Lobster Project 2002

Larval, Drift and Temperature Studies in LFA's 31A and 31B

Prepared by

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Plankton Study

Members of the Guysborough County Inshore Fishermen's Association have long held concerns that lobsters produced in the waters of Guysborough County do not remain on their grounds, but are drifting to other areas with prevailing winds and currents. Specifically, fishermen suspect that lobster larvae are drifting south-west. The Association initiated some research in 2002 to study larval drift and to find out whether larvae produced in the waters of Guysborough County are seeding other areas.

When lobster larvae hatch they float to the water's surface where they will develop over the next 20 to 40 days. The rate at which larval lobsters develop is related to water temperature. Lobsters go through 3 larval stages in their development, molting between each stage. Although lobster larvae can move up and down in the water column to take advantage of food or to escape predators, they are unable to swim against currents. These planktonic larval lobsters are largely at the mercy of water movements during their early stages of development, and thus can be carried considerable distances.

Lobsters in their last stage of development before settling (post larvae) are less than 1-inch (about 1.5 cm) long, and resemble miniature lobsters. At this stage they begin diving to the bottom, seeking out suitable habitat. These tiny lobsters require some kind of shelter such as cobble rock or eel grass where they can hide from predators. We suspect that post larval lobsters in eastern Nova Scotia will not settle out where the bottom temperature is below 11˚C. If a post larval lobster makes its way to the bottom and does not find suitable conditions, it will return to the surface and drift with the currents before returning to the bottom once again in search of suitable habitat.

In order to estimate drift, we need to know where and when lobster larvae are in the waters of Guysborough County. To do this we conducted a survey of berried females and a series of plankton tows. The location of berried females in June is probably near where they will hatch their larvae and where, in turn, we should begin to see larvae in the early stages of development. This is where larval drift should begin. Information on berried females was collected in May and June in LFAs 31A and 31B. Surveyors accompanied local fishermen at sea on their regular trap hauls. Thirteen sea samples were

completed during the 2002 lobster fishing season. Trap locations were recorded about every 5 traps, with or without berried females. Data was grouped into sets of 5 trap-hauls per fisherman and mapped using MapInfo 6.0 (figure 1.) On the map, each black X represents zero berried females per 5 traps. Each red star represents at least one berried female per 5 traps. As you can see from the map, there are no areas of unusually high or low concentration. Berried females were found all along the coast and 90% were found in less than 10 fathoms depth.

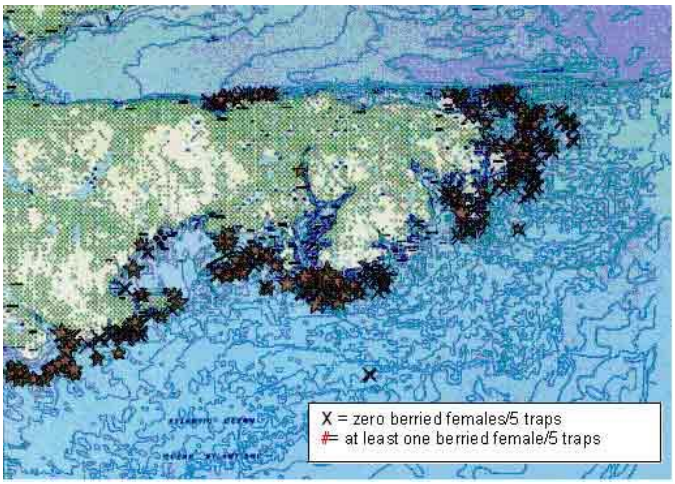

Figure 1. Distribution of berried females in June 2002.

In order to estimate drift we must also know the dates when lobster larvae are in the water. We wanted to find the dates when hatching begins and ends (i.e. when stage I's appear and then disappear), and when settling begins and ends (i.e. when stage IV's appear and then disappear.) To do this we conducted a series of plankton tows. In past sampling exercises in P.E.I. and South Shore, N.S., a plankton net was mounted on the front of a skiff and pushed along the waters' surface. Equipment had to be modified for use with a lobster fishing boat. We used a fine mesh net rigged to an aluminum frame with an 8' by 2' opening. The net was towed behind the boat, and a wooden deflector mounted on the side of the frame kept the net away from the wake of the boat (figure 2.)

Figure 2. View of plankton net and frame towed behind a fishing vessel.
Note the wooden deflector on the right-hand side of the picture.

We selected 48 stations for plankton tows. The stations extended from Durrell's Island (Canso) to Tor Bay and were in a combination of deep and shallow areas and sheltered and exposed areas. The stations were grouped into sets of twelve, giving 4 general sample areas: A (Canso), B(Canso-Dover), C(Dover-Whitehead), and D(Whitehead-Tor Bay), respectively (figure 3.) We collected about 12 samples per trip. Each tow lasted 10 minutes and the net was towed at a speed of about 3 knots. A flow meter mounted on the frame measured the distance the net moved through the water in each tow so we could calculate the volume of water passing through the net. We attempted to sample each station bi-weekly but weather and availability of boats and captains interfered. A total of 129 samples were collected from July 22 to September 17, 2002. Samples were preserved in 10% formaldehyde and lobster larvae were identified to stage within 2 days of collection.

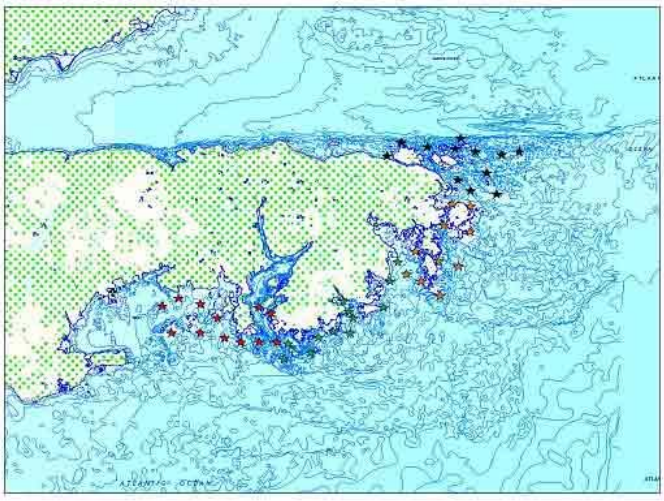

Figure 3. Location of stations for plankton tows.
Note that the stations are grouped into 4 general areas by colour.

We found the results to be highly variable. For example, 12 stations in Canso-Dover were sampled on July 22 and again on July 25. The results for these samples are graphed in figures 4 and 5, respectively. As you can see, the sample at station 2 on July 22 contained no lobster larvae, but 3 days later the sample at station 2 contained 300+ lobster larvae. This tells us that many samples must be collected, and sampling must be repeated throughout the sample season.

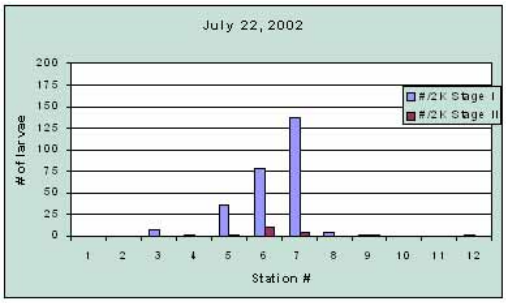

Figure 4. Results of plankton tows in Canso-Dover, July 22, 2002.

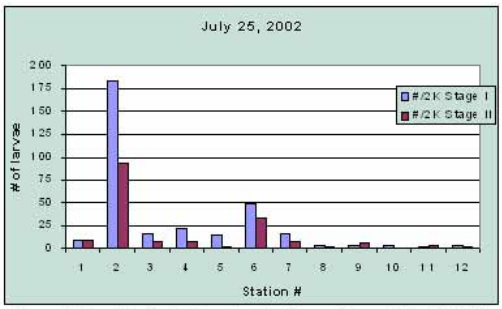

Figure 5. Results of plankton tows in Canso-Dover, July 25, 2002.

Since we collected substantial numbers of lobster larvae in our first days of sampling, we can conclude that hatching begins in this area prior to the 22nd of July (Tables 1 & 2.) Stage I larvae were most abundant in late July, and we saw reduced numbers of stage I's in mid-August. Stage IV larvae began appearing in early August and were most abundant in mid-August. Some stage II and stage III larvae were identified in late July. Numbers for stage I and stage IV larvae had dropped off by the time sampling ended in mid-September. There were many more stage I larvae than stage IV's in all locations.

Canso/Dover - Average catch		
Date	Stage I	Stage IV
22-Jul-02	23	0
25-Jul-02	27	0
8-Aug-02	13	0.08
23-Aug-02	10	0.52
27-Aug-02	3	0.1
4-Sep-02	2	0

Table 1. Average catch (per station) by date for Canso/Dover.

Whitehead/Tor Bay - Average catch		
Date	Stage I	Stage IV
31-Jul-02	6.4	0.15
1-Aug-02	1.8	0.08
19-Aug-02	7	0.08
20-Aug-02	2	0.7
10-Sept-02,	1	0

Table 2. Average catch (per station) by date for Whitehead/Tor Bay.

More stage IV's were collected in samples from 2002 than in previous samples collected in the area during the 1990's. There were substantial numbers of stage I's in all samples, but there are more stage IV's in the current year's samples than in samples from the 1990's. It is encouraging to see that abundance has increased in 2002.

From this year's lobster project we found that berried females were distributed all along the coast. Sampling from a fishing boat works well. Many samples need to be collected, and sampling must be repeated frequently. We found that hatching in this area begins before the end of July and ends in mid-August. Stage IV's appear (i.e. settling out begins) in early August and disappear (settling out ends) in September. We caught substantial numbers of stage I's, and more stage IV's in this year's sampling than in samples collected in the 1990's.

A review of the project and presentation of results took place on October 9, 2002. After the presentation, GCIFA members discussed how they would like to see the project progress. A general consensus was that another year of plankton sampling should be completed. If funding can be secured and a reliable boat and captain identified, sampling could be kept timely and consistent. Association members also expressed an interest in sampling juvenile lobsters in the future. These studies, along with the temperature and drift studies begun this summer, will give us a more complete picture of lobster recruitment and distribution in eastern Guysborough County.

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Temperature Studies

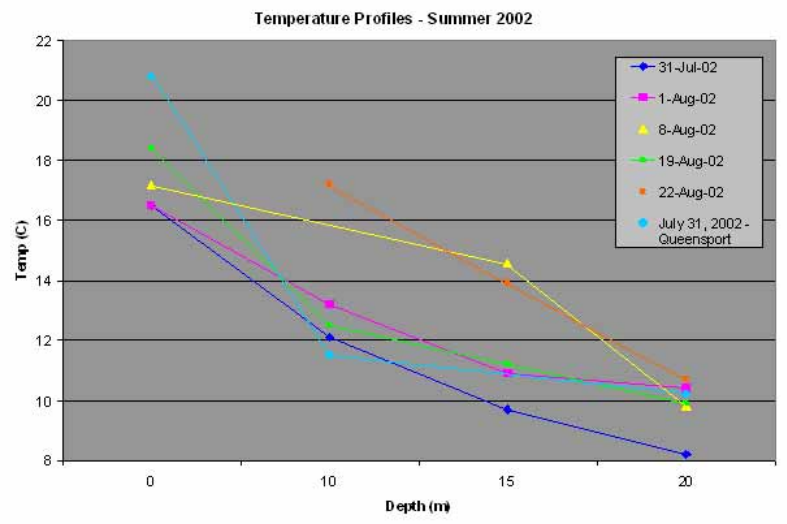
Temperature is a major factor in the survival of larval lobsters, along with bottom type, food availability and predation. When lobster larvae advance to stage 4 (post-larvae) they begin diving for bottom. Suitable bottom for lobster larvae is a rock substrate or ample seaweed or eel grass coverage, however, temperature must also be favorable. Based on laboratory studies, we suspect lobster larvae need a bottom temperature of 11o Celsius or above in order to survive. Therefore, we also suspect that if they encounter colder temperatures they will swim back up to the surface and look for another location. Stage IV larval lobsters have about a 12-day window or opportunity to find suitable bottom and temperature. After this, it is thought that they will die.

This summer we measured temperatures from Queensport, Guysborough County, to Tor Bay, Guysborough County. There were two main ways that temperatures were measured.

While we were doing larval samples with the fishermen, we took temperatures at a range of depths at various locations. Usually, 11o C occurred between 5 and 10 fathoms, or 10 - 20 meters. These results were then compiled on a graph for visual analysis.

The first graph is of the depth-temperature profiles that we obtained over the summer at various locations. On the bottom, we have the depth of the water in meters, and along the side we have the temperature in ° Celcius.

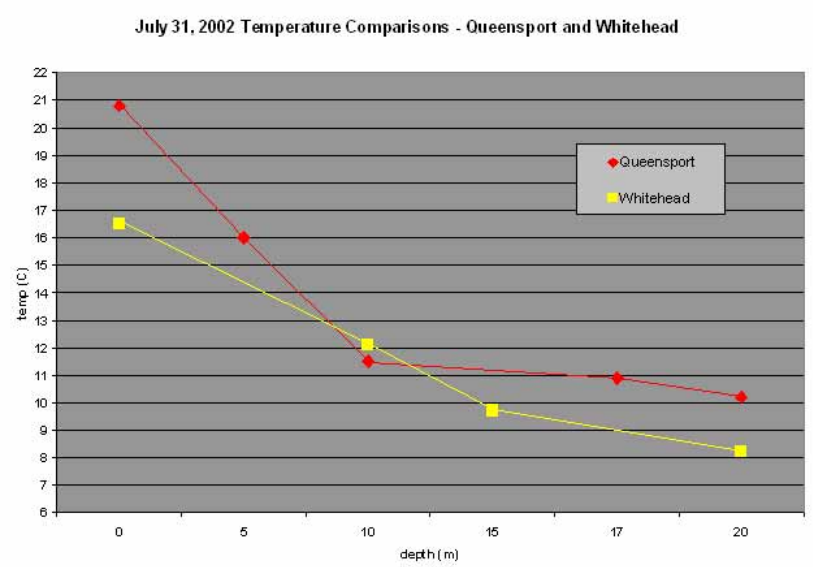
All fish were taken out of the nets on board the vessel and their stomachs were removed and placed in individual plastic bags. Individual stomachs were labelled with site number, date, species, length of fish, and whether the fish was in reproductive condition. The site number would be used later as a reference to which of the three sites the fish was sampled from. The plastic bags were immediately placed on ice and stored in insulated boxes. Upon return to the wharf, the stomachs were placed in a freezer until further analysis.



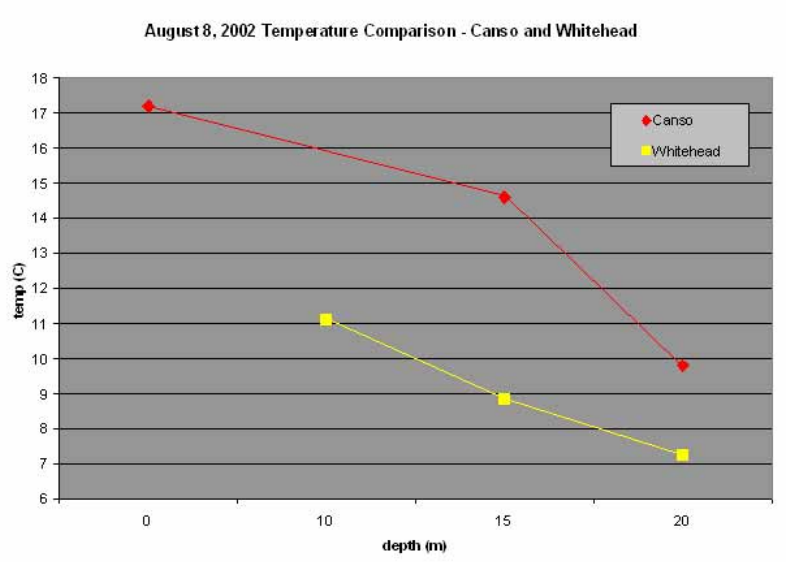
The dates in the legend correspond to particular locations. July 31 was in Whitehead, August 1 was in Whitehead, August 8 was in Canso, August 19 was in Whitehead, and August 22 was in Dover. The second July 31 was in Queensport. This graph shows that there is variability over time and between

locations. A general warming trend is seen through the summer, as expected.

The next graph is a comparison of two locations on the same day. This graph demonstrates that there can be similarity between two different areas on the same day.

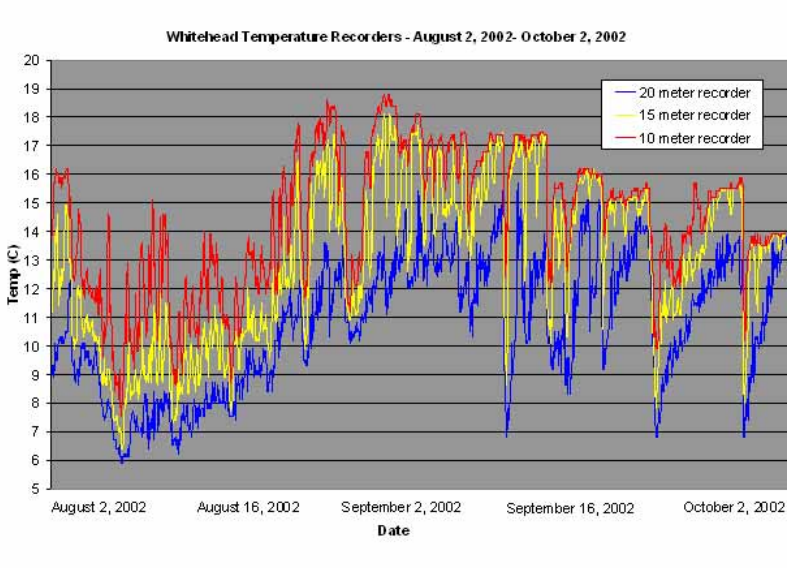


The next graph shows a comparison between two different areas again, but demonstrates that there can be a large discrepancy between areas on the same day.



Another component of our temperature studies was moored temperature recorders. The purpose of this part of the study was to measure temperature change in one location over a range of times. These were set in Whitehead Harbour on August 2, 2002 and retrieved on October 2, 2002. Three recorders measured temperature every hour at 33, 50, and 66 feet. After two months the recorders were retrieved, the data was downloaded to a computer, and the temperatures graphed.

The following graph was generated from this data. On the bottom, we have the dates that data was collected, and temperatures were recorded every hour for the two month period. Along the sides, we have the temperature in °C. The red line represents the temperature recorder set at 33 ft or approximately 10 meters, the yellow line, 50 ft or 15 m, and the blue line, 66 ft or 20 m.



Looking at this graph, we can see that it was very dangerous for the lobster larvae trying to settle out in early August. There was a very high variability in temperatures at all depths, and very cool. Late August through to early to mid-September is a good settlement time for lobster larvae at all depths as the temperature remains, for the most part, above the 11°C line. Mid-September to early October has several dramatic temperature changes, which can be very dangerous to the larvae, although the shallower depths seem relatively safe.

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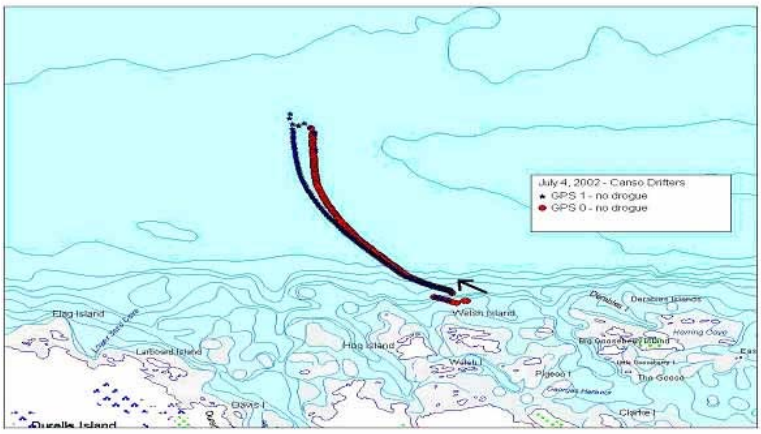
Drift Studies

Lobster larvae are planktonic organisms which, for the most part, are passively transported by the currents and the wind, and have little influence over where they end up. It is only once the larvae reach stage 4, or the post larval stage, that they begin to actively swim and have some control over where they go. Because of this, it is useful to understand the wind direction and current patterns, in order to get a better understanding of the larval drift.

During our drifter study, drifters were deployed in various locations around the study area, from Queensport to Whitehead, within Lobster Fishing Areas 31A and 31B. These drifter locations were chosen based on locations of berried females from sea samples, depth of surrounding water, proximity to ports so that retrieval would be possible using local fishermen, and degree of exposure to or sheltering from the elements, such as wind and currents. Once the locations were determined, arrangements were made either with local fishermen or by using a DFO boat, to place these buoys in the water. Buoys were generally placed in the morning, located and either left alone or moved in the late afternoon, and then retrieved the next morning, in an attempt to get a 24-hour track from the hand held GPS's placed inside the buoys. Sometimes 24-hour tracks were impossible to get, due to either weather or time constraints, but 6 or 12 hour tracks were still considered useful. After the buoys were located and removed from the water, the track information was downloaded from the GPS onto a computer. After adjustments to the data were made, for time of deployment and pick up, as well as gaps in the data caused by the GPS shutting off and turning on again, maps were generated with the tracks highlighted, to give a visual representation of the latitude/longitude readings.

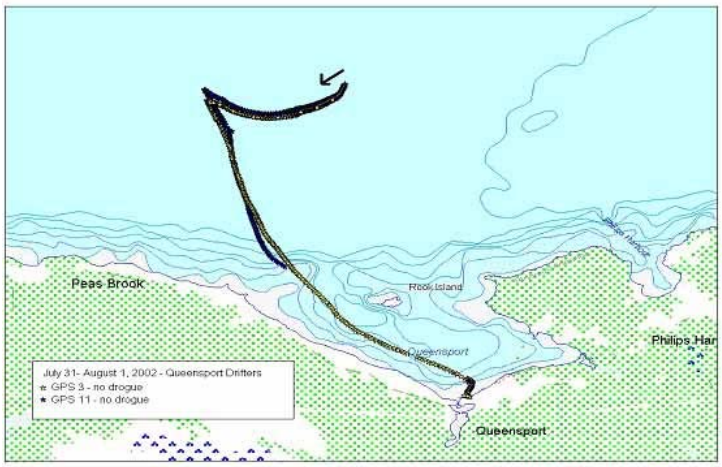
These maps were then analyzed for any obvious patterns of movement, and the data was then given to an oceanographer specializing in modeling to determine whether or not enough data had been gathered to create a model of the current and wind direction for this area. This data will hopefully aid in the explanation of where the lobster larvae are going that are hatching in the area, and where the lobsters are coming from that are in this area.

The first map is of the Canso area, starting above Welsh's Island. The buoys were set for about 5 hours.



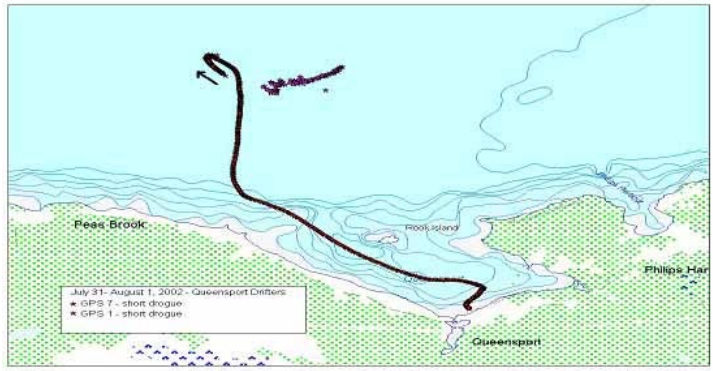
There is an obvious drift out from the islands, and this is possibly caused by the falling tide.

The next series of maps is from Queensport. The first map is of the buoys with no drogues, or no increased drag. They were started at the same time, from the same location.



There seems to be a tide shift and then they drifted in to shore. The blue buoy, the darker one, actually ended up close to the yellow one, but the GPS malfunctioned and stopped tracking.

The second map is of the buoys with short drogues, a bucket tied directly to the bottom of the buoy to increase drag.

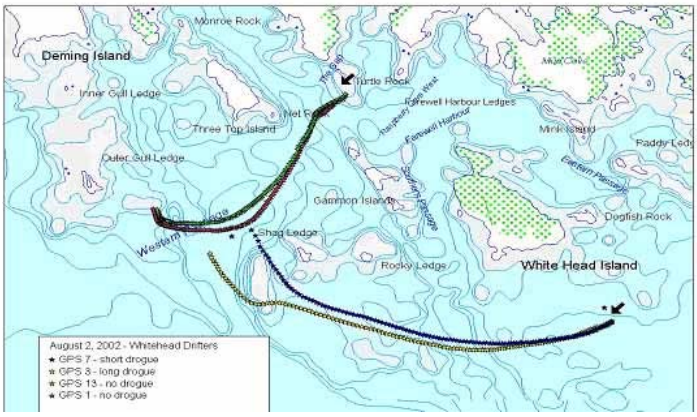


The red track was very good, with no obvious shifts, except for the initial tide shift. The purple buoy had a malfunctioning GPS again, so we did not get a good track from this buoy. We see a general drift into shore again, as with the previous buoys. The purple buoy was also found on shore.

The third map is of the buoys with long drogues, or with 10 meter rope tied to the bottom and the bucket attached at the end, to slow down the buoys.

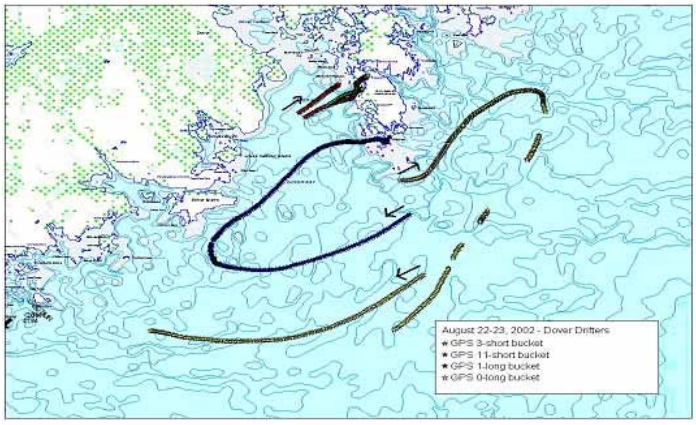
There is an obvious tide shift soon after setting, but then there was a general drift in to shore, although these buoys were picked up in the water, not beached like all the rest.

The next map is of the Whitehead area. During this set, there were four buoys set, two with no drogues, one with a short drogue, and one with a long drogue.



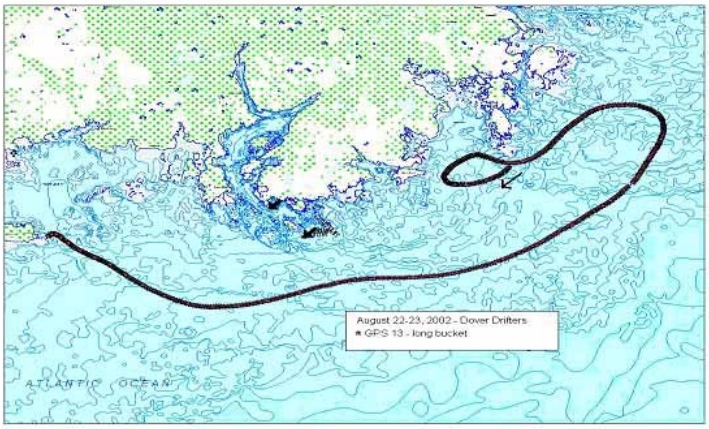
The two buoys with no drogues were set from the same, sheltered location, and were allowed to drift for five hours. They had a general movement to the west, but with only a five hour time period, this movement may be caused by tides. The two buoys with drogues were released from the same spot, only it was in an exposed area. These two buoys also followed the same westerly drift, and actually separated and drifted around a ledge, without beaching.

The next series of maps is from the Dover area. Eight buoys were set, and the following day, only four were recovered. All of these buoys had drogues attached, as the water they were set in was deep enough to allow for it. The first map shows the tracks of the buoys that were recovered the next day, two with short drogues, and two with long drogues.



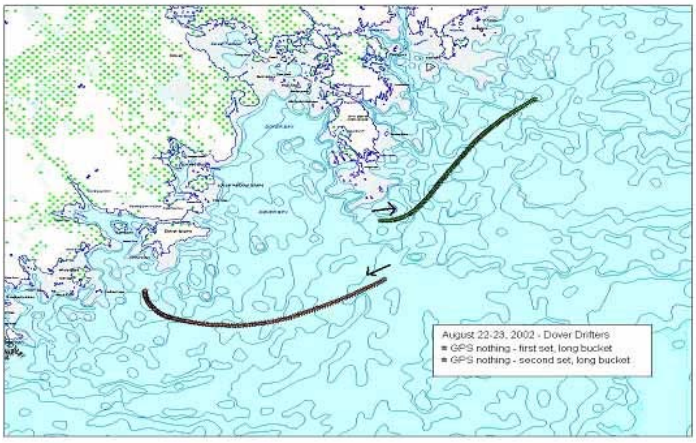
The buoys with short drogues were released on four sides of Horne Shoal. Two were recovered and two were not, although all four were beached when they were checked the day before. The long drogues were released 1/2 mile apart on the way out of the harbour. They show an initial westerly drift, and then a tide shift. Gaps in the data were caused by GPS malfunction.

Two weeks later, two more of the buoys were found. The first map shows the long drogue buoy with the best track.



This was a 36-hour track, and shows the westerly drift that is becoming a trend in our data collection. It was beached on Berry Head in Tor Bay on August 24.

The next map is of another buoy with a long drogue, that was actually picked up in Cole Harbour.



It was initially set, in orange, and drifted west. It was picked up and moved because it drifted a large distance in a short period. After the second set, in green, it drifted east, but then the GPS cut out. This buoy was found in Cole Harbour, so it had to shift back into a westerly drift before it beached.

In general, the trend that seems to pop up the most is a westerly drift along the coast. If this is actually what is happening, and it is believed that the lobster larvae in these larval stages are at the mercy of the currents, then it would seem logical that the larvae are following this trajectory as well. This means that it is possible that lobster that is hatched in the areas within 31A and 31B may actually be feeding lobster grounds further west and slightly south. Knowing how long the larvae are in the water column and how fast this drift is actually occurring may determine more precisely where the larvae hatched here are settling out to the bottom, more precisely, who's bottom 31A and 31B are seeding. As for where the lobsters are coming from that are seeding the grounds within 31A and 31B, not enough data was collected during this study to determine with any accuracy where the larvae are coming from. In order to determine this information, large-scale research would have to be carried out along the coast of Cape Breton. This would be to determine the possibility for larvae or lobsters, to make it down the coast and find suitable habitat within Chedabucto Bay or along the southeastern coast of Nova Scotia and Cape Breton. Larval sampling has proved that there are larvae in the area, ranging from stage 1 right up to stage 4, but whether or not these larvae are remaining in the area to mature is a question that may be answered with further study.

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