Preliminary monitoring of short term movements for lobsters (Homarus americanus) in the Bideford River, Prince Edward Island, using ultrasonic telemetry

by

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Summary

Ultrasonic transmitters were placed on the carapace of lobsters and tested in an aquarium for disturbing effects on behaviour and survival rates. No major disturbance was observed. Transmitters were used for tracking two lobsters over a 3 week period on a mud and shell bottom in the Bideford River estuary (Prince Edward Island). After a short period of adjustment the lobsters did not appear to suffer negative effects. Daily movements were observed to be as high as one kilometer in 6 hours. The lobsters displayed a pattern of roaming and "resting" in which they would remain within a small area for about two days and then actively head for another place. No well defined temporal rhythm of activity was evident.

Résumé

Des émetteurs d'ultrasons fixés sur la carapace de homards ont été testés en aquarium ils n'ont pas causé d'effets secondaires importants sur le comportement et la survie des homards. Ces émetteurs ont été utilisés pour suivre les déplacements de deux homards durant une période de trois semaines sur un fond de vase et de coquilles brisées dans l'estuaire de la rivière Bideford (Ile du Prince Edouard). Après une courte période d'adaptation, les homards n'ont pas semblé souffrir d'effets secondaires dus aux émetteurs. Les mouvements journaliers observés ont atteint un kilomètre en 6 heures. Les homards ont présenté un patron comportemental caractérisé par des périodes alternées de déplacement et de repos, mais sans rythme apparent.
Durant les périodes de "repos", les homards effectuaient des courts déplacements à l'intérieur d'une superficie limitée. Au cours des périodes de déplacement ils se dérigeaient de manière constante dans une direction définie.

Introduction

Lobsters have been tagged in many ways for fishery surveys. Information has been obtained on lobster growth, distance and direction moved between release and recapture, and exploitation rates. Questions are often raised about day to day mobility of lobsters, territorial, and foraging behavior in relation to carrying capacity of lobster grounds.

Biotelemetry can be used to monitor the daily movements of lobsters. Herrnkind (1975) has successfully used ultrasonic telemetry to track the spiny lobster Panulirus argus. Present technology provides small enough ultrasonic transmitters and sensitive ultrasonic receivers which can be used to track lobsters in the wild.

This is a preliminary attempt to test whether tagging and ultrasonic tracking of american lobster can be conducted with a minimum of disturbance to behavior.

Materials and Methods

Lobsters caught locally were held in tanks and observed, over a 40 day period, to determine what if any perturbing effect the ultrasonic transmitter would have on lobsters. A control group of 42 lobsters were held separately from a group of 25 lobsters with dummy transmitters attached by three different methods to the midorsal line of the carapace.

The cylindric transmitters, were 46 mm long and 16 mm in diameter, they weighted 18 g in air and 9 g in water. The test lobsters had an average weight of 228 g and a carapace length of 70 mm. The three test attachment methods were;

1 - glueing the transmitter directly to the carapace with "5 minute" epoxy, Figure 1.

2 - attaching elastic tubing to the transmitter and fitting it a top the carapace with the tubing tied around the carapace Figure 2.

3 - a combination of glueing and tieing the transmitters to the carapace.

Test and control lobsters were counted and fed weekly over the test period. Pieces of plastic pipe were placed in each tank as lobster shelters.

The behavior of lobsters was monitored the day after the dummy transmitters were attached by under water television camera which was placed in the tank. Video recordings were made over 30 minute daylight periods and further sub-divided in 2 minute periods to determine the level of activity of the two lobster groups.

The transmitters had a pulse rate of 1000 ms to 1500 ms at 65.54 kHz with an acoustic output of 152 dB re 1μ PASCAK at 1 meter and an approximate 21 day battery life.

An activated transmitter was glued to three lobsters under observation in order to test whether their behavior would be affected by the acoustic pulses. These lobsters were also used to test the receiving range and directional finding ability of the ultrasonic receiver and directional hydrophone. A lobster with transmitter was placed in a small plastic basket and submerged 15 ft to the bottom of the Bideford River. A lobster with transmitter was placed in a concrete construction block simulating a rock burrow and the openings covered with small mesh netting.

The tracking was carried out October, November and December 1983 on two lobsters in the Bideford River (Fig. 3). The surface and bottom temperatures during the experiment was $2^{o}C$ with the river surface periodically freezing over at night in late November and early December.

The first lobster tagged was a 73 mm carapace, 321.7 g male with two claws, which was caught by trapping. A transmitter numbered 5255 was glued to the carapace. The

lobster was held overnight in a tank and released on its capture site on November 8th. The second lobster tagged was a 65 mm carapace 193.4 g female, with the crusher claw missing. The lobster was captured by a diver November 15th in a marked burrow. A transmitter numbered 5257 was glued to the carapace and the diver returned the lobster to its burrow 20 minutes later.

The lobsters were tracked from a small outboard launch three times a day and twice at night. During the day, fixes were made on land points and a location reckoned. At night numbered buoys would be placed on the tracking sites and the fixes made during the next day. The sighting points were compiled from field notes and the distances between sites calculated with the formula: Distance - $\cos^{-1}$ ($\sin(LAT_s)$ $\sin(LAT_d)$ + $\cos(LAT_s)$ $\cos(LAT_d)$ $\cos(LNG_d - LNG_s)$ x 50 on a Hewlett Packard 41 C. As an index of activity, the speed of the lobster movement between sighting times was calculated and plotted against the midpoint of the time of the sightings. Without disturbing the lobsters a diver would periodically locate and check the condition of the lobsters and tag attachment.

Results

Out of 42 control lobsters, 3 died, and out of 25 lobsters with tags, 3 died. The mortality rates were not significantly different at P=0.05 on a contingency table. A Kruskal-Wallis test showed that the activity indices of the controls and the tagged lobsters were significantly different at the level P=0.05 (Table 1), the results from the underwater television observations immediately after the transmitters were attached to the lobsters seemed to indicate that their activity in the tank was reduced from that of the control lobsters (Table 2). When activated tags were attached to the lobsters their behavior did not seem to be affected by the acoustic pulse.

After an extended period of time the dummy transmitters which were only tied onto the carapace would slip to the side and would restrict the movement of the walking legs. Glued transmitters were less disturbing for the lobster. Glueing was the fastest attachment method.

The transmitter pulse for the lobster in the plastic basket was audible and directionally trackable at a maximum distance of 0.75 nautical miles. The transmitter pulse for the lobster in the concrete block was audible and directionally trackable at a maximum distance of 0.5 nautical miles.

The tracking results of transmitter #5255 and 5257 are presented on Figure 4, Table 3, Figure 5 and Table 4 respectively. Figures 6 and 7 show no relationship between time of day and index of activity. The movements of the lobster with

transmitter #5257 were almost nil after a 14 day period. Diver investigations showed the lobster remained within a radius of 5 meters over the 14 days but changed its cover several times, from a burrow under oyster shells, to a mud burrow, to a patch of dead zostera.

Discussion

The effect of handling and glueing the transmitters to the carapace may have affected the activity of the lobster immediately after release. The surge of activity showed by both lobsters immediately after release (Tables 3 and 4), might be related to the capture, handling, holding and release procedure. In Figures 8 and 9 the first two days for #5255 and the first day for #5257 after release have been deleted, the index of activity then shows a more stable pattern of movement.

The method of capture, handling and release for the lobster with tag #5257 may have had less of an affect on the lobsters' behavior, immediately after release. It took only one day instead of two of the other subject, to return to a stable movement pattern.

Three days after release the lobster with transmitter #5255 began a roaming, resting behavior. For a day or so the lobster would not move from a burrow, as observed by divers, then for a day or more move around constantly. At some points the lobster would move up to 500m in two hours. The lobster with transmitter #5257 had the same pattern or roaming and resting on a daily basis. Thomas (1968) described lobsters as over wintering in burrows in Bideford River. The lobster with transmitter #5257

also showed some tendency to remain in a burrow. A diver observed the lobster in a burrow partially covered with silt after it had been stationary for a day or so. However, this lobster later reverted to the resting, roaming periods of activity.

The bottom water temperature was 2°C the time of the experiment;. Thomas indicated that lobsters occupied burrows and became active at 1.5 C and 1.3 C. The experiment took place late in the fall, when the water was starting to freeze and the lobsters might have still been actively searching and testing out burrow sites for over wintering.

This preparation for over wintering may also explain why there was no clear diel periodicity in activity. At this time of the year, the lobsters may be actively searching for over wintering spots and little affected by diel patterns of activity.

The presence of the transmitters does not appear to increase the chances of mortality of a lobster. The initial presence of the sonic tags on the lobsters may have temporarily reduced the animals activity. Time for further control work was not available, as the river freeze up was impending. On the long term, the presence of the transmitters does not seem to have a negative affect on the lobster activity as they do not try to remove it. Longer series of observations of tagged lobsters behavior will be required.

Ultrasonic lobster tracking in shallow estuaries, in areas such as Bideford River seems to be an efficient method for studying behavior in the natural environment. It may also be

possible to track lobsters on a larger scale on different substrates such as boulders, mud and sand bottoms. The use of ultrasonic tracking could provide information on short term migration, territoriality and activity rhythms in lobsters.

Acknowledgments

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Bibliography

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Table 1. TEST KRUSKAL - WALLIS

SAMPLE 1 11

SAMPLE 2 11

(Samples sizes)
22

Control lobsters		Tagged lobsters	
SAMPLE NO. : 1		SAMPLE NO. : 2	
observ.	rank	observ.	rank
5.00	21.5	1.00	9.0
1.00	9.0	0.00	3.0
1.00	9.0	0.00	3.0
1.00	9.0	0.00	3.0
2.00	15.0	1.00	9.0
1.00	9.0	2.00	15.0
4.00	19.0	0.00	3.0
2.00	15.0	0.00	3.0
4.00	19.0	2.00	15.0
2.00	15.0	1.00	9.0
5.00	21.0	4.00	19.0
Sum (Ranks)	162.0	Sum (Ranks)	91.0

H STATISTIC

NUMBER OF TIED GROUPS : 5

CORRECTION FACTOR

D = .94128

H = 5.77308
DF = 1

ALPHA = .01623

Table 2. TEST KRUSKAL - WALLIS

SAMPLE 1 11
SAMPLE 2 11
SAMPLE 3 10

(Samples sizes)
32

Control lobster		Tag glued onto lobster		Tag tied onto lobster	
SAMPLE NO. : 1		SAMPLE NO. : 2		SAMPLE NO. : 3	
observ.	rank	observ.	rank	observ.	rank
5.00	31.5	1.00	16.0	1.00	16.0
1.00	16.0	0.00	5.0	1.00	16.0
1.00	16.0	0.00	5.0	1.00	16.0
1.00	16.0	0.00	5.0	1.00	16.0
2.00	25.0	1.00	16.0	0.00	5.0
1.00	16.0	2.00	25.0	0.00	5.0
4.00	29.0	0.00	5.0	0.00	5.0
2.00	25.0	0.00	5.0	0.00	5.0
4.00	29.0	2.00	25.0	1.00	16.0
2.00	25.0	1.00	16.0	1.00	16.0
5.00	31.5	4.00	29.0		
Sum (Ranks)	260.0	Sum (Ranks)	152.0	Sum (Ranks)	116.0

H STATISTIC

NUMBER OF TIED GROUPS : 5
CORRECTION FACTOR
D = .90671

H = 11.02161
DF = 2
ALPHA = .00404

Table 3. Table of lobster movements for lobster number 5255.

Site #	Date	Time	Distance in meters moved from previous site	Site #	Date	Time	Distance in meters moved from previous site
1	11/8	1430					
2	11/8	1600	130	15	11/14	2230	444
3	11/8	1715	150	16	11/15	0930	556
4	11/8	2230	722	17	11/15	1300	12
5	11/9	0900	1037	18	11/15	1630	10
6	11/9	1330	648	19	11/15	2230	Δ
7	11/9	1530	685	20	11/17	1015	648
8	11/9	2145	926	21	11/17	1345	Δ
9	11/10	0240	1019	22	11/17	1710	Δ
10	11/10	0945	185	23	11/17	2230	Δ
11	11/10	1045	148	24	11/18	1152	Δ
12	11/10	1330	Δ	25	11/18	1345	Δ
13	11/14	1500	278	26	11/21	0945	852
14	11/14	1630	Δ	27	11/25	1400	1130

Δ = no change from previous site

Table 4. Table of lobster movements for lobster number 5257.

Site #	Date	Time	Distance in meters moved from previous site
1	11/15	1000	
2	11/15	1310	9
3	11/15	1645	93
4	11/15	2300	425
5	11/17	1100	400
6	11/17	1445	Δ
7	11/17	1700	Δ
8	11/17	2320	12
9	11/18	1015	10
10	11/18	1110	Δ
11	11/18	1410	Δ
12	11/21	1000	Δ
13	11/25	1300	Δ
14	12/02	1420	Δ

Δ = no change from previous site.

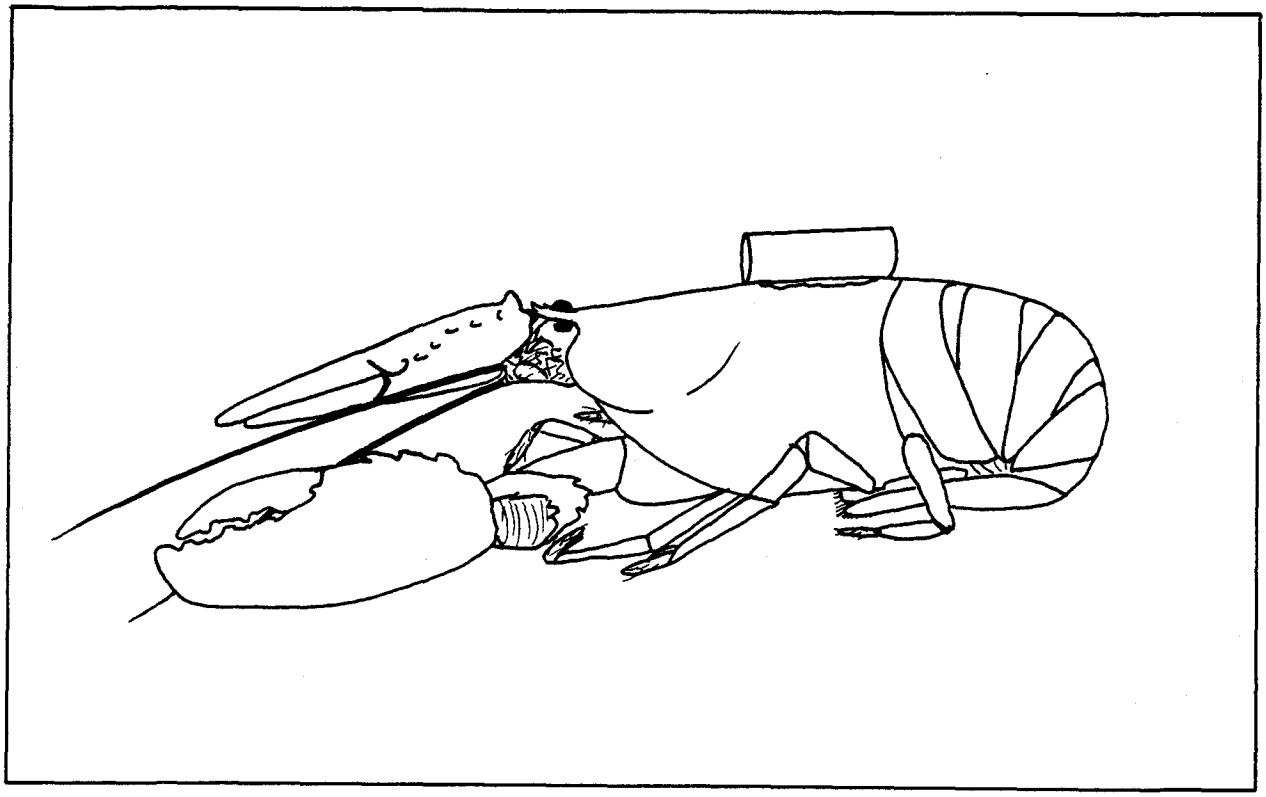

Figure 1 Transmitter attached to lobster with "5 minute epoxy".

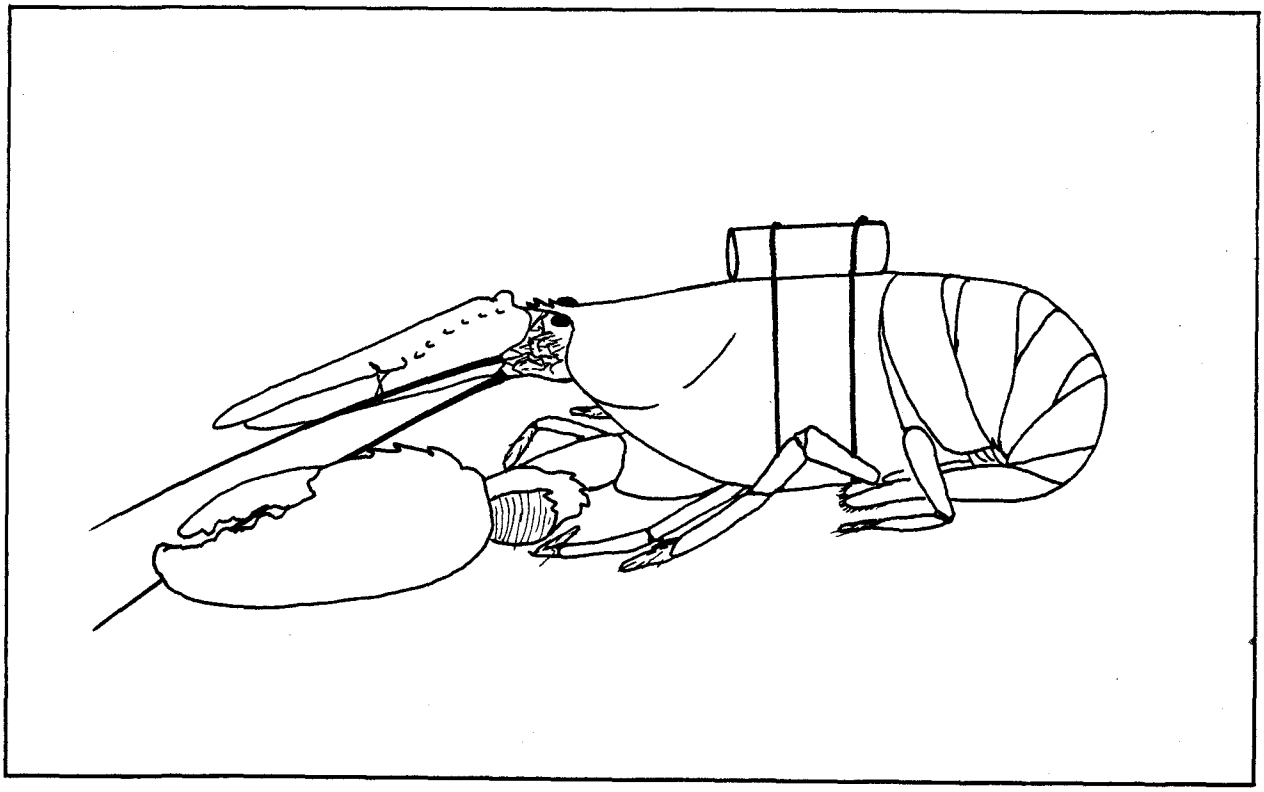

Figure 2 Transmitter attached to lobster by elastic tubes tied around carapace.

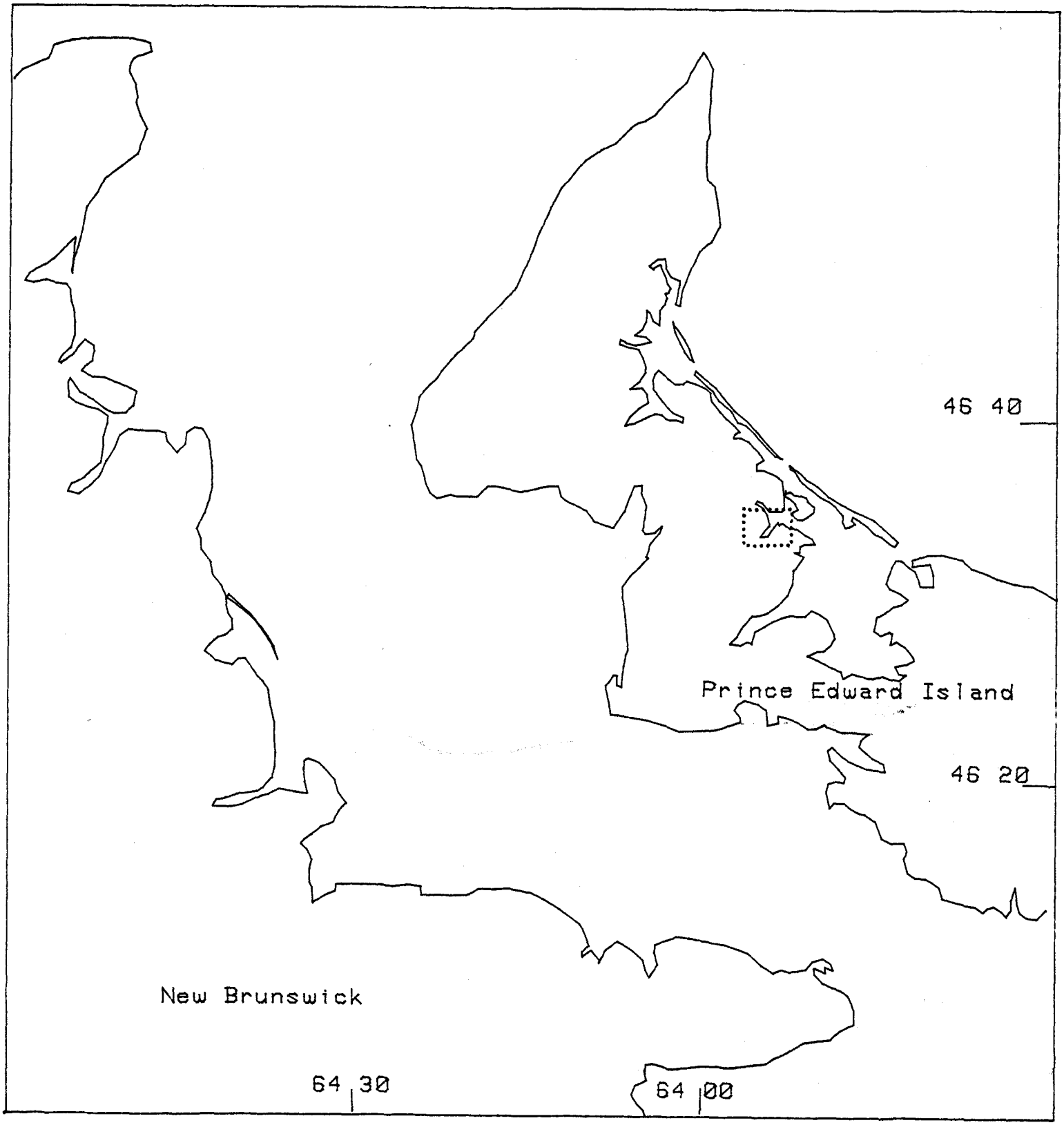

Figure 3 Bideford River, the experimental area.

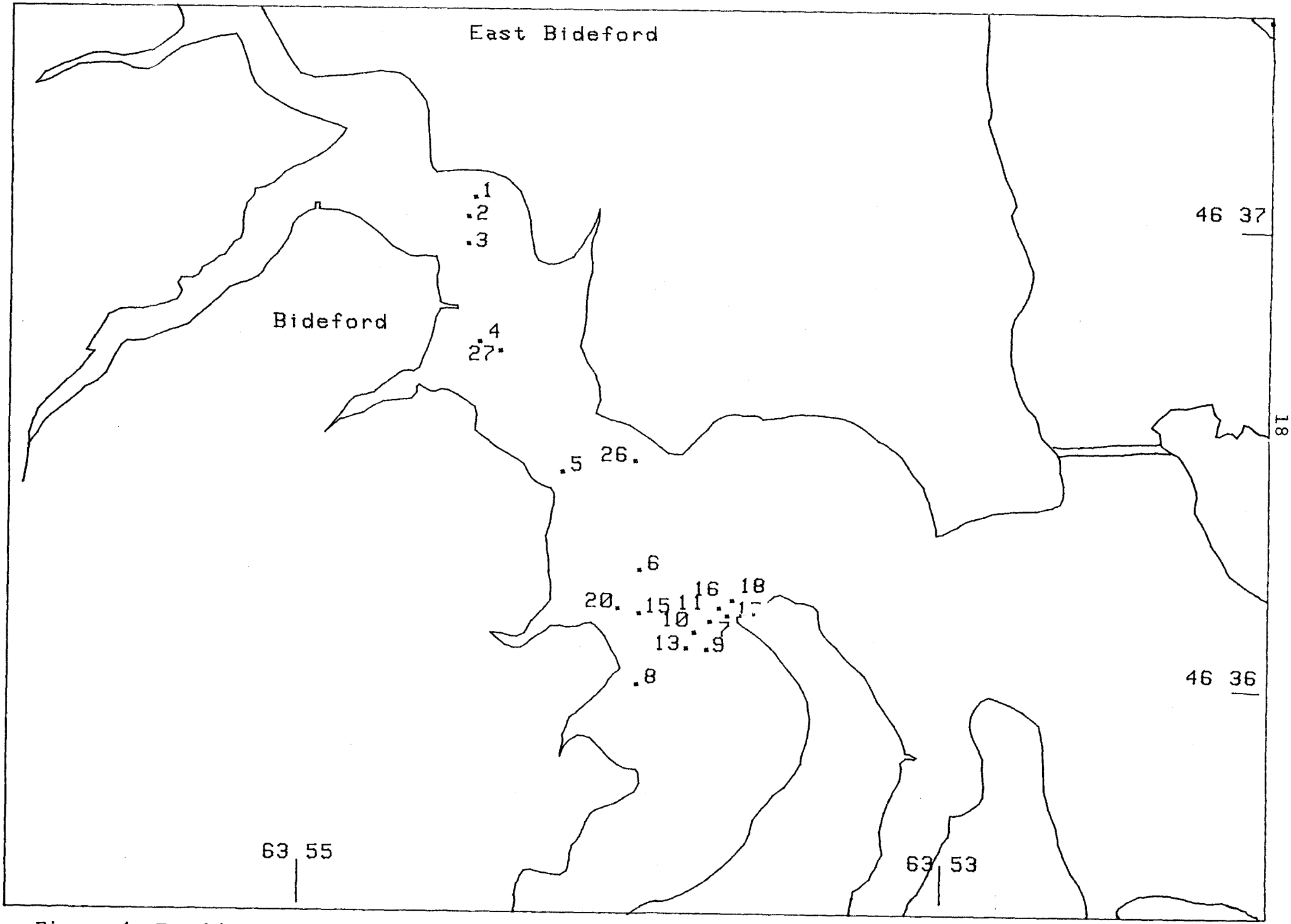

Figure 4 Tracking sites for lobster with transmitter #5255.

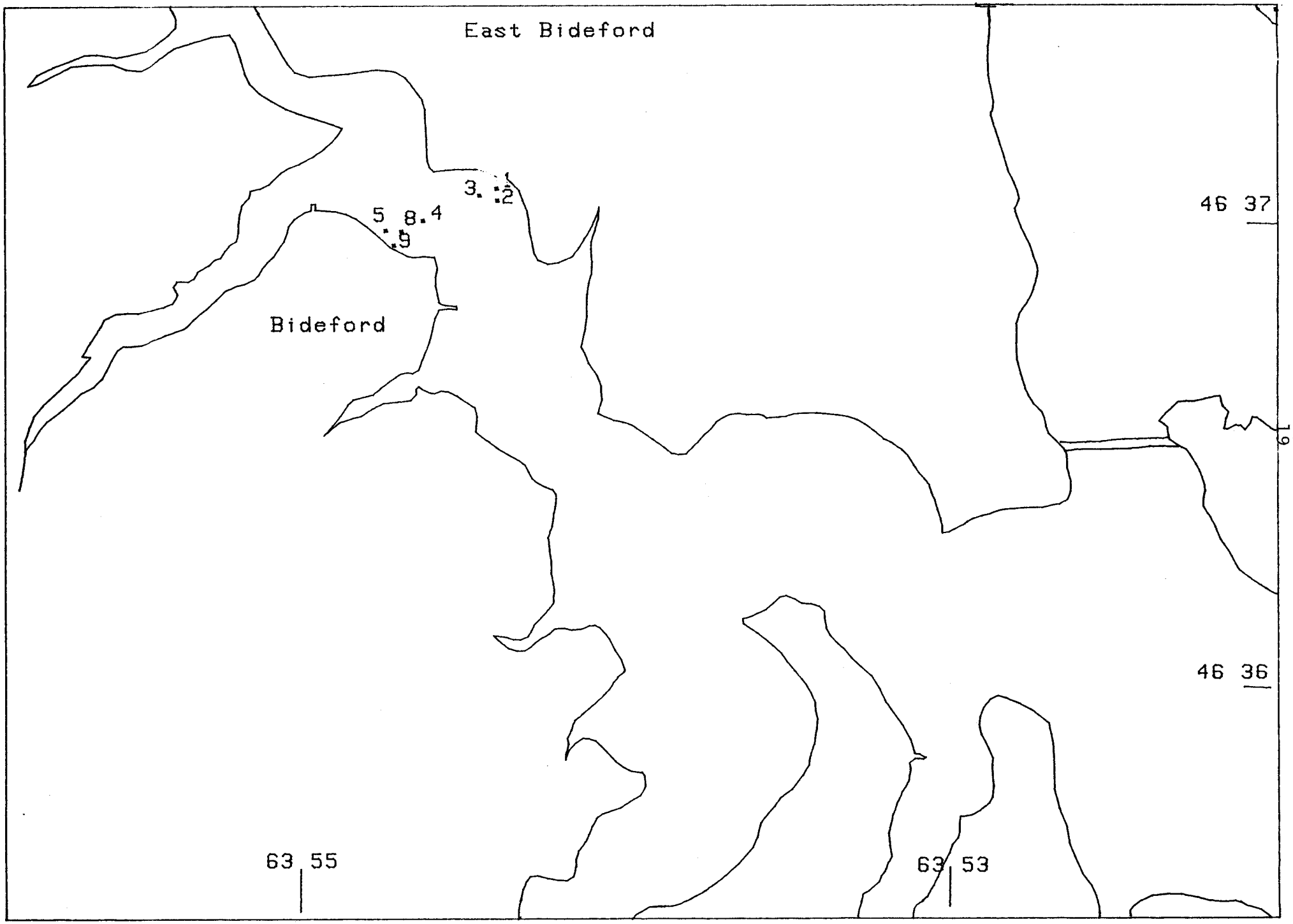

Figure 5 Tracking sites for lobster with transmitter #5257.

Figure 6 - Speed vs. time of day for tag No. 5255.

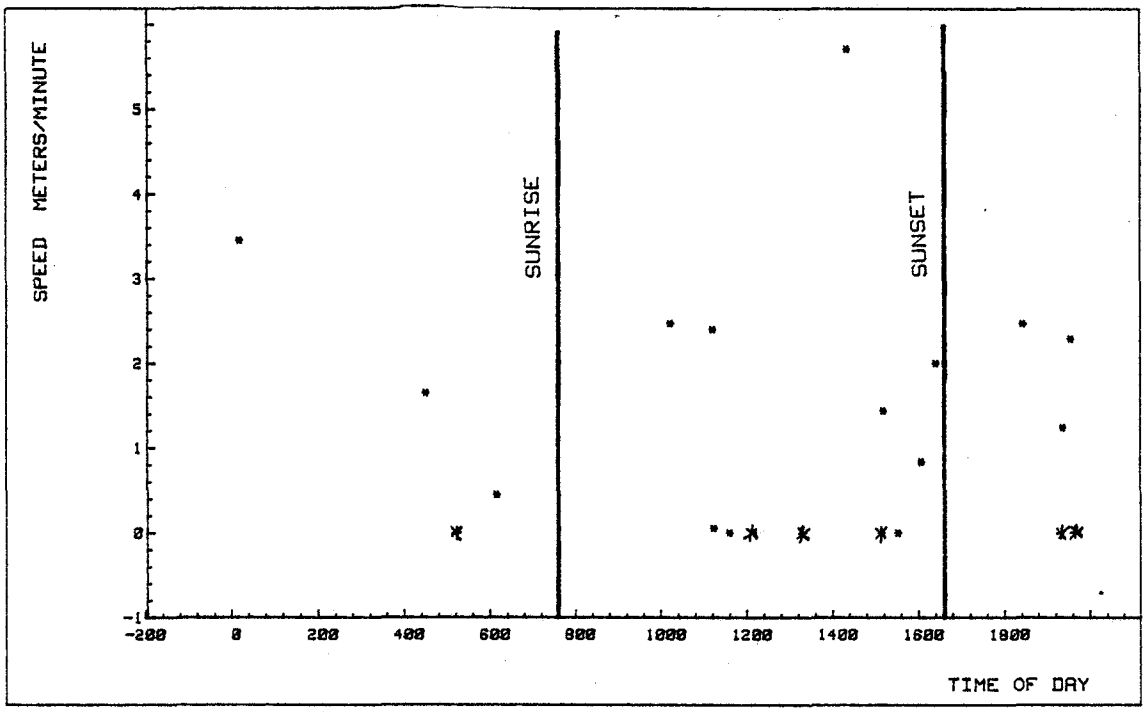

Figure 7 - Speed vs. time of day for tag No. 5257.

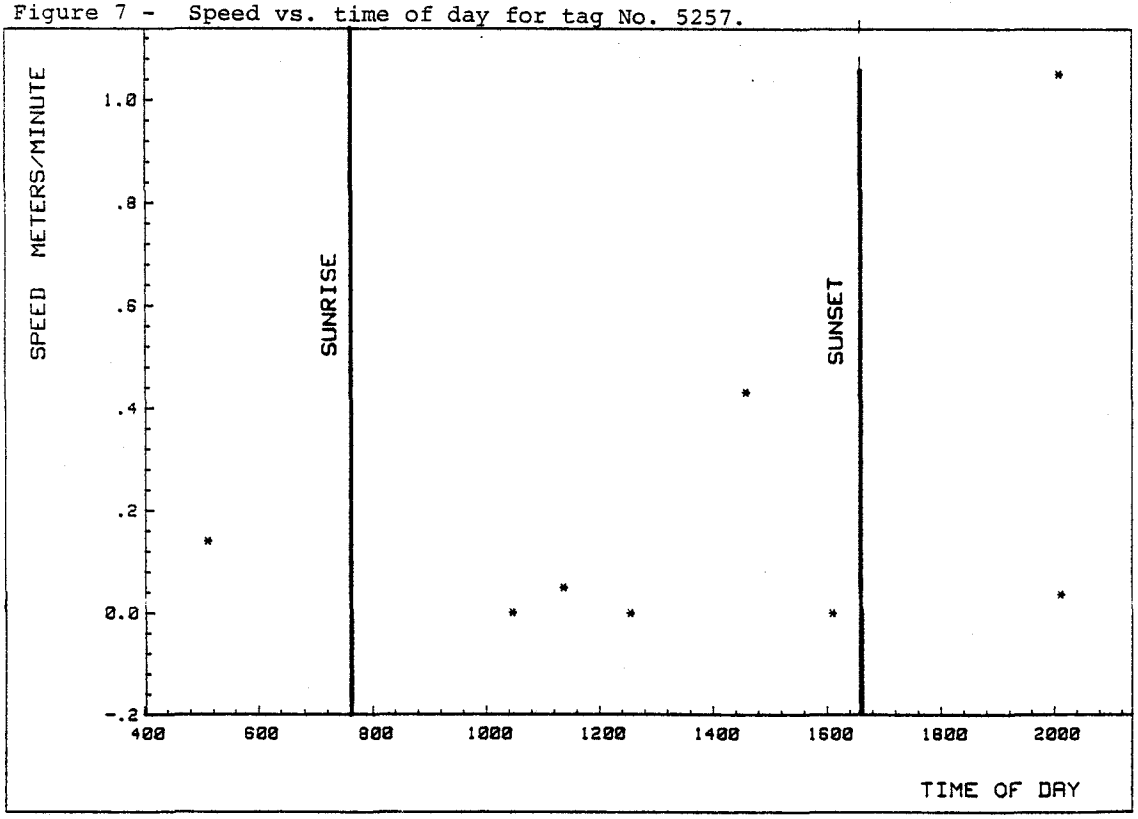

Figure 8- Speed vs. time of day for tag No. 5255, first two days deleted.

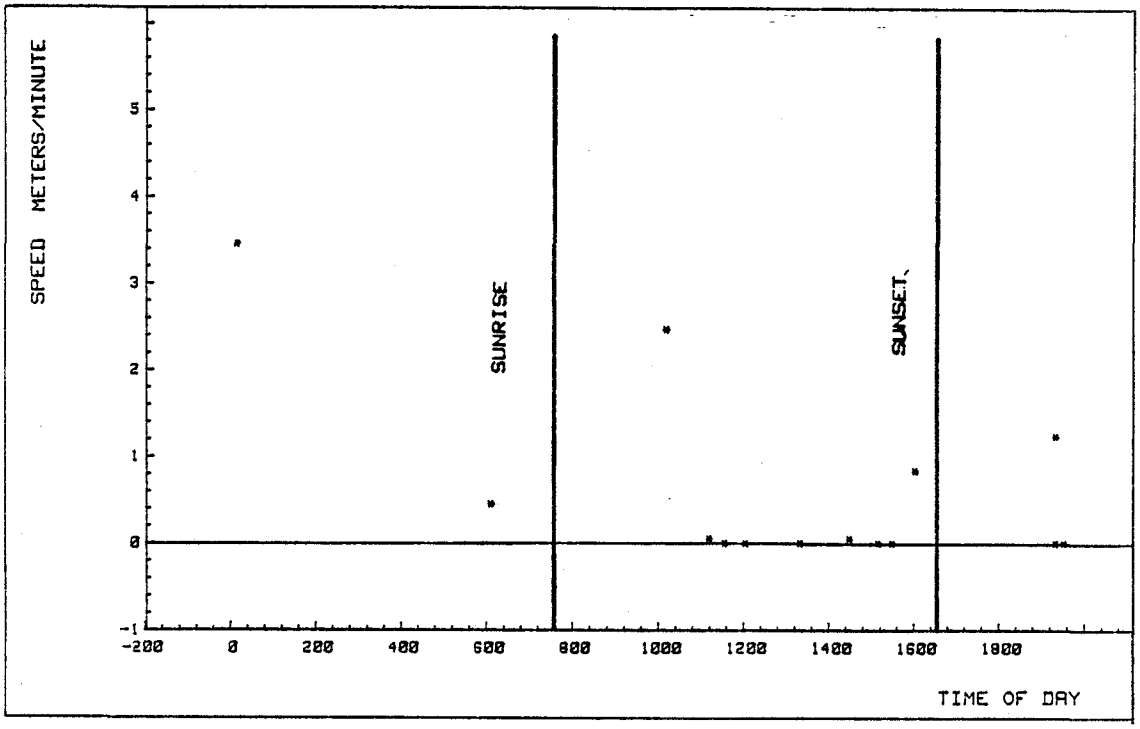

Figure 9 - Speed vs. time of day for tag No. 5257, first two days deleted.