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DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
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May 31, 2002

Robert W. Varney
Regional Administrator
US Environmental Protection Agency
Region I
1 Congress Street, Suite 1100
Boston, MA 02114-2023

RE: Brayton Point Station NPDES Permit No. MA0003654
Permittee Request for Thermal Discharge Limits Based on a Variance under Section 316(a) of the Clean Water Act

Dear Mr. Varney:

I am writing to transmit the RI Department of Environmental Management's comments on the Brayton Point Station Permit Renewal Application NPDES Permit No. MA0003654, 316(a) and (b) Demonstration, November 2001, submitted by PG&E National Energy Group ("the variance request").

After careful review, the Department finds that the variance request fails to demonstrate that the alternative discharge limits and proposed modifications to the Brayton Point Station (variable speed intake pumps and the enhanced multi-mode cooling tower system) meet the minimum requirements of sections 316(a) or (b) of the Clean Water Act. Specifically, the variance request does not demonstrate that the alternative effluent limits will "assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on the body of water" and it can not be concluded that the "location, design, construction, nor that the capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact." A summary of the major deficiencies of the variance request is present below. Specific comments are also attached.

Major Deficiencies in the Evaluation of Thermal Impacts

The 316a variance request evaluates the biological significance of increased Bay temperatures using a methodology that over emphasizes the ability for fish to acclimate to elevated temperatures and therefore is not sensitive to varying heat loads and the resulting changes in ambient temperatures. The method does not employ risk adverse theory and is based on inappropriate assumptions concerning acclimation, tolerances and migratory blockage. The variance request relies upon laboratory studies to establish temperature maxima.

These studies demonstrate that organisms held in tanks are able to withstand higher and higher temperatures (until the point of mortality) when gradually acclimated to temperature change, but do not provide the opportunity to evaluate avoidance behavior. Field data demonstrates that actual temperature maxima are lower than expected based on laboratory results and that aquatic organisms either exhibit avoidance behavior, lethal or sub-lethal effects at temperatures below the laboratory predicted temperature maxima.

Ecosystem induced impacts of elevated temperatures were not evaluated. The effect of elevated Bay temperatures, resulting from the proposed permit limits, on predator/prey relationships (e.g. timing and voracity of predators) have not been evaluated. However, the variance request acknowledges that researchers have attributed early ctenophore blooms, which coincide with the peak spawning periods of many fish species and increase mortality of fish eggs and larvae, to increased water temperatures.

The methodology used to estimate the Bay-wide temperature elevations resulting from the proposed thermal discharge limits underestimated the impacts. Specifically, averaging of model predictions over the top 10 of 11 water column layers underestimates the biological impacts. The thermal model and data collected by USGen New England, Inc. demonstrates that the upper two layers experience significantly greater impacts from Brayton Point Station, both in areal extent and absolute temperature. The temperature predictions and associated biological impact analysis were based on Station flow and thermal output levels that are less than the requested monthly maximum and seasonal average values. The variance request indicates that the evaluation was based on discharge levels that reflected the historic demand and unit outages. As a result, the historic timing of the unit outages significantly influenced the biological impacts of a specific thermal reduction alternative.

Major Deficiencies in the Evaluation of Cooling Water Intake Structures

The evaluation of entrainment and impingement impacts has significantly underestimated the impacts of the proposed intake system by: underestimating the through-plant mortality, underestimating the withdrawal factor on stage IV and by comparing the estimated losses to large regional stock abundance estimates. Winter flounder tagging studies leave no doubt concerning the homing ability of winter flounder and the need to evaluate Brayton Point Station's entrainment and impingement impacts based upon a distinct Mt. Hope Bay population.

As summarized above, and detailed in the attachments to this letter, RIDEM does not believe that variance request meets the requirements of Section 316(a) of the Clean Water Act, and urge EPA to deny the variance request. If this variance request is approved, the Department believes that its grave concerns regarding the unprecedented decline in fish populations and loss of species diversity in Mount Hope Bay, which the Department formally relayed to EPA in October 22, 1996, will remain unresolved. Under warm summer conditions, the discharge limits that US-Gen New England, Inc. has requested would cause 70% of the surface water volume and 52% of the middle water volume of the Bay to violate the Massachusetts and Rhode Island water quality criteria for temperature change, five or more times in a thirty-day period (based on a seven-day rolling average). The Department also estimates that as a result of the withdrawal rate requested, Brayton Point Station would interdict about 80% of the Mount Hope Bay virtual winter flounder population biomass, assuming that all the larvae entrained are of Mt. Hope Bay origin This represents more than three times the amount that fishermen would be permitted to take in order to maintain a managed sustainable fishery.

It is clear that substantial reductions in the withdrawal and thermal discharge associated with Brayton Point Station are necessary. Analysis conducted has by US-Gen New England, Inc. and EPA has shown that it is technologically and economically feasible to achieve substantial reductions to withdrawal and discharge levels by retrofitting Brayton Point Station to operate all units using closed cycle cooling. Further reductions in entrainment impacts can be achieved by using effluent from the Fall River wastewater treatment facility to provide a sizeable portion of the cooling water needs of a closed cycle cooling system.

We look forward to continue working with EPA and MA on the development of the draft and final permit.

Sincerely,

Jan H. Reitsma
Director

JHR/ASL:kz

Enclosures

pc: Lauren Liss, MADEP
Dave Webster, EPA

Attachment I.

Review of USGenNE 316 (a) and (b) Demonstration in Support of NPDES Renewal Permit No, MA0003654 Brayton Point Station and Variance Request for Thermal Discharge and Modified Cooling Water Intake System.

Mark Gibson
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March 2002

Introduction-

USGen New England, Inc. (USGEN) has provided a technical demonstration in support of their NPDES permit renewal application that includes a variance request from water quality standards and a modified cooling water intake system ("the demonstration"). The demonstration is made pursuant to provision 316 (a) and (b) of the Clean Water Act. Their enhanced multi-mode system (EMM) alternative is the company's preference to reduce coolant water flows and waste heat rejected to Mt. Hope Bay. The company's position is that the cause of the decline in fish stocks in Mt. Hope Bay is not relevant to the permit request. They state that the sole issue is weather future operations at Brayton Point Station (BPS) will be protective of the marine resources in Mt. Hope Bay. The following comments by DEM's Fish and Wildlife Division (RIDFW) on the USGEN's demonstration generally follow the organization of Volumes I and II of the demonstration. Comments are focused on winter flounder as this species was once numerically dominant in Mt. Hope Bay, supports important fisheries in the region, and is intensively studied and monitored. References to tables and figures in the USGEN (2001b) demonstration are labeled as "company table/figure" whereas original tables and figures generated by RIDFW in support of comments these are conventionally labeled.

Appendix A, Mt. Hope Bay Characterization-

The company summarizes the brown tide events of the mid-1980's that occurred in Long Island Sound and Narragansett Bay and suggests that they may have impacted fishery production in the region. However, they do not cite any evidence of finfish mortality resulting from the event. Further, examination of available data doe not support a hypothesis that the brown tide events reduced winter flounder abundance. Although, the brown tide event was widespread in the region, the abrupt collapse of winter flounder is seen only in the MRI trawl survey in Mt. Hope Bay (Gibson 1996, 2002a). Trawl surveys conducted in Long Island Sound by the Connecticut Marine Fisheries agency do not show a collapse in the mid-1980's as would be expected if the brown tide event had compromised winter flounder production in the Sound. The CTDEP data were recently presented in the MRI update to the BPS technical advisory committee (MRI 2002).

In USGEN's summary of bay phytoplankton dynamics, they omit an important paper by Keller et al. (1999a) who documented the impact of warming water on the winter-spring diatom blooms. Their findings may have important implication for heat additions to Mt. Hope Bay and food availability to higher trophic levels.

Conversion of the Falls River sewage treatment facility is also mentioned in the Bay characterization. The Company notes that, after the 1982 conversion of the plant from primary to secondary treatment, diversity in the benthic community of Mt. Hope Bay rose presumably due to improved water quality. Not surprisingly, biological oxygen demand (BOD) to the Bay increased with increasing plant load during the 1980's. However, there is no evidence of a long-term decline Mt. Hope Bay oxygen concentration data presented by the company in Appendix A. Recent research on Narragansett Bay oxygen levels using sophisticated monitoring technology has shown more widespread occurrence of low dissolved oxygen levels than heretofore thought (Ely 1999). Continued research may well show that low dissolved oxygen is impacted fishery production in Narragansett Bay. Still, the collapse of winter flounder in Mt. Hope Bay in 1985-1986 is so severe that a low dissolved oxygen cause would need to be widespread and acute. Again, no evidence of this appears in the MRI oxygen concentration time series and no large fish kills were reported.

On page A-64, the company notes observations of increasing ctenophore blooms in Mt. Hope Bay and the possibility of elevated larval fish predation. They cite research linking increasing water temperatures to the ctenophore abundance but don't consider a BPS source of extra heat. In Appendix C they state that temperature may be responsible for ctenophore abundance and that the plant discharge may be a factor. The inability to report something definitive on heat additions seems odd given that BPS adds about 40 trillion BTUs to the bay each year.

The company discusses management activities by state and federal agencies (page A-66) but omits documentation that fishing mortality rates have been substantially reduced (NEFSC 1999, Gibson 2000). They later plot the fishing mortality rate data in Appendix C, company Figure 2-2, which clearly shows a decline. These data should be presented up front in section A to rule out the possibility of continued over fishing on Mt. Hope Bay fish stocks. It also should have been noted that management efforts have made substantial progress in rebuilding stocks of striped bass, summer flounder, weakfish, tautog, scup, and winter flounder.

Cormorants are given significant attention in the demonstration as a fish predator and potential explanation for changes in fish abundance in Mt. Hope Bay. Although they have increased in abundance and eat large quantities of fish, several lines of evidence argue against this avian predator as the primary mechanism for reduced winter flounder abundance. First, the MRI standard trawl collapsed abruptly in 1985-1986 while cormorant abundance was still relatively low (Figures 1 and 2). Second, other trawl surveys in RI waters did not collapse to near zero in the 1990's (Gibson 2002a) despite a continued increase in the abundance of cormorants (Figure 2). Third, estimated survival rates of young of the year winter flounder in Narragansett Bay have varied without trend since 1986 despite a tripling of the cormorant population (Figure 3). Finally, we note that 67 cormorants sampled from Hope Island and Sakonnet Point in 1995 contained only 8.7% winter flounder in their stomachs (RIDFW unpublished data).

The main thrust of section 8 in Appendix A is that many factors have interacted to produce the observed changes in fish abundance in Mt. Hope Bay. Certainly true, but a more inclusive analysis would have considered the possibility that these factors have weakened the resilience of the fish stocks to other anthropogenic impacts such as those from power generation. The possibility that a suite of factors reduced winter flounder abundance across the region and was amplified by power plant impacts in Mt. Hope Bay so that a complete collapse occurred is not considered. Section 9 concludes, “The evolution of biological communities in estuaries such as Mt. Hope Bay has resulted in maximized productivity in a highly variable and naturally stressful environment. Adaptive feeding behaviors tend to buffer the effects of environmental fluctuations.” Examination of the MRI trawl data for Mt. Hope Bay in comparison to the RIDFW survey data for Narragansett Bay indicates that the buffering ability referred to above has been exhausted such that the fisheries community in Mt. Hope Bay has collapsed (Figure 4). That this has not occurred elsewhere begs the question of what is different about Mt. Hope Bay.

Biothermal Assessment: Predictive Demonstration-

We note that the spatial-temporal quantification of habitat usage is based on MRI survey data collected during a period of impact. As shown by Gibson (2002a), Mt. Hope Bay winter flounder were declining relative to other areas as early as 1972. Meng and Powell (1999) have shown that the spatial distribution of winter flounder varies with density so that when overall abundance is high, fish are more widely distributed. This means that using the MRI survey data to characterize habitat usage understates the amount of habitat utilized and therefore understates the amount compromised by thermal effluent.

The polygon approach to quantifying the temperature range suitable for growth and reproduction is flawed because it relies on the acclimation effect. While fish show this effect in laboratory enclosures, they don’t necessarily display it in the field. For example, RIDFW monthly trawl data for adult winter flounder at stations in Mt. Hope Bay show a sharp avoidance of temperatures above 15 C (Figure 5a) consistent with McCracken’s (1963) findings. Adult winter flounder (> 28 cm) abundance in the RIDFW survey generally increases as temperatures warm in the spring but drops abruptly when the 15 C limit is reached. Given the migratory nature and temperature sensitivity of adult winter flounder, it is also not likely that fish will remain in a grid cell for 7 days to acclimate. Juvenile winter flounder show the same temperature sensitivity but at higher levels. During the very warm 1999 summer, young of the year (YOY) winter flounder vacated the littoral zone when water temperatures increased in June and July (Figure 5b and 5c). The response was not ambiguous or gradual. As temperature increased above 24-25 C, winter flounder abundance declined sharply. These data do not support the company assumption that there is a plus or minus 5 C range in avoidance temperature response. By assuming that only half the fish display avoidance at the specified temperature, the company as underestimated thermal impacts.

Further, the regression calculations for the avoidance line in the polygon are flawed. In company figure B1.1-1a, the experimental values of acclimation and avoidance temperature are plotted along with the fitted regression line. Examination of the data in table B1.1-1a shows that there is no datum for an acclimation temperature of 14 C. Also, combining juvenile and adult data in the regression ignores the well-known difference in temperature sensitivity between juvenile and adult winter flounder (Casterlein and Reynolds 1982). Table B1.1-11 contains a slope estimate for the avoidance line regression equal to 0.411. Refitting the regression using the data in B1.1-

1a and including a body size covariate, produces a highly significant regression with a significant inverse body size effect. Of more importance is that the partial slope for acclimation temperature drops to 0.249. This means that the acclimation effect is far less than the company analysis indicates. The combined effect of the above problems is that the polygon approach overestimates the scope for growth in winter flounder and hence understates the thermal impact of the EMM preferred alternative.

Similar problems exist for the reproductive portion of the winter flounder polygon (company figure B1.11a). Crucial data from a recent study on temperature and winter flounder egg-larval survival (Keller and Klein-MacPhee 2000) are omitted. They showed through mesocosm experiments that egg-hatching success in winter flounder from Narragansett Bay was higher at lower incubation temperatures for a common acclimation temperature. Not remarkable in and of itself but the "high" incubation temperature in their study was only 5 C. This experimental treatment resulted in significantly reduced hatching success and if included would lie at the lower end of the reproductive zone in the company's Figure B1.1-1b. Inclusion of the Keller and Klein-MacPhee (2000) data would reduce the upper temperature limit of minimum egg mortality and reduce the overall scope for winter flounder reproductive success. The net result would be more egg loss for a given temperature increase in the EMM scenario. Again, the thermal impact of the EMM alternative is underestimated.

The biothermal assessment of USGEN (2001b) considers only eggs, juveniles, and adults of winter flounder (Company Table 2-2). There is no evaluation of thermal impacts to larvae. Buckley et al. (1990) showed that cold water produced larger larvae in good condition as evidenced by high RNA content. Colder temperatures also reduced predation on larvae that led to higher survival to metamorphosis (Keller and MacPhee 2000). Instantaneous larval mortality rates in their warm temperature treatments were twice that in the cold treatments. Compounding these rates over a 30-day larval stage duration results in one-third the surviving larvae in warmer water. By omitting consideration of the larval life stage in the context of added heat from BPS operations, the company has again understated thermal impacts.

Habitat areas of species/life stage occurrence are incorrect in company tables 2-2, 2-3 and figures 2-11 to 2-15. Juvenile winter flounder are likely found throughout Mt. Hope Bay due to the shallow depth. Adults of weakfish, bluefish and menhaden are found in the Bay in addition to juveniles. Minimizing the areas inhabited by species and life stages artificially minimizes thermal impacts under the EMM scenario by reducing overlap of elevated temperatures with fish distributions.

Protection of Balanced Indigenous Community: Retrospective Demonstration-

Modifications at the Falls River sewage treatment facility (FRSF) are identified as coincident to the collapse of fish stocks in the mid-1980's. The facility was upgraded in 1982-1983 from primary to secondary treatment that resulted in an immediate reduction in BOD loading to the bay. BOD loadings then fluctuated with an increasing trend through 1991. As noted earlier, the USGEN oxygen monitoring data show no evidence of a long-term reduction in oxygen concentrations in the bay. It is unlikely that the FRSF is responsible for the collapse of fish stocks in the bay.

The company claims no rare habitat occurs in Mt. Hope Bay. By virtue of its shallow depth and high freshwater input, Mt. Hope Bay is a rare habitat in the greater Narragansett Bay and would receive essential fish habitat designation (EFH) under the federal Sustainable Fisheries Act.

The company notes that ichthyoplankton sampling in 1990 showed lower levels of winter flounder and tautog larvae than in 1972-1973. They say the reasons are unclear and cite Keller et al. (1999b) who speculated that over fishing, habitat loss and pollution could be responsible. The company fails to note the collapse of winter flounder and tautog in their consultant's trawl survey in Mt. Hope Bay. Winter flounder larval abundance in Mt. Hope Bay is moderately correlated ($r=0.63$, $P<0.01$) with weight per tow in the MRI standard trawl in log scale when the obvious 1992 outlier is removed. Station operations have contributed to the decline of the winter flounder stock, which has in turn reduced larval abundance.

There is an extensive discussion of the reduction in Massachusetts and Rhode Island landings of winter flounder and tautog. The company attributes this to over fishing and do not acknowledge that production of these species in Mt. Hope Bay has collapsed as evidenced by their own monitoring data. They also fail to acknowledge that fishing mortality rates on both species have been reduced and stock rebuilding is underway (RIDFW, ASMFC, NEFSC stock assessments). Mt. Hope Bay, contrary to their assertion, is in fact unique, as no recovery is evident. This places responsibility for continued low abundance on a local factor. The company in general rejects the RIDFW position that Mt. Hope Bay winter flounder are a discrete stock despite the considerable evidence in the scientific literature that the species homes precisely to natal spawning areas (Lobell 1939, Perlmutter 1947, Saila 1961, Powell 1989, Crawford 1990). Gibson (1993), reported results from an RIDFW tagging study which marked flounder in both upper Narragansett and Mt. Hope Bay during the spawning season. His analysis found that 85% of tags returned during the following spawning season were on the home grounds. Saila (1962) found essentially the same thing while researching potential impacts of constructing the Fox Point hurricane barrier. Gibson (1991) also analyzed data from 9 winter flounder tagging studies going back to the 1930's and found an average rate of 84.5% fidelity to the tagging area. Most recently, RIDFW has been tagging adult winter flounder in Pt. Judith Pond during the spawning period. A total of 898 fish have been tagged from 1999-2001. Through the end of 2001, a total of 66 tags have been returned. No returns during subsequent spawning periods have come from other spawning areas. In one case, a fish captured in an RIDFW fyke-net and tagged in 1999, was recaptured in 2000 and 2001 in the same net. Genetic analyses may or may not discriminate proximate stocks depending on the amount of straying and the resolving power of the method. Genetic findings may be irrelevant when homing behavior creates stock subunits with population dynamics that can be desynchronized by local impacts. Such impacts can lead to the loss of elements of the population substructure. Indeed, the discovery of homing behavior in Atlantic cod in relation to the depletion of some stock subunits is now viewed as an impediment to stock recovery since recolonization rates are reduced (Robichaud and Rose 2002). There should be no doubt concerning the homing ability of winter flounder and the management implications of a rich stock structure. If uncertainty persists, then application of the precautionary principle requires an assumption that this structure exists and that depletion of substock components is unacceptable.

The company compares trawl survey programs and cautions that because of mesh size differences, abundance trends can't be compared. This will come as news to fisheries scientists who routinely use models tuned with multiple abundance indices from different sampling programs to assess individual fish stocks (Conser and Powers 1990, Prager 1994). The company asserts that methodological differences are the reason that the slope of the decline in Mt. Hope Bay is steeper than in other areas. This has been a company argument for many years and needs close examination. The MRI standard trawl survey collapsed abruptly in 1985-1986 whereas the RIDFW and URIGSO surveys did not and have not reached the low level of abundance currently seen in the MRI survey (Gibson 2002a). If over fishing caused the overall decline and mesh size differences created an artifact in the MRI survey slope, then several hypotheses can be tested with data accrued since the Gibson (1996) report.

First, over fishing should truncate the size distribution of larger fish until spawning biomass declines enough for recruitment to fail (the over fishing hypothesis). Second, the larger mesh surveys that don't catch small fish will collapse first to be followed by the smaller mesh surveys that collapse when recruitment ultimately fails (the selectivity hypothesis). Examination of MRI length frequency data refutes the over fishing explanation for the spectacular 1985-1986 collapse in Mt. Hope Bay. From 1972-1976, a full complement of lengths was present in the Mt. Hope bay stock of winter flounder (Figure 6). During the 1985-1986 collapse, all sizes decreased in abundance but small and intermediate size flounder almost entirely disappeared leaving only remnant adults (Figure 7). The Narragansett Bay stock sampled by RIDFW in 1984-1988 showed very different size structure dynamics (Figure 8). While over fishing was occurring (Gibson 2000) and truncation of large fish is apparent in the data, the full range of small and intermediate fish is maintained. Clearly, the collapse of winter flounder in Mt. Hope Bay was not due to over fishing. The second hypothesis of a lagged collapse due to smaller mesh is also refuted. As shown in Gibson (2002a) and in Figure 1, neither the URIGSO survey (large mesh) nor the RIDFW survey (small mesh) collapsed concurrently or at lag to the MRI survey as would be expected based on the selectivity hypothesis. It should be noted as well that both the MRI Wilcox small mesh trawl and impingement data at BPS have also collapsed to near zero (MRI 2002). The companies position that winter flounder in Mt. Hope Bay have followed the same pattern as in Narragansett Bay and that BPS has had no impact on the Mt. Hope Bay stock (demonstration Appendix C) cannot be supported. The loss of resident small and intermediate size flounder before older fish that are migratory is consistent with entrainment loss and thermal impacts as apposed to over fishing.

The company also reviews regional abundance data for winter flounder in Appendix C. They report federal trawl survey data through 1993 in support of the decline of the regional stock. Updated results from the NMFS/NEFSC federal survey through 2000 are plotted in Figure 1. Clearly, a stock recovery has been occurring since 1993. The MRI standard and small mesh trawls in Mt. Hope Bay however are at their lowest levels ever in 2000-2001, emphasizing the anomalous behavior of this stock. Knowledge of a winter flounder stock recovery on a regional basis is widespread having been published in New England Fishery Management Council news releases, local papers, and fishing association newsletters in addition to the scientific assessment literature. In another example of obsolete information or erroneous interpretation, the company cites NYDEC data from a Peconic Bay survey in support of their regional stock trend hypothesis. In fact, the NYDEC survey was dropped from the peer reviewed regional assessment because of residual problems, that is it did not correspond to regional trends (NEFSC 1999). The company's regional stock status summary (Appendix C 18-19) is obsolete and doesn't represent current stock conditions. The following summary is taken from the most recent peer reviewed assessment by NEFSC and should be contrasted to the obsolete information in the company demonstration.

"*The stock complex is at a medium level of biomass and is fully exploited. Reductions in fishing mortality, and to a lesser degree improvement in recent recruitment, have contributed to rebuilding of the stock… Fully recruited fishing mortality rate in 1997 was 0.31 (exploitation rate = 24%) about equal to the ASMFC target for 1997 of F30%=0.29*."

Source: Report of the 28th Northeast Regional Stock Assessment Workshop (28th SAW). Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. NOAA/ National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole MA. January 1999.

The company also misinterprets the status of the Mt. Hope Bay winter flounder stock (Appendix C 19). There is no question that over fishing has occurred (Gibson 2000). The evidence is compelling however that fishing mortality (F) had been substantially reduced on both local and regional scales (Gibson 2000 and updates, NEFSC 1999) and this has led to stock rebuilding as documented above. Fishing mortality rate on Mt. Hope Bay winter flounder has been reduced as well. Analysis of tag return data from tags implanted in winter flounder by MRI and RIDFW yielded an F=0.30 for the period 1996-1998 (RIDFW unpublished data). This is very close to the ASMFC management target. If the company had plotted their standard trawl or impingement index in company Figure 2-2, it would be clear that fishing mortality (which has been reduced) is not responsible for the continued lack of winter flounder in Mt. Hope Bay. They chose instead to plot the URIGSO index sampled in the lower west passage.

Similar criticisms can be made for tautog which are recovering in Narragansett Bay (RIDFW assessment update) but remain collapsed in Mt. Hope Bay (company figure 2-4).

USGEN uses the MRI standard trawl data to compute Shannon-Weiner diversity indices (D) for Mt. Hope Bay (Appendix C 2.7.4.7), identifies an upward trend (company Figure 2-8), and arrives at the incredible interpretation that the collapse of winter flounder in Mt. Hope Bay has produced more balance in the fish community. This interpretation is made despite the collapse of the fish community as shown by the company's trawl survey (Figure 4). The company's method to compute diversity indices is flawed and results in a spurious trend (company Figure 2-8). They use a computerized resample method to restrict the sample size in any year to 50 fish. With the collapse of the fish community, only about 50 fish are caught in the standard trawl in recent years. However, many more were caught per year prior to the 1985-1986 collapses. It is known by ecologists that the Shannon-Weiner index is related to the number of species sampled (DeJong 1975). It is also known that the number of species sampled is related to sample size (Hurlbert 1971). By restricting the effective sample size to 50 fish when many more were caught, the company reduces the number of species present and creates a negative bias in the estimated diversity index from 1972-1986. The bias does not occur after that because the resample method is using essentially all the fish actually caught. The effect can be seen in company Figure 2-8.

Most of the index values during the 1972-1986 periods are less than 1.5. The series then increases abruptly coincident to the collapse of the fish community and from 1987 to present, most values are over 1.5. Ludwig and Reynolds (1988) express caution over the use of rarefaction methods to adjust for sample size noting that spurious results can occur.

Retrospective Test of Balanced Community-

The retrospective test for a balanced indigenous community (Appendix C) fails in numerous areas as follows:

1) Nuisance and Heat Tolerant Species- Increasing frequency of ctenophore blooms is related to increasing temperature which operation of BPS has contributed to through the addition of waste heat. Heat addition to Mt. Hope Bay by BPS has averaged 39 trillion BTUs since 1996. The company's demonstration shows that operation of BPS has increased the volume of Mt. Hope Bay exposed to high temperatures (company Figure 1-9a). One must conclude that operation of BPS has contributed to the nuisance ctenophore blooms.
2) Formerly Abundant Species- Winter flounder, once the dominant species in Mt. Hope Bay, has declined much more than in other areas (Gibson 2002a). The species is subject to entrainment and impingement loss and is heat sensitive. One must conclude that operations at BPS are responsible for the deviation of Mt. Hope Bay winter flounder from other stocks in the area.
3) Loss of Economic and Recreational Use- The fisheries collapse in Mt. Hope Bay is well known to commercial and recreational fishermen, denying them fishing opportunity that formerly existed. Testimony from fishermen has been extensive on this matter having appeared in newspapers, RI Marine Fisheries Council minutes, and fishing organization newsletters. Indeed, the concerns of fishermen catalyzed RIDFW research on Mt. Hope Bay fish stocks.
4) Successful Completion of Life History- Since the effect of increased temperature on egg hatchability and larval survival in winter flounder is well established in the scientific literature and since waste heat from the station has exacerbated a natural warming trend, it must be concluded that operations at BPS have reduced the successful completion of this species life history in Mt. Hope Bay.
5) Trophic Structure Changes- A large change in trophic structure has occurred with the loss of the demersal fish community. The diversity demonstration is inconclusive because of the biased methods used. The company has not shown that past operations were protective of a balanced and indigenous community or that proposed operations will be.

Appendix F Entrainment and Impingement 316(b)-

The company dismisses entrainment mortality since their estimates of conditional entrainment mortality rate (CEMR) under current MOA II conditions are much lower than fishing mortality rates. Their estimates of CEMR however are too low for several reasons. First, the through plant larval mortality rate component of the CMER is underestimated. The probit model used to estimate through plant mortality rate from temperature and exposure time was fitted primarily to YOY and yearling data (company table 4-3). Because of their high surface area to volume ratio, larval flounder will be more sensitive to elevated temperatures and exposure time than larger fish. The probit model also does not account for delayed mortality due to elevated predation after transit through the plant, a criticism that applies to impingement survival assumptions as well. The company should assume 100% through plant mortality.

The CMER, as estimated by the empirical transport model (ETM), is related to among other things, the withdrawal factor (W). The company estimates stage specific W factors for winter flounder larvae using sampling data from the discharge stream at BPS and icthyoplankton sampling in Mt. Hope Bay. Estimates of W factors are conventionally made as the mean ratio of stage abundance in the discharge stream to stage abundance in the coolant source water. When the ratio is less than 1.0, some factor such as intake design or larval behavior reduces the efficiency of uptake. The company rejects this approach for stage IV larvae, arguing that the catchability of stage IV larvae in the bay ichthyoplankton sampling is less than that in the discharge sampling owing to the bottom dwelling nature of this stage. They substitute an area of vulnerability calculation based on the home range of YOY in the vicinity of the intake. The consequence of this method is that the W factor estimated for stage IV larvae is two orders of magnitude lower than that for stage II and III larvae. This is improbable as stage IV larvae have not yet metamorphosed and adopted the two-dimensional YOY life style. If it is true that there are sampling difficulties for stage IV in the Bay, the company should have used a more defensible approach to estimate the stage IV W factor. One possibility is to use literature based estimates of survival rates for large larvae (Pearcy 1962, Hjorleifsson and Klein-MacPhee 1991, Gibson 1993, Keller and MacPhee 2000) and grow the stage III bay abundance up to stage IV bay abundance and then proceed with the W factor estimation. Using company data on discharge abundance by stage and excepting the W=0.71 estimate for stage III, and assuming a mean stage III-IV survival rate of 0.15 (Gibson 1993), one can compute a stage IV W factor of 0.048. While still low in absolute terms, it is 36X greater than the company estimate of 0.0013. Since the instantaneous rate of entrainment mortality is directly related to W (page F-56), entrainment mortality for stage IV larvae is underestimated in the company demonstration. Similarly, CMER is underestimated for both current operating conditions and the EMM alternative.

Because of the difficulties in applying the ETM, which include specifying a Bay volume influenced by the plant, alternative calculations of entrainment impact should be made as a check. One of the primary reasons for development of the indirect ETM method was to avoid the need for stock size estimates, which are not often available. More direct estimates should be made when data allow. Entrainment impact can be assessed using stock biomass estimates and the estimates of larvae entrained at BPS. Gibson (2002b) made estimates of winter flounder exploitable stock biomass in Mt. Hope Bay from a biomass dynamic assessment model and the MRI standard trawl index. Exploitable biomass is approximately all fish age 3 and older. Winter flounder larval entrainment at BPS has been monitored from 1973-1985 and 1992-2001. Entrainment is strongly correlated with larval abundance in Mt. Hope Bay ($r=0.87$, $P<0.01$ for log regression) so missing years (1986-1991) can be predicted from larval abundance in Mt. Hope Bay as reported by MRI. The entrainment estimates were converted into equivalent adult (EA) biomass at age 3 using mortality rates and weight at age data as done by MRI (1999). The EA biomass estimates were then compared directly to the residual stock biomass estimates from the Gibson (2002b) report at lag 3 to calculate the proportion of the virtual population biomass [EA biomass/(EA biomass + remnant biomass)] missing because of entrainment interdiction. The virtual population is that which would have existed had there been no plant impact. The important distinction between this exercise and the company's demonstration is that the impacted winter flounder population is that in Mt. Hope Bay, not the stocks supplying Massachusetts and Rhode Island landings.

Entrainment at BPS, including the 1986-1991 retrospective estimates, is plotted in Figure 9. Several spikes occur but the general trend is down. Entrainment in recent years has been 50-70 million larvae. Stock biomass of winter flounder in Mt. Hope Bay, as estimated by Gibson (2002b), is currently very low (Figure 10). A stock that formerly ranged between 200 and 500 metric tons is now down to 2-3 tons. The biomass of EA losses now exceeds the residual stock by a considerable amount. Under MOA II operation, the BPS has interdicted about 80% of the virtual population biomass, assuming that all the larvae entrained are of Mt. Hope Bay origin (Figure 11). This is unlikely to be strictly true but Gibson (1993) has given the rational for assuming a low rate of larval import from down bay spawning units. If only 10% of the larvae entrained were of Mt. Hope Bay origin, it would mean that BPS is still interdicting about 30% of the virtual population in recent years. A plant impact that rivals the target fishing mortality rate is unacceptable. In order to reconcile the company estimate of CMER=0.13 under MOAA II, one would have to assume that only 3% of the larvae entrained were of Mt. Hope Bay origin.

Synthesis Modeling- The company's 316 (a) and (B) demonstrations contain no modeling synthesis of the competing sources of mortality on the winter flounder population. Government scientists and regulators had requested that the RAMAS population simulator be used to model winter flounder population dynamics so that the relative importance of over fishing, thermal impacts to habitat, impingment/entrainment losses, and natural mortality could be assessed. The company began development of such a model and reported results in the partial demonstration (USGEN 2001a). They abandoned it in the final demonstration when it was realized that the model output was more optimistic than their consultants monitoring data. Under the preliminary configuration used in the partial demonstration, modeled abundance of winter flounder began a recovery that is not evident in the MRI standard trawl, the small mesh Wilcox trawl, or the impingement abundance series. All of these indices are at historic low levels in 2000-2001. Moreover, the company identified over fishing as the dominant influence on winter flounder population dynamics. In order to make their simulation results conform to field data, the company would have needed to increase thermal habitat impacts and entrainment/impingement loss rates to realistic levels. They chose instead to drop the RAMAS modeling and utilize a piecemeal approach to evaluating impacts in the final demonstration. As shown above, the company has understated thermal impacts and impingement/entrainment losses and has overemphasized the role of over fishing and other factors in the final demonstration. It is readily apparent now why the early RAMAS simulations did not conform to field monitoring data.

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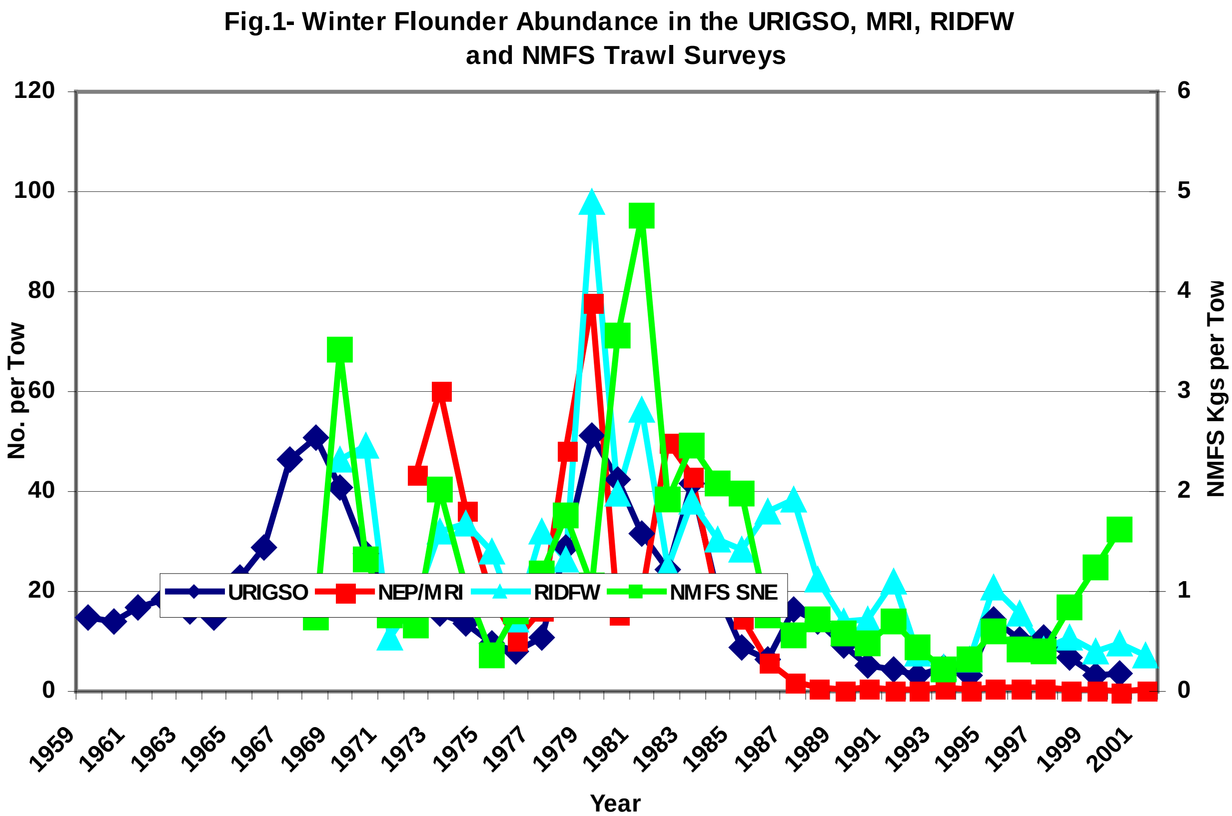


Fig.1- Winter Flounder Abundance in the URIGSO, MRI, RIDFW
and NMFS Trawl Surveys
No. per Tow
NMFS Kgs per Tow
Year
URIGSO
NEP/MRI
RIDFW
NMFS SNE
120
100
80
60
40
20
0
6
5
4
3
2
1
0
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001

Fig.2- Trend in Rhode Island Cormorant Abundance from RIDFW Marine Bird Survey, 1980-2001

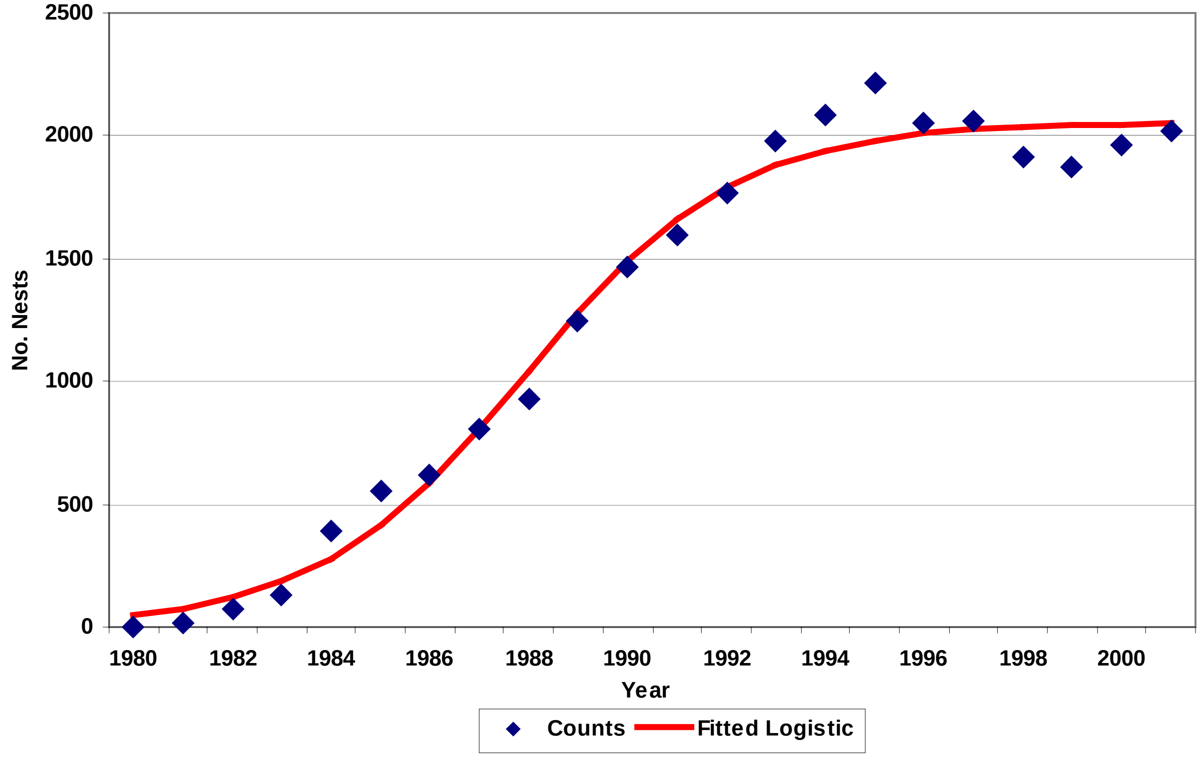
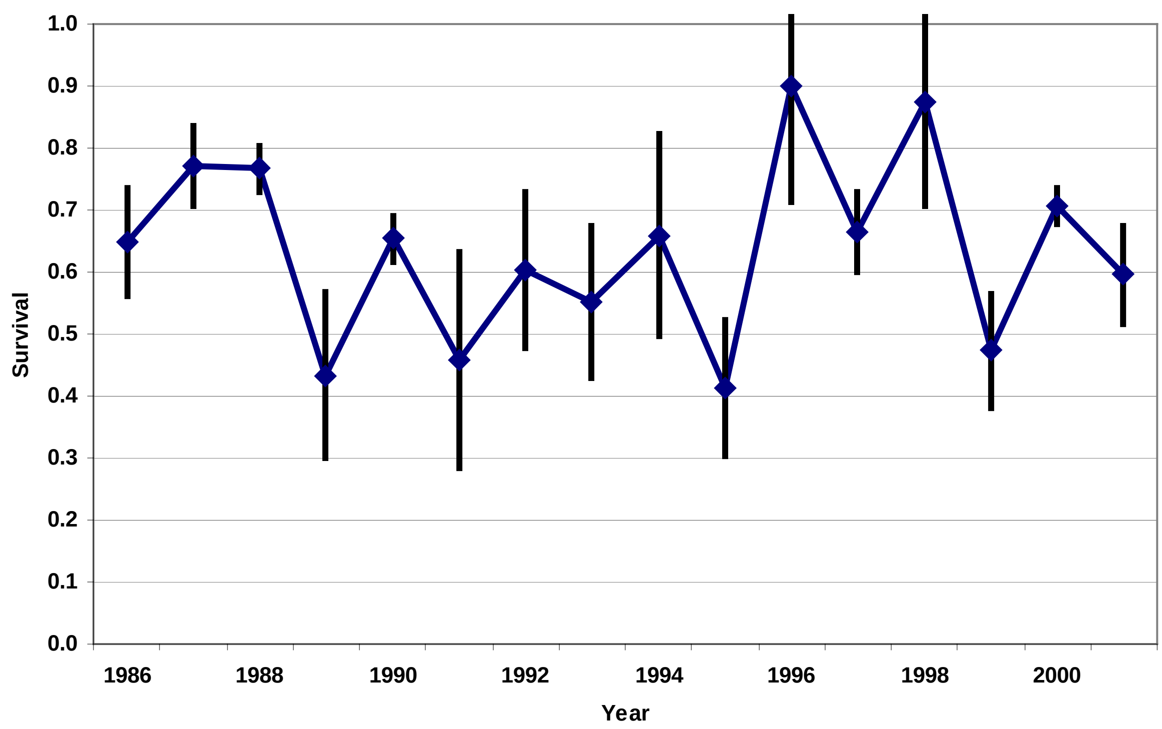


Fig.3- Estimated Monthly Survival Rates of YOY Winter Flounder in Narragansett Bay



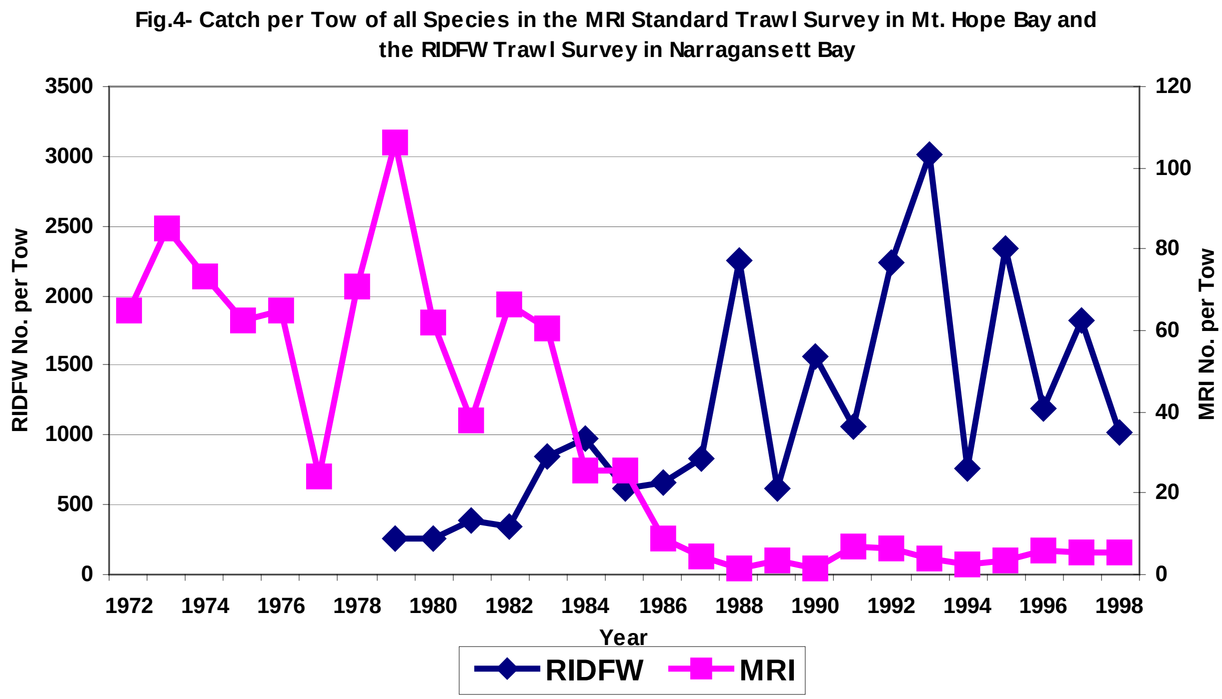


Fig.4- Catch per Tow of all Species in the MRI Standard Trawl Survey in Mt. Hope Bay and the RIDFW Trawl Survey in Narragansett Bay
RIDFW No. per Tow
MRI No. per Tow
Year
RIDFW
MRI

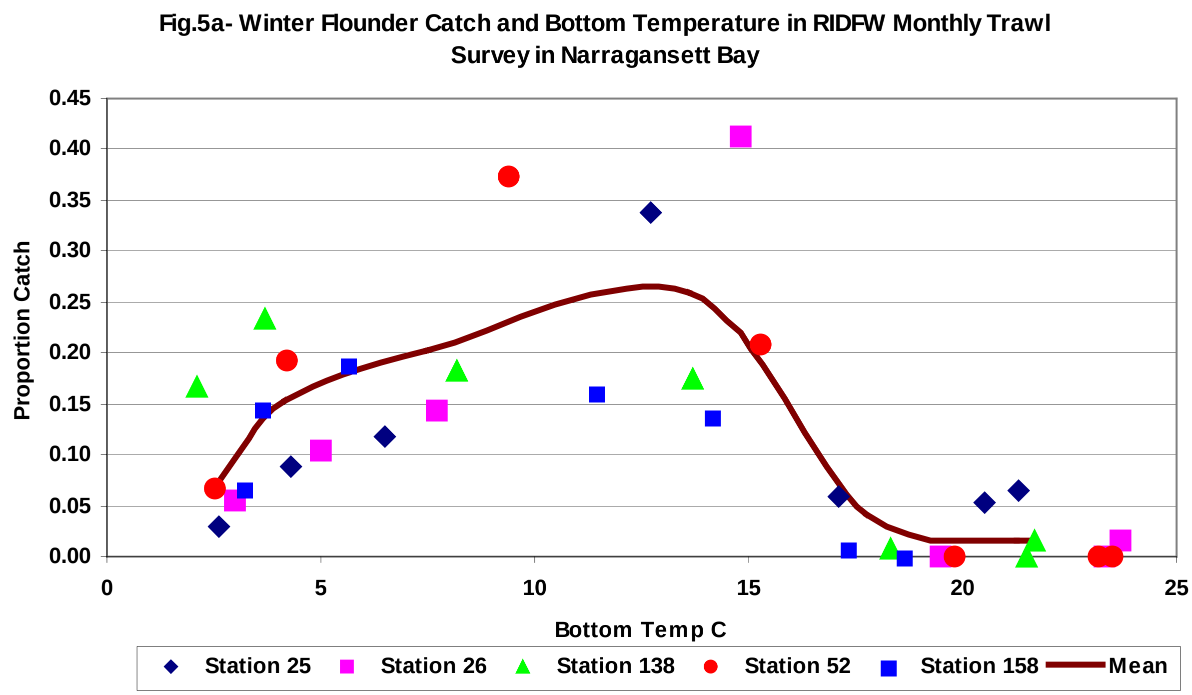


Fig.5a- Winter Flounder Catch and Bottom Temperature in RIDFW Monthly Trawl Survey in Narragansett Bay
Proportion Catch
Bottom Temp C
Station 25
Station 26
Station 138
Station 52
Station 158
Mean

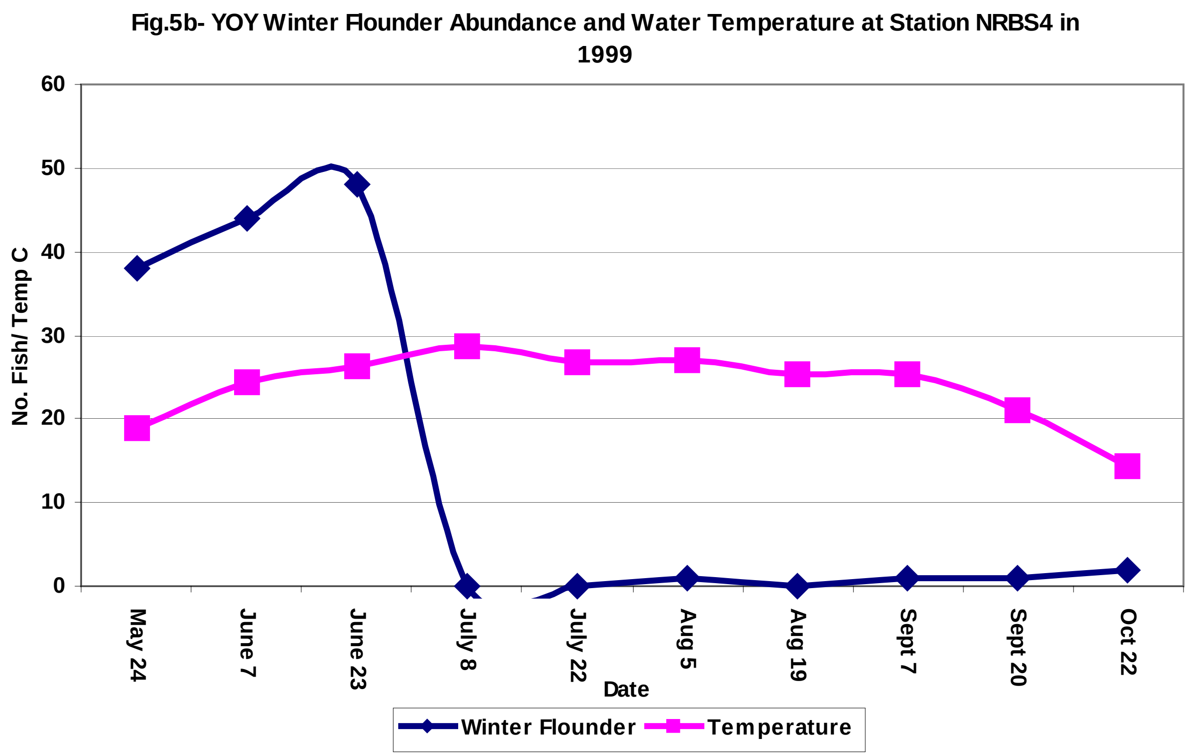


Fig.5b- YOY Winter Flounder Abundance and Water Temperature at Station NRBS4 in 1999
60
50
40
30
20
10
0
No. Fish/ Temp C
May 24
June 7
June 23
July 8
July 22
Aug 5
Aug 19
Sept 7
Sept 20
Oct 22
Date
Winter Flounder
Temperature

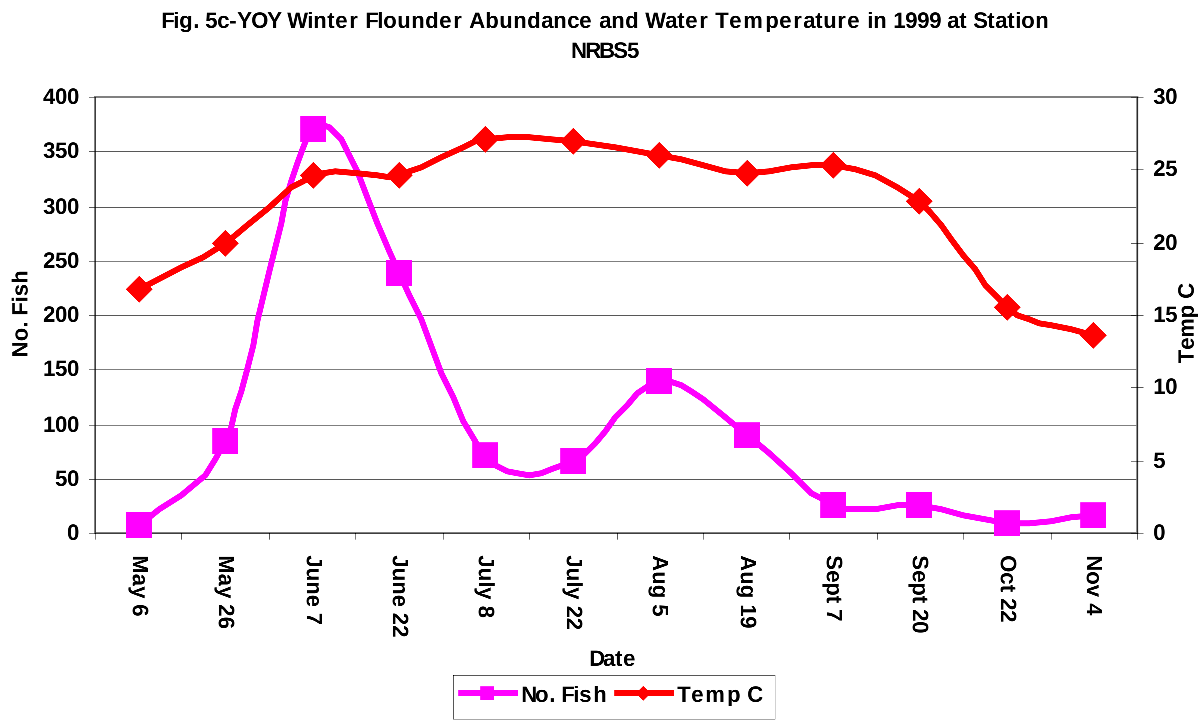


Fig. 5c-YOY Winter Flounder Abundance and Water Temperature in 1999 at Station NRBS5
400
350
300
250
200
150
100
50
0
No. Fish
30
25
20
15
10
5
0
Temp C
May 6
May 26
June 7
June 22
July 8
July 22
Aug 5
Aug 19
Sept 7
Sept 20
Oct 22
Nov 4
Date
No. Fish
Temp C

Fig. 6- Winter Flounder Length Frequency in the MRI Standard Trawl Survey in Mt. Hope Bay 1972-1976

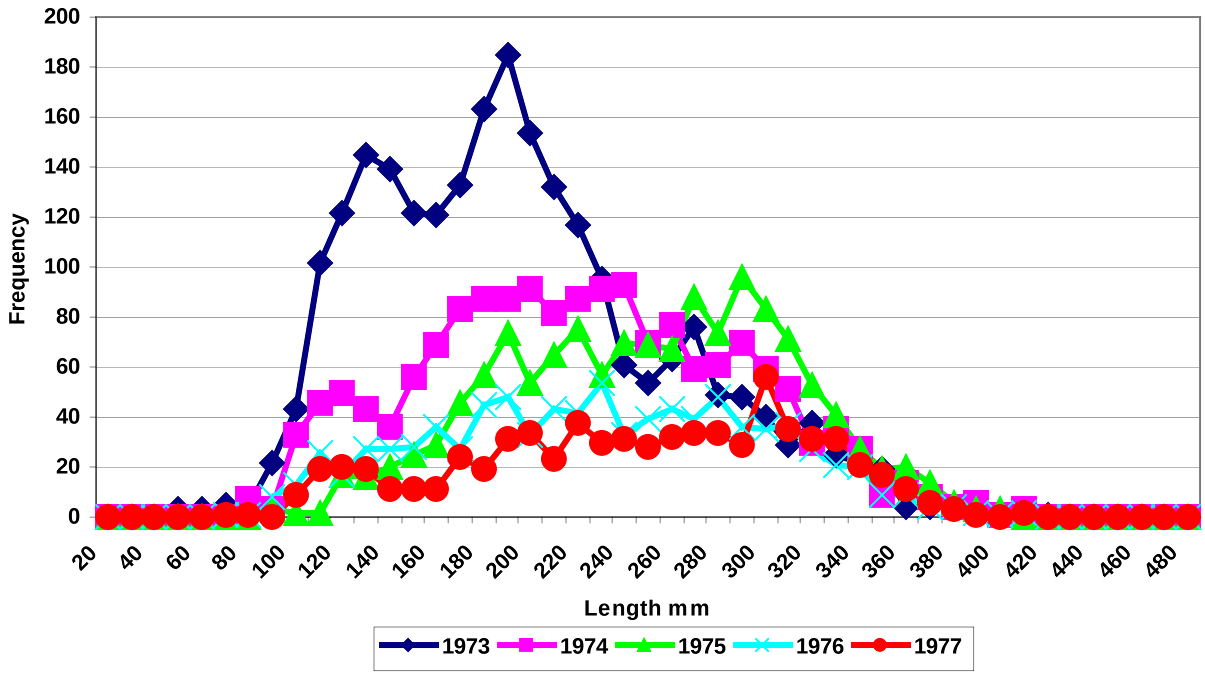


Fig. 7- Winter Flounder Length Frequency in the MRI Standard Trawl Survey in Mt. Hope Bay 1984-1988

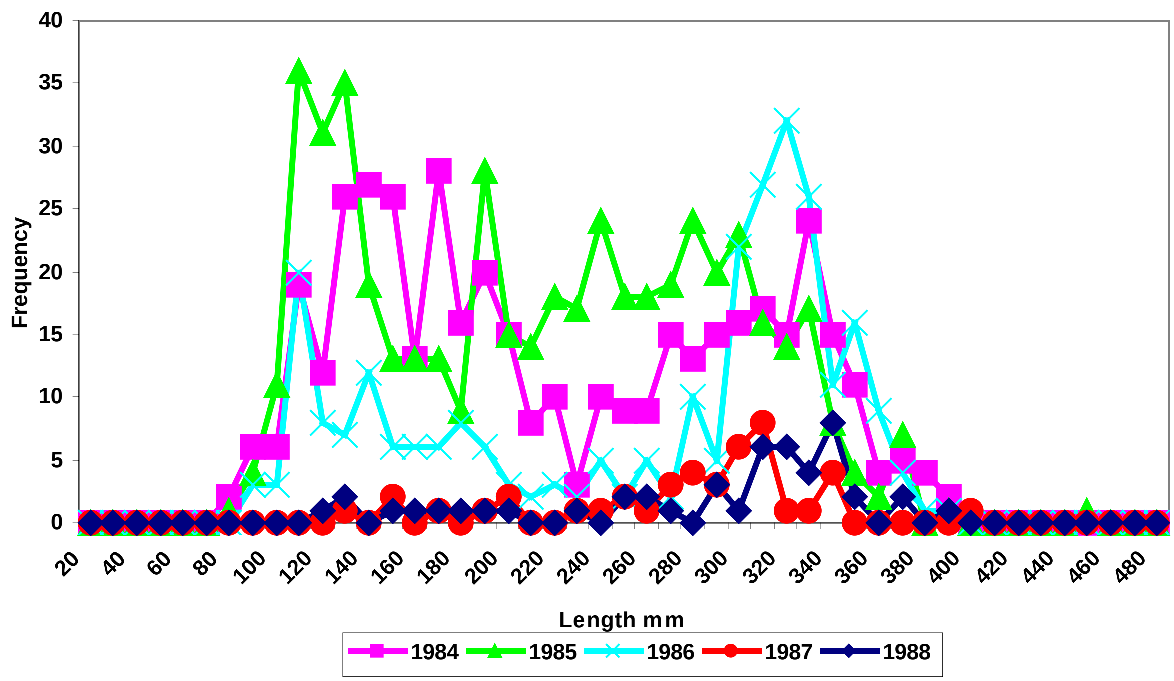


Fig.8- Winter Flounder Length Frequency in the RIDFW Spring Trawl Survey in Narragansett Bay, 1984-1988

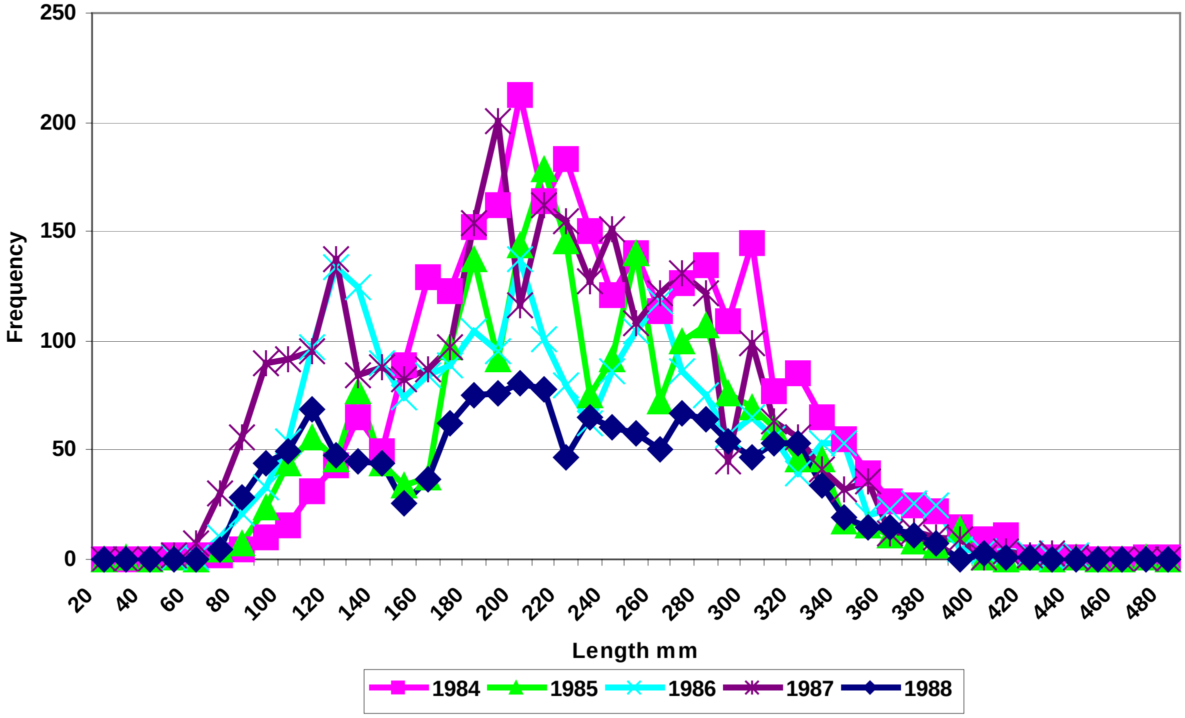


Fig.9- Estimated Winter Flounder Larval Entrainment at Brayton Point Station

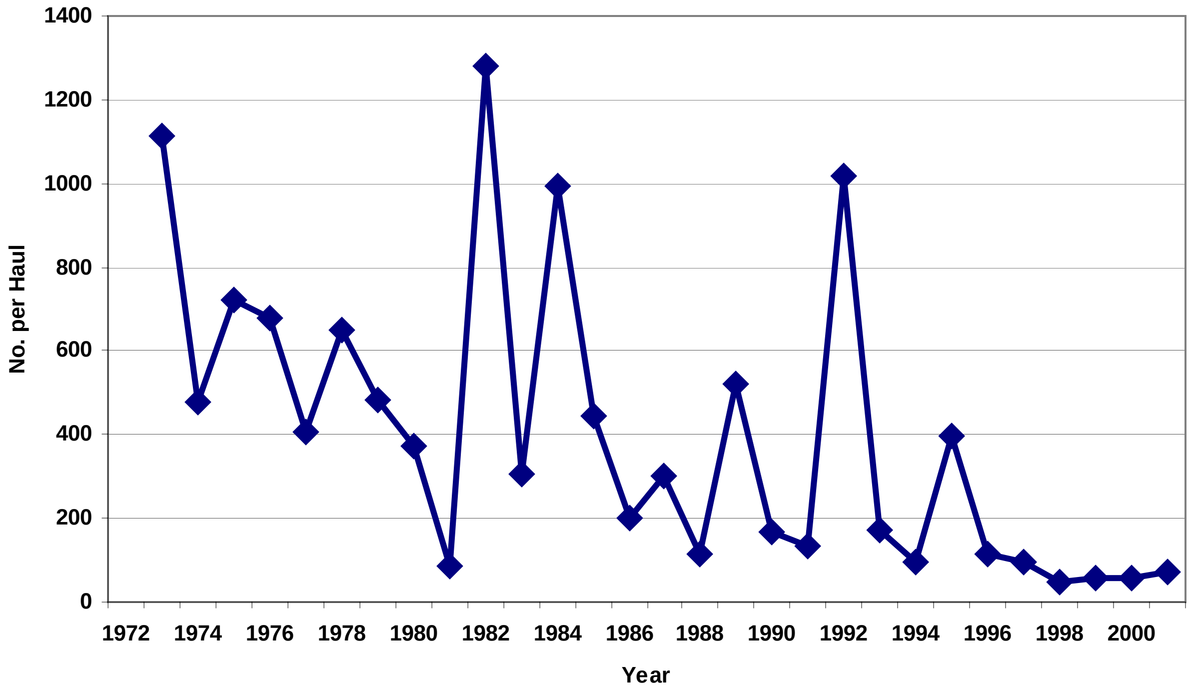


Fig.10- Estimated Biomass of Winter Flounder Stock in Mt. Hope Bay and Equivalent Adult Biomass Lost to Entrainment

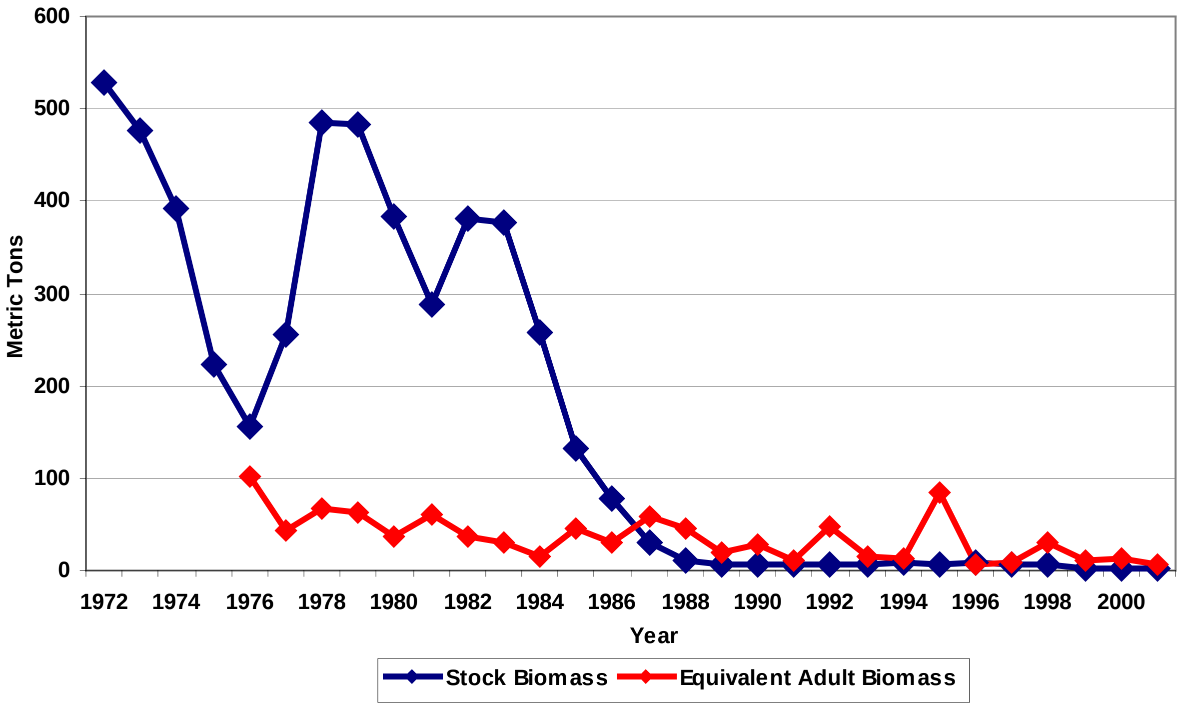
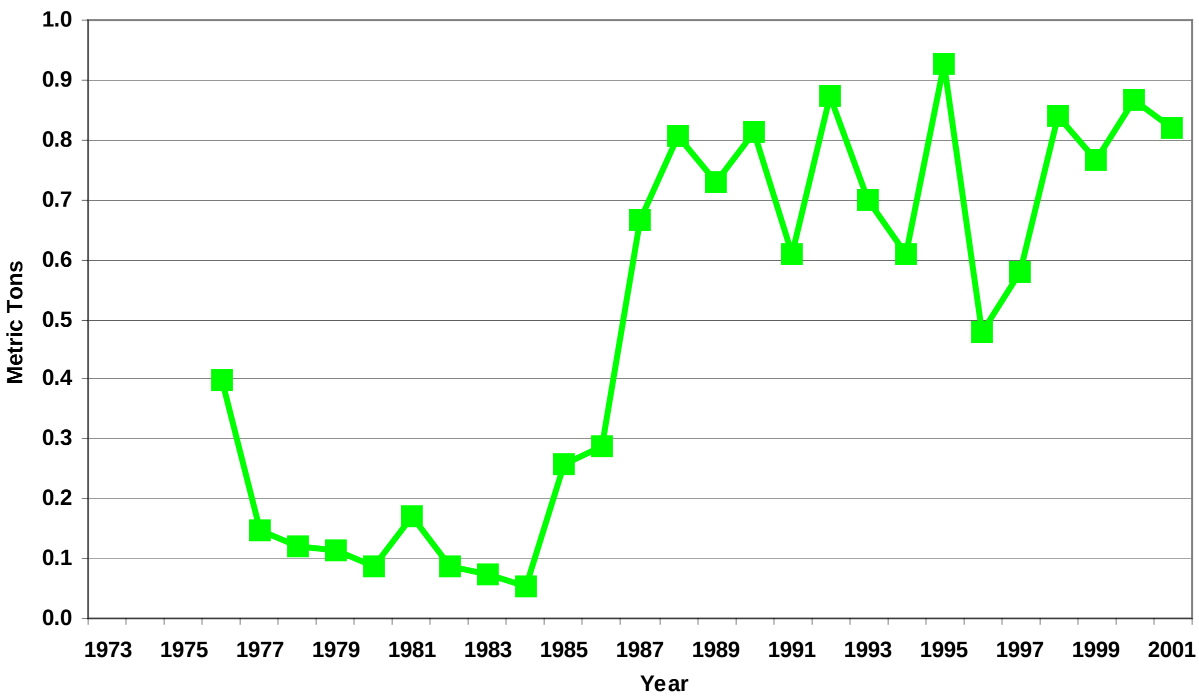


Fig.11- Proportion of Winter Flounder Virtual Population Biomass in Mt. Hope Bay Lost due to Entrainment at Brayton Point Station



Attachment II

Review of USGen NE 316 (a) and (b) Demonstration in Support of NPDES Renewal Permit No, MA0003654 Brayton Point Station and Variance Request for Thermal Discharge and Modified Cooling Water Intake System.

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Rhode Island Department of Environmental Management

May 2002

Appendix A

Section 1.4 Anthropogenic Freshwater Sources

This section lists the municipalities fully or partially located in the Taunton River Basin and includes a statement that some of the municipalities employ combined sewer systems that alter the natural water quality and hydrology of their associated portions of the drainage area.

- Additional language should be added to clarify that: Fall River is the only municipality with CSO discharges into the Mt. Hope Bay or its tributaries and the only other municipality listed that is served by CSOs, New Bedford, does not discharge within the Taunton River/Mt. Hope Bay drainage area.

Section 1.4.1 Wastewater Treatment Plant Discharges

The first sentence states, "collectively the three Mount Hope Bay WWTPs discharge treated secondary effluent into the bay at a rate of approximately
43.5 mgd, as shown in Table 1.7".

- While it is subsequently clarified that this flow rate represents a future design flow, the sentence should be modified to read collectively that three Mount Hope Bay WWTPs have been designed to discharge treated secondary effluent into the bay at a future design rate of approximately 43.5 mgd as shown in Table 1.7.

Section 4.1, Water Temperature

The first paragraph states that, "Mount Hope Bay receives heat from several anthropogenic sources, including three power generating facilities (Brayton Point Station, Somerset Power LLC, and Taunton Municipal Lighting Company) and a textile finishing facility (Harodite Finishing Company, Inc.). These facilities contribute to the overall heat budget in Mount Hope Bay".

- Consultants for USGen have previously applied the water quality model to determine the relative heat impacts of these facilities on Mount Hope Bay. It was determined that thermal impacts from the other facilities were negligible. While impacts from Somerset Power LLC., were measurable, they were insignificant when compared to those of the Brayton Point Station.

- Language should be added to the report to indicate the relative impacts of these facilities and to specifically quantify the impacts from Somerset Power LLC.

Section 4.4 Nutrients

Midway through the first paragraph, there is the statement, "In Narragansett Bay, wastewater treatment facilities that border the bay are responsible for 28% of the quantifiable nitrogen loading, and rivers deliver 62% of the bay's nitrogen loading.

- The literature cited for this statement should be (Nixon et.al. 1995).

Section 4.4.3 Nitrogen

The third paragraph in this section begins with the statement, "In Narragansett Bay, atmospheric deposition is responsible for the annual input of 420,000 kg (925, 940 lb.) of nitrogen.

- Similar to the statement above, literature cited for this statement should be (Nixon et.al. 1995).

Section 5.4 Municipal, Commercial and Industrial Use

The second bullet in this section, Users who rely on Mount Hope Bay for cooling-water includes the statement, "In addition to Brayton Point Station, two other power generating facilities (Somerset Power LLC and Taunton Municipal Lighting Co.) and a textile finishing company (Harodite Finishing Company, Inc.) use water from the Mount Hope Bay region for cooling operations".

- Text should clarify whether these facilities withdraw seawater from Mount Hope to supply cooling water.

Section 5.5.3 Other Stressors

Nutrients

The second paragraph in this subsection includes the following statements:

"Oxygen can dissolve in cold water more readily than in warm water, which becomes saturated with oxygen at lower levels than cold water. Therefore, less oxygen is available to aquatic organisms during the summer than in other seasons (RIDEM, 1998)".

- The second statement represents common knowledge and should not be cited from a DEM report. By citing a DEM report, readers may think this is a unique phenomenon that RIDEM has observed in Mount Hope Bay.

The fourth paragraph includes the sentence, In Narragansett Bay, wastewater treatment facilities that border the bay are responsible for 28% of the quantifiable nitrogen loading" and in another statement, "that rivers deliver 62% of the bay's nitrogen loading. As noted above, this statement should be cited from the reference (Nixon et.al. 1995).

Section 5.5.6 Contaminant Concentrations in Animal Tissue

This section states, "O'Connor and Beliaeff (1995) listed 0.24 ppm dry weight as the point where mercury concentrations can be considered high. This value was based on the mean plus one standard deviation for seven species of shellfish monitored throughout the United States. All mercury values in quahogs collected by MRI in 1998 and 1999 exceeded this level, ranging from 0.31 to 2.1 ppm dry weight. Although Mount Hope Bay values appear relatively high, FDA maintains an action limit of 1 ppm wet weight for mercury in fish, a value four times greater than the high value recorded in Mount Hope Bay shellfish samples.

- It would be helpful if this section included a typical conversion factor for values reported as dry and wet weight so the reader can more easily compare data to the FDA action limit of 1 ppm wet weight.

Section 7.1.2 Submerged Aquatic Vegetation (SAV)

Water Temperature

"Species specific tolerances may affect competitive relations and seasonal growth cycles, and may limit the latitudinal range of the species (Barko and Smart, 1981)". "In a study by Marsh et.al. (1983), widgeon grass and eelgrass showed an ability to respond positively to short-term temperature increases within the range 8-23°C (46.4-73.4°F); over the long-term, however, both species responded negatively as summer temperature increased above 19°C (66.2°F)".

- Based on the research cited above and the temperature impact modeling completed by US Gen, the thermal discharge from Brayton Point Power Station, even under proposed Enhanced Multi-mode operating conditions, will cause detriment impacts on eelgrass. Also recent research by Steve Granger, at URI indicates that the detrimental impact of excessive nutrients are exacerbated at higher temperatures.

Section 7.1.3 Phytoplankton

The fourth paragraph discusses research on the importance of zooplankton grazing on phytoplankton populations and states "However, recent studies indicated that while herbivory exerts a seasonal influence over phytoplankton populations in certain environments, it is unlikely to be a sever limitation overall (e.g. Martin, 1970; Oviatt et al., 1979.

- However the most recent research suggest virtual elimination of the typical winter-spring phytoplankton bloom has occurred since increases in water temperature have expanded the range and time of year that the ctenophore, *Mneimiopsis leidyi*, and phytoplankton grazers are present and actively grazing in Narragansett Bay (Oviatt et. al. 2002).

The fifth paragraph includes the following statements, "Phytoplankton growth and productivity decline in temperatures outside the community's range of temperature optima. Although temperature optima vary over a wide range (10-40°C/50-104°F) depending on species (Eppley, 1972), temperature tends to favor those populations whose optima coincide with local environmental conditions (Day et.al., 1989). Therefore, the opportunity for temperature acclimatization by a local population is limited". … "Karentz and Smayda (1984) also found that mean field temperature maxima were 3-14°C (5.4-25.2°F) lower than laboratory temperature optima. This suggests that ideal laboratory conditions are not replicated in the field and that synergistic interactions are taking place among temperature and other environmental factors in situ that cause temperature maxima to be lower than expected based on laboratory results".

- These studies demonstrate that ideal laboratory thermal tolerances for phytoplankton are significantly higher than those observed in the field.

Harmful Algal Blooms (a.k.a. Red and Brown Tides)

This section summarizes different types of harmful algal blooms and potential impacts associated with those blooms.

- Most of the impacts noted had been observed in Long Island Sound but have not been observed to any significant degree in Narragansett Bay and in particular in Mount Hope Bay.

The eighth paragraph states, "During the 1985 brown tide in Narragansett Bay, blue mussels suffered greater than 95% mortality; they also suffered from sublethal effects (Wise, 1986; Cosper et.al., 1987).

- To our knowledge the 95% mortality cited above is, occurred in Peconic Bay, NY, and not Narragansett Bay.

Section 7.2.1 Zooplankton

Narragansett Bay

The second paragraph includes the statement, "However, predation is dominated by ctenophores. The ctenophore population rises with increases in summer temperatures. Ctenophore densities may reach 50/m³ by late summer (Kremer and Nixon, 1976).

- Information should be added to this section summarizing the recent research conducted by Oviatt et. al. 2002, which showed that ctenophores are blooming sooner in the spring and having a larger impact on winter flounder larvae due to the small change in temperature. Since Brayton Point Station induces significant changes in the temperatures of Mount Hope Bay, it has the potential to impact on winter flounder lava densities by causing the Bay to become thermal refugia for ctenophores that spawn earlier in the spring when lava winter flounder densities are highest.

Section 7.2.3 Fish

Mount Hope Bay

The last paragraph states, " It is possible that several, perhaps even all, of the scenarios described earlier for Narragansett Bay (e.g., water temperature changes, changes in predator populations, etc.) are influencing the fish assemblage of Mount Hope Bay.

- As noted above, it is expected that temperature changes induced by the Brayton Point Station would have a significantly larger impact on the fish populations due to ctenophore population in Mount Hope Bay.

Section 8.1.2 Marine Assemblage

Winter Flounder

This section states as temperatures drop in the fall, juveniles join the adults in the deeper waters.

- However, for the period of occurrence 4/21/99 through 10/31/99, Appendix B figures 2-42 through 2-49 define the majority of the bay as unused area for winder flounder habitat. The only area shown as used for juvenile winter flounder habitat are the tributary rivers and northern portions of the bay immediately adjacent to these tributaries.

Literature cited

Oviatt, C.A., A.A. Keller, and L. Reed, 2002. Annual primary production in Narragansett Bay with no bay-wide winter spring phytoplankton bloom. Estuarine Coastal and Shelf Science.

APPENDIX B

Biothermal Assessment of Brayton Point Station Discharge
Predictive Demonstration---316(a)

Section 2.2.1 Acclimation Temperature (Step 2)

The first paragraph states, "In general, the higher the acclimation temperature, the higher the tolerance temperature until a maximum limit is reached".

- While this phenomena is typically observed in laboratory experiments where animals do not have the opportunity to avoid the thermal stress, in nature it can be shown that fish and other aquatic organisms will avoid the area of elevated temperatures rather than staying in the area and acclimating to higher and higher temperatures.

The second paragraph states, "The acclimation temperature was computed as the average temperature within that cell over the seven days prior to the day evaluated for the biothermal effect.

- As noted earlier, this assumes that the organisms will always be able to acclimate until they have reached their upper temperature limit and ignores daily variations which may have elicited the avoidance response even though the seven day average is not predicted to do so.

Section 2.2.4.2 Summary of Station Operating Conditions Evaluated

This section includes the following statements, "For the six hypothetical operating scenarios, the data are projections that take into account actual data from current operation of each individual generating unit. That is, included in each of the scenario projections are two variables:

- Times when each unit will be shut down due to scheduled and unscheduled outages

- Generation variability based on changing power demand in the region (daily and seasonal)

Based on historical operation, the simulated outages and changes in generation would occur at approximately the same time of the year under each operating scenario.

- By taking this approach, the projected biological impacts from the six hypothetical operating scenarios do not follow the patterns anticipated. For example, an operating scenario that results in higher flow and thermal output may not necessarily have the highest biological impacts. In particular, if a certain operating scenario is based on a unit operating in closed cycle and that unit is typically down for scheduled maintenance during a critical biological period, that operating scenario will show significantly greater biological impacts than another scenario where a generating unit being served by a cooling tower is predicted to remain in operation.

- This approach completely skews the estimation of biological impacts and cannot be used as the basis of a 316 (a) analysis unless the discharge limits and conditions proposed under the 316 are restricted to the historic operational scenario. In other words, the simulated outages and maximum changes in generation must be stipulated in the permit.

Section 2.2.4.4 Time-Step or Averaging Interval

The enhanced multimode operating scenario and two days in 1999-April 8 and September 6 were selected to test the one hour, six hour and 24 hour averaging intervals for excess temperature predictions. This section also states that as can be seen in both figures, 2-16 and 2-17, little difference exists among the four averaging intervals. The four intervals were the six hours around flood tide, six hours around ebb tide one-hour low slack tidal phase and 24 hour average.

- It should be noted that the conclusion that model predictions demonstrated, the plume location varied little with tidal phase was influenced significantly by the selection of six hour averaging period. Field data demonstrates that significant variation of the plume location occurs within the six-hour flood tide and ebb tide portions of the tidal cycle.

- In particular, when using the model predictions to evaluate zone of passage, it is important that model predictions averaged over significantly less than 24 hours should be evaluated.

Section 2.3.3 Thermal Avoidance and Habitat Loss

Individual temperature tolerance polygons in Figures 2-2 to 2-10 were developed to show the predicted mean avoidance temperature for each of the nine finfish species reviewed. The red line in Figures 2-2 through 2-10 depict the mean avoidance temperature, which is the temperature to which half the species population is predicted to have an avoidance response. The population response around this mean avoidance temperature was approximated as follows (as supported by Mathur and Schutsky, 1983):

- At 5°C below the mean avoidance temperature, 0% of the species population was predicted to have an avoidance response.

- At 5°C above the mean avoidance temperature, 100% of the species was predicted to have an avoidance response.

- In between these points, a normal distribution was assumed (At 1.25°C above the mean avoidance temperature, for example, approximately 75% of the species population will have an avoidance response.)

- First this approach assumes that the population response follows a normal distribution. Field data collected in salt ponds in Rhode Island has demonstrated that the entire population of winter flounder avoided excessive temperatures almost immediately. Furthermore, 5°C around the mean is used to set 0% avoidance and 100% avoidance values regardless of what the mean avoidance temperature is for any particular species. Therefore, 5°C may represent a small or large fraction of the mean avoidance temperature for different species. Clearly the 0% and 100% avoidance responses, if at all applicable, should vary with the mean avoidance temperature for a particular species. Also in general this approach assumes that each species has been able to acclimate to the seven-day average temperature in any particular grid. It has not been demonstrated that this response occurs in nature.

<u>Section 2.3.4 Potential for Blockage of Migratory Routes</u>

As noted in the third paragraph, "the potential for blockage is quantified by comparing the species mean avoidance temperatures in Figures 2-2 and 2-10 with predicted daily temperatures at the mouth of each tributary. If the potential for blockage is shown-that is, if the mean avoidance temperature is less than the predicted plume temperatures- then the cross-sectional area of the plume isopleths that exceed the avoidance temperature is determined."

- As noted earlier, flood tide temperatures particularly at the mouth of the tributary rivers are significantly different than the 24-hour daily temperatures predicted by the model. By basing the potential for blockage analysis on daily temperatures, the model approach is far less likely to predict blockage than if the flood tide bay temperatures are utilized.

The fifth paragraph in this section, also notes that the acclimation temperature for this analysis defined as the average temperature at Spar Island (located approximately at the Bay's midpoint) over the seven days prior to the day evaluated.

- As noted earlier, it is not appropriate to assume all finfish are capable of acclimating to the seven-day average temperature. Furthermore, this approach assumes that all finfish swim up Narragansett Bay until they reach Spar Island acclimate to the temperatures observed at Spar Island. In reality fish may sense elevated temperatures much further south of Spar Island and avoid further entry into Mount Hope Bay. Therefore, this approach significantly underestimates the potential for blockage of migratory routes due to the thermal plume from Brayton Point Station.

Appendix C. Protection of Balanced Indigenous community: Retrospective Demonstration

Section 2.2 - Water Quality Changes

The narrative in section 2.2.1 identifies CSOs, failed ISDSs, tributaries, and wastewater treatment facilities as the primary contributors of nutrient loadings to Mt. Hope Bay. Two citations are given, but these sources are drawn from the limited base of information available during the 1980's. The contributions of CSOs to the nutrient budget of the Bay are not supported by information in the document. CSOs have been found to be minor contributors in the nearby Providence and Seekonk Rivers, based on studies by RIDEM and consultants to the Narragansett Bay Commission. Dry weather CSOs were present during the 1980's. ASA (1990) reports that dry weather CSOs were virtually nonexistent by 1990 as a result of improved maintenance by the Fall River Sewer Commission ().

The report identifies the Fall River WWTF as a 31-mgd facility. This flow is not characteristic of normal plant conditions. For the period discussed in section 2.2.1, WTF monitoring data indicate that the average plant flow was 22.9 mgd on average. Flows did approach 31 mgd during 1989-1990, and were typically lower during most other years (e.g. a mean of 21.1 mgd during the 1984-1987 time frame coincident with the fishery collapse). Section 3.3.4.2 in Volume IV of the report states that the mean Fall River effluent flow for April 1, 1999 to May 31, 2000 is 20.1 mgd and that mean flows during the summer 1999 period range between 9.5 – 12.3 mgd.

Summaries of annual mean values of concentrations and daily loadings for BOD, TSS, and (total) copper are shown in the attached figures. Data for April – December 1982, the year before the WWTF improved treatment to secondary treatment, the concentrations and loadings of BOD5, TSS, and copper discharged to the Bay were considerably higher than for subsequent years. For example, the mean daily BOD loading for April – December 1982 was nearly 11,000 kg/day, more that four times the levels reported for 1985 to 1987 and subsequent years. Data were not available for periods prior to April 1982; RIDEM must assume that the 1982 data are representative of previous years because the plant was providing primary treatment during those years. Section 2.2.1 correctly reports that the mean daily BOD loading doubled from 1170 kg/day in 1985 to 2302 kg/day in 1987. The narrative fails to mention that the low value in 1985 follows a precipitous decline from a daily mean loading 10823 kg/day in 1982, nearly tenfold higher. RIDEM could not obtain information for the years prior to 1982, but we must assume that loads during the earlier years were similar because the WWTF was providing primary treatment of sewage.

The BOD parameter provides a measure of the direct oxygen demand caused by bacterial oxidation of effluent. The information provided in the 316 application, however, provides no context for evaluating the impact of BOD on Mt. Hope Bay because no comprehensive evaluation of the influences of BOD and other nutrient loadings has been conducted to our knowledge. RIDEM has initiated such a study for the Providence and Seekonk Rivers in upper Narragansett Bay, an area that is similar in many respects. A screening model conducted of the area (Limno-Tech, 1992) concluded that dissolved oxygen levels in the Providence River are not sensitive to variations in BOD loadings. Consequently, BOD sampling was performed in the Providence River study, but has not been shown to be a significant factor affecting dissolved oxygen levels.

Section 2.2.1 does not explain how the variations in TSS loadings during the mid-1980's can be connected to the fishery decline in Mt. Hope Bay. Section 2.2.1 also does not explain how plant upsets evidenced by high TSS and BOD emissions during August and September of 1993 would be connected to the maintenance of a fisheries decline that had begun in the mid-1980's.

Section 2.2.1 omits from its evaluation of Fall River WWTF impacts that loadings of copper, a toxic substance, decreased by more than 50% following the conversion of the plant to secondary treatment, starting in 1983. Data provided by the facility indicate that daily copper loadings dropped from a value of 12.4 kg/day in 1982 to an average value of 5.0 kg/day between 1983-1990.

2.3 Phytoplankton Biotic Category Analysis

This section states that: "In some areas of Narragansett Bay, blue mussel mortality rates exceeded 95%."

- We are not aware of the source of this statement and a citation is not provided.

It is also stated that While nuisance algal blooms have increased in Mount Hope Bay, throughout Narragansett Bay and throughout the Atlantic Coast …"

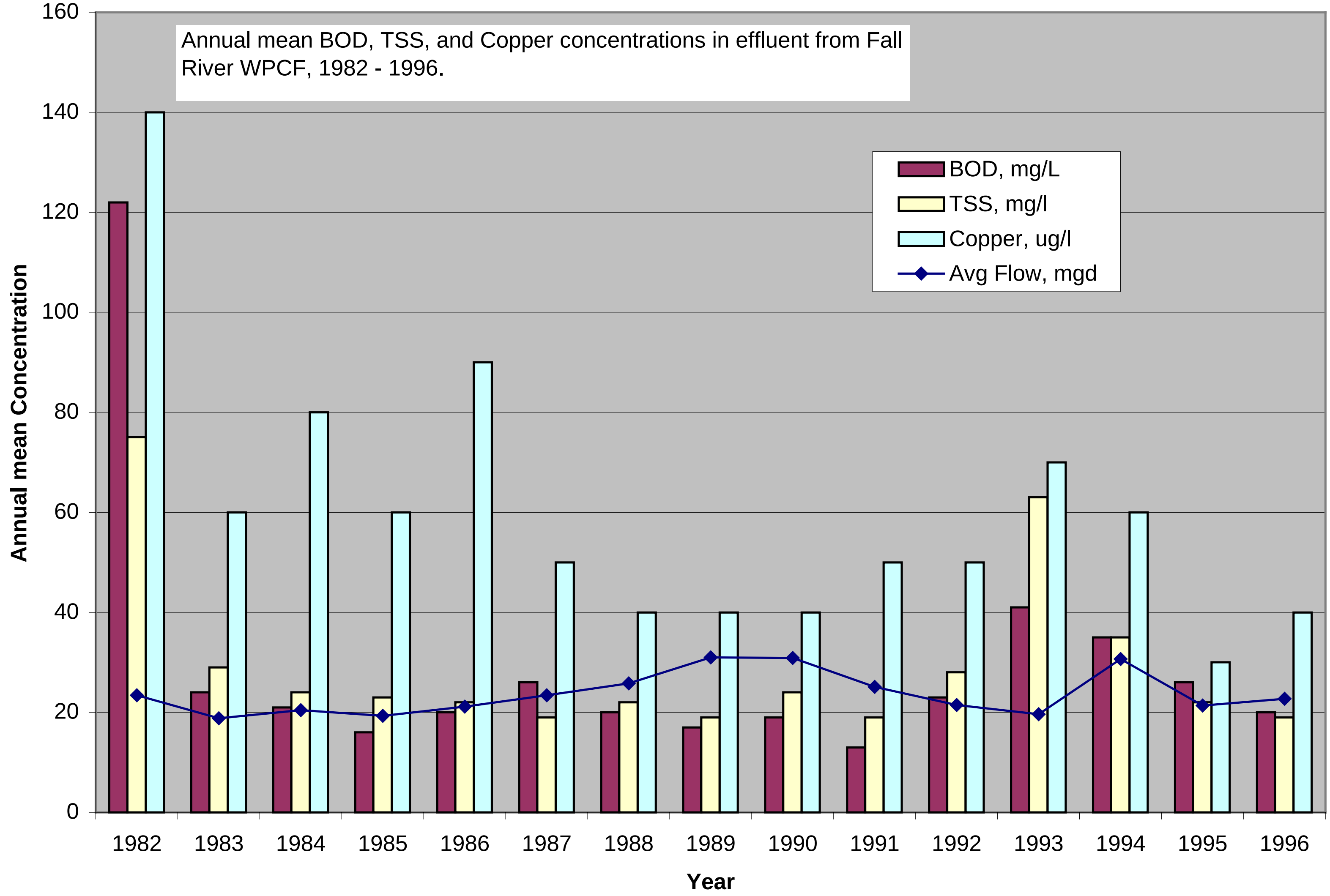
- We are not aware of any evidence that the frequency of nuisance phytoplankton blooms, including HABs have been increasing in Mount Hope or Narragansett Bay. Although HABs occur along the Atlantic coast, the NOAA Ecolab grants have been unavailable for work in Narragansett Bay due to the lack of hard evidence of any measurable HAB outbreaks in Narragansett Bay since the 1985 brown tide.

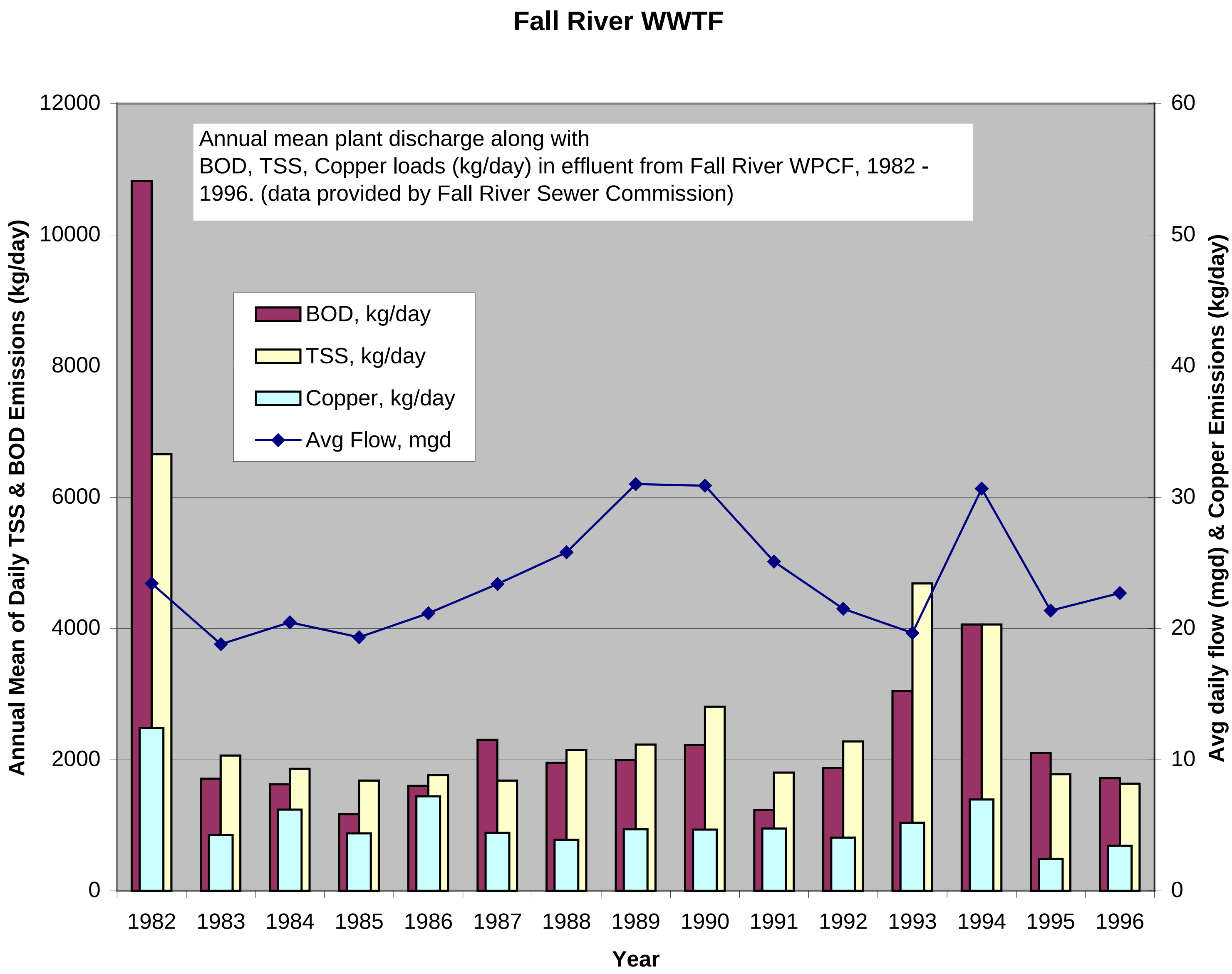
3. Conclusions Regarding Protection and Propagation of a Balanced Indigenous Community.

This section states: "While blooms of nuisance phytoplankton, including HABs (e.g., paralytic shellfish poisoning and brown tide), appear to be increasingly frequent in Mount Hope Bay, this change is consistent with the trend in Mount Hope Bay, Narragansett Bay and along the entire Atlantic cost."

- We are not aware of any evidence that the frequency of nuisance phytoplankton blooms, including HABs have been increasing in Mount Hope or Narragansett Bay.

Fall River WWTF - Mean Annual Effluent Concentraitons





Fall River WWTF
Annual mean plant discharge along with
BOD, TSS, Copper loads (kg/day) in effluent from Fall River WPCF, 1982 - 1996. (data provided by Fall River Sewer Commission)
BOD, kg/day
TSS, kg/day
Copper, kg/day
Avg Flow, mgd
Annual Mean of Daily TSS & BOD Emissions (kg/day)
Avg daily flow (mgd) & Copper Emissions (kg/day)
0
2000
4000
6000
8000
10000
12000
0
10
20
30
40
50
60
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
Year