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The Movement of the Gastrop Littorina Littorea in the Intertidal Zone during the Onset of Winter

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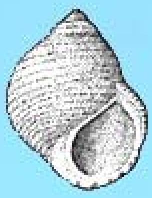

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The movement of the snail *Littorina littorea* on the North Atlantic coast is poorly understood. Most research has concentrated on the vertical distribution of the snail, and suggests that it prefers the low intertidal zone where its food source is most plentiful. In the winter, this distribution is reinforced by a documented seaward migration of snails from the high intertidal zone in response to falling temperatures. From October 14, 2006 to January 22, 2007, I examined the individual movements and recovery of snails in response to the onset of winter. I proposed that falling water and air temperatures drive the majority of snail movement within the intertidal zone, and that water temperature had the greater effect. I also examined the possibility that, in addition to a seaward migration, winter weather patterns in the Gulf of Maine and their effect on the ocean may encourage the wintertime vertical distribution of snails. Finally, I examined the possibility that populations of snails in the comparatively inhospitable high intertidal zone may endure the winter if given access to proper resources.

METHODS: **Each week, I collected 80 snails and divided them into four equal groups. These four sets were placed by increasing tidal elevation. The snails in each set were assigned a color: red blue, green or orange. The red set was placed at the extreme low tide mark, followed by the blue set in the low intertidal zone, the green set in the high intertidal zone, and finally the orange set at the extreme high tide mark.**

Each set was placed in a 5" x 5" red square painted on the rock. The square was divided in lengthwise and each half designated with one or two dots. The 20 snails for each set were then divided evenly, assigned one or two dots, and placed in the square. The snails were left to wander for a one week interval, upon which I returned to measure and record the distance traveled by each set.

When a snail was found, the distance from the square was determined to the corresponding dot within the square. The orientation (horizontal or vertical) and topography (crevice or flat) of the location where each snail was found were also recorded, along with water and air temperatures for that date. After I had collected as many data as possible, I returned the snails to the square and replaced those that were not able to be located so that the square once again totaled 20 snails. These were allowed to wander freely until the following week.

Table 1: Cumulative data for all four sets organized on a weekly basis. Data not collected indicated by N/A.

Date	Average Distance Moved (cm)	Percent Horizontal	Percent in Crevice	Air Temperature (°C)	Water Temperature (°C)	Percent Recovered
10/22/2006	83.3 (±91.57)	N/A	N/A	8.9	11.3	56.0
11/11/2006	143.0 (±102.72)	72.4	72.4	13.7	10.7	35.0
11/17/2006	87.6 (±56.79)	46.2	57.7	8.1	10.1	65.0
12/10/2006	121.7 (±51.74)	73.7	84.2	6.0	9.2	31.0
12/16/2006	148.6 (±89.21)	31.8	72.7	11.1	9.9	55.0
01/13/2007	141.0 (±120.57)	79.2	66.7	5.9	7.9	40.0

RESULTS: **The average distance moved by an individual snail was 118.1 cm (±93.3) per week, as calculated from the cumulative data. There was a 46.1% total recovery for the study. There was moderate negative correlation between the distance moved and the percent recovered (r = -0.58). There was a moderate positive correlation between water temperature and the percent recovered (r = 0.39), but no correlation between air temperature and the percent recovered (r = 0.06).**

Of those snails that were recovered, 72.3% were found on a horizontal surface. 54.5% of snails were found in crevices, and 64.8% of those snails found in crevices were on horizontal surfaces.

Temperature trends for the seawater declined at a steady rate, with a net change of -5.9 ºC (Table 1). There was an overall moderate negative correlation between the water temperature and the distance moved (r = -0.48). Temperature trends for the air were more erratic, but also ultimately decreased over time, with a net change of -7.8 ºC. There was an overall slight moderate positive correlation between the air temperature and the distance moved (r = 0.30).

DISCUSSION: **Snail movement is primarily affected by falling water and air temperatures, although water temperature was seen to affect movement to a greater degree than air temperature. The falling temperatures were the result of winter weather patterns, which may also play a role in the recovery and distribution of the snails, especially in those of the extreme high intertidal zone, by facilitating more powerful and intense wave shock and tides. At the same time, it is the intense wave shock and tides that may also prevent the settling of *L. littorea* in the extreme low intertidal zone. Finally, for those snails in the sheltered mid-intertidal zone, it is the likely the proximity to resources and standing water that determines distribution and movement. Further study on this topic might include examining the exchange of snails in the extreme high intertidal zone with a larger sample size to conclude if the tide plays a role in both population establishment and vertical distribution, examining the preference for crevices by snails in the extreme low intertidal zone and the role it may play in counteracting wave shock and storm surges, and finally examining the horizontal distribution of the snails to conclude if resources and standing water are prominent factors in determining snail survival during the winter.**

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