Dominion Nuclear Connecticut, Inc.
Millstone Power Station
Rope Ferry Road
Waterford, CT 06385

Dominion

APR 2 8 2005

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No. 05-110
NSS&L/DF R0
Docket No. 50-423
License No. NPF-49

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 3
2004 ANNUAL ENVIRONMENTAL PROTECTION PLAN OPERATING REPORT

In accordance with Section 5.4.1 of the Environmental Protection Plan (EPP), Dominion Nuclear Connecticut, Inc. hereby submits the Annual Environmental Protection Plan Operating Report, describing implementation of the EPP for the previous year. Enclosure 1 transmits information for the period January 1, 2004, to December 31, 2004.

Should you have any questions regarding this report, please call Mr. Paul Blasioli, Environmental Services, at (860) 447-1791, extension 0417.

Very truly yours,

J. Alan Price
Site Vice President - Millstone

IE25

Enclosure (1)

Commitments made in this letter: None.

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Serial No. 05-110
Docket No. 50-423
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Enclosure 1

Millstone Power Station, Unit 3

Annual Environmental Protection Plan Operating Report
January 1, 2004 - December 31, 2004

Annual Environmental Protection Plan Operating Report
January 1 - December 31, 2004

Millstone Unit 3 Environmental Protection Plan

Dominion Nuclear Connecticut, Inc.
Millstone Power Station
Rope Ferry Road
Waterford, Connecticut 06385

April 2005

2004 Annual Environmental Protection Plan Operating Report (AEPPOR)

1. Introduction

This report covers the period January 1, 2004 through December 31, 2004. During 2004, Millstone Power Station Unit 3 (MP3) operated at a capacity factor of 88.5%; this included a 37-day refueling outage (3R09 4/3/04 – 5/9/04). The capacity factor from the end of the refueling outage until the end of 2004 (cycle 10) was 98.5%.

As required by the MP3 Environmental Protection Plan (EPP), this AEPPOR includes:

- summaries and analyses of the results of environmental protection activities,
- a list of EPP noncompliances,
- a list of all changes in station design or operation which involved a potentially significant unreviewed environmental question, and
- a list of non-routine reports, describing events that could have resulted in significant environmental impact.

2. Environmental Protection Activities

2.1 Annual National Pollutant Discharge Elimination System (NPDES) Report of Ecological Monitoring (EPP Section 4.2)

Paragraph 5 of the Millstone Power Station (MPS) NPDES permit requires continuation of biological studies of supplying and receiving waters, entrainment studies, and intake impingement monitoring. These studies include analyses of intertidal and subtidal benthic communities, finfish communities, entrained plankton, lobster populations, and winter flounder populations. Paragraph 7 of the permit requires an annual report of these studies to the Commissioner of the Connecticut Department of Environmental Protection (DEP). The report that fulfills these requirements for 2004, Annual Report 2004 - Monitoring the Marine Environment of Long Island Sound at Millstone Power Station, Waterford, Connecticut (Annual Report), presents results from studies performed during construction and operation of MPS, emphasizing those of the latest sampling year. Changes to the biological communities noted in these studies are summarized in the Executive Summary section of the Annual Report, which is attached as part of this report.

Table 1. MP3 NPDES Data Summary, Jan. 1 - Dec. 31, 2004.
Selected water quality parameters for Unit 3[1].

	discharge flow (max) (10^6 gpd)	discharge pH range	discharge temp. range (°F)	discharge temp. (avg) (°F)	avg ΔT (°F)	max FAC (ppm)	max TRC (ppm)	max SWS FAC (ppm)
Jan.	1357	8.1-8.2	47.9-65.3	56.1	18.1	0.13	0.03	0.23
Feb.	1357	8.1-8.3	50.7-56.3	53.2	17.3	0.15	<0.03	0.21
Mar.	1357	8.1-8.3	52.5-58.9	54.4	15.1	0.20	0.04	0.20
Apr.	1357	7.4-8.3	38.5-56.2	44.0	1.3	.[2]	<0.03	0.24
May	1357	8.1-8.3	44.0-74.6	62.0	9.8	0.11	0.04	0.20
June	1357	8.1-8.3	70.3-81.3	75.7	13.1	0.16	0.04	0.20
July	1357	7.9-8.3	76.8-86.2	81.2	15.5	0.16	0.04	0.19
Aug.	1357	7.7-8.0	82.1-89.9	84.7	15.5	0.08	0.06	0.20
Sep.	1357	7.7-7.9	81.5-91.0	84.8	15.7	0.11	0.05	0.17
Oct.	1357	7.8-7.9	73.2-84.3	78.1	16.0	0.14	0.04	0.22
Nov.	1357	7.8-7.9	64.6-79.6	69.9	16.8	0.22	<0.03	0.19
Dec.	1357	7.7-7.9	57.1-76.7	63.6	17.7	0.13	<0.03	0.21

Notes:

(1) Parameters are measured at MP3 discharge (DSN 001C), except for TRC, which is measured at MPS discharge (quarry cuts; DSN 001), and SWS FAC (service water system; DSN 001C-5).

(2) For April 2004, no MP3 circulating water chlorine injection occurred, due to the scheduled refueling outage.

Abbreviations Used:

Temp. = Water Temperature
ΔT = Delta-T (difference between discharge and intake water temperature)
FAC = Free Available Chlorine
TRC = Total Residual Chlorine
SWS = Service Water System

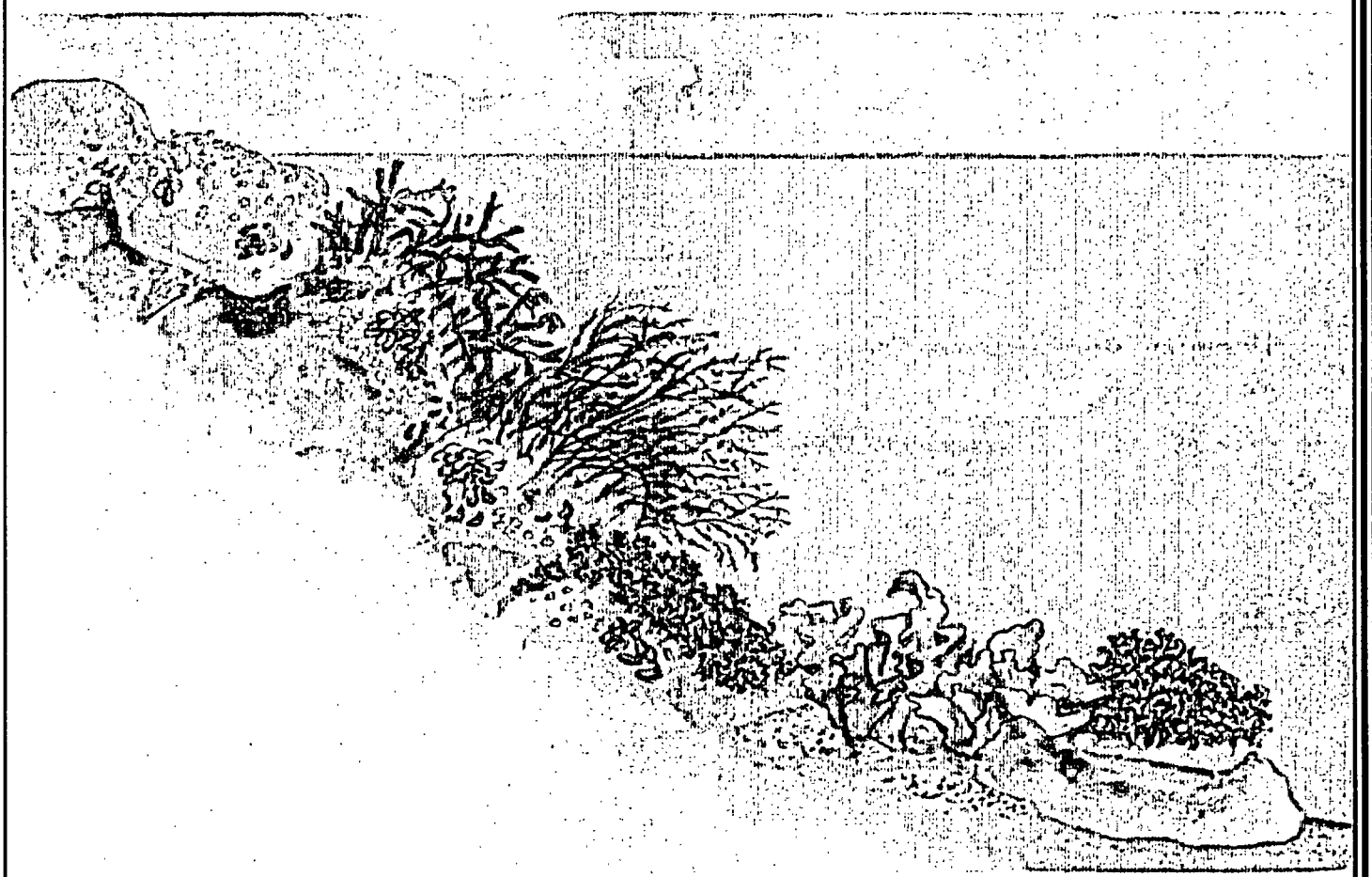
Attachment to

2004 Annual Environmental Protection Plan Operating Report
January 1 – December 31, 2004

Executive Summary Section of
"Annual Report 2004 - Monitoring the Marine Environment of Long Island Sound at Millstone Power Station, Waterford, Connecticut"
dated April 2005

ANNUAL REPORT 2004

Monitoring the Marine Environment of Long Island Sound at Millstone Power Station, Waterford, Connecticut



Millstone Environmental Laboratory

April 2005

Dominion

Executive Summary

Eelgrass

Historically, eelgrass has ranged to far western reaches of Long Island Sound (LIS), but over the last century has become restricted to the easternmost third of the Connecticut coastline, where it remains as a locally important habitat former. Near Millstone Power Station (MPS), eelgrass shoot density, seed-bearing shoot abundance, shoot length, standing stock biomass, and distribution were monitored during summer months from 1985 to 2004 at three locations (Jordan Cove, JC; White Point, WP; and Niantic River, NR). Short-term declines in eelgrass abundance were directly associated with fouling and overgrowth of eelgrass on three occasions; once by blue mussels at NR in 1992, and twice by blooms of green algae (*Cladophora* spp.) at WP in 1991 and 2004. Analysis of long-term trends indicated some degree of decline in most of the above parameters at all three areas. Two populations to the east of MPS and near the fringes of the thermal plume (JC and WP; <1.5 km from the MPS discharge to LIS) exhibited more gradual declines over the 20-year study period suggestive of regional causes unrelated to MPS operation. Thermal input to these nearby study sites was minimal under three-unit operation (<1°C above ambient conditions), and decreased since the effective retirement of Unit 1 in late 1995 that reduced total MPS cooling water flow by about 25%. Heavy, often sudden, eelgrass losses were documented on five separate occasions between 1985 and 2001 at sites in the Niantic River, located well beyond the influence of the MPS thermal plume. Since 2001, eelgrass population health in the river has shown some signs of improvement based on expanded distribution and increases in shoot density and biomass. Research on eelgrass populations elsewhere in the northeastern U.S. has associated similar declines with anthropogenic influences, such as nutrient loading from surface run-off and groundwater sources. These influences, coupled with increases in regional water temperature and waterfowl grazing, may factor strongly in observed declines in this study.

Rocky Intertidal

Rocky intertidal monitoring studies during 2004 continued to document ecological changes to the shore community near to, and associated with, the MPS thermal discharge. These changes are not widespread, and remain restricted to approximately 150 m of shoreline on the east side of the power plant discharge to LIS.

Seasonal shifts in occurrence of annual algal species were noted at Fox Island-Exposed (FE) during 2004. These shifts included abbreviated season for cold-water species (*e.g., Monostroma grevillei, Spongomorpha arcta,* and *Dumontia contorta*) and extended season for warm-water species (*e.g., Grinnellia americana, Dasya baillouviana,* and *Bryopsis hypnoides*). Similar shifts have been observed in most years since Unit 3 began operation (1986), with the exception of the extended shutdown of all MPS reactors from March 1996 to June 1998 when seasonality of these species at FE during the recent shutdown period was more typical of other sites.

Thermal effects on dominant species abundance and distribution patterns were also evident at FE in 2004 and most apparent in the low intertidal zone. Seasonally high abundance of *Hypnea musciformis*, a species observed for the first time in 2001, and expanded populations of *Sargassum filipendula, Corallina officinalis*, and *Gelidium pusillum* now characterize the lower shore community at FE. *Polysiphonia* spp. maintained a perennial population at FE in 2004, but occurred as a summer annual at sites unaffected by MPS. The heavy blue mussel set observed regionally in 2004 was particularly pronounced at the FE site.

Higher *Ascophyllum* growth at Fox Island-New (FN, the study population nearest the MPS discharge) than at other sites was observed in 2003-2004, as in many previous study years since Unit 3 began operation in 1986. Natural influences of other factors such as ambient temperature conditions, nutrients and light, also played an important role in *Ascophyllum* growth at FN.

The rocky intertidal monitoring program has also documented regional patterns and modifications to shore communities unrelated to MPS operation. These include the introduction to the region of two exotic red algae, *Grateloupia turuturu* in 2004 and *Antithamnion pectinatum* in 1986, decreases in barnacle abundance in recent years, and a long-term increase in abundance of the common brown rockweed, *Fucus vesiculosus.*

Benthic Infauna

The objective of the benthic infaunal monitoring program is to measure infaunal species composition and abundance and to assess whether observed changes are related to construction and operation of MPS. This report includes data from the period 1980-2004, with focus on 2004 data.

The analysis of data indicates measurable impact at three stations Effluent (EF), Jordan Cove (JC), and Intake (IN) in the immediate vicinity of MPS. All changes in benthic community structure are associated with corresponding changes in sediment composition.

Prior to start-up of Unit 3 and construction of the second quarry cut in 1986, the sediments at the EF site were of medium size and the benthic community was dominated by polychaetes. Following startup of Unit 3, the increase of water flow removed fine to medium sediments, leaving coarser sediments with low silt/clay levels. Community structure became oligochaete-dominated. Following shutdown of Unit 1 in 1995, water flow from the discharge was reduced and sediment characteristics again became similar to the pre-Unit 3 operational period. As a result, oligochaete abundance has significantly decreased. The high settlement of *Mytilus edulis* in 2004 resulted in high community abundance when compared to previous years.

Dredging and erosion from cofferdam removal at the Unit 3 intake (1983-1985) resulted in changed sedimentary characteristics (primarily increased silt/clay content). Following construction completion, the sediment characteristics became more consistent over time. The 2004 data continue to show recovery of the infaunal community. The number of individuals and species richness at IN have increased over the study period, in particular abundance of organisms more common in early years, such as *Acmira catherinae*. These trends, along with concomitant decreases in abundance of opportunistic species, such as *Nucula annulata*, indicate continued recovery at the IN station. However, the persistence of other opportunistic species, such as *Protodorvillea gaspeensis*, indicates that the sedimentary environment is disturbed and needs a longer time to completely recover.

Following Unit 3 start-up in 1986, fine sediments scoured from the MPS discharge were deposited in Jordan Cove, resulting in increased silt/clay content and changes to infaunal community structure at the JC monitoring site. Most of the sediments were scoured within the first year of Unit 3 operation. Initial impact has lessened over time, but is still evident. For example, *Acmira catherinae* and *Tharyx* spp. abundance returned to levels observed prior to Unit 3 operation within a few years after Unit 3 start-up; however, the opportunistic mollusk *Nucula annulata* is maintaining a population level above the two-unit operational period. The sediment parameters, grain size and silt/clay content, remained elevated through 2004, but are approaching pre-Unit 3 operational levels.

Sediments and infaunal community characteristics at the more distant reference site of Giants Neck (GN) have exhibited changes that were not related to operation of MPS. Mean grain size has been variable, while silt/clay was relatively consistent, with no long-term trends in either parameter. Infaunal community composition at GN has generally been dominated by three taxa (*Tharyx* spp., oligochaetes and *Acmira catherinae*). *Acmira catherinae*, common at GN in the early monitoring years, has declined in abundance, while *Tharyx* spp. and oligochaete abundances have increased over the entire study period. The GN station has been valuable in validating periodic area-wide shifts in species abundance and community structure in response to natural factors not impacted by construction and operation of MPS. Population increases of *Mytilus edulis* in 2004 described above were also observed at GN. Similar to pulses of the opportunistic polychaete *Mediomastus ambiseta* that occurred during 1983-88, 1994, and 1998-99 at all sampling stations, the area-wide increase of *Mytilus edulis* suggests a natural event rather than an effect of MPS operation.

Lobster Studies

The American lobster occurs in the Northwest Atlantic from Canada to Cape Hatteras and supports one of the most active commercial fisheries in the northeast United States. The local lobster population in the vicinity of MPS has been studied since 1978 to determine if power plant operation has contributed to population changes beyond those expected from natural variability and the level of fishing activity. Several aspects of MPS operation could potentially impact the local population of American lobster. In early summer, after hatching from eggs, lobster larvae swim to the surface to begin the 6- to 8-week planktonic phase of their life cycle and are susceptible to entrainment through cooling water systems. Juvenile and adult lobsters can be impinged on intake traveling screens or be exposed to the heated effluent in the discharge area.

Objectives of the lobster monitoring program at MPS are to: 1) evaluate year-to-year, seasonal, and among-

station changes in catch-per-unit-effort (CPUE); 2) monitor lobster population demographics, including length frequencies, growth rates, sex ratios, female size at maturity, characteristics of egg-bearing females; and 3) monitor movements of lobsters collected in the vicinity of MPS. Lobster larvae entrainment studies have been conducted since 1984 to estimate the number of larvae entrained through the cooling-water systems. Impacts associated with recent plant operations on the local lobster population were assessed by comparing results of the 2004 study with those from 1978 to 2003. Emphasis has been placed on assessing long-term trends in the abundance and population characteristics of lobsters collected in the Millstone Point area.

Results of lobster monitoring from 1978 to 1999 indicate that the local lobster population was stable or increasing. The lower abundance of lobsters observed from 2000 to 2004 were unrelated to MPS operations and attributed to an increase in natural mortality associated with a shell disease affecting lobster populations from eastern LIS to the Gulf of Maine. During 2004 the incidence of lobsters found dead in our traps and shell disease prevalence and severity declined substantially. No significant long-term trends were identified in the overall total CPUE of lobsters or in the total CPUE at the three monitoring stations. The CPUE of legal-size lobster has exhibited a significant declining trend at the Jordan Cove and Twotree stations, but no significant trend in legal lobster CPUE occurred at the station located near the MPS intakes. Furthermore, the combined CPUE of legal-size lobster at the three stations increased by almost 70% during 2004, when compared to catches in 2003. Similar results were reported for commercial lobster catches in our area during 2004, nearly doubling the catch of legal lobsters reported during 2003. On the other hand, lobster catches remained depressed in other areas of LIS; the commercial landings for the entire State during 2004 (about 0.7 million pounds) were the same as reported in 2003. The long-term sustainability of the Connecticut lobster fishery may be threatened if the condition of lobsters in western LIS does not improve. If lobster recruitment in our area depends on larval production in western LIS and the population in western LIS does not recover, catches in our area would be affected in the future.

Long-term trends in some lobster population characteristics have been identified over the past 27 years (growth, female size at maturity, abundance and size characteristics of egg-bearing females), which were related to natural increases in seawater temperature and not the operation of MPS. Increased water temperature may also be responsible for the increased susceptibility and transmission of diseases affecting lobsters in LIS, near their southern range of distribution in nearshore waters.

Fish Ecology Studies

The objective of the fish ecology monitoring program at MPS is to determine whether operation of the MPS electrical generating units has adversely affected the occurrence, distribution, or abundance of local fishes. Potential impacts include entrainment of fish eggs and larvae through the condenser cooling-water system, impingement of juvenile and adult fish on intake screens, and changes in distribution or abundance attributable to the thermal discharge. Trawl, seine, and ichthyoplankton monitoring programs were established in 1976 to provide the basis for identifying taxa potentially affected, as well as information on long-term abundance trends used to measure changes in the local populations.

This report summarizes data collected from monitoring programs during June 2003 through May 2004. MPS Units 2 and 3 were both operating during most of this report period, except for scheduled refueling outages of 51 days and 37 days at Units 2 and 3 in fall 2003 and spring 2004, respectively. Unit 1 was effectively retired on November 4, 1995, which eliminated the potential impacts of that cooling-water system on fish and larvae in the MPS area. Detailed analyses on seven taxa most susceptible to MPS operational impact from entrainment or thermal effects assessed the potential effects of MPS. Analyses of these species generally focused on comparing temporal trends over the past 28 years.

Results from the fish ecology monitoring program during 2003-04 indicate that no long-term abundance trends determined for various life stages of the seven selected taxa could be directly related to the operation of MPS. No significant long-term trends were detected for juvenile or adult silversides collected by trawl or seine. Similarly, no long-term trends were identified in grubby larvae, juveniles or adults, cunner eggs or larvae, or tautog larvae. Atlantic menhaden larvae showed a significant increasing trend in abundance, as did juveniles taken by seine and trawl. Likewise, a recent stock assessment indicates that Atlantic menhaden abundance has increased in Southern New England waters. Since the late 1970s and early 1980s, cunner and tautog have become less abundant at the Intake trawl station, exhibiting a significant negative trend. However, this occurred following the removal of the Unit 3 rock cofferdam, a preferred habitat for these species. No significant trend was detected in the abundance of cunner or tautog at Intake in subsequent years.

Cunner abundance at the Jordan Cove and Niantic River trawl stations has fluctuated without trend since 1976. Tautog, primarily juveniles, are increasing in abundance at the Niantic River trawl station and in Jordan Cove catches by both trawl and lobster pot. Although tautog eggs exhibited a long-term negative trend in abundance, egg abundance and subsequent larval production have increased since 2000. Tautog larval abundance during 2003-04 was nearly four times larger than any previous value reported, likely reflecting an increase in spawner biomass as a result of decreased fishing mortality. The large numbers of tautog and cunner eggs entrained at MPS did not appear to affect future recruitment or subsequent spawning stock biomass of these two fishes, because the proportion of juvenile recruits relative to adults has increased, and there has been a significant increase in tautog in the Niantic River and Jordan Cove. This is supported by independent research, which showed that annual fecundity of tautog in eastern LIS is nearly twice that reported in more southerly waters. This relatively high reproductive capacity likely buffers entrainment losses.

American sand lance larvae exhibited a significant long-term decrease in abundance since 1976, but this was likely due to large-scale ecological effects (e.g., increases in abundance of its major predators). Densities of both anchovy eggs and larvae also showed significant negative trends. The bay anchovy appears to be experiencing a regional decline in abundance. A sharp drop in abundance was measured over the past decade in Narragansett Bay and populations declined dramatically in Chesapeake Bay after 1993. The bay anchovy is an important forage species for striped bass and recent increases in striped bass abundance along the Atlantic coast may have contributed to the reduced numbers of bay anchovy.

Trends in abundance of many of the fishes collected over the past 28 years may also be affected by increasing seawater temperatures as suggested in recent scientific literature. Fishes more commonly found in the New York Bight, such as spotted hake and black sea bass, are now becoming increasingly common in LIS. Based on increasing trends in abundance or the lack of decreasing trends not attributed to natural causes, MPS has had minimal effect on local fish assemblages.

Winter Flounder Studies

The local Niantic River winter flounder population is potentially affected by the operation of MPS, particularly from entrainment of larvae through the cooling-water systems of the operating units. As a result, extensive studies of the life history and population dynamics of this important sport and commercial species have been undertaken since 1976. Surveys of adult spawners are conducted each year in the Niantic River during late winter and early spring. Larval sampling is conducted at the plant discharges, in Niantic Bay, and at three stations in the Niantic River. Settled, post-entrainment age-0 juveniles are collected at two sites in the river. Winter flounder are also commonly taken in the year-round trawl monitoring program (TMP).

Seawater temperature has potentially important effects during spawning, egg incubation, and the periods of larval development and first year settlement. Mean water temperature at the MPS intakes in winter 2004 was cooler than the long-term average, but was warmer than average during the other three seasons. The cool winter resulted in ice formation in the Niantic River, which delayed the start of both the adult spawning survey and larval sampling.

The Δ-mean trawl catch-per-unit-effort (CPUE) of fish larger than 15 cm in the Niantic River during the 2004 adult winter flounder spawning season was 1.7, a decrease of 0.5 from 2002 and 2003 and the third lowest CPUE of the time-series. The Jolly stochastic model was applied to spawning survey mark and recapture data to estimate the absolute abundance of the Niantic River adult spawning population. Only 201 fish were marked in 2004, the fewest of the time-series. Based on the mark-recapture data, the initial overall abundance estimate of winter flounder larger than 20 cm that were present in the Niantic River during 2003 was 4.2 thousand. Annual female spawner abundance estimates since 1976 ranged from a low of 2 thousand in 2001 and 2004 to 75 thousand in 1982, with corresponding total egg production estimates of about 1.7 to 44.8 billion. Historically, abundance of Niantic River winter flounder spawners peaked in the early 1980s and decreased thereafter. This decline was attributed to stock and recruitment effects (i.e., decreased per-capita recruitment at high stock sizes), a general winter warming trend, and increased rates of exploitation. Niantic River CPUE was significantly positively correlated with several other winter flounder abundance indices from throughout Southern New England and abundance currently remains low throughout the region.

To provide some perspective on Niantic River winter flounder stock size estimates, annual exploitation rates were determined using annual recreational and commercial landings data of winter flounder in LIS. The calculated exploitable biomass of Niantic River winter flounder represented approximately 2% of the entire winter flounder resource in LIS during the past two decades.

Winter flounder larvae in 2004 were moderately abundant in the Niantic River and Bay. While the aggregate abundance of winter flounder larvae in the Niantic River decreased in 2004 from 2003, abundance was nevertheless equal to or greater than aggregate abundance estimates made since 1999. Abundance in Niantic Bay was the seventh highest of the time-series, which began in 1983. In the river, more Stage 1 larvae were found than expected from the relatively low adult spawner abundance. This finding suggested a potentially important density-dependent compensatory mechanism in that reduced egg predation by sevenspine bay shrimp occurring under low egg densities resulted in higher egg survival and more Stage 1 larvae.

Rates of larval growth and development were positively correlated with water temperature, but other factors such as density and prey abundance most likely affected growth as well. Despite cooler than average water temperatures during winter 2004, growth rates of larvae in both the river and bay were above average and greater than expected. The 2004 larval mortality rate was higher than the long-term average, despite faster larval growth rates. Density-dependence was examined by comparing mortality and egg production estimates (a measure of Stage 1 larval stage abundance) at various monthly and seasonal water temperatures. Results of this analysis suggested that larval mortality decreased with decreasing egg production (i.e., density-dependency) and increasing spring water temperatures (i.e., an effect of faster development).

Following larval metamorphosis and settlement, densities of age-0 young in 2004 were twice as high at the lower river station than at the mid-river station. Overall, abundance of young was about average. Mean lengths this year were larger than found in almost a decade, which may have contributed to a lower than average mortality rate. High juvenile mortality rates in some years reduced the abundance of relatively large year-classes, whereas the lower rate in 2004 should result in an average-sized year-class.

The 2003-04 Δ-mean CPUE of 8.4 calculated for young winter flounder taken during late fall and early winter at TMP stations was the largest value found in several years and consistent with high abundance of the 2003 year-class, first indicated by beam trawl sampling during summer of 2003. Although these two age-0 abundance indices were significantly correlated and both can identify emerging strong or weak year-classes, their correspondence has decreased during the past few years.

Fewer age-1 juveniles have been taken during each year of the Niantic River adult spawning population surveys since the early 1980s, with CPUEs of fish taken in the lower river navigational channel particularly low. However, this abundance decrease was much less when CPUEs were calculated for fish taken only in the upper portion of the river. The relative distribution of age-1 fish in Niantic River and Bay may have also changed over the years, possibly due to environmental factors, such as bottom composition.

Age-0 abundance indices were either not significantly correlated or were negatively correlated with the abundance of female adult spawners 3 to 5 years later. Conversely, positive correlations were found between age-1 abundance indices and these older fish. However, there was much scatter in these relationships and none of the early life stages were considered to be a reliable predictor of potential future year-class strength. Unknown processes not related to MPS operation occurring after juvenile winter flounder leave shallow nursery waters in the fall of their first year of life seem to be operating such that fewer adults are produced from more abundant year-classes of younger fish. The older juvenile life stage (ages-1 and 2) may be where a bottleneck is occurring in winter flounder population dynamics.

A stock and recruitment relationship (SRR) was determined for the Niantic River winter flounder population using adult CPUE data. A February water temperature parameter significantly improved the model fit. At the request of the Connecticut Department of Environmental Protection, the SRR was modified by adding a depensatory parameter (i.e., per capita recruitment rate decreasing with decreasing parental stock size). However, the data analysis showed that this parameter was not statistically significant.

The number of larvae entrained through the condenser cooling-water system at MPS is a measure of potential impact to winter flounder. As in previous years, Stage 3 larvae predominated (53%) in entrainment collections during 2004. Annual estimates of entrainment were related to both larval densities in Niantic Bay and MPS operation. An entrainment estimate of about 243 million was the fifth highest since 1976 and was related to above average larval abundance in Niantic Bay and relatively moderate cooling-water demand. A spring 2004 refueling outage at Unit 3 reduced potential entrainment by an estimated 199 million larvae. Annual entrainment density (abundance index divided by total seawater volume) has varied without trend since 1976, indicating that larval production and availability in Niantic Bay remained relatively stable despite increased water use during the 1986-95 period of three-unit operation and reduced cooling-water demand in 1995-97. Correlations between entrain-

ment estimates and abundance indices of post-entrainment age-0 juveniles were positive, implying no entrainment effect, and that the more larvae available, the more that metamorphosed and settled in Niantic River and Bay. This was also demonstrated by a comparison of annual entrainment and juvenile year-class strength, which indicated that entrainment estimates were an index of emerging year-class strength and that this process was not the most important factor in determining juvenile abundance.

The potential impact of larval entrainment on the Niantic River stock depends upon the fraction of the annual winter flounder production entrained each year, which was determined in this study as equivalent eggs (termed production loss). Empirical mass-balance calculations showed that a large number of entrained larvae likely come from a number of sources in LIS besides the Niantic River. The Niantic River production loss of nearly 44% in 2004 was the second largest estimate and well above the long-term average of 15%. However, based on an apparent increase in egg survival noted in recent years, a factor that was not incorporated into this model, most production loss estimates since 1995 were likely conservatively high. Correcting the more recent estimates by using a higher egg survival estimate resulted in lower production losses, which fluctuated about the long-term mean.

To date, efforts of regulatory agencies to control fishing mortality have not resulted in large increases in abundance for winter flounder stocks across the region or in the Niantic River. Even so, the remaining small adult spawning stock in the river continues to produce relatively large numbers of larvae and young fish, which are a likely result of population compensatory mechanisms. The effective retirement of Unit 1 in late 1995 resulted in an immediate reduction of about one-quarter of the MPS cooling-water flow, which has permanently reduced potential plant impact, but has not resulted in stronger year-classes and subsequent enhanced recruitment to the spawning stock. Despite relatively good abundance of age-0 winter flounder (a post-entrainment life stage), significant recruitment to the adult spawning population has not occurred in recent years. This was due to unknown factors unrelated to MPS operation removing these fish from the population. Environmental effects, including changes to the Niantic River habitat, a warming water temperature trend, and interactions with other species (e.g., predation), especially during early life history, also are important factors likely affecting the winter flounder recruitment process.