

**Survey of American lobsters, *Homarus americanus*, in the Fore River,
Portland Harbor, Portland, Maine**

**Prepared for the Portland Harbor Dredge Committee
Lobster Working Group**

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Executive Summary

This report summarizes the results and conclusions of the American lobster, *Homarus americanus*, surveys conducted in the Fore River, Portland Harbor, Portland, Maine between March 17 and April 16, 1998 in anticipation of dredging of the federal shipping channel scheduled to begin in November 1998. The purpose of this study was to determine if a winter-resident population of lobsters exists within the Fore River, and if so, whether the density of the population meets or exceeds the threshold value of 0.1 lobsters/m² historically used by the Maine Department of Marine Resources as an indicator of important lobster habitat.

The survey consisted of five major tasks: 1) daylight underwater video surveys of the bottom at all but one of the eleven proposed dredge sites in March and April, 2) nighttime underwater video surveys of selected proposed dredge sites, 3) additional daylight video surveys of areas outside of, but adjacent to, selected proposed dredge sites, 4) a determination of occupancy rates of burrows found in the bottom, and 5) an Early Benthic Stage (EBS) survey using both hand and suction excavation methods.

The results of this study clearly show that a winter resident population of lobsters does exist in at least certain areas of the Fore River and at levels meeting or exceeding the 0.1 lobster/m² threshold. It is equally clear that, during this time of year, the distribution of lobsters within the proposed dredge areas varies considerably from one end of the harbor to the other. Generally, the population decreases westwardly from the entrance to the harbor. Similarly, the trend in occupancy rate of burrows is to decrease from east to west. East of the Casco Bay bridge the threshold value of 0.1 lobster/m² was met or exceeded on all but one of fourteen dives. Conversely, the threshold level was only met or exceeded on two of sixteen dives west of the bridge.

No yearling lobsters (≤ 20 mm carapace length, CL) were found. This is not particularly surprising since soft sediment is not a preferred substrate for lobster settlement. The smallest lobster recovered using the suction and hand excavation methods, despite efforts to ensure capture of small organisms, was 28 mm CL. The successful collection of small amphipods using these methods suggests that lobsters of similar or somewhat larger size would also have been collected had they been present.

Introduction

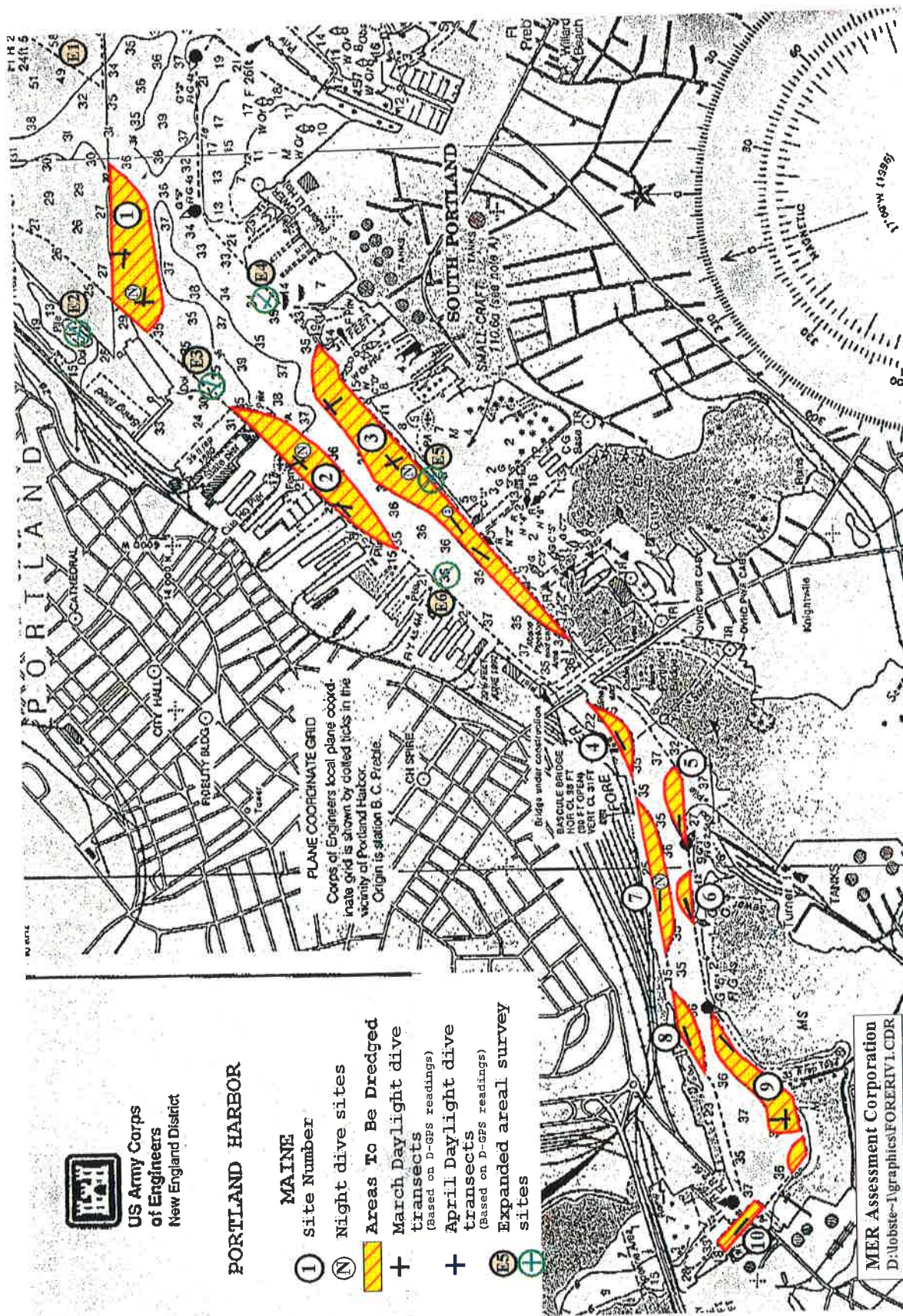
MER Assessment Corporation was contacted by members of the Portland Harbor Dredging Committee on 6 March 1998 requesting assistance in evaluating the extent of the lobster, *Homarus americanus*, population in the Fore River, Portland, Maine in anticipation of dredging operations to be conducted by the U.S. Army Corps of Engineers (USACE) tentatively scheduled to begin in November 1998.

Initially, MER was requested to conduct a daylight underwater survey of the bottom within the eleven (11) sites scheduled for dredging along the north and south shores of the Fore River both east and west of the new Casco Bay bridge (refer to Figure 1.). This survey was conducted at ten of the eleven proposed dredge sites between March 17 and 23, 1998, but the results of the survey were inconclusive for many of the sites and raised additional questions. The Lobster Working Group was therefore formed as a subset of the Dredging Committee in April 1998 to serve in an advisory capacity to review the initial survey information and recommend changes to the survey project. This group included representatives of the Maine Department of Marine Resources (MDMR), Maine Department of Environmental Protection (MDEP), USACE, U.S. Environmental Protection Agency (USEPA), Maine State Planning Office (SPO), Maine Department of Transportation (MDOT), the Casco Bay Estuary Project (CBEP), and the Friends of Casco Bay (FOCB) BayKeeper (see Appendix I). In addition, several area lobster fishermen, Peter Pray, Scott Kittredge, Bill Coppersmith, David Johnson, and Bill Doane, and dealer, Peter McAleney, attended meetings as part of the broader Lobster Working Group.

The Lobster Working Group met on April 2, 1998 to review the March survey video footage. Based on this review and a discussion of the results, the Working Group expanded the scope of work for the survey project to include: 1) a determination of occupancy rates of burrows found in the bottom, 2) additional daylight video surveys in April at all ten previously surveyed sites, 3) additional video surveys of areas outside of, but adjacent to, selected proposed dredge sites, 4) nighttime video surveys within selected proposed dredge sites to determine the degree of nocturnal activity, and 5) an Early Benthic Stage (EBS) survey.

This report summarizes the results of all tasks associated with the lobster survey project.

Figure 1. Reproduction of NOAA/NOS Navigational Chart No. 13292 showing proposed dredge areas and location of lobster survey related activities



US Army Corps
of Engineers
New England District

PORTLAND HARBOR

- MAINE**
- ① site Number
 - Ⓝ Night dive sites
 - ▨ Areas To Be Dredged
 - + March Daylight dive transects (based on D-GPS readings)
 - + April Daylight dive transects (based on D-GPS readings)
 - Ⓜ Expanded areal survey sites

PLANE COORDINATE GRID
Corps of Engineers local plane coordinate grid is shown by dotted ticks in the vicinity of Portland Harbor.
Origin is station B. C. Peabody.

MER Assessment Corporation
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Task Methods and Results

Daylight Dives

Methods

Two sets of daylight dives were made, the first on 17 and 23 March and the second on 14 and 16 April 1998, within ten (10) of the eleven (11) proposed dredge sites (refer to Figure 1.). Each video survey was conducted along a transect as generally described below. Global Positioning System (GPS) coordinates for all transects are given in Appendix II.

Transect lines consisting of 60 meter ropes marked in 10 m alternating black and white sections, with the exception of the first and last 10 m which are marked as two 5 m sections, the last five of which are marked in alternating 1 m black and white increments, were used to measure distance along the bottom. In the larger sites, two transect lines, marked at each end with buoyed end-weights, were deployed approximately perpendicular to each other, crossing near the center, one deployed along an approximate north-south axis, the other along an east-west axis. In smaller sites, only a single transect line was used parallel to the longer axis of the site.

The field of view was set at approximately 1 meter wide by adjusting the angle of the camera and the distance off the bottom. First, the camera was focused on a single 1-meter section of the measured transect line and moved up off the bottom until the 1-meter section just filled the field of view. A lead line attached to the handle of the camera was then adjusted until the end of the line just touched the bottom. This line was used as a "tickler" during the swim of the transect to ensure proper distance off the bottom to maintain an approximate 1-meter wide field of view.

The video recordings were taken with an Amphibico/Nikon VN-750 video camera package in Hi8 format. Lighting was used throughout the dives provided by dual 50 watt Ikelite Modular Video-Lites. The video recordings were started at the end-weight and were allowed to run continuously along each transect. Video recordings were reviewed and analyzed on a Sony Trinitron screen using the original recording. VHS copies of the original recordings were made for presentation purposes and the originals retained for archiving. Hardcopy *video-graphic* representations of each recording were made using CorelDraw 3.0 showing the approximate locations of burrows relative to the transect line and are included here as Appendix IIIa. These graphics were used to count the burrows along each transect.

Results

The qualitative results of the video reviews can be summarized as follows:

1. Site 1, east of the BIW dry dock, has a mud bottom with epilithic diatoms and numerous burrows. Between dives on 17 March, fisherman Peter Pray arrived and was filmed hauling two eight-trap trawls for 19 lobsters (18 sub-legals and 1 legal). Two lobsters were seen in burrows at the start of the first of two dives, but were beyond the transect area and were consequently not included in the survey results. This site has the second highest burrow densities of all sites surveyed.

2. Site 2, between State Pier and Vessel Services, also has a mud bottom with burrows, but no lobsters were seen on either of two dives. This site has the highest burrow densities of all sites surveyed.
3. The large site along the South Portland shore, Site 3, has a soft mud bottom with a moderate number of burrows, but no lobsters were seen on any of three dives along the site.
4. Site 4, the first site along the north shore west of the Casco Bay bridge, has a packed sand bottom with no burrows and no lobsters were seen.
5. Site 5, at the Turner Island Star Terminal facility along the southern side of the channel, has a hard clay bottom with a thin veneer of silt. The sediment is very hard and no burrows were found.
6. Site 6, to the west of Site 5 along the South Portland shore, has a softer bottom but very few burrows.
7. Site 7, further to the west along the Portland shore, has a soft mud bottom with a moderate number of burrows, but no lobsters were seen.
8. Further west, Sites 8, 9 and 10 have soft mud bottoms but the number of burrows is very low, dropping to nearly zero at the last site just beyond Merrill's Terminal along the south shore.
9. There is clearly very little lobster activity during March and April, at least during the day. Although only two lobsters were directly observed in burrows, this does not necessarily mean the burrows are not occupied.

Tables 1a. and 1b. summarize the burrows (b) counts by site, east and west of the Casco Bay bridge, respectively, based on the review of the video surveys. The area covered by the video transects at each site is given as m² surveyed along with the resultant burrow density.

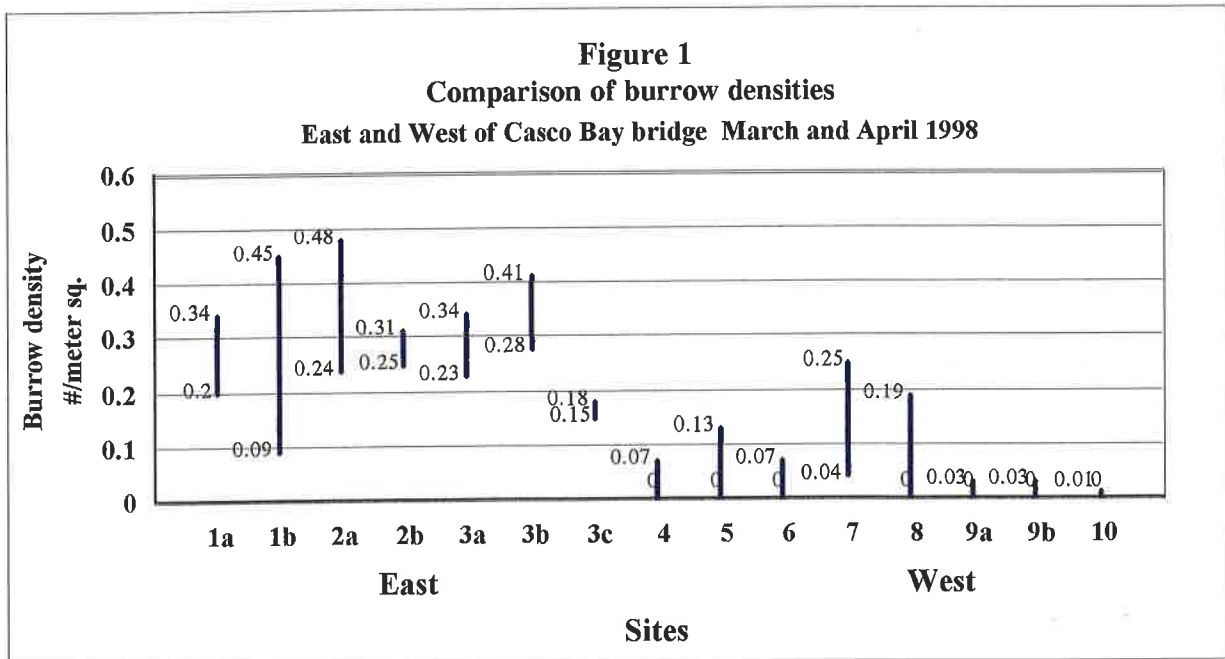
Table 1a.
Mean number of burrows per site by date, area (m²) covered by survey, and burrow density for sites East of Casco Bay bridge

March 17/23				April 14/16			
Site	# b	m ² surveyed	b/m ²	Site	# b	m ² surveyed	b/m ²
1a	24.0	120	0.20	1a	40.5	120	0.34
1b	11.0	120	0.09	1b	54.5	120	0.45
2a	28.5	120	0.24	2a	57.5	120	0.48
2b	30.0	120	0.25	2b	37.5	120	0.31
3a	14.0	60	0.23	3a	20.5	60	0.34
3b	33.5	120	0.28	3b	49.0	120	0.41
3c	17.5	120	0.15	3c	21.5	120	0.18

Table 1b.
Mean number of burrows per site by date, area (m²) covered by survey, and burrow density for sites West of Casco Bay bridge

March 17/23				April 14/16			
Site	# b	m ² surveyed	b/m ²	Site	# b	m ² surveyed	b/m ²
4	0.0	60	0.00	4	4.0	60	0.07
5	0.0	60	0.00	5	7.5	60	0.13
6	4.0	60	0.07	6	0.0	60	0.00
7	12.0	60	0.25	7	2.5	60	0.04
8	0.0	60	0.00	8	11.5	60	0.19
9a	0.0	60	0.00	9a	2.0	60	0.03
9b	0.0	120	0.00	9b	3.5	120	0.03
10	0.0	60	0.00	10	0.5	60	0.01

Figure 1 shows the distribution of burrow density ranges for all of the study sites in the Fore River. Sites 1a through 3c are located east of the bridge and sites 4 through 10 west of the bridge. The range numbers for sites 1a through 3b indicate the consistently higher number of burrows found east of the bridge in March and April. By comparison, the ranges for sites 4 through 10 are, for the most part, consistently low. Further, the variability seen between March and April at Sites 5, 7, and 8 suggests a heterogeneous or “patchy” distribution of burrows compared to the more homogeneous or even distribution in the eastern section of the River.



Lobster burrows occupancy rate

Methods

On April 9, MER tested a number of burrows at several sites along the Fore River, Portland Harbor, to determine occupancy rate using various probes and an airlift system. Two types of probe were used: 1) 12 mm (0.5 in.) PVC pipe, and 2) 3 mm (~ 0.12 in) PVC welding rod. The probes were inadequate to determine whether the burrows were occupied, for even when occupancy was determined positively, the diver was still unable to determine what was occupying the burrow, *i.e.* lobster or crab. Two airlifts were used, a 52 mm (2 in.) and 75 mm (3 in.) PVC suction pipe, both driven by air supplied from a SCUBA tank, similar to that described by Wahle and Steneck (1991). Both proved exceptionally effective, quickly uncovering the burrows, at least in certain sediments, and revealing the occupants as lobsters in the majority of cases.

Burrows were excavated at three proposed dredge sites east of the Casco Bay bridge and one site west of the bridge. Burrows were excavated until the occupant exited the burrow or, where possible, until the burrow was entirely excavated and found vacant.

Results

Burrow occupancy can be summarized quantitatively as follows:

Table 2
Lobster burrow occupancy rate based on burrows excavation study

Site	Occupancy lobsters/burrow	% Occupancy
1	7/10	70
2	2/2	100
3	2/4	50
7 shoal	1/4	25
<u>7 deep</u>	<u>5/6</u>	<u>83</u>
Overall	17/26	65.6 ±36.2 (95%)

Combining these results with the burrow counts of the March 17, 23 and April 14, 16 videos, lobster density estimates have been calculated for the ten surveyed sites.

Table 3
Lobster density by site based on visual observations and estimated occupancy rate

March 17/23		April 14/16	
<i>East of Casco Bay bridge</i>		<i>East of Casco Bay bridge</i>	
Site	lobsters/m ²	Site	lobsters/m ²
1a	0.14	1a	0.24
1b	0.06	1b	0.32
2a	0.15	2a	0.31
2b	0.16	2b	0.20
3a	0.15	3a	0.22
3b	0.18	3b	0.27
<u>3c</u>	<u>0.10</u>	<u>3c</u>	<u>0.12</u>
<i>Mean</i>	<i>0.13 ±0.038 (95%)</i>	<i>Mean</i>	<i>0.24 ±0.063 (95%)</i>
<i>West of Casco Bay bridge</i>		<i>West of Casco Bay bridge</i>	
Site	lobsters/m ²	Site	lobsters/m ²
4	0.00	4	0.04
5	0.00	5	0.08
6	0.04	6	0.00
7	0.17	7	0.03
8	0.00	8	0.12
9a	0.00	9a	0.02
9b	0.00	9b	0.02
<u>10</u>	<u>0.00</u>	<u>10</u>	<u>0.01</u>
<i>Mean</i>	<i>0.03 ±0.05 (95%)</i>	<i>Mean</i>	<i>0.04 ±0.034 (95%)</i>

In addition, the following qualitative observations should be noted:

1. The diver counted only those lobsters directly observed. The sediment cloud created by the suction operation may have concealed lobsters leaving some of the burrows identified as unoccupied. ***Thus, 66% should be considered a conservative mean.***
2. Also of interest is the observation that all burrows occupied by lobsters were observed to have both a "front" and "back" entrance, that is, all of these burrows were "U"-shaped, explaining the observation in one of the videos showing water being drawn into the burrow. The distance between openings of an individual burrow is highly variable. Therefore, when reviewing an approximate 1 meter wide field of view, ***the existence of both "front" and "back" entrance requires that the number of burrows observed in the video recordings be divided by 2 for purposes of calculating numbers of shelters, for failure to do this could result in significant overestimation of the population.***

Night Dives

Methods

In response to the lobster fishermen's requests for observations of nocturnal lobster activity within the proposed dredge areas, four night dives were made on Friday, 10 April at Sites #1 at BIW dry dock, #2 off of Custom House wharf, #3 across from DiMillo's Marina, and #7 across from the Star Turner Island Terminal facility. Transects for these dives were located using the coordinates from the previous March daylight dives in an attempt to approximate dive locations as much as possible. Transect line deployment and video recording were done as described above for the daylight dives.

Results

Video-graphic representations of the night dives are included here as Appendix IIIb, but the following general observations were made:

1. Three (3) lobsters were seen at Site #2 and four (4) at Site #1; none were seen at Sites #7 or #3.
2. Observed lobsters were seen either in their burrows or in very close proximity to them. Upon approach by the diver, some were seen entering the burrows "claws first", behavior previously reported and recorded by Dr. Robert Steneck, University of Maine School of Marine Sciences.
3. More activity was seen at night than during the day, but based on the results of the burrows occupancy study, even the night activity does not accurately represent lobster presence at this time of year.

Expanded Areal Survey (Outside proposed dredge areas)

Methods

The Lobster Working Group requested that dive surveys be conducted outside of the proposed dredge areas to allow comparison between those areas which would be directly affected by the dredging activity and other areas in the harbor that would not be dredged. Responding to this request, MER conducted a series of dive surveys on 14 April 1998 within the Fore River over areas not proposed for dredging but within close proximity to some that are, referred to here as *adjacent sites*. One area outside of the Fore River, near Fort Gorges, was used as an out-of-harbor "control". Several of the dives intentionally crossed the vertical "wall" of the dredged channel to allow comparison between lobster densities in shallow and deeper water. Video recordings were carried out as previously described above.

Results

Based on our review of the 14 April 1998 videos (refer to Appendix IIIc), combined with the results of the occupancy rate study, the following lobster densities estimates have been calculated:

Table 4
Comparison of lobster density at expanded areal coverage “adjacent” and nearby proposed dredge sites based on visual observations and estimated occupancy rate

Site	Adjacent site lobsters/m ²	Nearby dredge site density lobsters/m ²
E1 (control)	0.26	----
E2	0.16	0.24 / 0.32
E3	0.30	0.32 / 0.31
E4	0.12	0.12
E5	0.06	0.22 / 0.27 / 0.12
E6	0.17	----
Mean	0.16 ±0.11 (95%)	~0.24 ±0.07 (95%)

The mean value of 0.16 lobsters/m² for the *adjacent sites* is substantially lower than that found just two days later in the nearby areas proposed for dredging (0.24 lobsters/m²). Generally, the survey sites, individually, yielded lower density values than the nearby proposed dredge areas. Within the same site, shallow areas tended to yield lower density values than deeper areas. The exceptions are Sites E3 and E4 which yielded values very similar to those found at their respective nearby proposed dredge areas. E1, as the “control”, has no areas nearby that are proposed for dredging and is consequently not included in the calculation of the mean density.

On the clay banks, observed at Ft. Gorges, northeast of BIW dry dock, and across from BIW, numerous lobsters were found burrowed into the wall creating a “honeycomb” appearance or a “pueblo” or “condo” effect.

Early Benthic Stage (EBS)

Methods

Two days of dives on the early benthic stage lobster survey were completed on April 22 and 24, 1998. The survey was carried out by setting a 0.25 m² frame on the bottom over areas of small to intermediate-sized burrows and excavating the entire area within the frame with an airlift to a depth of 20-25 cm (8-10 inches). The surface of the bottom within the frame was suctioned prior to any extensive excavation to ensure capture of any lobsters on the immediate surface. All excavated material was passed through a 6 mm (1/4 in.) mesh bag attached to the exhaust end of the airlift. The contents of the bag were immediately examined for small lobsters of all sizes upon return to the surface. Hand probing was also used to investigate small burrows in the 40-80 mm diameter range. Sites #1, #2, #3, and #7, having the highest probability of supporting juvenile lobsters, were sampled for the survey.

Results

No small early benthic stage lobsters were found at any of the sites, however, larger juvenile lobsters with carapace lengths (CL) (eye socket to carapace edge measurement) ranging from 28 mm (1 1/4") to 75 mm (2 7/8") were found within the framed area, effectively avoiding the suction of the airlift. An attempt was therefore made to determine whether these lobsters were residing in burrows smaller than those investigated in the burrows occupancy study that focused on larger burrows suspected to be occupied by near legal-size lobsters.

The investigation of small burrows in the 40-110 mm diameter range revealed that smaller lobsters are, indeed, occupying these burrows and at a rate similar to that found for larger burrows and larger lobsters, *i.e.* 55-70%. However, these smaller lobsters seem to be confined to the eastern section of the harbor in the vicinity of Sites #1 and #2. Two dives along the southern side of the channel within Site #3 showed very few burrows, particularly within the 40-110 mm range. At Site #7 burrows were found within this size range, but the majority of burrows were larger, and most of these were occupied, corroborating the earlier findings. No lobsters were found in burrows <60 mm in diameter.

Table 5 below summarizes the results of the small burrows investigation:

Table 5
Burrow diameter comparison to occupant carapace length; occupancy rate and sex ratio by site

Site	Burrow size	Lobster size	Sex	Occupancy/Sex ratio
1	60 mm	35 mm / 1 3/8"	♂	
	N/A	60 mm/ 2 3/8"	♂	
	100 mm	48 mm/ 1 7/8"	♀	
	120 mm ?	76 mm/ 3"	♂	
	60-90 mm	33 mm/ 1 5/16"	♀	
1a	110 mm	73 mm/ 2 7/8"	♀	
	90 mm	73 mm/ 2 7/8"	♂	
	60 mm	36 mm/ 1 7/16"	♀	9 lob./14 burrows - 64%
	90 mm	73 mm/ 2 7/8"	♀	55% ♀/45% ♂
1b	Test in shoal cobble area with 2" airlift - nothing			
1c	60-90 mm	52 mm/ 2 1/16"	♀	5 lob./9 burrows - 55.5%
	60 mm	59 mm/ 2 5/16"	♂	50% ♀/50% ♂

(Three additional lobsters were seen, but could not be captured for measurement; four negative occupancies could be false negatives due to poor visibility)

**Table 5
(Continued)**

Burrow diameter comparison to occupant carapace length; occupancy rate and sex ratio by site

Site	Burrow size	Lobster size	Sex	Occupancy/Sex ratio
2	Very poor visibility - abandoned on 21 April			
7	120 mm	82 mm/ 3 1/4"	♀	
	80 mm	81 mm/ 3 3/16"	-	
	80 mm	76 mm/ 3"	♂	(all "lobster-looking" burrows occupied - 100%)
	90 mm	67 mm/ 2 5/8"	♂	~50% ♀/50% ♂
2	60 mm	28 mm/ 1 1/8"	-	
	80 mm	48 mm/ 1 7/8"	-	
	90 mm	38 mm/ 1 1/2"	♀	
3	Nothing (across from DiMillo's)			
3a	100 mm	57 mm/ 2 1/4"	♀	(across from State Pier)
	100 mm	73 mm/ 2 7/8"	♂	50% ♀/50% ♂

A further attempt was made to identify the occupants of intermediate-sized burrows by hand excavating randomly selected burrows in the 60-80 mm diameter range. Site 2, in the vicinity of State Pier, was selected due to the relatively large number of small burrows previously encountered in the area. Table 5 below summarizes the results of that effort.

**Table 6
Randomly selected burrows in 60-80 mm range dug by hand**

Site	Lobster size	Sex	
2 (at State Pier)	44 mm/ 1 3/4"	♀	
	28 mm/ 1 1/8"	♂	
	70 mm/ 2 3/4"	♂	
	51 mm/ 2"	♀	
	57 mm/ 2 1/4"	♀	
	51 mm/ 2"	♀	
	70 mm/ 2 3/4"	♀	
	38 mm/ 1 1/2"	♀	
	57 mm/ 2 1/4"	♀	78% ♀/22% ♂

Additional observations include:

1. Occupants of burrows < 40 mm in diameter could not be determined. At Site #3, a sample of very small burrows 5-10 mm in diameter was taken. These appeared to contain amphipods, although it is difficult to determine if the amphipods were actually occupying these small burrows. A sample of the amphipods was collected for identification.
2. Based on these results, it seems reasonable to extend the ~66% occupancy rate value to burrows 40 mm or greater (taking into account the "U"-shape feature) in certain areas east of the Casco Bay bridge. This rate, however, does not seem to apply to the southern side of the channel or to most of the area west of the Casco Bay bridge.

Discussion

It is generally believed that the majority of the lobster population in Casco Bay is migratory, coming into shoal water in the Spring and moving into deeper water offshore in the late Fall. Many fishermen, however, believe there may be three distinct groups within the Casco Bay lobster population: 1) those that migrate back and forth seasonally between the inner shallow Bay and deeper outer Bay, 2) those that are coastal migrants, that is, they enter the Bay in the Spring on their way south and leave in the Fall to resume their trek south, and finally 3) those that are permanent, year-round residents of the Bay, termed "grounders" by the fishermen.

Lobster fishing in the Fore River is intense during the summer and is continued through the winter, albeit at a substantially reduced level, by a handful of local fishermen. It has been generally thought that the reduced catch of this winter fishery reflects the small number of lobsters, at least legal-size lobsters, remaining in the River. However, another plausible explanation is the existence of a relatively large year-round population that, due to the low water temperatures and consequent low activity level in winter, is simply not "trapable". Given this possibility, and anticipating a Fall 1998 start of dredging in Portland Harbor, the Maine Departments of Environmental Protection and Marine Resources wished to determine if a resident population of lobsters exists in Portland Harbor and, if so, whether the population density meets the threshold value of 0.1 lobster/m², the density level that MDMR considers to indicate important lobster habitat.

Accordingly, this project initially consisted simply of a single set of daylight dives in March. Consistent with general thought, the video recordings made on those dives show little, if any, lobster activity. Based solely on these results the conclusion may well have been that, although burrows are present, few lobsters are present. It was, therefore, fortuitous that lobsterman Peter Pray happened to arrive to haul his traps while we were still on-site, for the success of his haul, although consisting mostly of sub-legal lobsters, indicated that lobsters were, indeed, present even though not observed. This chance meeting and subsequent conversation with Mr. Pray led to the expansion of the project to include the investigation of the burrows that ultimately revealed the extent of the population. It is important to note, however, that this study does not attempt to estimate the size of the over-wintering lobster population in Portland Harbor, but seeks only to determine the relative abundance of this population in different areas of the harbor and whether the population density within those areas meets or exceeds the threshold value.

The combined results of the video survey and the occupancy study show clearly that the relative distribution of lobsters is higher east of the Casco Bay bridge than to the west, and that the distribution continues to decline the further west one travels along the Fore River. This trend holds for both March and April, the magnitude of the relative difference increasing through April. Furthermore, for the study period, the threshold value of 0.1 lobster/m² was consistently met or exceeded at the study sites east of the bridge but was only reached west of the bridge on two occasions. Based on these results, the Lobster Working Group is considering mitigation measures for those proposed dredge areas east of the Casco Bay bridge.

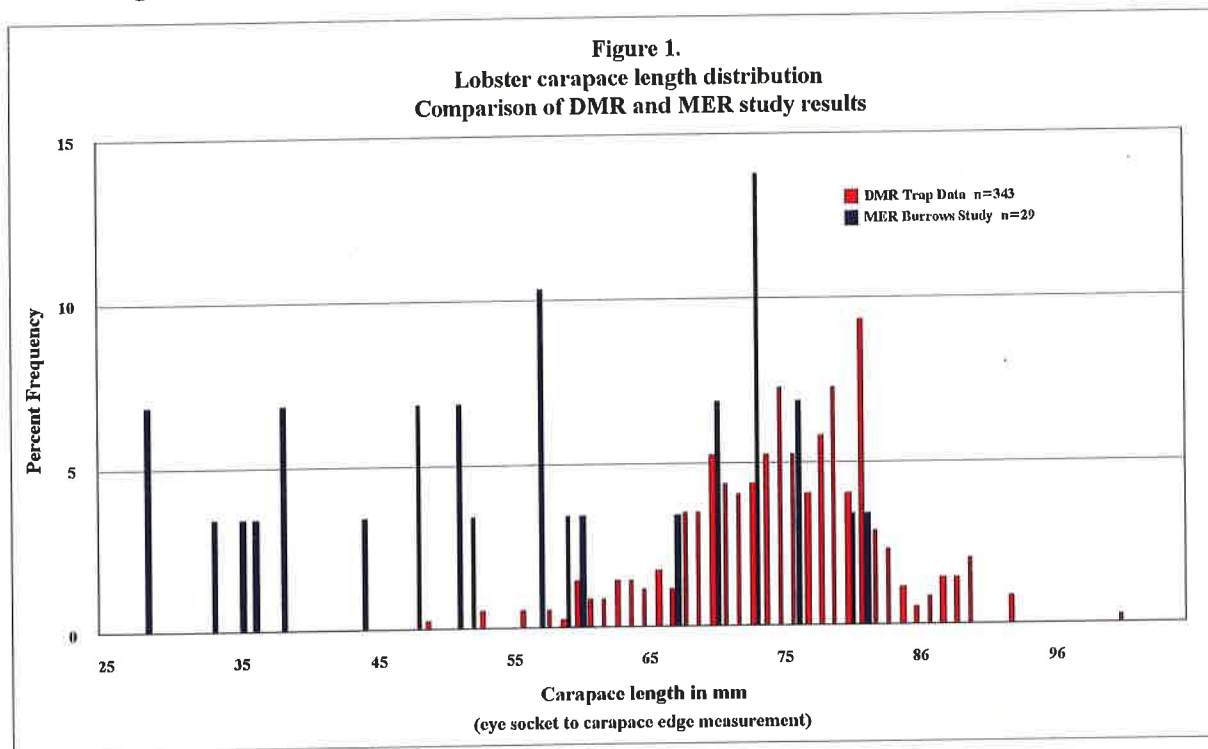
Several observations made during the occupancy study, mentioned previously, deserve further elaboration here since they have a direct bearing on interpretation of the video recording results. First, the observation that *true* lobster burrows, as constructed in the soft sediments of the Fore River, tend to have both front and rear entrances is important (Cobb, 1971), for it affects the population density estimate calculations and allows discrimination, to a certain extent, between lobster and non-lobster burrows. Clearly, if most or all lobster burrows have two entrances within fairly close proximity to one another, both are likely to appear within the 1 meter-wide view covered by the video survey. Failure to account for this dual entrance feature could lead to an inadvertent doubling of the estimated number of lobsters if one is using number of burrows and an occupancy coefficient to estimate density.

It is interesting to consider, in retrospect, that the mere presence of burrows in winter may indicate activity, albeit reduced, on the part of lobsters, for the relatively high rate of occupancy observed may simply reflect the fact that burrows only persist in these soft sediments when actively maintained. There are several reasons for considering this possibility. First, if one assumes that in soft sediment habitats all lobsters build burrows for shelter, whether for winter hibernation or molting protection in summer, the number of burrows seen during the dives does not account for the large number of lobsters caught in the Fore River during the summer. The mean occupancy rate for the River was estimated at ~66%, but in some areas reached as high as 83% and 100%. If the burrows seen during the dives were the only burrows available, then there would only be room for an additional 17% occupancy or none at all, respectively, and this would not accommodate the increased lobster population that exists in the area during the summer. Second, in view of the soft sediment composition at the sites surveyed and the amount of sediment stirred up in the River as a result of shipping traffic and winter storms, it is very likely that burrows would quickly fill in if not actively maintained. Third, few burrows were found at the sites west of the Casco Bay bridge, yet these areas are successfully fished for lobsters during the summer months. Additional surveys during the peak lobster season in summer might shed light on this question.

Given these observations, it is likely that burrows persist only when actively maintained and, therefore, all lobster burrows seen during the surveys are either actively maintained or have only recently been abandoned. If this is the case, then the already conservative estimated occupancy rate of 66% may be a substantial underestimate. It is very likely that substantially greater numbers of burrows would be found during the summer months than during the late winter/early spring. Although a seasonal increase in the number of burrows is not of direct concern to the dredge operations, since any later season burrows would represent lobsters arriving after the dredge operations ceased in April, a comparison of pre-dredge and post-dredge densities may allow a determination of the longer-term effects of dredge operation disturbances on lobster behavior and the consequent impacts to the fishery.

The intent of the early benthic phase study was to determine if recently settled lobsters are present within the proposed dredge areas during the winter months. The smallest lobster recovered using the suction and hand excavation processes, despite efforts to ensure capture of small organisms, was 28 mm CL. Indeed, amphipods were successfully collected, suggesting that lobsters of similar or somewhat larger size would also have been collected, had they been present. The fact that no yearling lobsters (≤ 20 mm carapace length, CL) were found comes as no surprise since soft sediment is not a preferred substrate for lobster settlement (Cooper and Uzmann, 1980; Hudon, 1987; Wahle and Steneck, 1991; Miller *et al.*, 1992).

The results of the early benthic phase survey are of particular interest when viewed in light of the study conducted by the MDMR in cooperation with lobster fisherman Norman Solak on 17 April 1998 (MDMR unpublished data). A subsample of 343 lobster taken from the MDMR trap sampling yielded a carapace length range of 49 to 101 mm with a peak at 82 mm. Few lobsters were trapped measuring less than 60 mm, but as the MDMR report points out, the decline in the frequency of lobsters of small size is probably attributable to trap selectivity and should not be taken as an indication of absence of lobsters of this size. The MER data proves this to be true as shown in Figure 1.



The sample size for the MER data is considerably smaller than for the MDMR study, nevertheless, the MER results show that small lobsters with carapace lengths in the 28 to 50 mm range are present in the Fore River during late-Winter/early-Spring. Despite the small MER study sample size, it is interesting to note that the general distribution trend is similar for both data sets, that is, building towards the 81 mm legal-size level. The precipitous decline at 81 mm in the MDMR study simply reflects cropping of the population by commercial harvesting, beginning at that size. These data suggest a broad population size distribution and any mitigation effort should not, therefore, focus solely on legal- or near-legal-size lobsters, but should attempt to include smaller-size lobsters down to ~30 mm carapace length.

Conclusions

The purpose of this study was to determine if a winter-resident population of lobsters exists within the Fore River, Portland Harbor, and if so, whether the density of the population meets or exceeds the threshold value of 0.1 lobsters/m² used historically by the MDMR as an indication of important lobster habitat.

The results of this study clearly show that a winter resident population of lobsters does exist in at least certain areas of the Fore River and at levels meeting or exceeding the 0.1 lobster/m² threshold. It is equally clear that the distribution of lobsters within the proposed dredge areas varies considerably from one end of the harbor to the other. Generally, the population decreases westwardly from the entrance to the harbor. Similarly, the trend in occupancy rate of burrows is to decrease from east to west. East of the Casco Bay bridge the threshold value of 0.1 lobster/m² was met or exceeded on all but one of fourteen dives. Conversely, the threshold level was only met or exceeded on two of sixteen dives west of the bridge.

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Appendix I

List of Lobster Working Group Members

Lobster Working Group

Members:

Paul VanCott	ME DEP
Olga Quirin	US EPA
Linda Mercer	ME DMR
Jay Krouse	ME DMR
Ray Francisco	US ACE
Cathy Demos	US ACE
Brian Nutter	ME DOT
Katherine Groves	CBEP
Lee Doggett	ME DEP
Doug Burdick	ME DEP
Brian Swan	ME DMR
Todd Burrows	ME SPO
Joe Payne	FOCB
Dick Ingalls	Portland Harbor Dredging Committee

Consultants:

Chris Heinig	MER Assessment Corporation (MER)
Brian Tarbox	MER
Marcia Bowen	Normandeau Associates, Inc (NAI)

Fishing Industry Participatnts:

Peter Pray	lobsterman
Scott Kittredge	lobsterman
Bill Coppersmith	lobsterman
David Johnson	lobsterman
Bill Doane	lobsterman
Peter McAleney	dealer

Other State Agency Representatives

Jim Salisbury	ME DMR - Marine Patrol
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Appendix II

Global Positioning System (GPS) coordinates for all survey transects

MER Assessment Corporation

Fore River Lobster Survey 3/17/98 and 3/23/98

**Video Transect Locations and
Coordinates**

Site #	Dive #	Location	Coordinates	
1a	1	100° from SE corner of BIW dry dock biw1.cdr	N 43° 39' 34.4" S 43° 39' 32.6" E 43° 39' 34.3" W 43° 39' 33.6"	-70° 14' 24.6" -70° 14' 24.5" -70° 14' 22.3" -70° 14' 25.7"
1b	2	Further East from BIW dry dock biw2.cdr	N 43° 39' 37.1" S 43° 39' 35.0" E 43° 39' 36.3" W 43° 39' 35.8"	-70° 14' 16.6" -70° 14' 16.5" -70° 14' 14.8" -70° 14' 17.9"
2a	3	W of State Pier. S of Custom house wharf statpier.cdr	N 43° 39' 17.1" S 43° 39' 15.6" E 43° 39' 16.6" W 43° 39' 15.6"	-70° 14' 53.0" -70° 14' 51.8" -70° 14' 51.5" -70° 14' 53.4"
2b	4	Just South of DiMillo's Restaurant dimillos.cdr	N 43° 39' 11.8" S 43° 39' 10.4" E 43° 39' 11.3" W 43° 39' 10.2"	-70° 15' 01.2" -70° 14' 59.9" -70° 14' 59.4" -70° 15' 01.2"
3a	5	W of U.S.C.G. station channel SP side uscgsp.cdr	E 43° 38' 55.0" W 43° 38' 53.4"	-70° 15' 06.3" -70° 15' 08.4"
3b	6	Across channel from DiMillo's SP side spdimill.cdr	N 43° 39' 05.0" S 43° 39' 02.7" E 43° 39' 04.9" W 43° 39' 03.5"	-70° 14' 53.8" -70° 14' 52.6" -70° 14' 52.4" -70° 14' 54.3"
3c	7	Across channel from State pier SP side spwtanks.cdr	N 43° 39' 12.4" S 43° 39' 11.1" E 43° 39' 13.1" W 43° 39' 11.6"	-70° 14' 43.7" -70° 14' 41.8" -70° 14' 42.5" -70° 14' 44.6"
4	8	Just West of bridge on Portland side pwbridge.cdr	E 43° 38' 38.3" W 43° 38' 37.6"	-70° 15' 37.3" -70° 15' 39.7"
5	9	Just East of "C1" marker in front of Irving spirving.cdr	E 43° 38' 30.6" W 43° 38' 30.5"	-70° 15' 51.9" -70° 15' 54.8"
6	10	Just East of "C3" marker, N of moorings spec3.cdr	E 43° 38' 30.0" W 43° 38' 29.3"	-70° 16' 06.2" -70° 16' 08.1"
7	11	North across channel from "C3" and "C1" pspc3c1.cdr	E 43° 38' 33.9" W 43° 38' 36.7"	-70° 16' 02.9" -70° 16' 05.3"
8	12	Just East of barge at end of granite pier pecbgp.cdr Across from "C5"	E 43° 38' 31.7" W 43° 38' 31.3"	-70° 16' 24.2" -70° 16' 26.8"
9a	13	Southwest of "C5" marker S.P. side spswc5.cdr	E 43° 38' 26.7" W 43° 38' 25.1"	-70° 16' 25.9" -70° 16' 27.9"
9b	14	NW of tanker tie-up, N of cemetery S.P. side spnwtnc.cdr	N 43° 38' 20.1" S 43° 38' 18.5" E 43° 38' 18.5" W 43° 38' 18.8"	-70° 16' 40.2" -70° 16' 40.3" -70° 16' 39.2" -70° 16' 41.3"
10	15	W most tanker tie up, S.P. side, Julie N repair westmost.cdr	E 43° 38' 23.5" W 43° 38' 24.2"	-70° 16' 57.9" -70° 16' 59.3"

Fore River Lobster Survey 4/9/98

Initial Air-Lift trials and Transect Locations

Site #	Dive #	Location	Coordinates	
1	1	100° from SE corner of BIW dry dock	N 43° 39' 34.9"	-70° 14' 24.4"
2	2	W of State Pier, S of Custom house wharf	N 43° 39' 17.0" S 43° 39' 15.6"	-70° 14' 53.1" -70° 14' 51.1"
7	3	North across channel from "C3" and "C1"	E 43° 38' 33.1" W 43° 38' 32.8"	-70° 16' 02.6" -70° 16' 05.2"
7	4	Same coordinates as previous dive #3	" "	" "
3	5	Across channel from DiMillo's SP side	E 43° 39' 05.8" W 43° 39' 04.3"	-70° 14' 51.6" -70° 14' 53.9"

Fore River Lobster Survey 4/10/98

Night Dive Video Transect Locations

Site #	Dive #	Location	Coordinates	
7	1	North across channel from "C3" and "C1" night1.cdr (Approximate dive location)	E 43° 38' 33.9" W 43° 38' 36.7"	-70° 16' 02.9" -70° 16' 05.3"
3	2	Across channel from DiMillo's SP side night2.cdr	E 43° 39' 04.8" W 43° 39' 03.5"	-70° 14' 52.6" -70° 14' 54.2"
2	3	W of State Pier, S of Custom house wharf night3.cdr	N 43° 39' 17.0" S 43° 39' 14.9"	-70° 14' 53.3" -70° 14' 52.7"
1	4	100° from SE corner of BIW dry dock night4.cdr	E 43° 39' 34.0" W 43° 39' 32.4"	-70° 14' 23.0" -70° 14' 24.6"

Fore River Lobster Survey 4/14/98

Expanded Area Coverage Transect Locations and

Site #	Dive #	Location	Coordinates	
E1	1	Just South of Fort Gorges, outside of harbor (Control) expand1.cdr	N 43° 39' 42.8" S 43° 39' 41.7" E 43° 39' 41.8" W 43° 39' 42.7"	-70° 13' 14.3" -70° 13' 12.1" -70° 13' 14.4" -70° 13' 12.5"
E2	2	Adjacent of BIW dry dock, North of site 1 expand2.cdr	N 43° 39' 41.9" S 43° 39' 41.0" E 43° 39' 42.2" W 43° 39' 40.8"	-70° 14' 30.0" -70° 14' 28.0" -70° 14' 28.1" -70° 14' 29.8"
E3	3	Between BIW dry dock and State Pier Southwest of dry dock expand.cdr	N 43° 39' 26.3" S 43° 39' 24.9" E 43° 39' 26.7" W 43° 39' 25.7"	-70° 14' 39.6" -70° 14' 38.5" -70° 14' 38.2" -70° 14' 38.4"
E4	4	Across channel from BIW dry dock expand4.cdr	N 43° 39' 19.6" S 43° 39' 18.5" E 43° 39' 20.0" W 43° 39' 18.8"	-70° 14' 25.3 " -70° 14' 23.0" -70° 14' 23.5" -70° 14' 25.4"
E5	5	East of entrance to U.S.C.S., S. Portland side expand5.cdr	N 43° 38' 59.4" S 43° 38' 58.2" E 43° 38' 59.6" W 43° 38' 58.0"	-70° 14' 58.1" -70° 14' 56.3" -70° 14' 55.2 " -70° 14' 57.0"
E6	6	Outside of channel, across from U.S.C.G. station on P. side of channel. expand6.cdr	N 43° 38' 58.8" S 43° 38' 57.4"	-70° 15' 11.2" -70° 15' 09.7"

Fore River Lobster Survey 4/14/98

Repeat daylight dive Transect Locations and

Site #	Dive #	Location	Coordinates	
2b	7	Just South of DiMillo's Restaurant dimillo2.cdr	N 43° 39' 11.7"	-70° 15' 01.1"
			S 43° 39' 10.8"	-70° 14' 58.9"
			E 43° 39' 11.5"	-70° 14' 59.6"
			W 43° 39' 10.4"	-70° 15' 01.0"
2a	8	W of State Pier, S of Custom house wharf statpie2.cdr	N 43° 39' 17.2"	-70° 14' 52.8"
			S 43° 39' 16.4"	-70° 14' 50.2"
			E 43° 39' 18.1"	-70° 14' 50.8"
			W 43° 39' 16.4"	-70° 14' 52.1"

Fore River Lobster Survey 4/16/98

Repeat daylight dive Transect Locations and

Site #	Dive #	Location	Coordinates	
1a	1	100° from SE corner of BIW dry dock biw1-2.cdr	N 43° 39' 35.2"	-70° 14' 27.4"
			S 43° 39' 33.7"	-70° 14' 26.1"
			E 43° 39' 35.1"	-70° 14' 25.7"
			W 43° 39' 33.7"	-70° 14' 27.4"
1b	2	Further East from BIW dry dock biw2-2.cdr	N 43° 39' 37.1"	-70° 14' 23.4"
			S 43° 39' 35.1"	-70° 14' 22.2"
			E 43° 39' 36.9"	-70° 14' 22.0"
			W 43° 39' 36.8"	-70° 14' 23.6"
3a	3	E of "C1" @ U.S.C.G. station channel uscgspe2.cdr S.P. side	E 43° 38' 57.8"	-70° 15' 01.9"
			W 43° 38' 56.6"	-70° 15' 04.1"
3b	4	Across channel from DiMillo's SP side spdimil2.cdr	N 43° 39' 03.4"	-70° 14' 55.2"
			S 43° 39' 02.1"	-70° 14' 53.1"
			E 43° 39' 02.7"	-70° 14' 54.1"
			W 43° 39' 00.2"	-70° 14' 56.2"
3c	5	Across channel from State pier SP side in front of Sunset Marina floats spwtank2.cdr	N 43° 39' 10.8"	-70° 14' 43.1"
			S 43° 39' 09.5"	-70° 14' 41.3"
			E 43° 39' 11.0"	-70° 14' 42.0"
			W 43° 39' 09.5"	-70° 14' 43.7"
4	6	Just West of bridge on Portland side pwbridg2.cdr	E 43° 38' 38.6"	-70° 15' 36.7"
			W 43° 38' 37.8"	-70° 15' 39.1"
5	7	Just East of "C1" marker in front of Irving spirvin2.cdr	E 43° 38' 31.8"	-70° 15' 52.5"
			W 43° 38' 31.1"	-70° 15' 55.1"
6	8	Just East of "C3" marker, N of moorings spec3-2.cdr	E 43° 38' 30.9"	-70° 16' 06.3"
			W 43° 38' 29.6"	-70° 16' 09.4"
7	9	North across channel from "C3" and "C1" pspc3c12.cdr	E 43° 38' 34.1"	-70° 16' 03.0"
			W 43° 38' 33.5"	-70° 16' 05.3"
8	10	Just East of barge at end of granite pier pecbgp2.cdr across from "C5"	E 43° 38' 30.9"	-70° 16' 23.7"
			W 43° 38' 30.4"	-70° 16' 26.4"
9a	11	Southwest of "C5" marker S.P. side spswc5-2.cdr	E 43° 38' 26.4"	-70° 16' 26.3"
			W 43° 38' 25.7"	-70° 16' 28.7"
9b	12	NW of tanker tie-up, N of cemetery S.P. side spnwtnc2.cdr	N 43° 38' 19.5"	-70° 16' 40.5"
			S 43° 38' 17.7"	-70° 16' 39.5"
			E 43° 38' 19.3"	-70° 16' 38.2"
			W 43° 38' 18.5"	-70° 16' 40.7"
10	13	W most tanker tie up, S.P. side, Julie N repair westmos2.cdr	E 43° 38' 23.5"	-70° 16' 57.4"
			W 43° 38' 24.6"	-70° 16' 59.5"

Appendix III

Video Survey Graphics

- a. March and April Daylight Dives**
- b. April Night Dives**
- c. Expanded Areal Survey (Outside proposed dredge areas)**

Appendix III

Video Survey Graphics

a. March 17/23 and April 14/16 Daylight Dives



Two lobsters observed, both were in traps

Transect 1

09:33:37
43° 39' 32.6"
-70° 14' 24.5"

- Mud bottom
- Slight current
- Burrows present

Lines cross @ 09:30:23
and 09:43:57

Transect 2

09:39:50

43° 39' 34.3"
-70° 14' 22.3"

100°

End
09:45:20

43° 39' 33.6"
-70° 14' 25.7"

Traps, each containing
one lobster

biw1.cdr

-----▶ Diver's course

43° 39' 34.4"
-70° 14' 24.6" 10°

Start 09:28:13

37.2'

30 m

Fore River Lobster Survey
Site 1, Dive 1, Double transect
Off of BIW Dry Dock @ 100° from Southeast corner
Heading South first, West second
3-17-98

©MER Assessment Corporation, 1998



no lobsters observed

- Smooth mud bottom
- Steady current
- Burrows present

Transect 1

40.5' 11:03:43
43° 39' 36.0" 180°
-70° 14' 16.5"

Transect 2
11:07:35

41.4'

43° 39' 36.3" 82°
-70° 14' 14.8"

Large depression in mud

Obstructed burrow

Diver removes material
from burrows

Lines cross @ 11:02:52
and 11:12:03

End
11:12:21

43° 39' 35.8" 180°
-70° 14' 17.9"

41.5'

biw2.cdr

-----► Diver's course

30 m

Fore River Lobster Survey
Site 1, Dive 2, Double transect
Further East from BIW dry dock
Heading South first, West second
3-17-98

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43° 39' 37.1" 180°
-70° 14' 16.6"
Start 11:01:17

40.3'

no lobsters observed

Transect 1

11:45:23

42.0' $43^{\circ} 39' 15.6''$ $-70^{\circ} 14' 51.8''$ 154°



-Smooth mud bottom
-reddish layer on top
-Burrows present

Transect 2

11:49:57

$43^{\circ} 39' 16.6''$
 $-70^{\circ} 14' 51.5''$
41.4'

End

11:52:44

$43^{\circ} 39' 16.6''$
 $-70^{\circ} 14' 53.4''$
41.3' 244°

Lines cross @ 11:44:25
and 11:51:51

statpier.cdr

-----> Diver's course

30 m

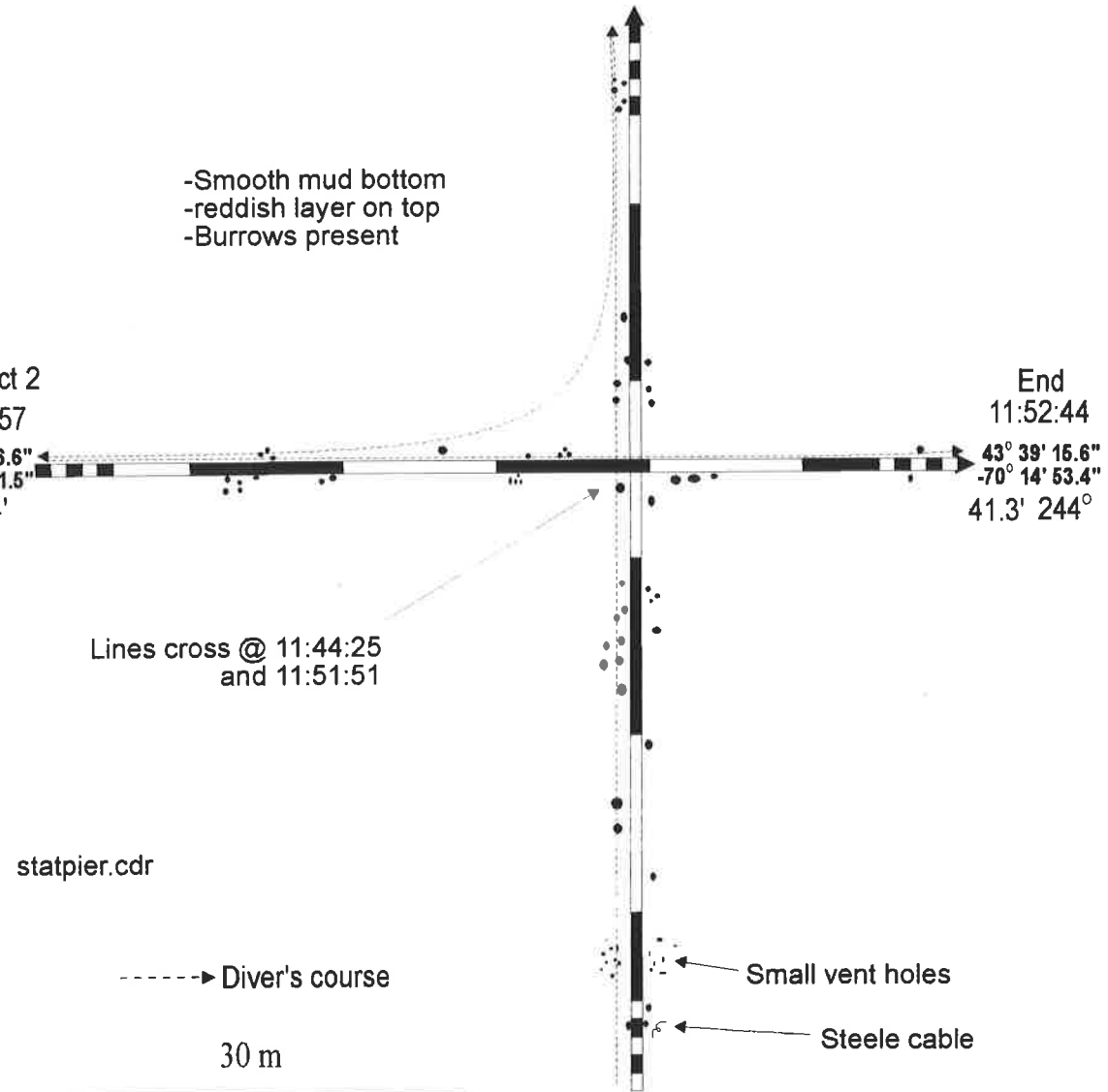
Small vent holes

Steele cable

Fore River Lobster Survey
Site 2, Dive 3, Double transect
West of State Pier, Portland side of channel
Heading South first, West second
3-17-98

©MER Assessment Corporation, 1998

$43^{\circ} 39' 17.1''$
 $-70^{\circ} 14' 53.0''$
Start
11:42:30
41.4'



no lobsters observed

-Mud bottom
-Burrows present

Transect 1
12:21:22 42.9'

$43^{\circ} 39' 10.4''$
 $-70^{\circ} 14' 59.9''$ 155°



Boat antenna

Lines cross @ 12:20:27
and 12:24:44

Transect 2
12:23:39

41.5'

Beer cans End 12:26:15

$43^{\circ} 39' 11.3''$
 $-70^{\circ} 14' 59.4''$

Dead rock crab

Dug out areas

Mud depressions

Glove

$43^{\circ} 39' 10.2''$
 $-70^{\circ} 15' 01.2''$
45.7' 244°

dimillos.cdr

Rock crab

Soda can

-----> Diver's course

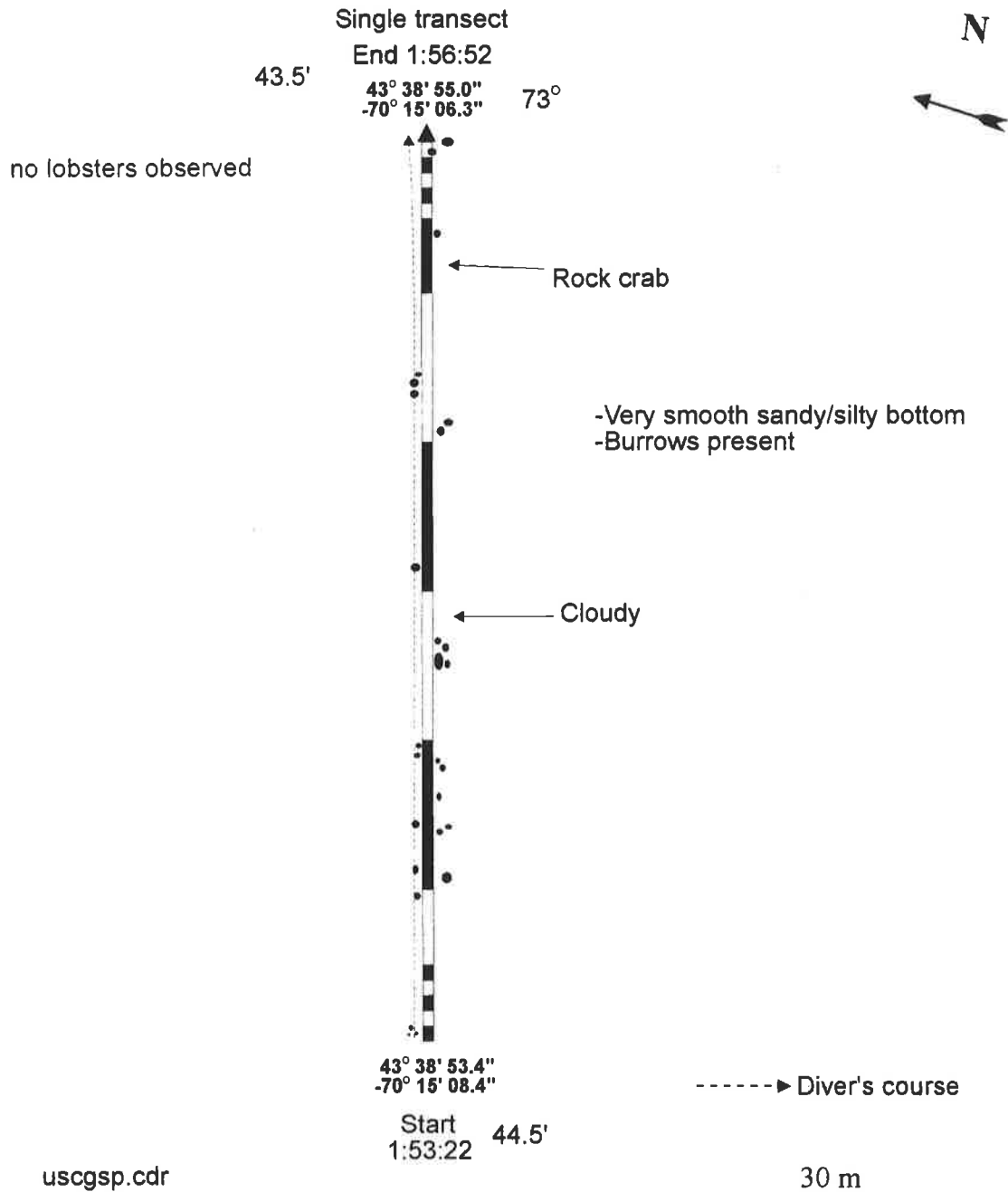
$43^{\circ} 39' 11.8''$
 $-70^{\circ} 15' 01.2''$

Start 12:18:40
35.8'

30 m

**Fore River Lobster Survey
Site 2, Dive 4, Double transect
South of DiMillo's Restaurant
Heading South first, West second
3-17-98**

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Fore River Lobster Survey
Site 3, Dive 5, Single transect
West of channel to U.S.C.G. station on South Portland side
Heading East towards red nun # 2
3-17-98

©MER Assessment Corporation, 1998

no lobsters observed



Transect 1

2:21:41
43° 39' 05.0" 43.9'
-70° 14' 53.8"

Transect 2 video was very cloudy due to the previous dive. Few clear shots occurred.

Depression in mud

Covered burrow

Beer can

Transect 2
2:23:54

43° 39' 03.5" 43.7'
-70° 14' 54.3"

End 2:26:41

43° 39' 04.9" 43.4'
-70° 14' 52.4"

Lines cross @ 2:20:50
and 2:25:16

Depression in mud

Rock crab

-Mud bottom
-Burrows present

Depression in mud

spdimmill.cdr

43° 39' 02.7" 44.3'
-70° 14' 52.6"

Start
2:18:49

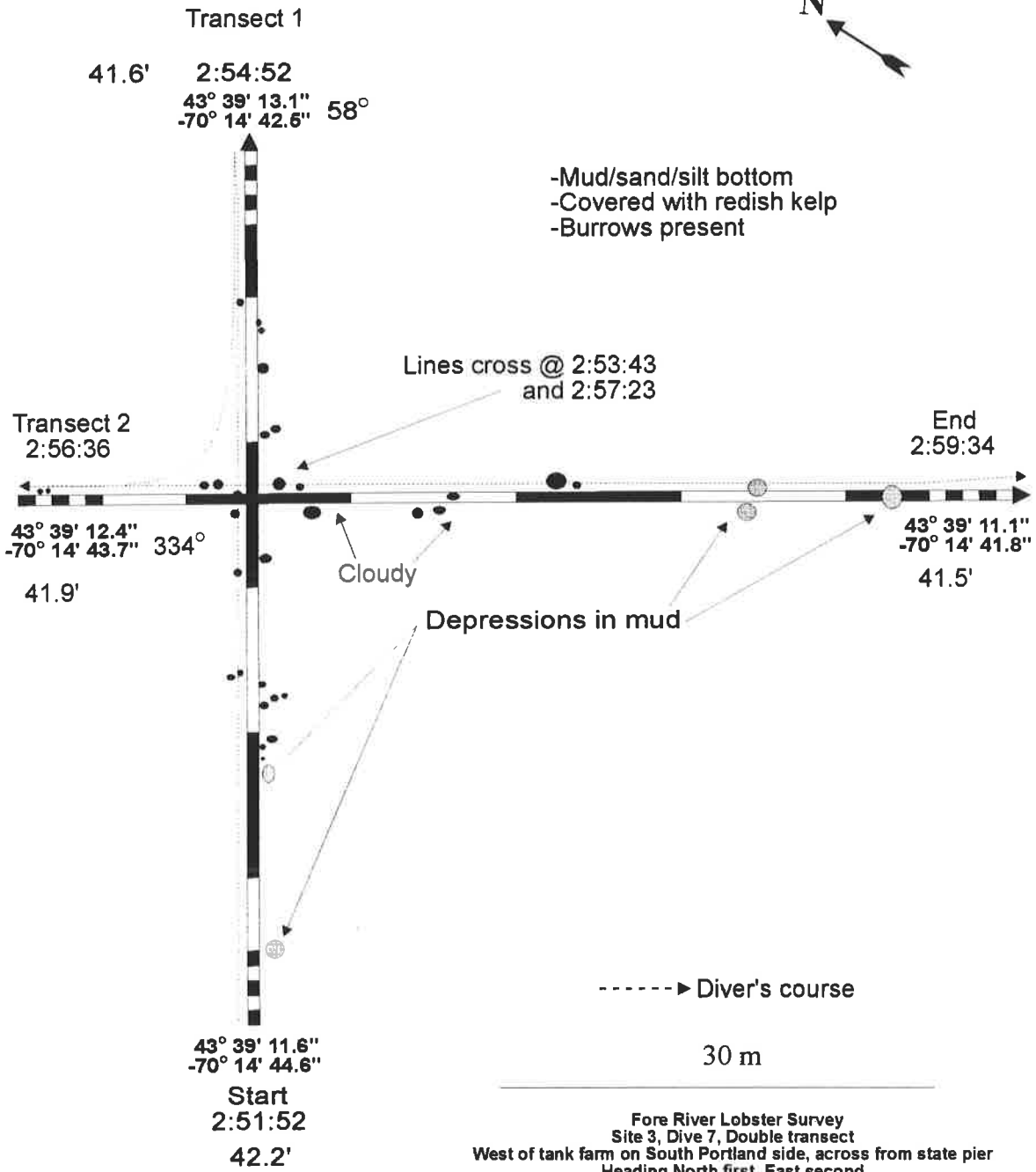
-----> Diver's course

30 m

Fore River Lobster Survey
Site 3, Dive 6, Double transect
Across channel from DiMillo's restaurant on South Portland side
Heading North first, East second
3-17-98

©MER Assessment Corporation, 1998

no lobsters observed



spwtanks.cdr

Fore River Lobster Survey
 Site 3, Dive 7, Double transect
 West of tank farm on South Portland side, across from state pier
 Heading North first, East second
 3-17-98

©MER Assessment Corporation, 1998

no lobsters observed

Single transect

End
1:47:26

$43^{\circ} 38' 37.6''$ 65°
 $-70^{\circ} 15' 39.7''$



-Packed sand bottom
-no burrows

clear bottom

Rock crab

Log

Wood

Logs

pwbridge.cdr

$43^{\circ} 38' 38.3''$
 $-70^{\circ} 15' 37.3''$

Start
1:44:19
39.3'

-----> Diver's course

30 m

Fore River Lobster Survey
Site 4, Dive 8, Single transect
Just West of Casco Bay bridge, Portland side, off of clay banks
Heading West
3-23-98

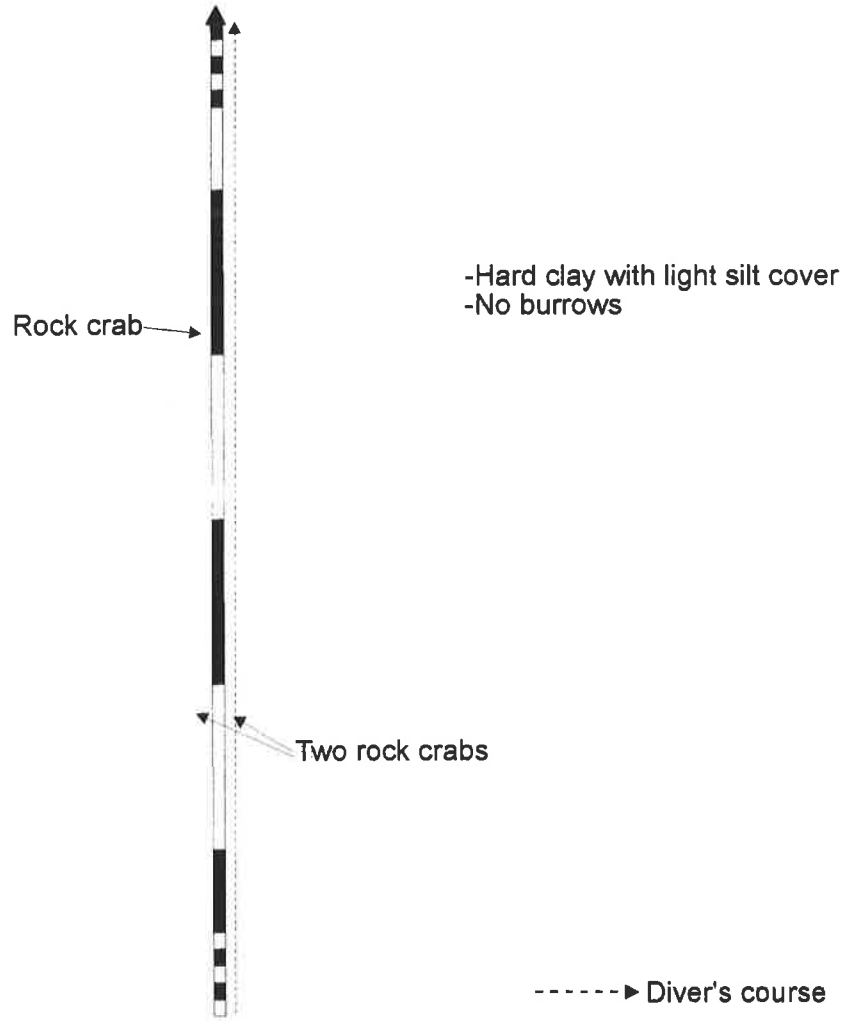
©MER Assessment Corporation, 1998

no lobsters observed

Single transect

End 2:11:24

43° 38' 30.5"
-70° 15' 54.8" 95°



spirving.cdr

43° 38' 30.6"
-70° 15' 51.9"

Start 2:08:44

38.3'

Fore River Lobster Survey
Site 5, Dive 9, Single transect
East of "C1" channel marker in front of Irving off-loading
Heading West
3-23-98

©MER Assessment Corporation, 1998

no lobsters observed

Single transect

End 36.0'
2:32:15
43° 38' 29.3" 97°
-70° 16' 08.1"



Rock crab

-Mud bottom
-Few burrows

spec3.cdr

43° 38' 30.0"
-70° 16' 06.2"

Start
2:29:27
37.8'

-----▶ Diver's course

30 m

Fore River Lobster Survey
Site 6, Dive 10, Single transect
Just East of "C3" marker, West of stone pier and Irving gantry
Heading West towards "C3"
3-23-98

©MER Assessment Corporation, 1998

no lobsters observed

Single transect

End
2:55:39 36.7'

43° 38' 36.7"
-70° 16' 05.3"



Diver digs out burrow,
no lobsters were observed.

Abandoned trap

-Mud bottom
-Burrows present some
outside of camera view

pssc3c1.cdr

43° 38' 33.9"
-70° 16' 02.9" 278°

Start
2:51:47

36.8'

-----▶ Diver's course

30 m

Fore River Lobster Survey
Site 7, Dive 11, Single transect
Stone pier, North side of channel across from "C3" and "C1"
Heading West
3-23-98

©MER Assessment Corporation, 1998

no lobsters observed

Single transect
 End
 3:38:28
 43° 38' 31.3"
 -70° 16' 26.8" 105°



-mud bottom
 -dive along slope of channel
 -obstructed burrows only

pecbgp.cdr

43° 38' 31.7"
 -70° 16' 24.2"
 Start
 3:35:40
 34.8'

-----▶ Diver's course

30 m

Fore River Lobster Survey
 Site 8, Dive 12, Single transect
 Portland side, East of Cianbro barge at end of granite pier
 Heading West towards pier
 3-23-98
 ©MER Assessment Corporation, 1998

Single transect

no lobsters observed

End 4:02:39 32.2'
43° 38' 25.1"
-70° 16' 27.9"



-Mud bottom
-no burrows
-steady current

43° 38' 26.7" 250°
-70° 16' 25.9"
Start 3:59:58
43.5'

-----> Diver's course

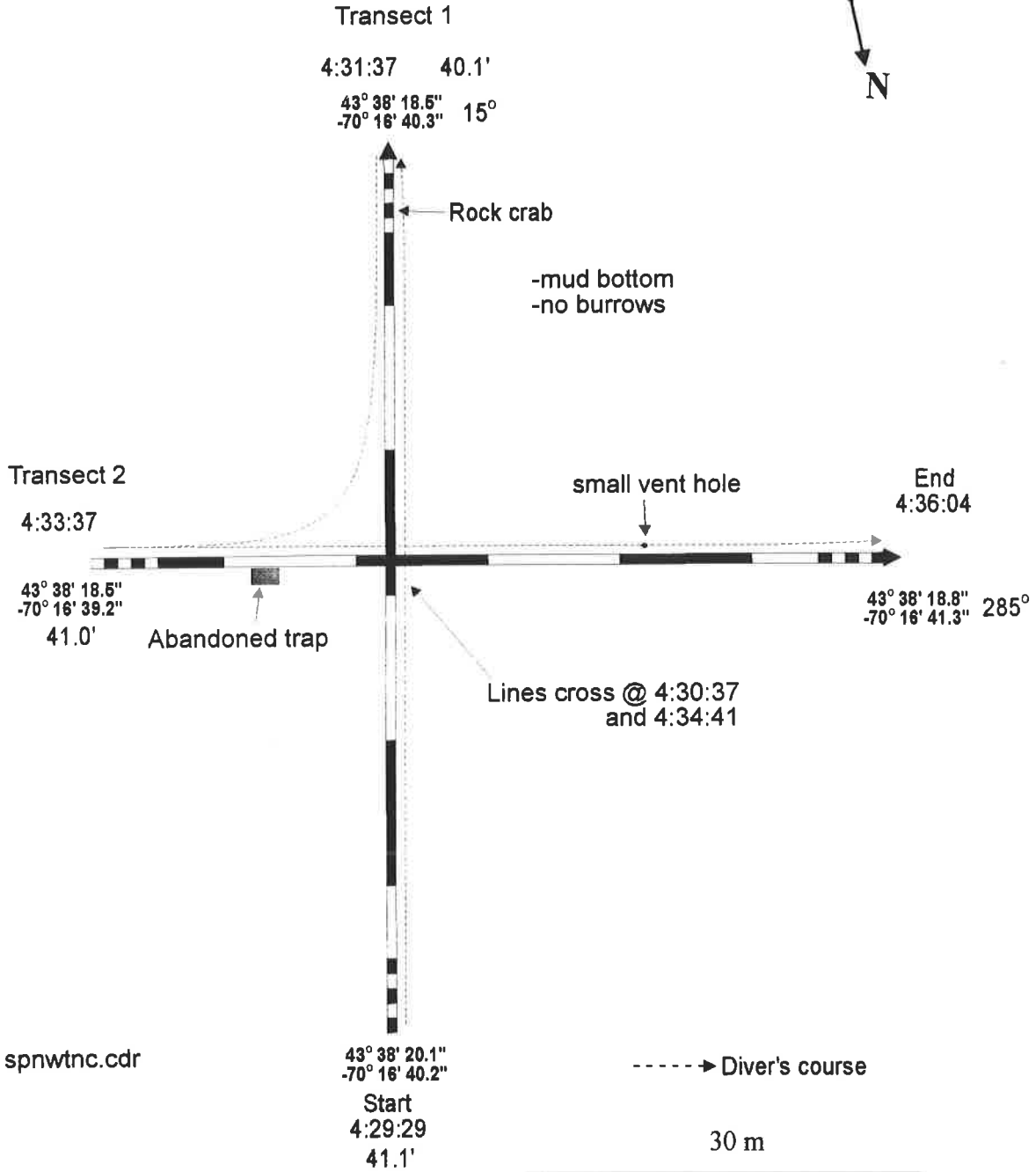
30 m

spswc5.cdr

Fore River Lobster Survey
Site 9, Dive 13, Single transect
Southwest of "C5" marker on the South Portland side
Heading West along edge of the channel
3-23-98

©MER Assessment Corporation, 1998

no lobsters observed



spnwtn.cdr

Fore River Lobster Survey
 Site 9, Dive 14, Double transect
 Northwest of tanker tie-up, North of cemetery on South Portland side
 Heading South first, West second
 3-23-98

©MER Assessment Corporation, 1998

Single transect

End
5:02:50 41.6'

no lobsters observed

43° 38' 23.5" 300°
-70° 16' 57.9"



-mud bottom
-no burrows

westmost.cdr

43° 38' 24.2"
-70° 16' 59.3"

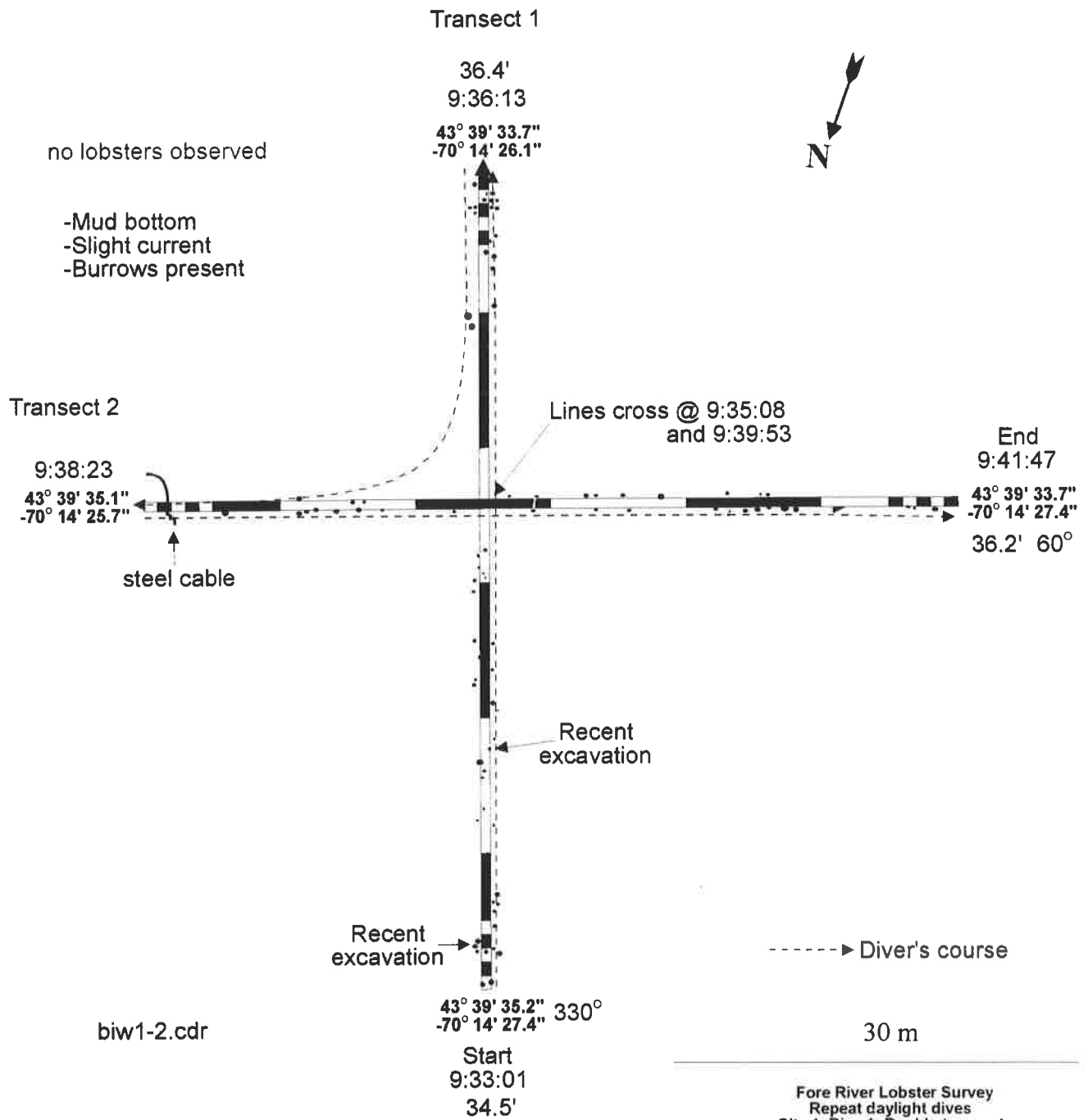
Start
5:00:16
39.8'

-----> Diver's course

30 m

Fore River Lobster Survey
Site 10, Dive 15, Single transect
Western most tanker tie-up, South Portland side
Heading East
3-23-98

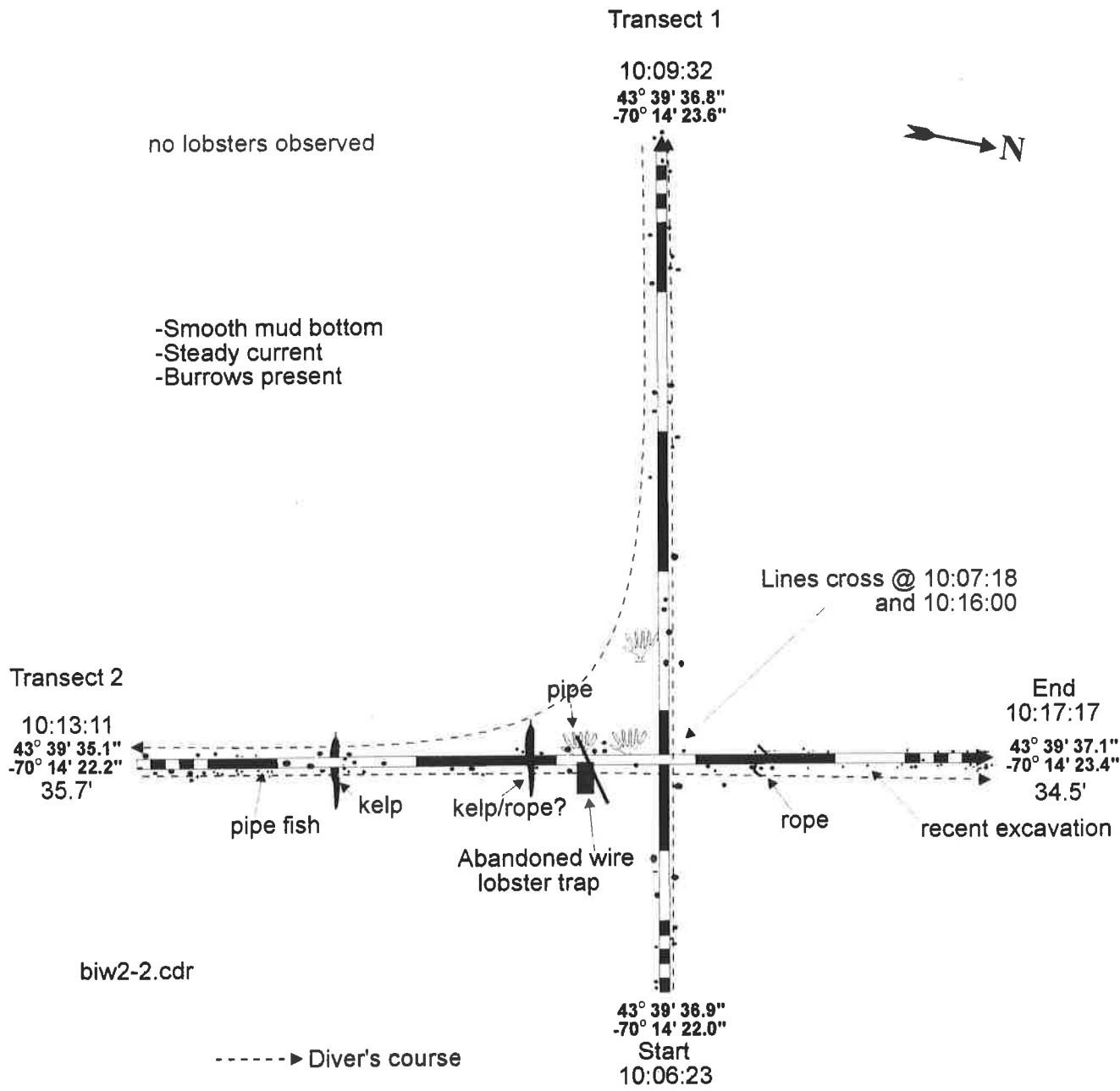
©MER Assessment Corporation, 1998



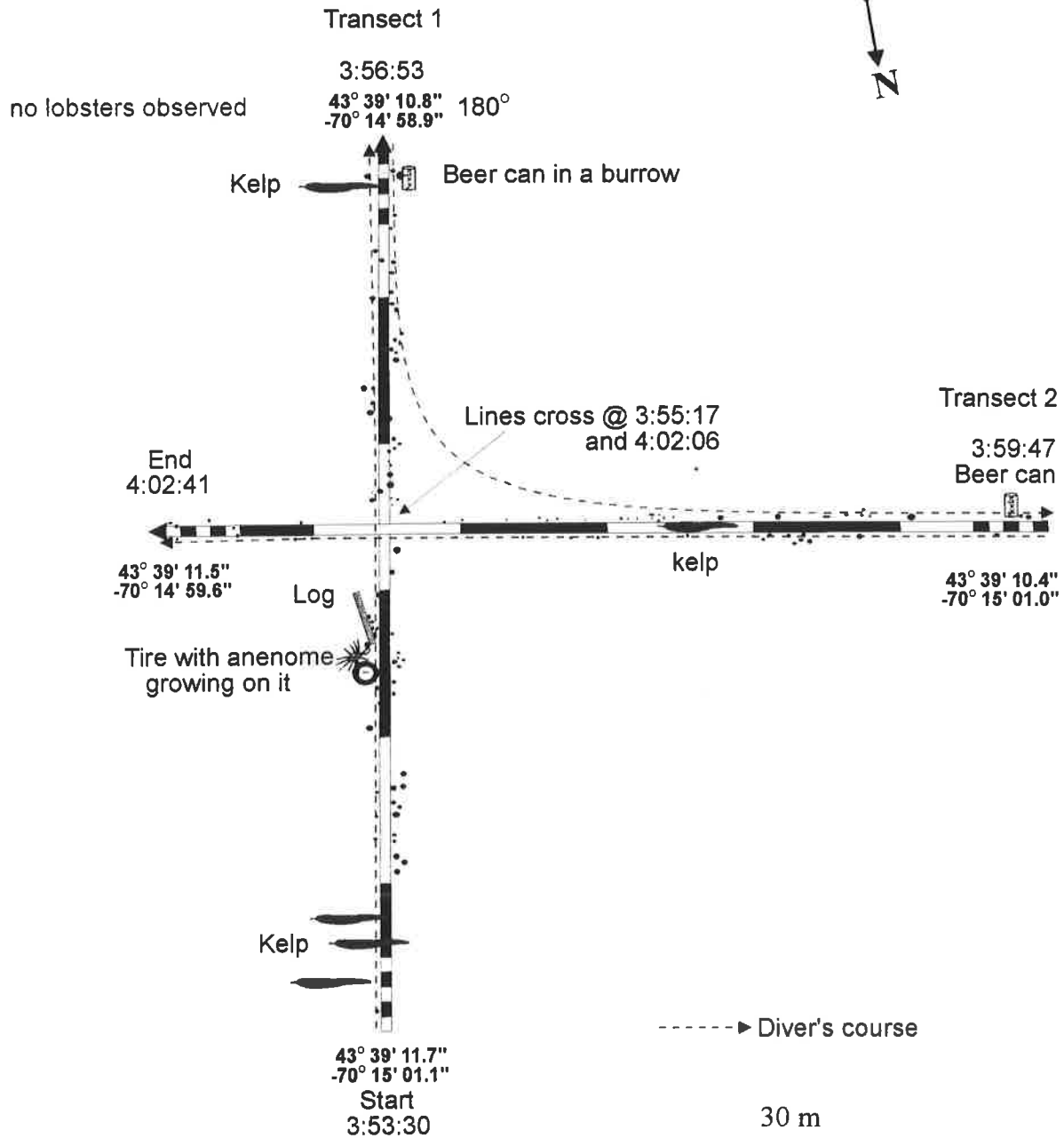
biw1-2.cdr

Fore River Lobster Survey
 Repeat daylight dives
 Site 1, Dive 1, Double transect
 Southwest of BIW dry dock
 Heading South first, West second
 4-16-98

©MER Assessment Corporation, 1998



Fore River Lobster Survey
Repeat daylight dives
Site 1, Dive 2, Double transect
East of dive 1 at BIW dry dock
Heading West first, North second
4-16-98

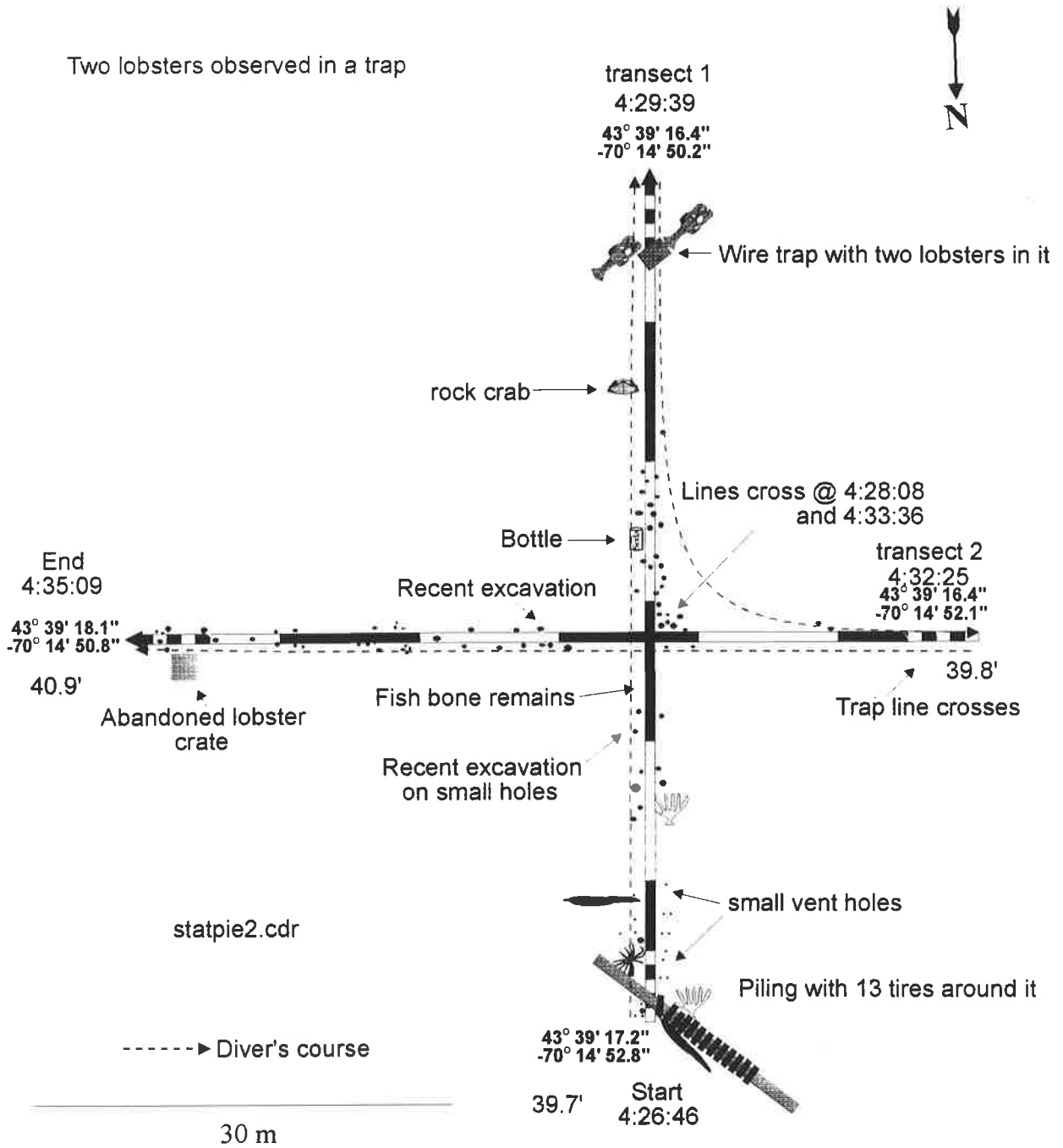


dimillo2.cdr

Fore River Lobster Survey
 Repeat daylight dives
 Site 2, Dive 7, Double transect
 South of Dimillo's restaurant
 Heading South first, East second
 4-14-98

©MER Assessment Corporation, 1998

Two lobsters observed in a trap

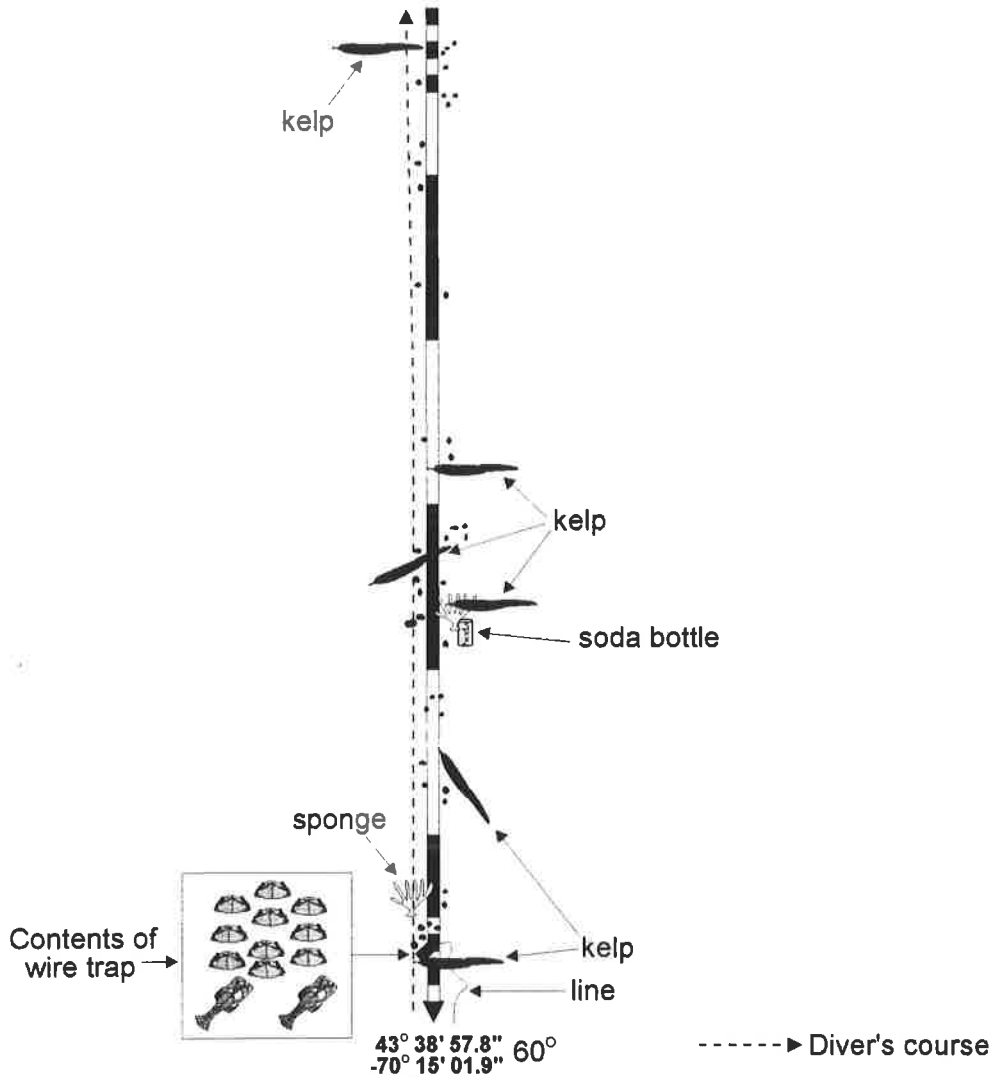


Fore River Lobster Survey
Repeat daylight dives
Site 2, Dive 8, Double transect
West of state pier, South of Custom house wharf
Heading South first, East second
4-14-98

single transect
 End
 10:47:23 36.7'
 43° 38' 56.6"
 -70° 15' 04.1"

two lobsters observed in a trap

↗ N



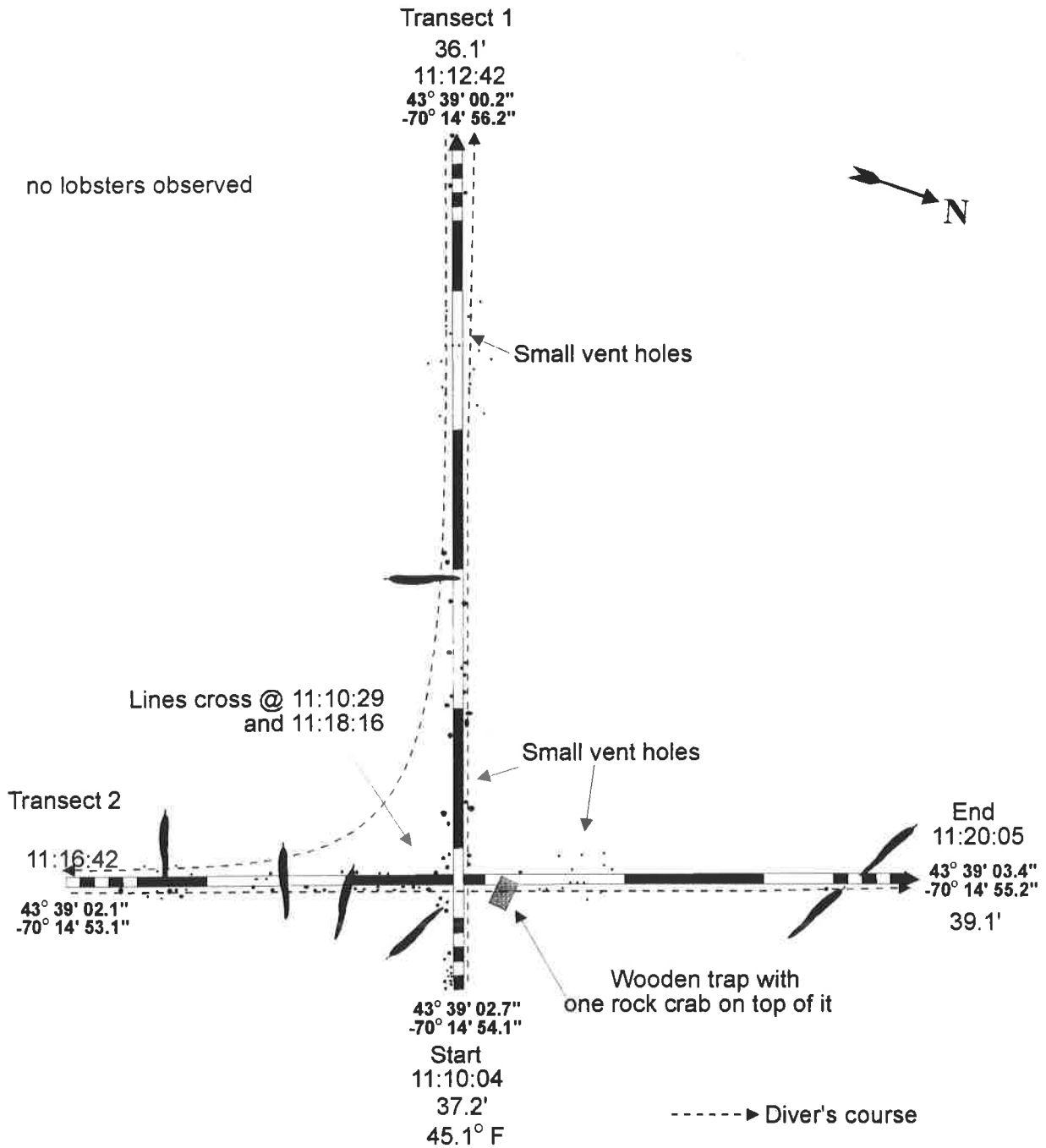
43° 38' 57.8"
 -70° 15' 01.9" 60°

Start
 10:44:30
 37.2'
 45.1° F

30 m

Fore River Lobster Survey
 Repeat daylight dives
 Site 3, Dive 3, Single transect
 East of entrance to Coast Guard station S.P. side
 Heading West
 4-16-98

uscgspe2.cdr

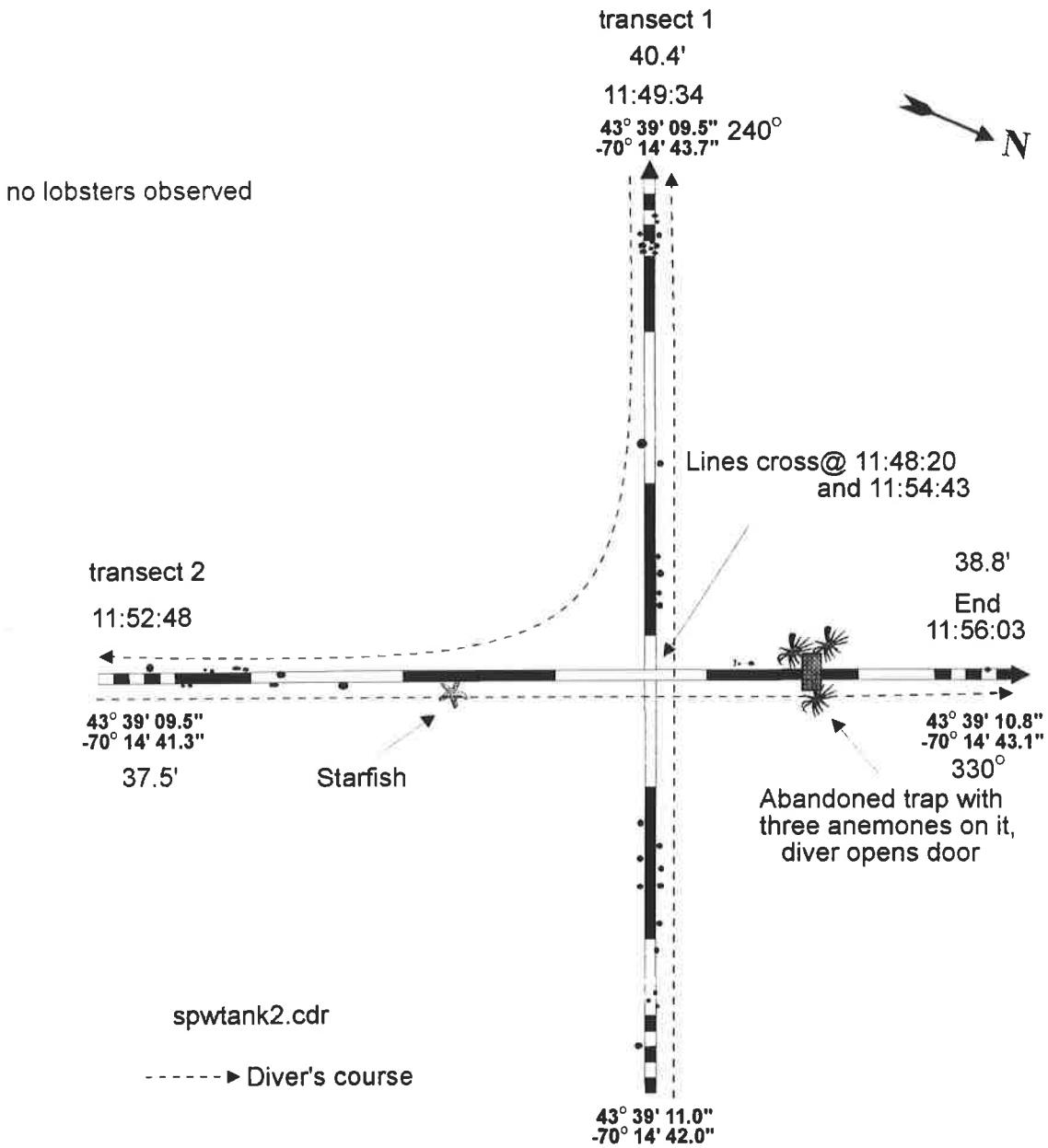


spdimit2.cdr

30 m

Fore River Lobster Survey
Repeat daylight dives
Site 3, Dive 4, Double transect
Across channel from Dimillos restaurant S.P. side
Heading West first, North second
4-16-98

©MER Assessment Corporation, 1998

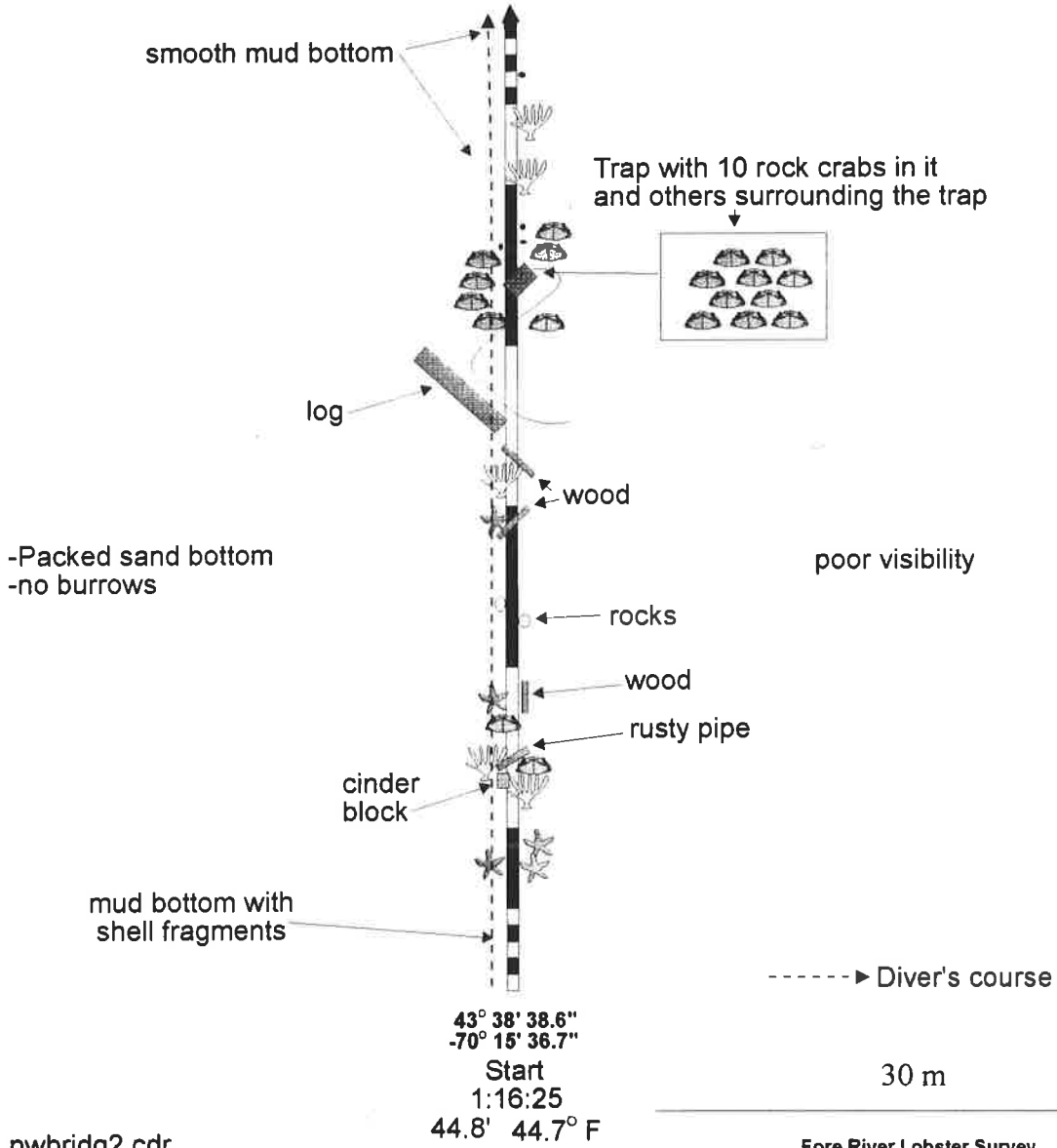


Fore River Lobster Survey
Repeat daylight dives
Site 3, Dive 5, Double transect
Across channel from State pier and Custom house wharf
Heading West first, North second
4-16-98

no lobsters observed

Single transect

End
1:19:39 42.0'
43° 38' 37.8"
-70° 15' 39.1"



pwbridg2.cdr

Fore River Lobster Survey
Repeat daylight dives
Site 4, Dive 6, Single transect
Just West of Casco Bay Bridge on Portland side
Heading West
4-16-96

no lobsters observed

Single transect

43.2'
End
1:38:01

43° 38' 31.1"
-70° 15' 55.1"



rock crabs

stick with sponges on it

Hard mud bottom with
shell fragments

spirvin2.cdr

43° 38' 31.8"
-70° 15' 52.5"

95°

Start
1:35:36

45.2'
44.6° F

-----> Diver's course

30 m

Fore River Lobster Survey
Repeat daylight dives
Site 5, Dive 7, Single transect
Star terminal, S.P. side of channel
Heading West
4-16-98

no lobsters observed

Single transect



43.2' End
1:58:10
43° 38' 29.6"
-70° 16' 09.4"



-Mud bottom
-No burrows

43° 38' 30.9" 90°
-70° 16' 06.3"

spec3-2.cdr

Start
1:55:44
41.8'

-----► Diver's course

30 m

Fore River Lobster Survey
Repeat daylight dives
Site 6, Dive 8, Single transect
Just East of "C3" marker, West of stone pier and Irving gantry
Heading West
4-16-98

©MER Assessment Corporation, 1998

Single transect

no lobsters observed



42.3'

End
2:16:41

43° 38' 33.5"
-70° 16' 05.3" 270°



A few small burrows.

pspc3c12.cdr

43° 38' 34.1"
-70° 16' 03.0"

Start
2:13:38
41.5'

-----▶ Diver's course

30 m

Fore River Lobster Survey
Repeat daylight dives
Site 7, Dive 9, Single transect
North across channel from "C3" and "C1"
Heading West
4-16-98

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no lobsters observed

Single transect
44.3'
End
2:35:04
43° 38' 30.4" 90°
-70° 16' 26.4"



pecbgp2.cdr



-----► Diver's course

30 m

Fore River Lobster Survey
Repeat daylight dives
Site 8, Dive 10, Single transect
Across from "C5" on Portland side
Heading West
4-16-98

©MER Assessment Corporation, 1998

no lobsters observed

single transect

42.7'

End

3:16:28

43° 33' 25.7" 250°
-70° 16' 28.7"



small vent holes

rock crab

sponges

beer cans

Two green crabs

spswc5-2.cdr

43° 38' 26.4"
-70° 16' 26.3"

Start

3:13:41

46.4'

-----> Diver's course

30 m

Fore River Lobster Survey
Repeat daylight dives
Site 9, Dive 11, Single transect
West of "C5", S.P. side of channel
Heading West
4-16-98



no lobsters observed

Transect 1
40.9'
3:45:44
43° 38' 18.5"
-70° 16' 40.7"

Rock crab

Lines cross @ 3:44:06
and 3:49:02

Green crab

transect 2
3:47:57
43° 38' 19.5"
-70° 16' 40.5"
41.9'

End
3:51:08
43° 38' 17.7"
-70° 16' 39.5"
43.1'

Stick

spnwtnc2.cdr

-----> Diver's course

30 m

43° 38' 19.3"
-70° 16' 38.2"
Start
3:42:34
42.1'

Fore River Lobster Survey
Repeat daylight dives
Site 9, Dive 12, Double transect
Northwest of tanker tie-up, North of cemetery on South Portland side
Heading West first, South second
4-16-98

©MER Assessment Corporation, 1998

single transect

41.5'

End

4:17:54

43° 38' 23.5"
-70° 16' 57.4"

no lobsters observed



Starfish



no burrows

Mysid shrimp

westmos2.cdr

43° 38' 24.6"
-70° 16' 59.5"

Start

4:15:15

43.9'

-----▶ Diver's course

30 m

Fore River Lobster Survey
Repeat daylight dives
Site 10, Dive 13, Single transect
Western most tanker tie-up, South Portland side
Heading East
4-16-98

Appendix III

Video Survey Graphics

b. April 10 Night Dives

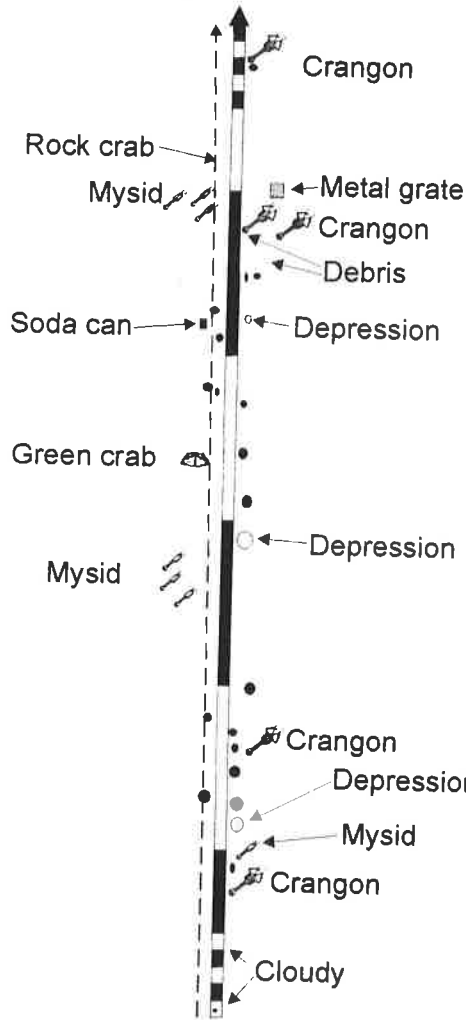
Night dive #1

No lobsters observed



Single transect

End
8:32:30
43° 38' 36.7"
-70° 16' 05.3"



night1.cdr

43° 38' 33.1"
-70° 16' 02.9"

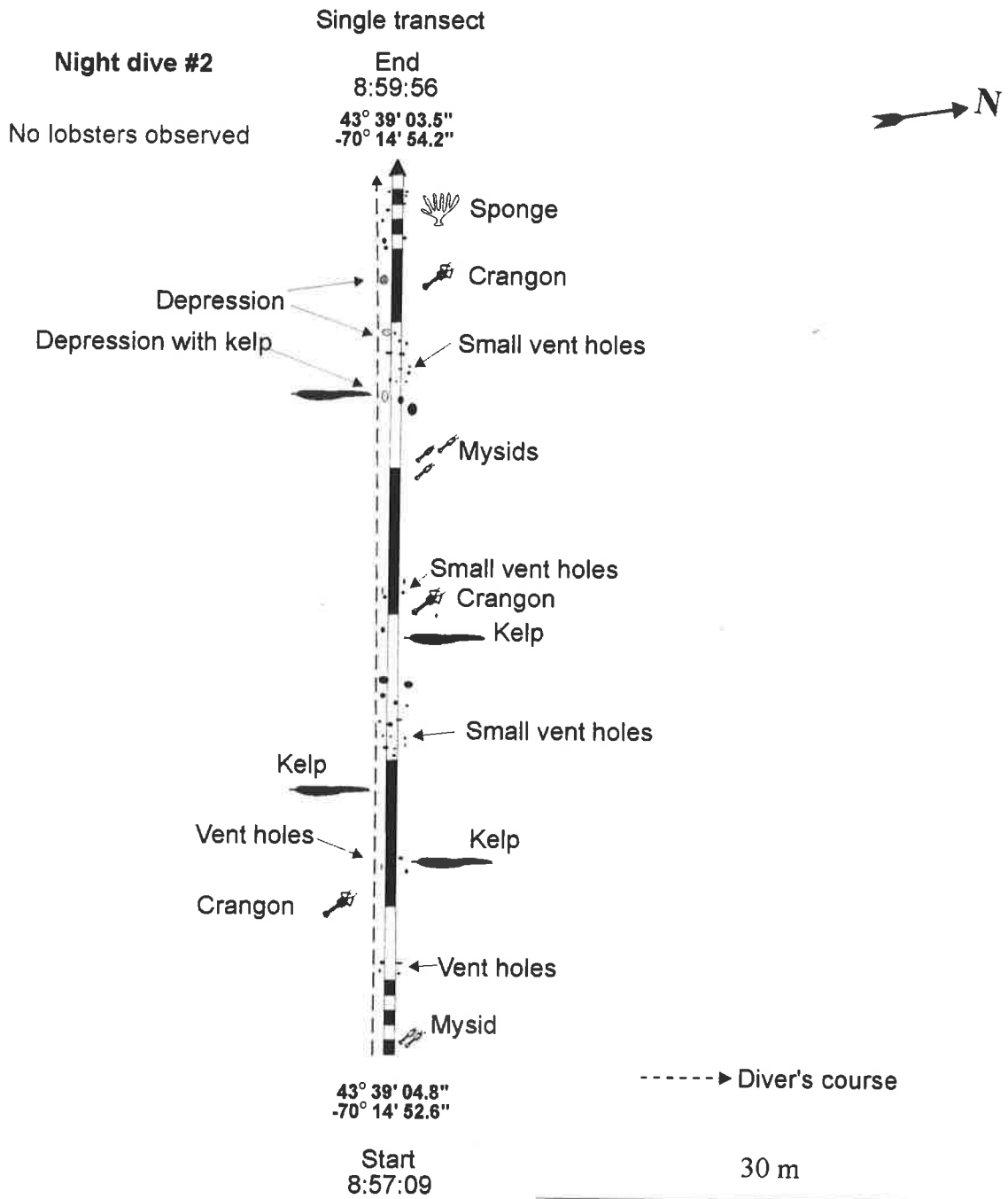
Start
8:29:08

-----> Diver's course

30 m

Fore River Lobster Survey
Site 7, Night Dive 1, Single transect
Stone pier, North side of channel across from "C3" and "C1"
Heading West
4-10-98

©MER Assessment Corporation, 1998

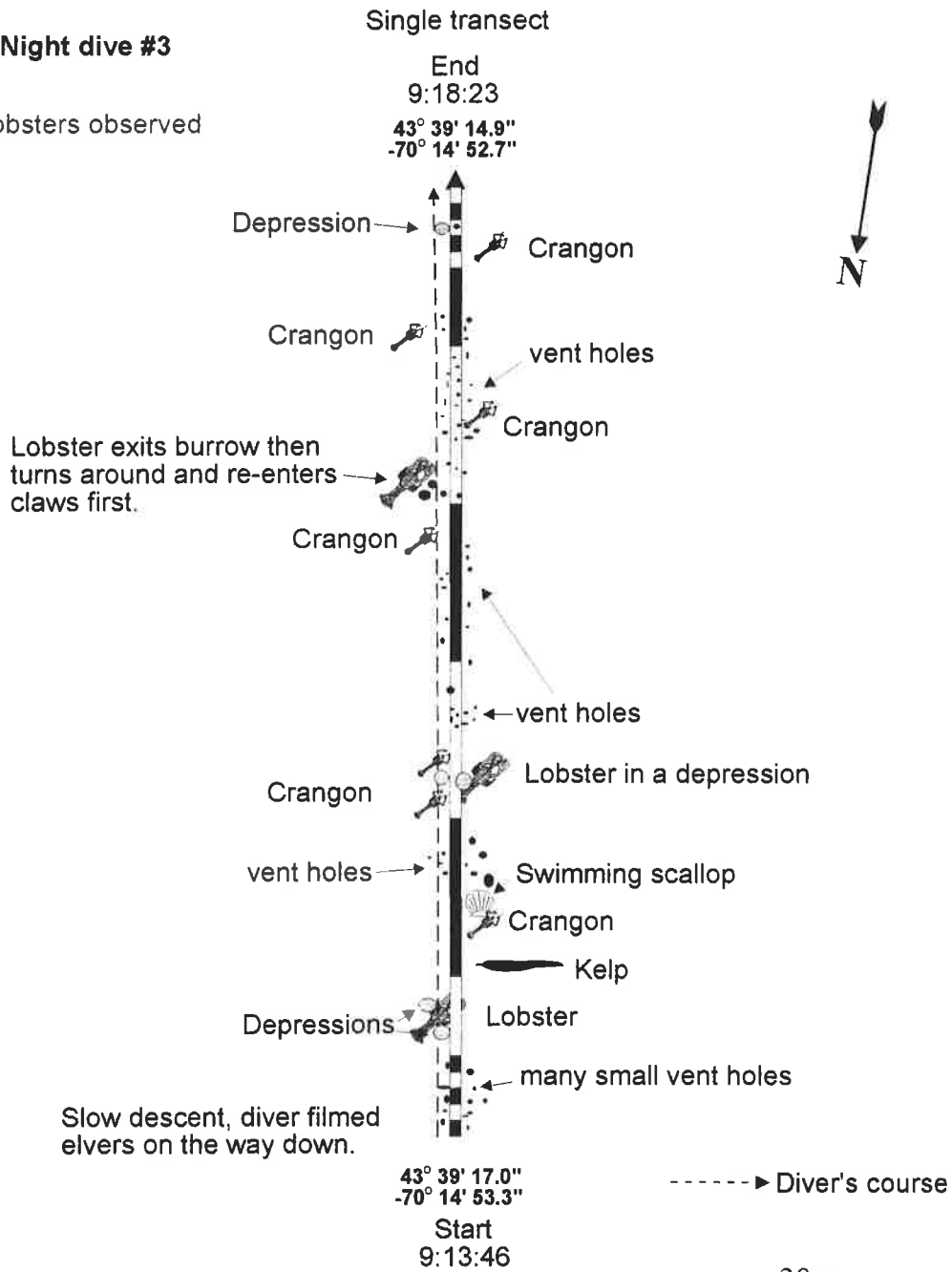


night2.cdr

Fore River Lobster Survey
Site 3, Night Dive 2, Single transect
Across channel from DiMillo's restaurant on South Portland side
Heading West
4-10-98
©MER Assessment Corporation, 1998

Night dive #3

3 Lobsters observed



Slow descent, diver filmed elvers on the way down.

night3.cdr

Fore River Lobster Survey
Site 2, Night Dive 3, Single transect
West of State pier, Portland side of channel
Heading South
4-10-98

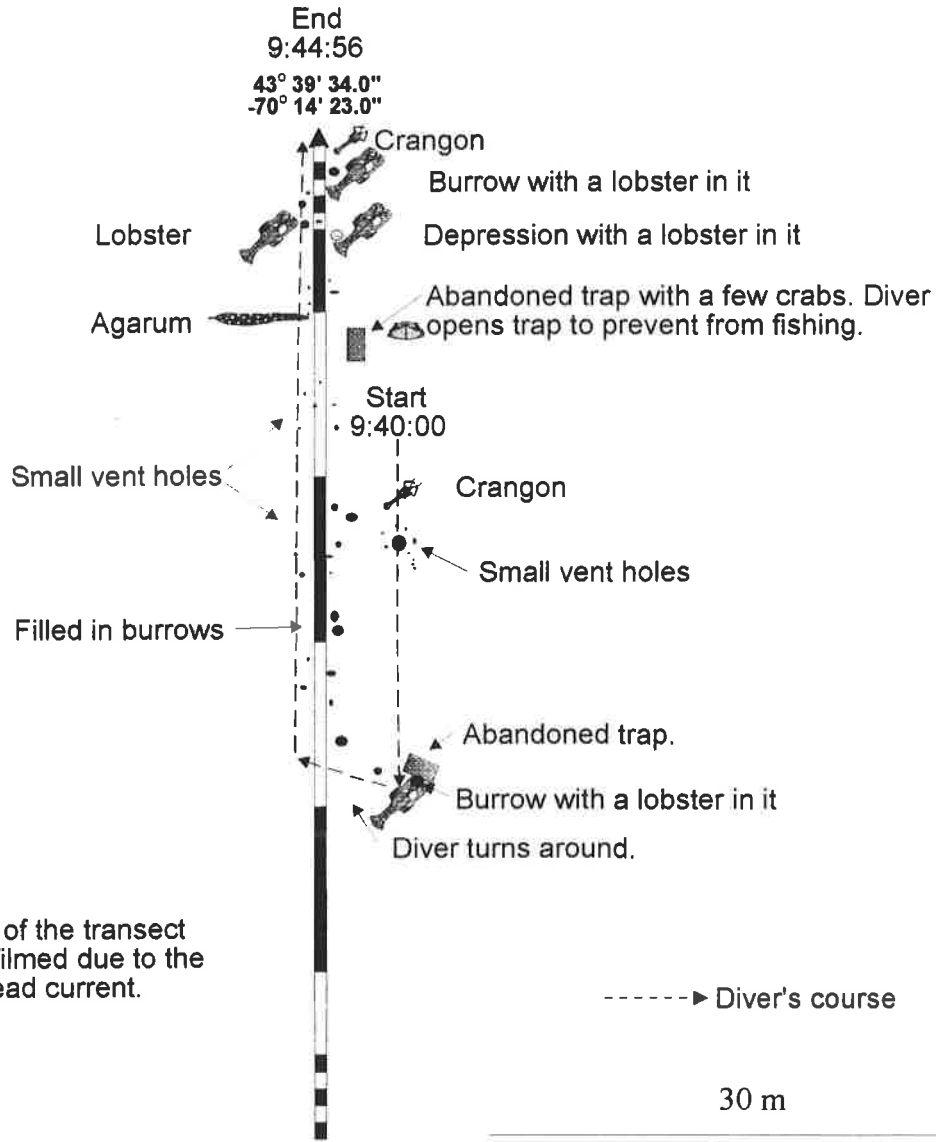
©MER Assessment Corporation, 1998

Night dive #4

4 Lobsters observed



Single transect



This end of the transect was not filmed due to the strong head current.

-----▶ Diver's course

30 m

43° 39' 32.4"
-70° 14' 24.6"

Fore River Lobster Survey
Site 1, Night Dive 4, Single transect
Off of BIW dry dock @ 100° Southeast corner
Heading West then East
4-10-98

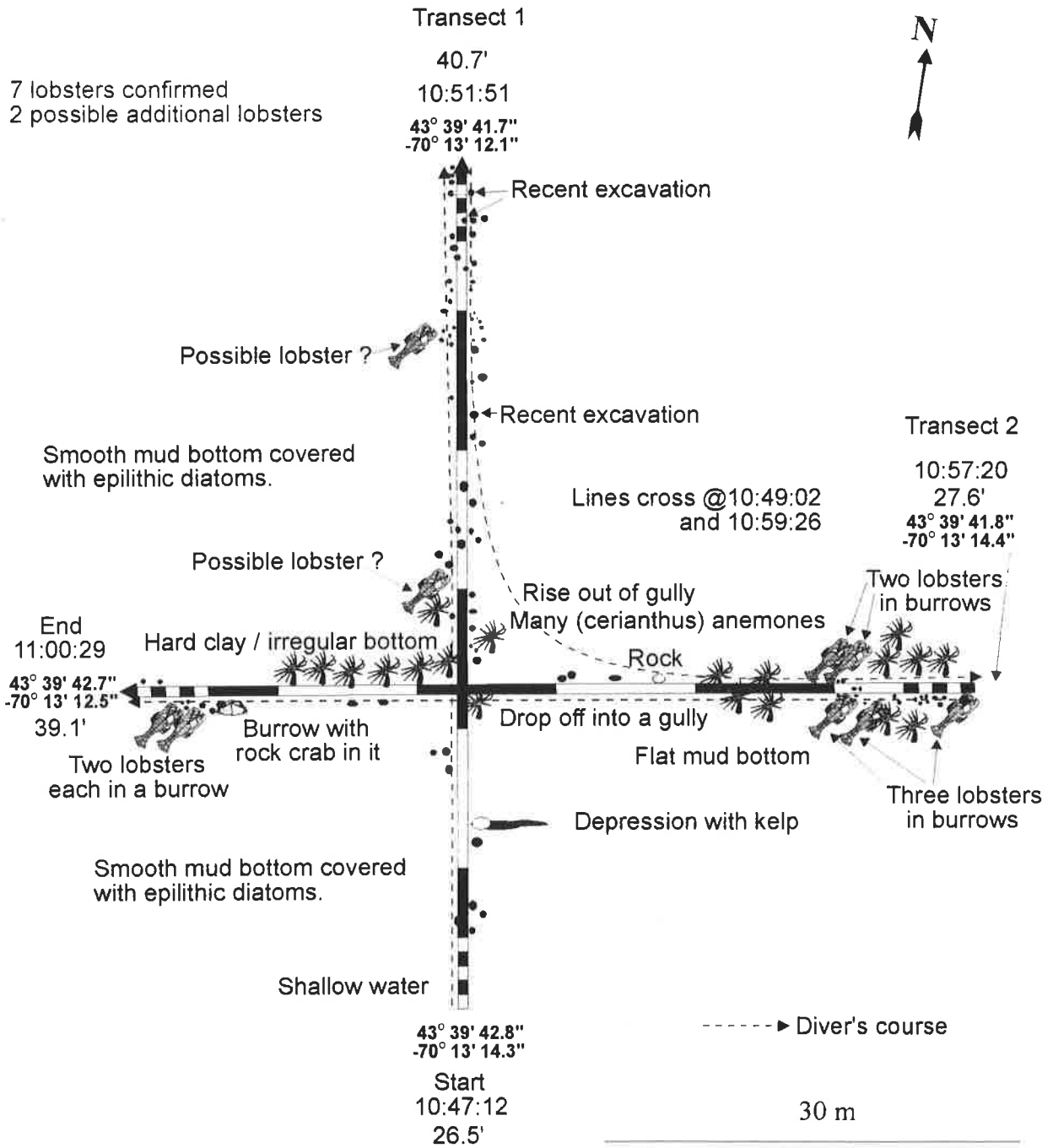
night4.cdr

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Appendix III

Video Survey Graphics

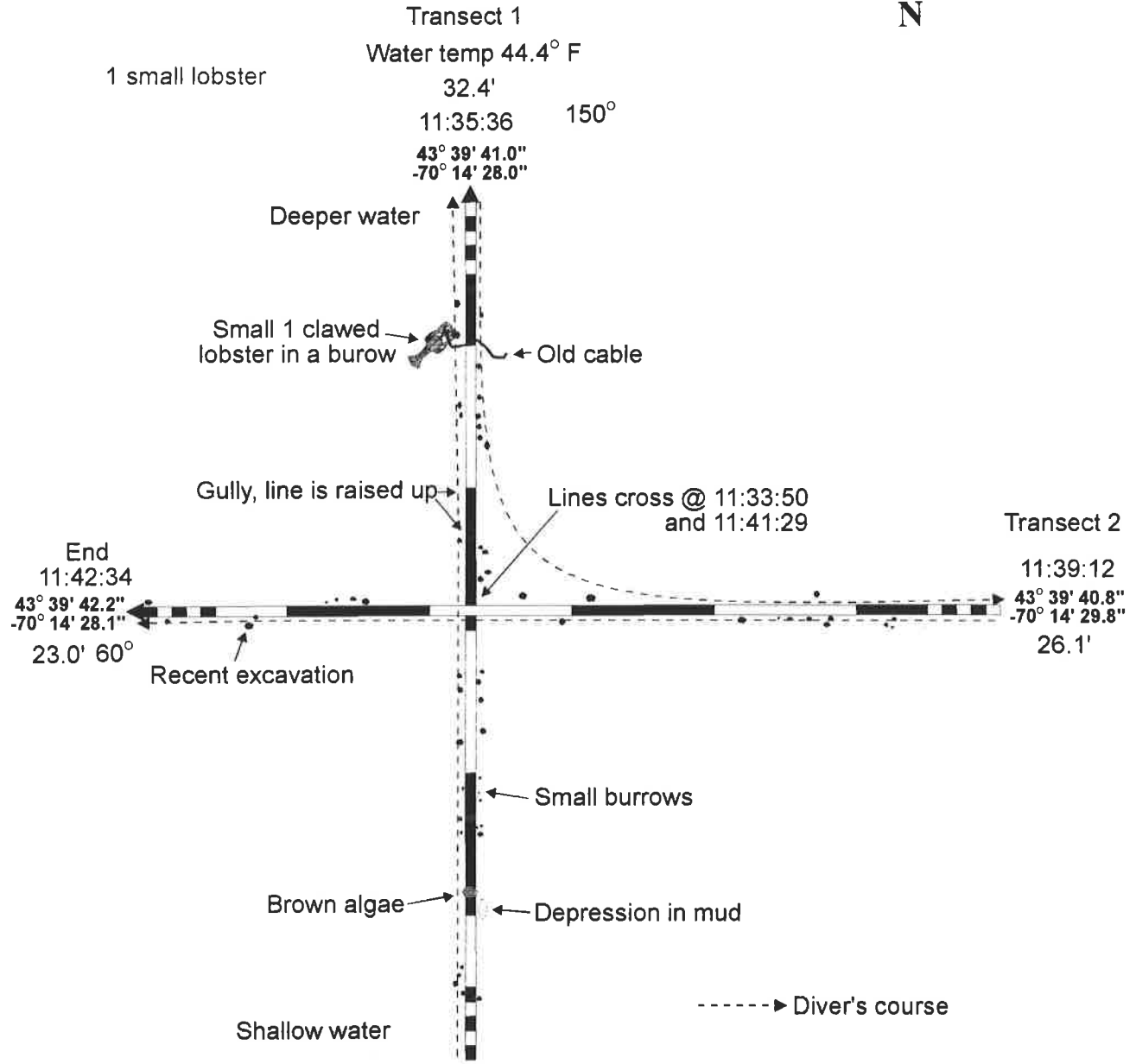
c. Expanded Areal Survey (Outside proposed dredge areas)



expand1.cdr

Fore River Lobster Survey
Expanded Area Coverage
Site E1, Dive 1, Double transect
Just South of Fort Gorges (Control area)
Heading South first, East second
4-14-98

©MER Assessment Corporation, 1998



1 small lobster

Transect 1
Water temp 44.4° F
32.4'
11:35:36 150°
43° 39' 41.0"
-70° 14' 28.0"

Deeper water

Small 1 clawed lobster in a burow

Old cable

Gully, line is raised up

Lines cross @ 11:33:50 and 11:41:29

Transect 2

End
11:42:34
43° 39' 42.2"
-70° 14' 28.1"
23.0' 60°

Recent excavation

11:39:12
43° 39' 40.8"
-70° 14' 29.8"
26.1'

Small burrows

Brown algae

Depression in mud

Shallow water

-----> Diver's course

43° 39' 41.9"
-70° 14' 30.0"
Start
11:32:08
18.8'

30 m

expand2.cdr

Fore River Lobster Survey
Expanded area coverage
Site E2, Dive 2, Double transect
Adjacent to BIW dry dock, North of previous site 1
Heading South first, East second
4-14-98

©MER Assessment Corporation, 1998

No lobsters observed



Transect 1

44'

12:13:43

43° 39' 24.9"
-70° 14' 38.5" 150°

-Soft mud bottom
-Burrows of all sizes

Lines cross @ 12:12:07
and 12:19:27

Brown algae
obstructing a burrow

Transect 2

12:17:05

43° 39' 26.7"

-70° 14' 38.2"

60° 43.6'

End

12:20:08

43° 39' 25.7"

-70° 14' 38.4"

43.6'

Turns to silty mud

Stick

43° 39' 26.3"

-70° 14' 39.6"

Start

12:10:06

42.1'

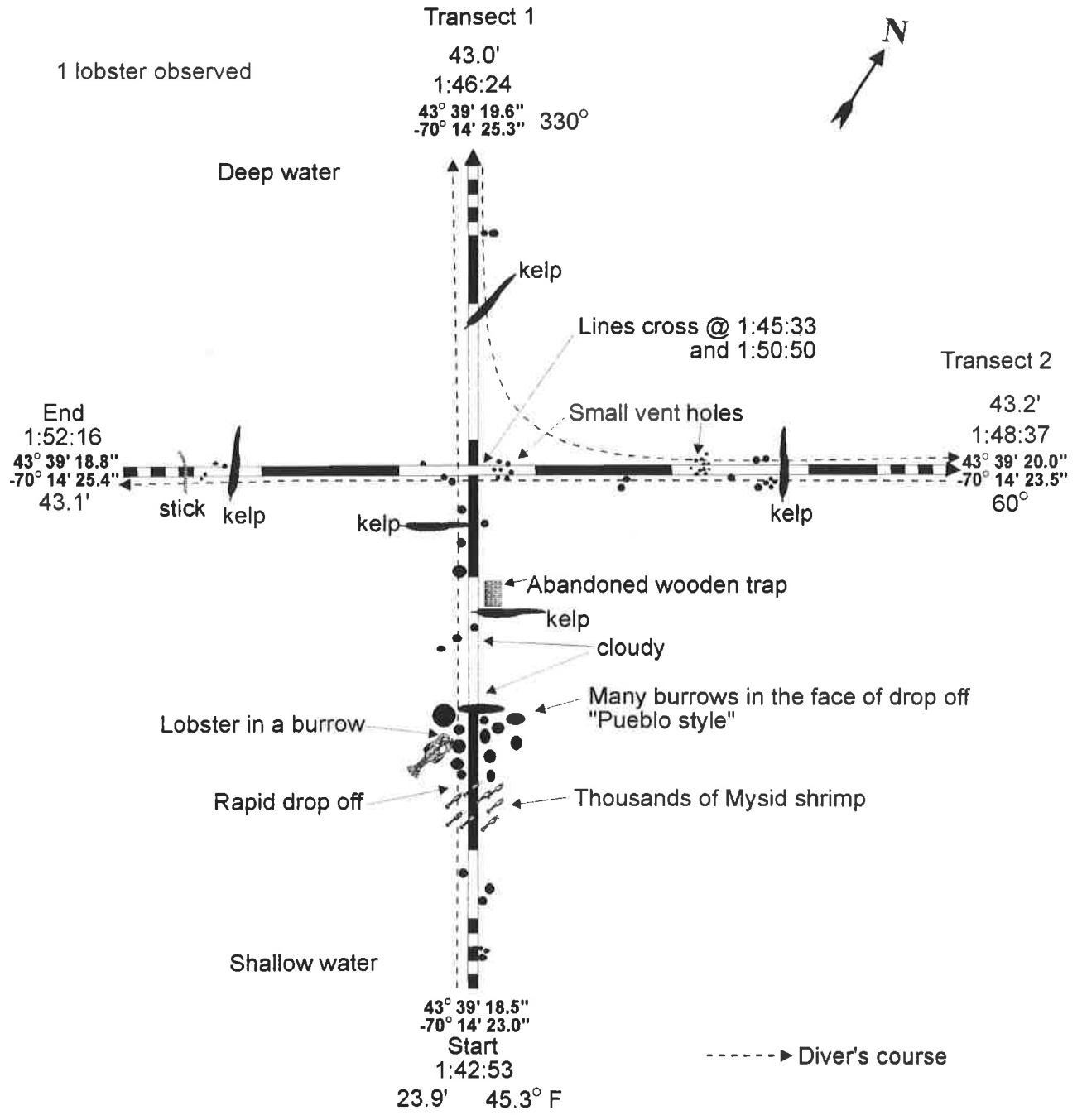
-----> Diver's course

30 m

Fore River Lobster Survey
Expanded area coverage
Site E3, Dive 3, Double transect
Southwest of BIW dry dock
Heading South first, West second
4-14-98

©MER Assessment Corporation, 1998

expand3.cdr

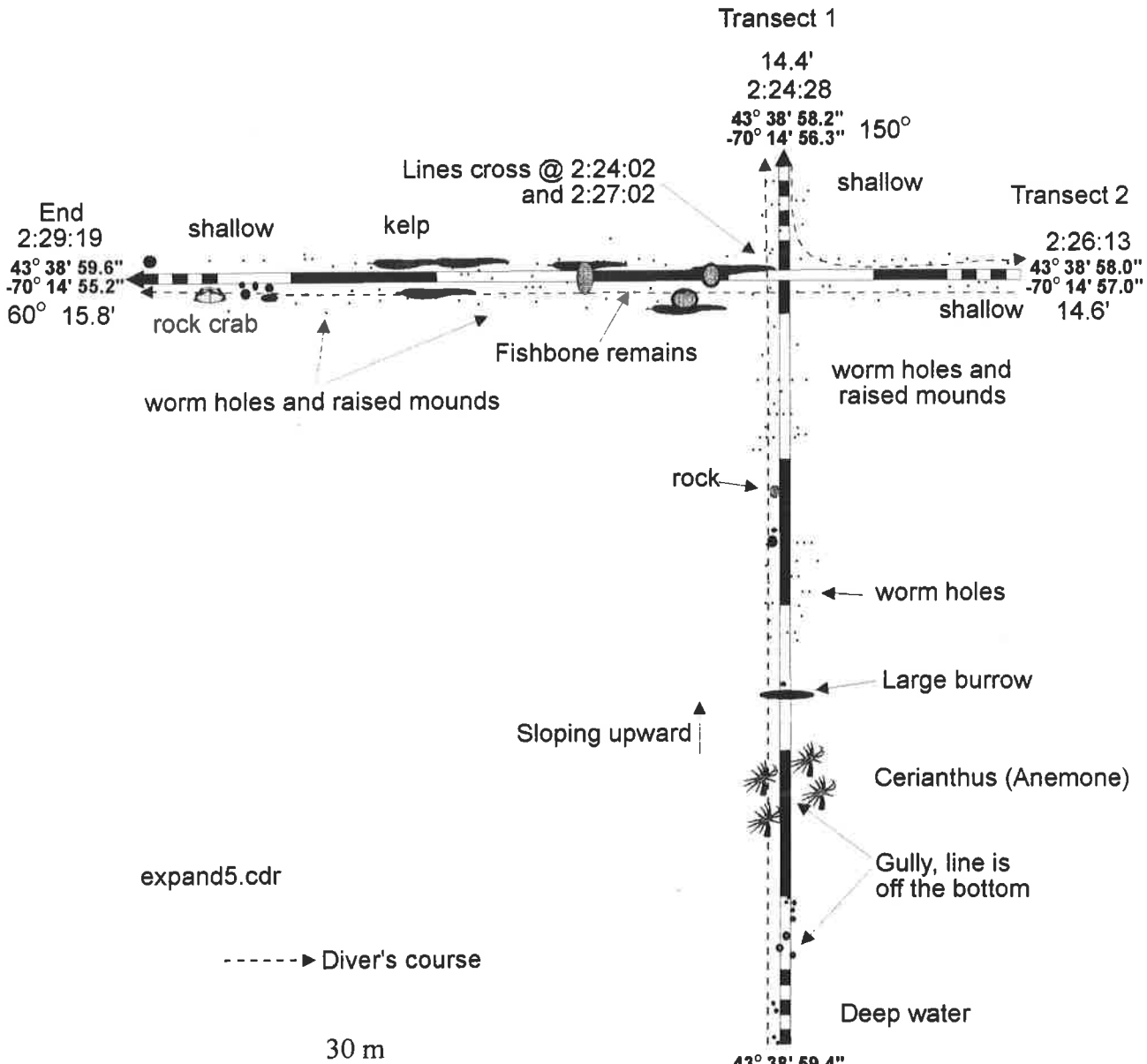


expand4.cdr

Fore River Lobster Survey
 Expanded area coverage
 Site E4, Dive 4, Double transect
 Across channel from BIW dry dock
 Heading North first, West second
 4-14-98

©MER Assessment Corporation, 1998

No lobsters observed



expand5.cdr

-----> Diver's course

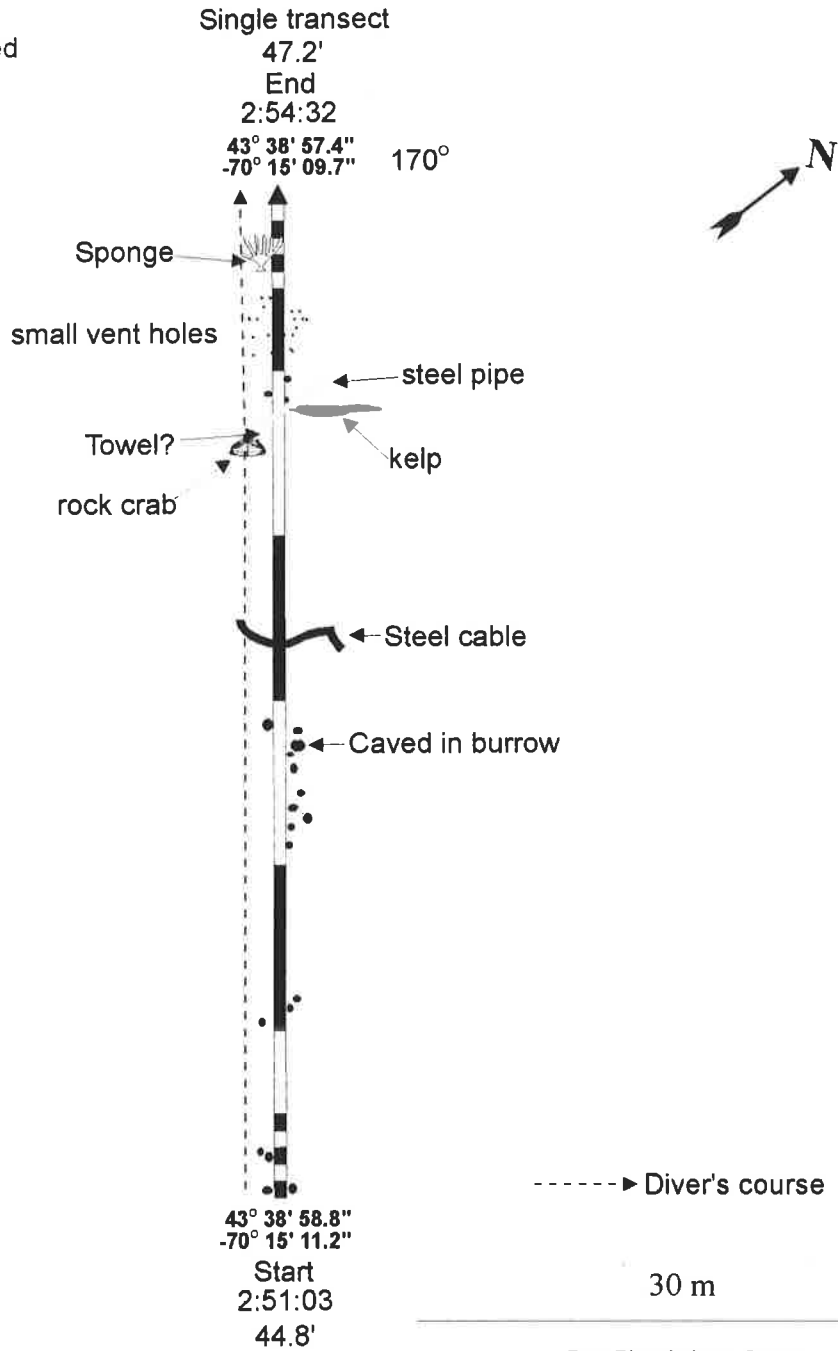
30 m

Fore River Lobster Survey
 Expanded area coverage
 Site E5, Dive 5, Double transect
 East of entrance to Coast Guard station on
 South Portland side of the channel
 Heading South first, East second
 4-14-98

©MER Assessment Corporation, 1998

43° 38' 59.4"
 -70° 14' 58.1"
 Start
 2:20:35
 41.2'

No lobsters observed



expand6.cdr

Fore River Lobster Survey
Expanded area coverage
Site E6, Dive 6, Single transect
Across from Coast Guard station on
Portland side of channel in line with nuns
Heading South
4-14-98

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