the little skate. Our results clearly demonstrate that damage to little skate eggs owing to predation is widespread; however, they do not as yet permit us to assign a specific role to egg predation in the evolution of viviparity or reproductive potential in this elasmobranch.

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