Enclosure 1 to Letter No. B04812

ECOLOGICAL STUDIES PROPOSED FOR 1992 AT MILLSTONE NUCLEAR POWER STATION

NORTHEAST NUCLEAR ENERGY COMPANY
MILLSTONE NUCLEAR POWER STATION
NPDES PERMIT No. CT0003263

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FISH ECOLOGY STUDIES

The objectives of the fish ecology sampling program are to monitor the occurrence, relative abundance, and distribution of finfish in the vicinity of Millstone Point, and assess whether there are any power plant-induced changes in the fish communities.

Shore-zone Seine

Shore-zone fish will be collected with a 30-foot seine net of 0.25-inch mesh at three sites (Fig. 1): White Point (WP), Jordan Cove (JC), and Giants Neck (GN). During the year, sampling at all stations will be conducted monthly during January through March and in November and December, and biweekly from April through October. Three 100-foot hauls at adjacent beach areas will be made approximately parallel to the shoreline at each site. The fish in each haul will be identified, counted, and measured. When a large number of a fish is caught, length measurements will be made on a representative subsample. Every effort will be made to return fish to the water alive.

Trawl

Sampling by trawl will be conducted biweekly at six sites (Fig. 1): Niantic River (NR), Niantic Bay (NB), Jordan Cove (JC), Twotree Island Channel (TT), Bartlett Reef (BR), and Intake (IN). Triplicate tows will be made using a 30-foot otter trawl with a 0.25-inch cod-end liner. Under certain rarely occurring conditions, which would include damage to the boat or trawl net or severe weather, the number of tows at a station may be reduced from three to two. If only one tow has been made, the station will be re-sampled later in the week. When excessive loading of the trawl occurs by macroalgae and detritus, tow distances may be reduced, but catches will be standardized to 0.69 km. All fish collected will be identified, counted, and a representative number of selected species will be measured in the field. Every effort will be made to return the fish to the water alive.

Ichthyoplankton Monitoring

The objectives of the entrainment and offshore plankton programs are to monitor changes in density or seasonal occurrence of fish eggs and larvae in the vicinity of MNPS and to quantify the number of these organisms passing through the condenser cooling water system.

Entrained ichthyoplankton will be sampled weekly at the discharge of Unit 1, 2, or 3. Samples will be collected with a 1-m, 0.333-mm mesh net, and each sample will consist of about 400 m^3 of filtered water. Sample volume may be reduced during periods of high plankton or detritus concentrations. The planned monthly sampling frequencies and the early life history stages (eggs and/or larvae) that are identified and enumerated are provided in Table 1. This sampling design is a result of several evaluations that increased the efficiency of the monitoring program by maximizing the number of samples collected during the periods of greatest ichthyoplankton abundance.

Offshore ichthyoplankton sampling will be conducted in mid-Niantic Bay (station NB in Fig. 1) with a 60-cm bongo sampler. Oblique stepwise tows will be made for 6 to 15 minutes using 0.202- (generally February and March) or 0.333-mm mesh nets with equal sampling time at the surface, mid-depth, and near bottom. Tow duration may be reduced to less than 15 minutes during periods of high plankton or detritus concentrations. Each tow represents a sample volume of about 120 m^3 (6-minute tow) to 300 m^3 (15-minute tow). Monthly sampling frequency is provided in Table 1; with this design the sampling effort is greatest during high ichthyoplankton abundance. Larvae from these samples will be identified and enumerated, but fish eggs will only be enumerated from the NB collections.

Impingement Monitoring

Routine impingement monitoring at Unit 2 was discontinued in December 1987 and was replaced by a procedure to monitor unusual impingement events (more than 300 fish or crustaceans in a 24-hour period). Plant operators check the impingement basket as part of their regular rounds and if large numbers of fish or crustaceans are in the basket they will notify NUSCO staff biologists. The latter will then identify, count, and measure up to 50 specimens and report results to the DEP as part of the monthly operating report.

Winter Flounder Studies

The objectives of the winter flounder studies are to investigate the population dynamics of this species and assess possible MNPS impacts, such as the entrainment of larvae through the cooling-water system. Studies of winter flounder in the Millstone Point area of Long Island Sound have been conducted since 1973 and have largely focused on the stock known to spawn in the Niantic River. Studies planned for 1992 are described below.

Adult Population Abundance Index: The population abundance index for the adult (>20 cm) Niantic River stock will be estimated during the spawning season using both a mark-recapture model and trawl catch-per-unit-effort (CPUE). The survey of adult winter flounder abundance in the Niantic River will begin after ice-out, which usually occurs in February. Sampling will be conducted on at least two days each week (weather or water conditions permitting) and will continue until the proportion of gravid females decreases to less than 10% of all females examined during two consecutive weeks (usually in early April). During each week, approximately 30-40 tows will be made using an otter trawl in up to eight areas of the river (1, 2, 4, 6, 51, 52, 53, and 54 in Fig. 2). The tows will be allocated to stations based on area and observed abundance of winter flounder. The sex ratio and length distribution of the population will be determined.

Larval Studies: Larval winter flounder studies will be conducted to estimate natural survival rates, to determine the spatial and temporal distribution of larvae in Niantic River and Bay, and to estimate the number entrained at MNPS. Sampling in the Niantic River will start in February (ice conditions permitting) with preliminary tows made in the upper portion of the river to determine when larvae are first present. After larvae are present, routine sampling will be conducted at stations A, B, and C (Fig. 1). Weather permitting, sampling will be conducted one day a week with a 60-cm bongo sampler. Oblique stepwise tows will be made for 6 minutes with equal sampling time at surface, mid-depth, and near bottom. From the start of routine sampling through the end of March, collections will be made during daylight within 1 hour of low slack tide using 0.202-mm mesh nets. For the remainder of the season, collections will be made at night with 0.333-mm mesh nets during the second half of a flood tide. Sampling will continue at each station until no larvae are found or they are collected in low densities (<30 per 500 m^3). This sampling design is based on the results of several years of sampling and is structured to maximize the catch of larvae. The sampling schedule may be modified due to adverse weather.

Post-larval Juvenile Studies in Niantic River and Bay: Post-larval winter flounder in the Niantic River will be sampled weekly beginning when most larvae have metamorphosed to demersal juveniles (usually late May) at two stations (LR and WA in Fig. 3). These data will be used to monitor juvenile abundance and to estimate the mortality rate during this post-larval period. Four tows of a 1-m beam trawl (two replicates with each of two successive mesh sizes) will be made during the day within a period extending from 2 hours before to 1 hour after high tide. Depending upon weather and wind conditions, similar sampling on the same date will also be conducted in Niantic Bay at stations BP and RM (Fig. 3). The latter two stations will be sampled either before or after the stations in the river, depending upon the time of sunrise or sunset in relation to high tide. Collections at a station will cease at the end of September or when the mean

density of young winter flounder is less than 1 per 100 m^2 for two consecutive weeks.

Specimens Supplied for Research

Depending upon his needs, NUSCO will continue to supply biweekly as many as 40 adult winter flounder to Dr. Larry Renfro for physiological research at the University of Connecticut. NUSCO may also cooperatively supply limited numbers of fish or invertebrates for research needs at the Universities of Connecticut and Rhode Island, Wesleyan University, the National Marine Fisheries Service, and other legitimate scientific or educational institutions.

BENTHIC STUDIES

Subtidal and Intertidal Sand Study

The subtidal and intertidal sand programs have been designed to assess the potential impact of construction and operation of MNPS on the local infaunal communities. To meet the objectives, samples will be collected four times a year (March, June, September, and December) at four subtidal and three intertidal stations (Fig. 4a). Station locations are as follows: Giants Neck subtidal and intertidal, Intake subtidal, Effluent subtidal, Jordan Cove subtidal and intertidal, and White Point intertidal. Ten replicates will be taken at each station with a 10 cm diameter corer to a 5 cm depth to describe density and distribution of the dominant forms. The samples will be fixed with buffered formalin for at least 48 hours, stained with rose bengal, sieved through a 0.5 mm mesh screen, and stored in 70% ethanol. The organisms retained by the screen will be sorted from debris, identified to the lowest practical taxon, and enumerated.

Intertidal Rocky Shore Study

The objectives of this program are to characterize the rocky intertidal areas in the vicinity of MNPS in terms of the attached algae and sessile invertebrates, and to determine if differences in abundance or distribution of these intertidal species could be attributed to the operation of MNPS.

The monitoring program will include qualitative algal collections, percentage cover estimates of intertidal organisms, measurement of community recolonization, and growth studies of *Fucus vesiculosus* and *Ascophyllum nodosum*. Rocky shore study sites are located as follows: Giants Neck, Bay Point, Millstone Point, Twotree Island, Fox Island - Exposed, Fox Island - Sheltered, White Point, and Seaside (Fig. 4b).

Quantitative and qualitative collections will be made at least bimonthly at all stations except Twotree Island, where only qualitative collections will be made. Each quantitative collection will consist of sampling permanently marked undisturbed strip transects (5 per station) that run from mean high to mean low water levels, and are divided into 0.5 x 0.5 m quadrats. The percentage of all organisms and remaining free space in each quadrat will be estimated. At each of four sites (Giants Neck, Fox Island - Exposed, Fox Island - Sheltered, and White Point), three similar transects (recolonization strips) that were denuded by burning and scraping in March 1991 will be sampled until rates and patterns of community recovery under three-unit operating conditions have been determined. Qualitative algal collections will be made from the transect area and habitats not sampled quantitatively (e.g., tide pools, crevices, and sublittoral fringe). Inclusion of these micro-habitats will allow us to characterize the rocky shore sites in terms of the species and developmental stages found at each sampling time.

At three rocky shore sites (Giants Neck, Fox Island, and White Point), populations of *Ascophyllum nodosum* (a large perennial brown alga) will also be monitored. At each site, 5 tagged growing tips on each of 50 tagged plants will be measured from the top of the most recently formed vesicle to the apex. The increase in length over time will be a measure of growth, and the pattern of loss of tagged tips and plants will be a measure of mortality. Growth of *Fucus vesiculosus*, another perennial brown alga, will be monitored at four rocky shore sites (Giants Neck, Fox Island - Exposed, Fox Island - Sheltered, and White Point). At each site, 18 permanently marked 20 x 20 cm areas (six each in high, mid, and low intertidal zones) will be sampled bimonthly. Nine of these areas at each site (three in each zone) are protected from grazing and predation by stainless steel mesh exclusion cages. If *Fucus* thalli are present in caged or control areas, the 20 longest plants will be measured from the holdfast to the tip.

Exposure Panels

The objectives of this study are to quantify the abundances of wood-boring species in the Millstone area and to relate these abundances to wood-loss from exposure panels. Standardized pine panels (25.4 x 9.5 x 2.0 cm) will be placed at five dock sites in the Millstone area and at three sites of increasing distance from the Millstone Quarry Cuts: White's dock at White Point (WP); the Northeast Utilities Environmental Laboratory dock next to Fox Island (FI); the MNPS Quarry effluent (EF); Fredrick's dock at Black Point (BP); Harcke's dock at Giants Neck (GN); and at 100, 500, and 1000 m from the Quarry Cuts (Fig. 4c).

At each dock site, a set of six replicated panels (25.4 X 9.5 cm) will be deployed in February, May, and August. Panels will be retrieved after 6 months of exposure and processed. The density of *Limnoria* spp. and *Chelura* spp. (number per panel) and the percentage of panel surface excavated by their activity will be assessed for each panel. The number of shipworms per panel will be estimated from the examination of radiographs; the percentage loss of wood will be estimated by comparing retrieved panel weights to those obtained before deployment. The identification of shipworms in each panel will be accomplished by splitting the panels and removing individuals for examination. At the 100, 500, and 1000 m sites, panels will be deployed in May and in October for exposure periods of five and seven months, respectively. These panels will be processed only for the identification and enumeration of shipworms.

This proposed program incorporates a single change. This year it is proposed to delete the sections of this program that deal with the identification, enumeration, and determination of the percentage of substratum covered by fouling organisms such as barnacles, mussels, bryozoans, and algae. Justification for this change is presented in Attachment I.

Lobster Population Dynamics

The lobster study is designed to assess the potential effect of MNPS on the lobster population in the Millstone Point area. The study area will include the nearshore coastal region surrounding Millstone Point. Three stations (Intake, Jordan Cove, and Twotree Island) have been established near rocky outcrops (Fig. 4d). Lobsters will be collected from May through October using 20 wire lobster traps at each station. Traps will be hauled on Monday, Wednesday and Friday, weather permitting. On weeks with holidays, pots will be checked on the first and last working days of the week. Lobsters will be tagged with serially numbered sphyrion tags. Carapace length, sex, crusher claw position, missing claws, and molt stage will be recorded for each lobster. Recaptured lobsters will be released after recording the tag number and the above information.

Lobster larvae will be sampled during their period of occurrence (usually from May through July) at the discharge of Unit 1, 2, or 3 (station EN in Fig. 1). Samples will be taken using a 1.0 x 6.0-m conical plankton net (1-mm mesh) that filters about 4,000 m^3 of water during a typical

collection. The sample volume may be reduced when plankton or detritus is abundant or when the number of circulating-water pumps has been reduced. Four day and four night samples (total of eight) will be collected each week.

Eelgrass Study

The objective of this study is to estimate the above-ground standing stock of eelgrass in Jordan Cove and the Niantic River. These data will augment results of previous studies, indicate any increase or decrease in the size of the beds, and allow evaluation of potential impacts due to MNPS operation. Two study sites (JC, WP) are located in Jordan Cove and one (NR) in the Niantic River (Fig. 4d). Average blade length, biomass, and plant density estimates will be made in June, July, August, and September. These months were selected because they represent periods of peak biomass. In each month, sixteen replicates (25 x 25 cm quadrats) will be taken at the three study sites.

MISSING SAMPLES

On rare occasions, a sample may not be available for laboratory processing (e.g., sample container was broken or sample was spilled) or sampling gear deployed in the field (e.g., lobster pots or exposure panels) was lost or damaged. Such incidents, however, represent an insignificant fraction of the overall sampling effort for any program and the loss of data has not and will not affect the conclusions made as a result of any particular study.

REPORT SCHEDULE

Northeast Utilities Service Company, acting as agent for Northeast Nuclear Energy Company, will submit annually on April 30 a detailed report of ongoing biological studies. This report will include summaries of data from the monitoring programs and comprehensive analyses of temporal and spatial variation of marine communities.

Table 1. Planned distribution of sampling effort for monitoring entrained and offshore ichthyoplankton.

Number of samples per week for entrainment ichthyoplankton

	J	F	M	A	M	J	J	A	S	O	N	D
collected:	1D,1N	1D,1N	4D,4N	4D,4N	4D,4N	3D,3N	3D,3N	3D,3N	3D,3N	1D,1N	1D,1N	1D,1N
processed												
for larvae:	all	all	all	all	all	1D,1N	all	all	all	all	all	all
for eggs:	none	none	none	3D,3N	3D,3N	all	all	all	all	none	none	none

Number of offshore ichthyoplankton samples collected per week and processed for larvae only

J	F	M	A	M	J	J	A	S	O	N	D
|<	1D,1N biweekly	>|<		2D,2N weekly			>|<		1D,1N biweekly		>|

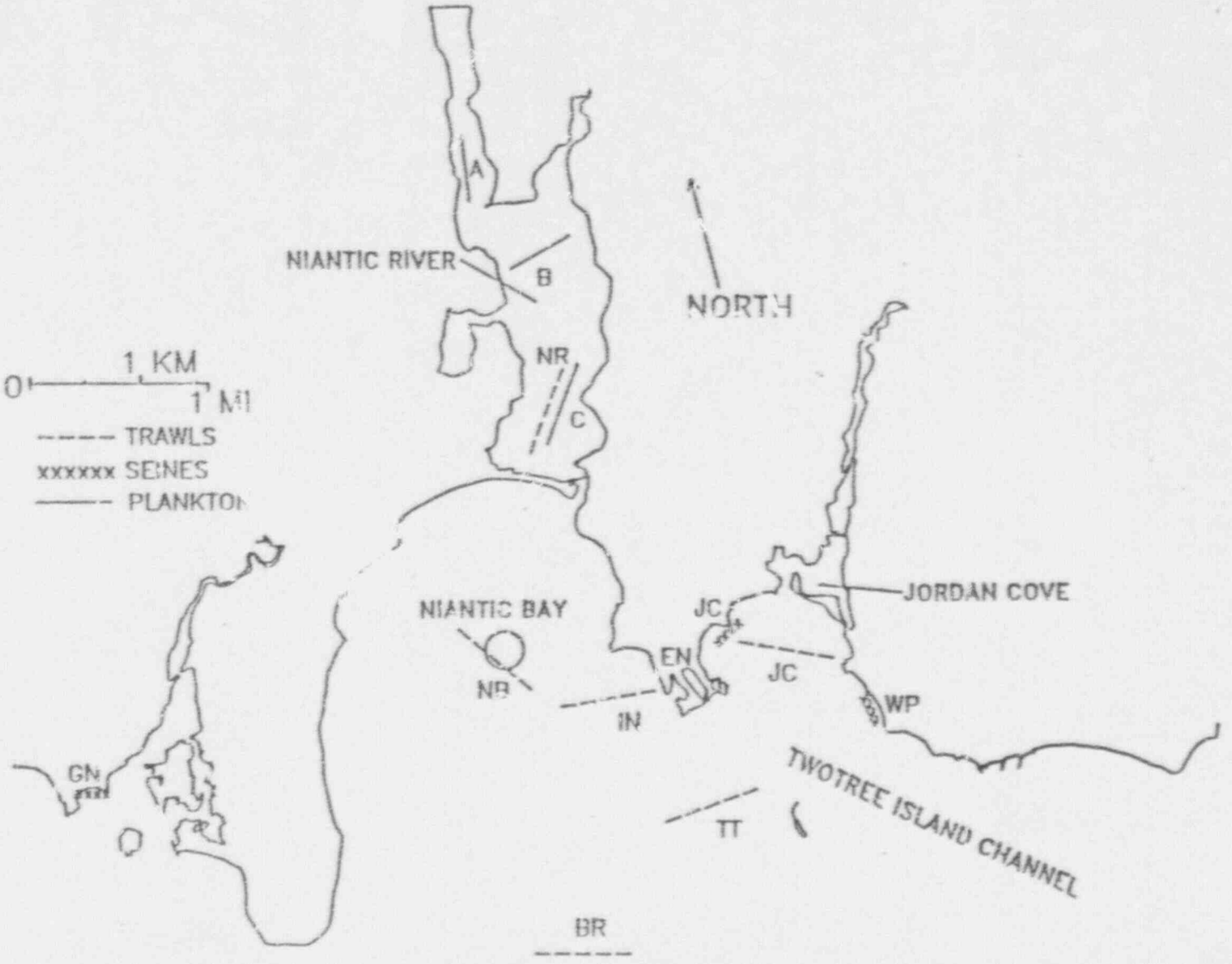

Figure 1. Location of trawl, seine and plankton stations.

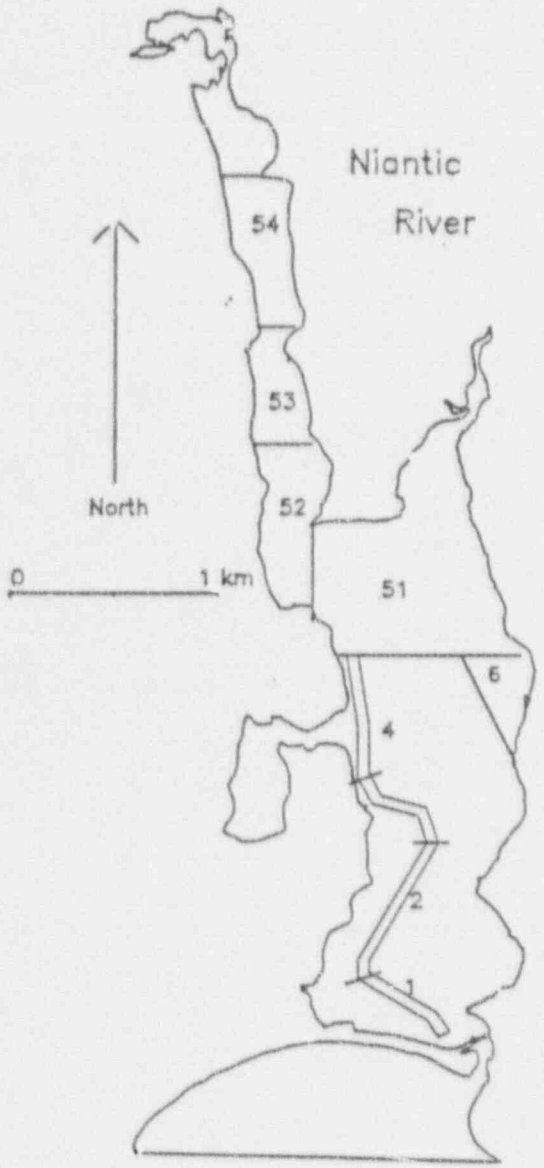

Figure 2. Location of stations sampled for adult winter flounder in the Niantic River.

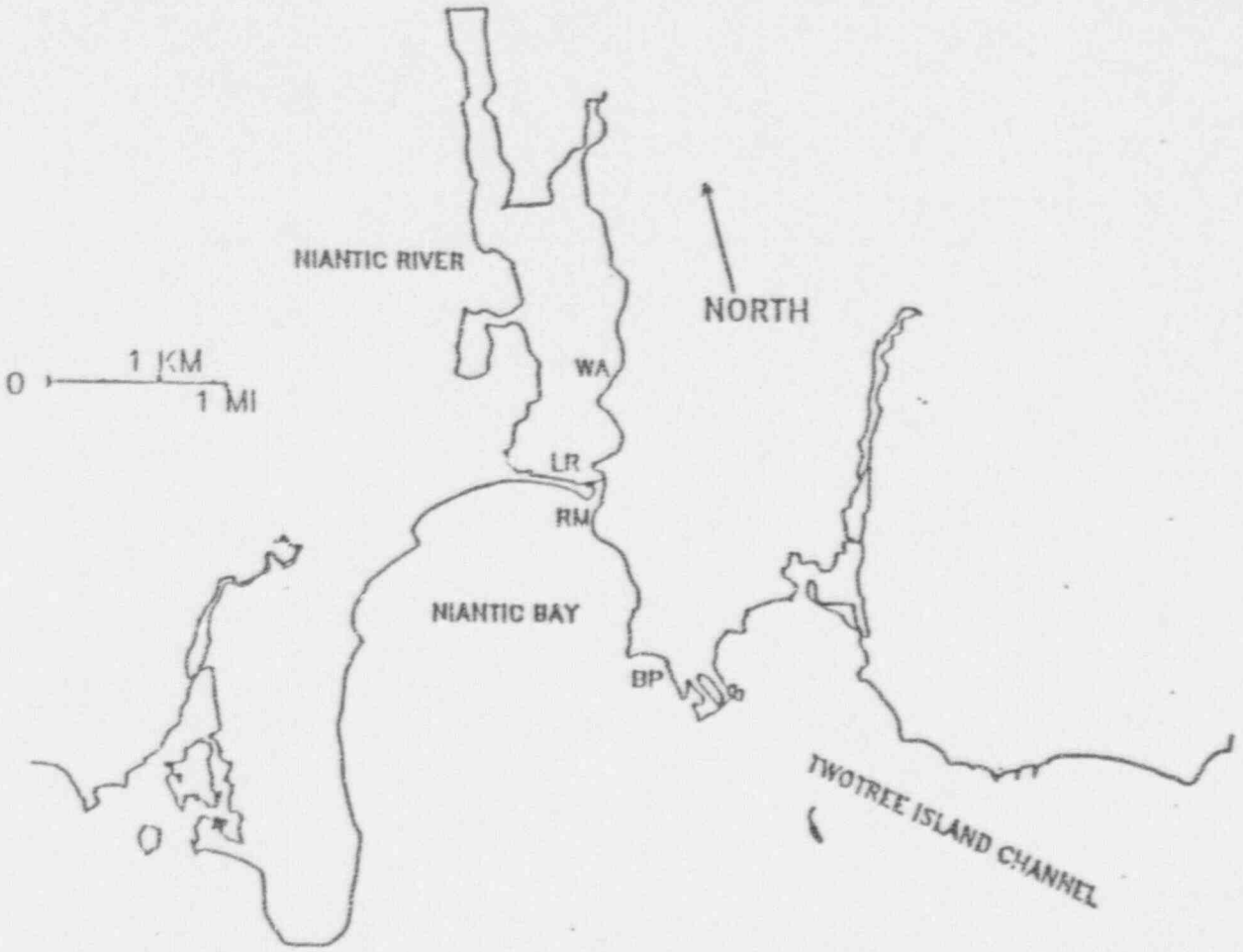

Figure 3. Location of stations sampled for juvenile winter flounder in Niantic River and Bay.

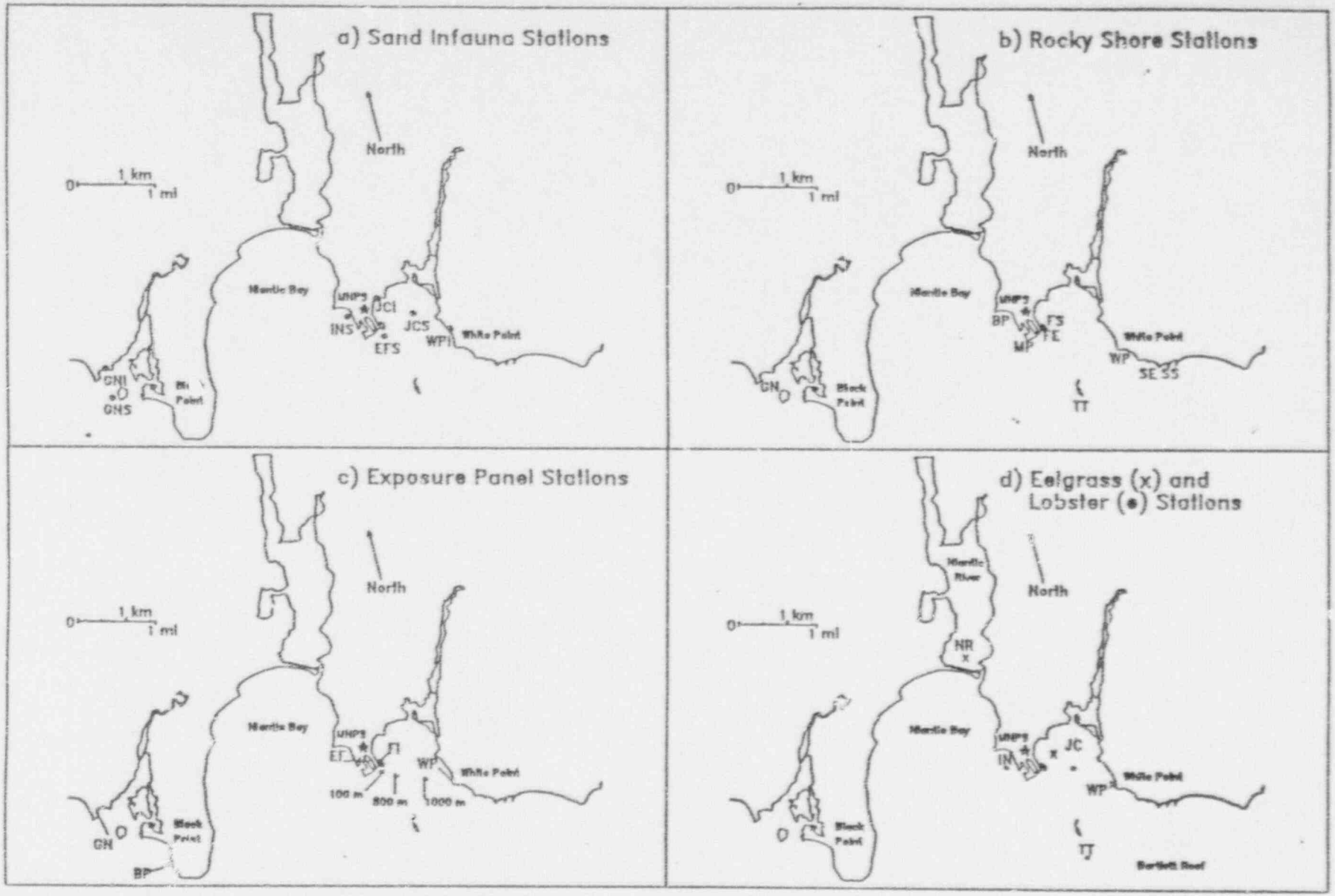

Figure 4. Location of stations sampled in Benthic Studies monitoring programs.

Attachment 1

It is proposed to delete the sections of the Exposure Panel Program that deal with identification, enumeration, and determination of percentage of substratum covered by fouling organisms (e.g., barnacles, mussels, bryozoans, algae).

Reasons for change

Present sampling methodology incorporates three, 6-month exposure periods: Feb-Aug, May-Nov, and Aug-Feb. These exposure periods encompass the entire year, and overlap during the period of peak annual settlement and growth of shipworms. Based on 7 years of sampling prior to 1989, when the methodology included a Nov-May exposure period, it was determined that the highest coverage by surface foulers typically occurred Nov-May and Feb-Aug, corresponding to the peak settlement periods of mussels and several species of barnacles and algae. It was also determined that little or no correlation could be found between identity or abundance of surface foulers and the density of woodborers.

The lack of a relationship between surface foulers and woodborers in our study is largely explained by the sampling design; e.g., a fouling species that settles primarily around March or April can have no effect on a panel that is exposed from May-Nov or Aug-Feb. Species with different settlement periods (e.g., *Semibalanus balanoides* and *Teredo navalis*) do not compete with each other on our panels.

Examples of the relationships, or lack thereof, between surface foulers and woodborer abundance or activity, are illustrated in Figure 1. Figure 1a shows the average percentage of cover for sessile fouling organisms on exposure panels collected between 1979 and 1990 at the ambient water dock sites, Figure 1b shows the average numerical abundance of *Teredo navalis* in the same panels, and Figure 1c shows the resulting wood-loss. Not surprisingly, Figures 1b and 1c are very similar, excepting the Feb-Aug exposure period when the woodborers are recently settled juveniles, and do not account for much wood-loss. Similar comparisons with Figure 1a are inconsistent; for example, in May-Nov of 1979 at Giants Neck, more than 60% of the panel surfaces were covered by fouling organisms, yet these panels supported high densities of *Teredo* (almost 300 individuals/panel). However, during the same exposure period at White Point, panels with virtually identical degrees of surface fouling supported an unusually low number of shipworms (less than 50 individuals/panel).

There is an apparent inverse relationship between total fouling (high at Fox Island and Black Point, lower at White Point and Giants Neck) and woodborer attack (low at FI and BP, higher at WP and GN). However, this correlation does not imply causality; rather, trends in woodborer abundance are attributed to the building materials used in nearby docks. *Teredo* densities are high at WP and GN (where docks are supported by untreated oak piles), and lower at FI and BP (where piles are treated with copper chromated arsenate (CCA) preservative). Throughout the study, variability in woodborer abundance has been attributed more to physical (e.g., severe winters, availability of wood) and intrinsic biological (e.g., fecundity, resistance to disease, larval mortality) factors than to settlement inhibition caused by interactions with fouling organisms.

The 6-month exposure periods used by the Exposure Panel Program do not typically permit development of mature fouling communities; characterization of such communities is not an objective of the Program. The process of colonization by marine plants and animals is assessed by another facet of the monitoring program, i.e., the recolonization studies in the Rocky Intertidal program.

The data acquired from analyses of superficial fouling species on exposure panels are not needed to fulfill the objectives of the Exposure Panel Program, i.e., to quantify the abundances of wood-boring species in the Millstone area, and to relate these abundances to wood-loss from exposure panels. Based on above information, we request approval of our proposal to delete the analyses of surface foulers on panel surfaces from the Exposure Panel Program.

Attachment I
Figure 1

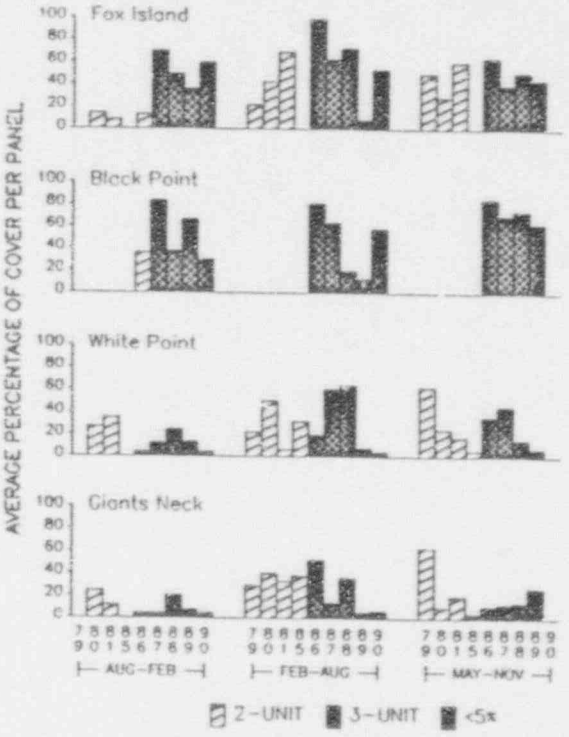

Fig. 1a. Average percentage of cover for sessile fouling organisms, live and dead components combined, on exposure panels collected from 1979-1990.

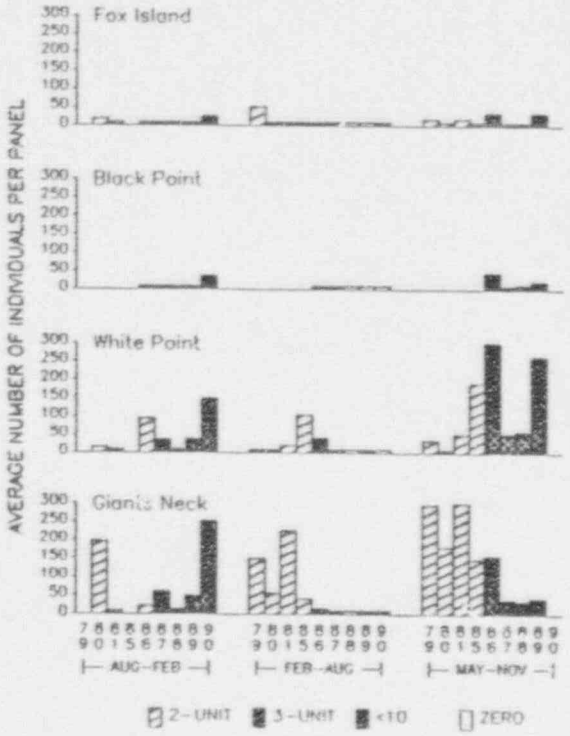

Fig. 1b. Average numerical abundance of the shipworm, *Teredo navalis*, in exposure panels during 1979-1990.

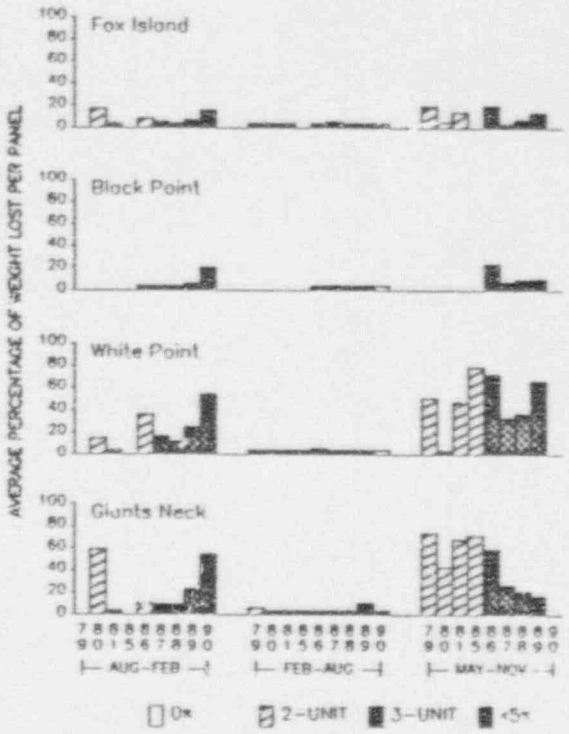

Fig. 1c. Average wood-loss (as a percentage of weight lost) from exposure panels collected during 1979-1990.