

Appendix to Report

Entergy: Our Bay is Not Your Dump

June 8, 2015

Part I: Impingement

Impingement of marine life in a cooling water intake structure (CWIS) at a nuclear power station such as Pilgrim can cause harm in several ways. Marine organisms are drawn into the CWIS with Pilgrim's cooling water. Larger marine organisms, such as adult or juvenile fish, can get impinged either on the "trash racks" or on the screens that protect the pumps.¹ See, Report Figure 1. Marine life may be killed immediately by mechanical abrasion and suffocation on the trash racks or on other parts of the CWIS.² If impinged marine life survive, the stress from getting trapped on the intake screens may lead to mortality from exhaustion, suffocation, lowered resistance to predation or disease, reduced ability to feed, or external or internal injuries.³

Since it began operating in 1972, Pilgrim has impinged marine life, primarily fish, such as river herring,⁴ Atlantic silversides, Atlantic menhaden, butterfish, Atlantic tomcod, grubby, red hake, winter flounder, black seabass, and northern puffer. Since 1980, eighty species of fish have been impinged on Pilgrim's intake screens.⁵

Entergy's Clean Water Act NPDES (National Pollution Discharge Elimination System) permit requires the reporting of impinged organisms at Pilgrim based on screen wash samples in semi-annual and annual Marine Monitoring Reports. Notable or large impingement incidents are further required to be reported to the U.S. Environmental Protection Agency (EPA).⁶

In addition to the routine impingements that occur throughout the year, since the 1970s Pilgrim has regularly had "large impingement events," which are defined as those involving greater than 20 fish per hour and an overall event total of 1,000 fish or more⁷ (Table 1). According to Entergy, "these events often occur in the late summer and autumn when young fish are abundant, actively moving offshore for the winter and water temperatures are declining. As water temperatures decline, metabolism declines along with swimming ability."⁸

Table 1. Estimated number of species impinged in “large impingement events” at Pilgrim from 1973 to 2010.

Date	Species	Estimated Number
August-September, 1973	Clupeids	1,600
August 5, 1976	Alewife	1,900
November 23-28, 1978	Atlantic menhaden	10,200
December 11-29, 1978	rainbow smelt	6,200
March/April, 1979	Atlantic silverside	1,100
September 23-24, 1981	Atlantic silverside	6,000
July 22-25, 1991	rainbow smelt	4,200
December 15-28, 1993	Atlantic silverside	5,100
November 26-28, 1994	Atlantic silverside	5,800
December 26-28, 1994	Atlantic silverside, rainbow smelt	11,400
September 8-9, 1995	Alewife	13,100
September 17-18, 1999	Atlantic menhaden	4,910
November 17-20, 2000	Atlantic menhaden	19,900
August/September, 2002	Atlantic menhaden	33,300
November 1, 2003	Atlantic menhaden	2,500
November 12-17, 2003	Atlantic menhaden	63,900
November 19-21, 2003	sand lance, Atlantic menhaden	17,900
November 29, 2003	Atlantic silverside	3,900
August 16-18, 2005	Atlantic menhaden	107,000
September 14-15, 2007	Atlantic menhaden	6,500
July 29, 2010	Alewife	1,061

Here are some examples of the impingement events at Pilgrim described in Entergy’s marine monitoring reports. In most instances, Entergy blames the impingement on “natural causes” such as the fish swimming too close to the intake, or being chased near the intake by larger fish — instead of acknowledging the fact that the CWIS itself draws in the fish, particularly species that migrate close to the shoreline like rainbow smelt. See, Report Part II(C)(2).

- In **2005**, 97% of the more than 300,000 fish Entergy impinged were Atlantic menhaden (Figure 1) and their survival rate was low – only between 18 and 27% of the fish survived.⁹ In 2005 there were also 19 impingement events where more than twenty fish were sampled – or collected off the intake screens – per hour, which consisted primarily of Atlantic menhaden and Atlantic silversides. There was one large impingement event in 2005 (August 16-18) which involved exclusively young Atlantic menhaden. This event in 2005 was the largest single impingement event in Pilgrim’s history with a total of 107,000 fish impinged.
- In **2006**,¹⁰ Entergy impinged an estimated total of 29,711 fish consisting of 34 species. The following species made up more than 90% of the annual total of fish impinged: Atlantic menhaden (51.1%)¹¹, Atlantic silversides (26.9%), winter flounder (4.2%), rainbow smelt (2.5%), Atlantic cod (2.3%), Atlantic tomcod (2.1%), and blueback herring (1.9%) Also in 2006, Entergy impinged 9,619 invertebrates representing 13 taxa,¹² with cancer crabs (36%) and sevenspine bay shrimp (21%) dominating the annual total, and an extrapolated total of 1,493 American lobsters.



Figure 1. Atlantic Menhaden (*Brevoortia tyrannus*) have typically ranked first or second as the most commonly impinged species at Pilgrim (1980-2011). Photo: Brian Gratwicke/Wikimedia Commons

- In **2007**,¹³ Entergy impinged an annual extrapolated total of 162,991 fish consisting of 36 species. Atlantic menhaden accounted for 95% of the total (154,832 fish). Atlantic silversides (3,362 fish), rainbow smelt (1,191 fish), and winter flounder (715 fish) were also dominants. The 2007 impingement total of 162,991 was nearly four times the 27-year mean of 44,284 fish due in part to the large impingement event of juvenile menhaden that occurred on September 14th-15th (6,500 fish).

In a letter to the Massachusetts Department of Environmental Protection (MassDEP) dated September 20, 2007¹⁴ concerning the September large impingement event, Entergy estimates the total number of menhaden impinged as 17,600 (not the 6,500 reported in its marine monitoring report). Entergy states that, “during the day, larger fish – probably striped bass and/or bluefish – were in the vicinity of the plant, at times observed vigorously feeding on these small menhaden in the intake,” implying that the larger fish were causing the high impingement rates (Figure 2). In fact, Entergy’s CWIS is the cause of the impingement because it interferes with the use of Cape Cod Bay by the fish for foraging or refuge.

In 2007, Entergy also impinged an estimated annual total of 8,884 invertebrates representing 12 taxa, with squid (27%), cancer crabs (22%) and sevenspine bay shrimp (18%) making up most of the annual total.

During the day, larger fish – probably striped bass and/or bluefish – were in the vicinity of the plant, at times observed vigorously feeding on these small menhaden in the intake. Continuous rotation of the screens and increased screenwash sampling and monitoring were maintained. A one-hour screenwash sample (10:23 – 11:23 am) collected after the backwash determined the impingement rate to be 788 fish per hour (all young-of-the-year menhaden except for one butterfish). Another screenwash collection (3:54 – 4:54 pm) yielded an impingement rate of 587 fish per hour – all juvenile menhaden.

Figure 2. Excerpt from an Entergy letter to MassDEP attempting to explain the large impingement event of Atlantic menhaden that occurred in September 2007.

- In **2008**,¹⁵ Entergy impinged an estimated annual total of 11,821 fish, consisting of 37 species. Atlantic silversides, winter flounder, rainbow smelt, Atlantic menhaden, grubby, sand lance, and Atlantic tomcod were the dominants accounting for 52.7, 8.5, 8.0, 6.1, 3.2, 2.7, and 2.4%, respectively, of the estimated annual total. Sevenspine bay shrimp (43%), green crabs (18%), and cancer crabs (16%) accounted for the majority of the estimated annual total of 8,309 invertebrates in 2008.

- In **2010**, Entergy impinged an estimated total of 32,962 fish consisting of 33 species. Atlantic silversides, alewife, Atlantic menhaden, winter flounder, rainbow smelt, and cunner were the top species (41, 38, 4, 3, 3, and 2%, respectfully). A large impingement event occurred on July 29, 2010 when more than 1,000 alewives were impinged. Entergy impinged 12,454 invertebrates representing 13 taxa with the majority being sevenspine bay shrimp (51%), cancer crabs (18%), and green crabs (8%).
- In **2012**, Entergy impinged an estimated extrapolated total of 9,287 fish representing 34 species. Atlantic silversides (21%), blueback herring (18.8%), Atlantic menhaden (15.8%), butterfish (5.3%), alewife (5.1%), Atlantic tomcod (3.8%), grubby (3.6%), red hake (3%), winter flounder (3%), black sea bass (2.8%), and northern puffer (2.4%) were the top species. Entergy impinged a total of 11,931 invertebrates, with sevenspine bay shrimp (56%), ribbon worms (17%), and longfin squid (10%) accounting for the majority of the annual total.
- In **2014**, according to Pilgrim's October¹⁶ and December¹⁷ Discharge Monitoring Reports (DMRs), there were three significant impingement events. On October 25, 2014, an impingement rate of 114 fish per hour was recorded during a screenwash (most fish involved were juvenile Atlantic menhaden). On December 3, 2014 an impingement rate of 33 fish per hour was recorded during a routine screenwash. On December 10, 2014 an impingement rate of 223 fish per hour was recorded during a routine screenwash (most fish involved were Atlantic silversides). All three events, according to Entergy, were not caused by any change in conditions related to Pilgrim's operations but were due to "natural circumstances." Again, Entergy blames the fish for getting trapped in the CWIS.

Part II: Entrainment

Entergy's CWIS operations entrains **phytoplankton** (mostly microscopic marine plants), **zooplankton** (small marine animals that live all or part of their life as plankton, such as krill, copepods and crustacean larvae), **ichthyoplankton** (fish eggs and larvae), and any other organism small enough to pass through the trash rack and intake screens. These organisms are drawn into Pilgrim's industrial operations where they are exposed to hot water, chemicals, and battered around by mechanical equipment. With the used cooling water, the entrained marine life is dumped back into Cape Cod Bay.

Entergy's entrainment of **phytoplankton and zooplankton** is a concern because they form the foundation of the marine food web and are a key component of healthy oceans. Phytoplankton supports **zooplankton** such as copepods, which are a primary food source for planktivores such as certain species of small fish, whales, seabirds, and crustaceans. Critically endangered North Atlantic right whales seasonally use Cape Cod Bay as a critical feeding area, and depend on the quality and quantity of copepods for survival.

"...Cape Cod Bay appears to be a unique habitat where relatively small-scale oceanographic processes and mid water biological conditions conspire to produce extraordinarily high concentrations of thin and exceptionally dense surface layers of the three taxa of calanoid copepods that, with such a combination of conditions, release surface feeding behavior by right whales; this rare combination of circumstances is the reason that Cape Cod Bay is considered a critical habitat for the remnant population of the North Atlantic right whale." -- Dr. Stormy Mayo, Center for Coastal Studies, Provincetown, MA 2012¹⁸

The only assessments of Pilgrim's impact on phytoplankton and zooplankton were done from 1973 to 1975.¹⁹ These studies found that phytoplankton in Cape Cod Bay were dominated by diatoms, flagellates, and dinoflagellates, and zooplankton in the vicinity of Pilgrim contained many copepod species.

The type of **ichthyoplankton** (fish eggs and larvae) entrained at Pilgrim vary by season, but species commonly include American plaice, windowpane/yellowtail/four-spot flounder, Atlantic cod, fourbeard rockling, Atlantic mackerel, sand lance, grubby, rock gunnel, tautog, cunner, labrid, hake, butterfish, black sea bass, silver hake, Atlantic herring, among others.²⁰

Efforts to determine the amount of winter flounder **larvae** entrained at Pilgrim began in the mid-1970s. About 3.5 to 88.8 million individual **winter flounder larvae** were entrained annually between 1980 and 1999.²¹ As many as 124,000 equivalent adults were killed in 1997 and 1998.²² When converted to pounds of fish taken, this approaches 40% of the annual total recreational and commercial catch. **In 1998, one of the highest records of larval winter flounder entrainment occurred (77,000 equivalent adults), which was nearly 30% loss of the adult population that year.**²³

In the late 1990s, Pilgrim's consultants estimated that "entrainment of [winter flounder] larvae through the Pilgrim facility in 1997 resulted in a loss to the adult Plymouth/Duxbury Bay population of 9-41% (this range is based on projections from different models)."²⁴

Entergy's monitoring and sampling of the marine organisms impacted by entrainment in the CWIS at Pilgrim is inadequate in many ways. First, Entergy only reports entrainment of **ichthyoplankton and lobster larvae**. Pilgrim's 1983 NPDES permit states that entrainment monitoring should focus on **ichthyoplankton**.²⁵ There is no clear reason for why monitoring of other zooplankton or phytoplankton is not required by Pilgrim's NPDES permit.

In January 2000, federal and state representatives on the oversight committee required by the NPDES permit, the Pilgrim Administrative-Technical Committee (PATC; See, Report Part IV) made recommendations and raised several concerns about Entergy's ichthyoplankton monitoring. In a memo dated January 3, 2000,²⁶ the sub-committee **recommended Bay-wide ichthyoplankton monitoring and criticized the limited frequency of Entergy's entrainment monitoring** by underlining the fact that entrainment monitoring only occurs less than 1% of a week – a period of time and frequency that simply cannot accurately capture the variability or measure the density of ichthyoplankton.

This January 2000 memo and minutes of the PATC state²⁷ that Entergy should be conducting population impact/risk assessment using seven models for six species, including Atlantic menhaden. When referring to impingement and entrainment at Pilgrim, the PATC said while "impacts on a particular species may be found to be insignificant locally, there is still concerns of the cumulative effects, including other sources of perturbation to the species." The PATC states, "there is still a concern regarding the significance of entrainment mortality when using the Equivalent Adult model without having adult population assessments to compare it to." For more information on why the Equivalent Adult model is inadequate, see Report Part III, and below.

The PATC assumed that 100% of ichthyoplankton entrained at Pilgrim are destroyed. The January 2000 memo says, "there are reasons why we assume 100% lethality of entrained ichthyoplankton. It is assumed because in addition to the number of eggs and larvae killed during entrainment, there is no ability to measure long term viability or success of surviving entrained organisms. Numerous studies have shown significant metabolic, behavioral, reproductive, and population sex ratio alterations from short duration exposures of eggs and larvae to moderately elevated water temperatures and no known studies have examined the effects of cooling-water pressure and turbulence on organism viability. Short term survivability is no prediction of long term organism viability."²⁸ See also, Report Part II(A)(2).

Part III: Internal Agency Documents Criticizing Entergy's Marine Monitoring and Describing Marine Destruction

Example A: EPA comments on Entergy's NRC license application (2007).

During Pilgrim's 2012 Nuclear Regulatory Commission (NRC) relicensing, EPA ranked the NRC's draft supplemental environmental impact statement (DSEIS) for Pilgrim as deficient.²⁹ EPA criticized the NRC's data and "recommended that the [DSEIS] explore alternative modes of operation that would avoid and minimize impacts." The NRC ignored this advice, saying "it cannot impose mitigation requirements" such as those recommended by EPA. The NRC also stated that it "is prohibited from placing any restrictions or requirements upon the licensees of these facilities with regards to water quality."³⁰ The NRC could, however, have denied Pilgrim's new license until EPA and MassDEP renewed the expired NPDES permit. As described in the Report, watchdog groups challenged Pilgrim's relicensing with the expired NPDES permit in place and the NRC passed the buck to EPA and MassDEP, relicensing Pilgrim anyway.

During Pilgrim's relicensing before the NRC, EPA made these additional comments on the impact of Pilgrim's continued operation from 2012 to 2032 with the CWIS in place.³¹

- "...winter flounder is a species of particular interest due to its commercial, recreational and ecological importance" and estimates of losses due to Pilgrim range from "less <1% of the Cape Cod Bay population to almost 30% of the population annually."
- The NRC should "evaluate measures such as retrofitting the once-through cooling system with closed-cycle cooling to mitigate adverse impacts identified in the DSEIS..."
- The DSEIS had "insufficient information" "for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment..."
- With regard to the 20% entrainment rate of winter flounder, the fact that Entergy "emphasized that the higher rate may have been a result of some methodological difficulties such as lost sampling gear, resulting in no sample collection from several survey locations" is a conclusion not supported by data and EPA recommends "that an expanded explanation of the higher entrainment rate be provided..."
- With regard to the NRC's claim that Pilgrim has a "minor" impact on species other than flounder, EPA states that "it does not appear that this conclusion is fully supported in the DSEIS" and that "without effective mitigation measures to reduce entrainment, several fish species will be adversely affected."

- “There is little discussion regarding the impact of the impingement losses...other than relying on ENSR reports [Entergy’s paid consultant] and general statements such as “[t]he Atlantic menhaden stock is considered to be healthy with stable stock size and high biomass.””
- Entergy violates the NPDES permit limit for chlorine, and EPA recommends “that improvements to the screenwash system be included in this discussion because chlorine exceedances occurred when there were problems with the screenwash dechlorination system.”
- There is no evidence to suggest that hatchery fish from Entergy’s winter flounder stocking program “can persist in the environment and recruit to the adult population” and the DSEIS “appears to lack support for the assertion that if the current winter flounder stocking program is expanded, that it “may have a beneficial impact” on the local population.”
- Pilgrim was supposed to do a re-impingement study but never did; EPA recommends there be a “discussion of the effectiveness of physical and operational modifications to the fish return system including more frequent or continual screen rotation.”

Example B: NOAA Fisheries identifies several adverse impacts from Pilgrim on essential fish habitat, protected species, and other public trust resources (2006).

During Pilgrim’s NRC relicensing process, another federal agency, NOAA’s National Marine Fisheries Service (NOAA Fisheries), identified several problems with Pilgrim’s impacts. As part of the relicensing, the NRC was required to coordinate with NOAA Fisheries to get an opinion on whether Pilgrim’s continued operations would harm “essential fish habitat, protected resources, as well as other public trust resources.” The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and the Fish and Wildlife Coordination Act both require “federal agencies to consult with federal and state natural resource agencies regarding activities or licensing that impact fish and wildlife resources.”³²

In June 8, 2006 comments to the NRC, NOAA Fisheries points out several ways that Entergy’s operation of Pilgrim harms essential fish habitat, protected species and other public trust resources. For example:

- Pilgrim “adversely affects a variety of fish and shellfish resources through impingement on cooling water intake screens and through entrainment into the plant’s cooling system.”

- Regarding the NRC’s use of “adult equivalent” (EA) analysis to determine relative impact of Pilgrim on fisheries resources, NOAA Fisheries states “this method focuses solely on finfish survival to maturity and does not account for ecosystem and food web benefits resulting from egg and larval predation. In order to fully account for adverse impacts resulting from the facility, the proposed assessment should include an analysis of the ecosystem and food web benefits foregone as a result of operational impacts on eggs and larvae.”

NOAA Fisheries’ comments highlight the inadequacy of EA analysis for entrained fish larvae and eggs. The models essentially try to determine the number of adults that would have been produced by the entrained larvae and eggs had they not been killed by Pilgrim. Entergy uses several methods to determine EA and then averages the results to produce EA estimates. These models have many assumptions and are unlikely to yield accurate results. Entergy also only models EA for a small fraction of the species entrained at Pilgrim (7 out of 40 species in 2012). The EA model is also inadequate because it fails to take into account the organisms that may not be killed immediately during impingement, but can be affected long-term by exposure to stressful conditions or injuries, which can lead to eventual mortality.³³

In other words, the almost thirty years of marine monitoring reports produced by Entergy’s paid consultants that are filling file cabinets say little about Pilgrim’s actual impacts to the food web and ecosystem in Cape Cod Bay.

Example C: EPA recommends Entergy implement mitigation measures and “take a more active approach” to preventing adverse impacts on fisheries and essential fish habitat” (2001).

EPA’s draft report titled “Essential Fish Habitat Assessment for Reissuance of the Discharge Permit for the Pilgrim Nuclear Power Plant”³⁴ was submitted to NOAA Fisheries in 2001, in the anticipation of Pilgrim’s NPDES permit being renewed. EPA is required to consult with NOAA Fisheries under Section 305(b) of the Magnuson-Stevens Act. In the report, EPA reviewed three types of impacts: (1) thermal discharge, (2) impingement, and (3) entrainment. The draft findings state,

- “Discharge of heated effluent can have both lethal and sublethal effects on organisms in the vicinity of the discharge.” “Sublethal effects may include reduced egg hatching success, larval developmental inhibition, or a change in the composition of the biotic community.”

- With regard to Pilgrim’s discharge of thermal effluent, “...the surface plume would occupy 2 acres at a depth of 8 feet at a maximum temperature increment of 48°F (9°C) over the ambient temperature. Lower temperature increments would encompass larger areas, e.g., the 33.8°F (1°C) isotherm would cover 3,000 acres [4.7 square miles] at a 5 foot depth.”
- “It is the opinion of EPA that **entrainment, impingement and thermal effects** from PNPS are likely to have an adverse impact on EFH [essential fish habitat]. However, even after completion of several studies it is difficult to quantify the significance of the impact on EFH productivity.”
- “Some loss of EFH habitat occurs as a result of the thermal effluent that has stunted or removed [i.e., killed] aquatic vegetation in an approximately 1-acre area.”
- There exists the possibility that a “large-scale, lethal thermal event” could occur.
- “Minimization of all three stresses is needed to ensure against significant cumulative impacts or the combined effects of all stresses on a single species or its habitat. The cumulative and combined effects of one or more of these stresses coinciding, or in sequence, could have a far greater impact on productivity than any single stress taken alone.”
- NOAA Fisheries recommendations require Entergy to “take a more active management approach to the variable environmental conditions as a trade-off for the absence of alternative cooling systems that do not utilize once-through cooling.” Entergy should “maintain all current monitoring and mitigation practices.” “Other mitigation such as scheduled maintenance/shutdowns during high entrainment periods should also continue.”
- NOAA Fisheries states that if “significant adverse impacts” to EFH species, habitats or forage occur, then “authorization to discharge under the NPDES permit can be revoked” by EPA.

Example D: Pilgrim’s Administrative-Technical Committee recommends to EPA and MassDEP that Pilgrim should shut down at key times to avoid entraining fish eggs and larvae (1998).

In a letter to EPA dated December 8, 1998,³⁵ the PATC recommended that EPA and MassDEP ask the then-owner of Pilgrim, Boston Edison, to mitigate and/or compensate for losses of winter flounder in the Plymouth area by timing Pilgrim’s planned refueling outages or to use “alternate cooling” during the last two weeks of April until the end of May to “coincide with the peak densities of winter flounder larvae in the water column.” The PATC made the same recommendation to MassDEP. In the letter, the PATC also stated that Boston Edison’s data show that Pilgrim had killed up to 15% (about 47,000

fish) of the winter flounder population in Plymouth/Duxbury Bay in 1997, and 1998 estimates were about double that (about 30% or 77,400 fish) – “a magnitude of impacts to be ecologically significant and of great concern.”

There is no record that EPA or MassDEP ever heeded the PATC’s recommendation. While Pilgrim’s scheduled refueling outages often overlap with the months of April and May, the outages do not fully follow the PATC’s recommendation (last two weeks of April and throughout May). In years when refueling does not occur Entergy does not use an alternate cooling system as recommended during this timeframe, despite the potential for “unacceptable” impacts to winter flounder.

In recent years, other than emergency scrams or shutdowns due to water in Cape Cod Bay being too hot, storms, or other problems, or for scheduled refueling outages, Entergy has been running Pilgrim at close to 100% power year round.³⁶

Example E: Pilgrim’s Administrative-Technical Committee outlines adverse effects of Pilgrim’s operations and makes several recommendations to Boston Edison to reduce the impacts (1998).

In a letter dated October 15, 1998 to Pilgrim’s then-owner, Boston Edison, the PATC addresses a number of adverse effects of Pilgrim’s operations on fisheries. In the letter, the PATC states:

- There are “large-scale fish kills, which have occurred at the facility as a direct result of the discharge (e.g., in 1973 an estimated 43,000 menhaden died from gas bubble disease), the interruption of the fall migration of those species that are attracted to the thermal plume (e.g., striped bass) and the potential for thermal shock to the later in the event of an outage.”
- “Winter Flounder: entrainment of larvae from this species in 1997 has resulted in an estimated loss to the adult Plymouth/Duxbury bay population of 9-41% (range based on results of different models)...We consider these losses to be substantial. In addition, the equivalent adult loss of winter flounder in 1997 was estimated by the MA Division of Marine Fisheries to have a commercial value in excess of \$50,000.00 (ex-vessel).”
- “Rainbow Smelt: impingement events over the last 5 years average about 5,000 fish per year. Rainbow smelt are an anadromous fish and the available spawning habitat, as well as the size of adult populations have undergone dramatic declines over the past 20 years. As a result, biologists on the [PATC] Committee feel that these impingement events have had a substantive negative effect on local populations...”

- “Cunner: the number of eggs entrained for this species is higher than for any other; cunner larvae entrained are also dominant. In 1997 alone, the number of cunner entrained equated to the loss of about 498,000 adult fish from the local population.”

The PATC also raises several concerns about monitoring impacts and makes recommendations to reduce adverse effects, including:

- “Due to the difficulties...in evaluating impacts at Pilgrim, we cannot currently be assured that effects from the intake and discharge of cooling water at this facility are not causing substantial harm to some fish species in Western Cape Cod Bay. In many cases, it appears that techniques are not available to assess plant effects with a satisfactory degree of statistical power.”
- “Scheduled re-fueling and/or maintenance outages should occur during the peak period of winter flounder larval densities...”
- “...during impingement events of juvenile or adult fish, Pilgrim should reduce plant operation as much as possible, by reducing intake flows through the plant and/or by continuously operating the intake traveling screens...”

Example F: MA Office of Coastal Zone Management tells EPA that Entergy has not demonstrated no adverse impacts on species near Pilgrim (2000).

In a letter to EPA dated June 27, 2000, the Massachusetts Office of Coastal Zone Management (MassCZM) addresses Entergy’s Clean Water Act “demonstration report.” In the letter, MassCZM asserts:

- Entergy’s demonstration report “does not adequately support the conclusion of no significant impact to the species inhabiting the waters surrounding Entergy-Pilgrim Station.”
- “...at least one modeling study predicts that hundreds of acres of Cape Cod Bay may increase by one degree Celsius or more due to thermal loading from the discharge.” Entergy’s report “does not provide adequate evidence to determining how a temperature increase of just a few degrees may affect the development and survivorship of eggs and larvae or how a temperature increase may affect the future fecundity of adults exposed to the discharge plume in Cape Cod Bay.”
- Entergy’s report “provides evidence that the rate of fish impinged by the continuous action of the cooling water intake structures is thousands to tens of thousands per year.” While large impingement events are confined to only a few species, it has yet to be determined how large single-day losses of these important prey species affect food web dynamics in the region of Cape Cod Bay...”

- “Of most concern is the entrainment of eggs and planktonic larvae by the cooling water intake structures.” “The removal of these eggs and larvae from the ecosystem and food web is an issue that has not been adequately addressed...” by Entergy.
- “Given that winter flounder stocks are declining and the Entergy-Pilgrim Station is killing tens of thousands of winter flounder annually, we cannot agree that [Entergy] has demonstrated that they are not having an adverse environmental impact.”

Example G: The PATC finds that Entergy’s flounder hatchery program has no proven results (2001).

In a letter to EPA dated March 20, 2001, the PATC addresses Entergy’s plans to support fisheries restoration and/or enhancement by funding a winter flounder hatchery program to spawn, rear and release flounder to Plymouth-Kingston-Duxbury Bay. In the letter, the PATC states:

- It “does not support this program because it has not been shown, to date, to be successful for stock enhancement.”
- “About 15,000 young, hatchery-reared flounder were released to the Bay. None were recovered in surveys that followed.” The PATC “strongly feels that money spent on this project could much more beneficially be spent on other fishery-habitat related projects...”³⁷

Hatchery restocking programs are controversial because of the potential negative impacts hatchery-reared fish can have on natural populations. This includes impacts to the genetic integrity of natural populations and to population dynamics, and a variety of ecological interactions including disease.³⁸

Entergy uses its past flounder hatchery funding as a public relations tool in an effort to minimize the marine destruction described in state and federal reports. Entergy’s website for Pilgrim says, “Marine Research, Inc. has studied the affect of the plant on the Bay ecosystem and has rendered it safe.”³⁹ This is a clear misrepresentation: Marine Research’s report does **not** address these potential negative ecological problems and to our knowledge there have been no other investigations into these issues.⁴⁰ The Marine Research report referred to on the website is clearly not a “study of the affect” of Pilgrim on the ecosystem, but merely a description of the hatchery program. Moreover, the funding for this program appears to have ended in 2010.

Part IV: Protected Species

There are about 140 species protected by the Massachusetts Endangered Species Act (ESA) in Cape Cod Bay or in the coastal areas adjacent to the Bay.⁴¹ There are eight marine species protected under the Federal ESA and under NOAA Fisheries jurisdiction that have the potential to be in the immediate vicinity of Pilgrim, including four species of sea turtles (loggerhead, green, leatherback, and Kemp's ridley), three species of whales (fin whale, North Atlantic right whale, and humpback whale) and one species of fish (Atlantic sturgeon).⁴²

River herring (an umbrella term for alewife, *Alosa pseudoharengus*, and blueback herring, *A. aestivalis*) are a "species of concern" under the ESA.⁴³ River herring are in decline along the Atlantic coast primarily due to overfishing, predation, and habitat loss. As a result of declines in river herring abundance, the Massachusetts Division of Marine Fisheries established a three-year moratorium on the sale and harvest of river herring throughout the state in 2005. In 2008 the moratorium was extended through 2011 because of a lack of recovery of river herring. Since January 2012 the moratorium has been extended under the oversight of the Atlantic States Marine Fisheries Commission.

Despite all the protections and recovery efforts, Entergy routinely kills river herring by impinging them on the CWIS intake screens, with no repercussions whatsoever. For example, in 2012 river herring was the top group impinged (24% of the estimated annual total: blueback 19% and alewife 5%), with more than 2,200 fish impinged that year.⁴⁴

It is also important to note that while not protected under the ESA, minke whales, gray seals, harbor seals, harbor porpoises, and Atlantic white-sided dolphins are common in Massachusetts waters, may be present in the vicinity of Pilgrim, and are protected under the Marine Mammal Protection Act of 1972.

The NRC, along with NOAA Fisheries or U.S. Fish and Wildlife Service (USFWS), are required under section 7 of the ESA to conduct consultations that consider impacts of Pilgrim's operations on species listed as threatened or endangered.⁴⁵ The NRC is required to follow a process that involves getting input from federal agencies to ensure that Pilgrim's operations do not jeopardize the continued existence of a species or adversely impact important habitat for listed species.

During the NRC relicensing proceedings for Pilgrim in 2012, local groups filed formal contentions asserting that the NRC failed to properly comply with the ESA.⁴⁶ The NRC was asked not to relicense Pilgrim if problems related to consultation are not resolved, and NOAA Fisheries was asked to recognize the real impacts to endangered species.

The groups claimed that the section 7 consultations between the NRC and federal agencies were flawed. The groups challenged the NRC's determination that Pilgrim's continued operations would have no effect on endangered species or their habitat. In March 2012, Jones River Watershed Association and Pilgrim Watch filed a challenge before the NRC on marine species,⁴⁷ and in May 2012 they filed a challenge regarding the roseate tern (listed as endangered under both the state and Federal ESA).⁴⁸ The ESA requires that NOAA Fisheries either issue a written concurrence with NRC's assessment or write a biological opinion that sets forth its own proposal for the protection of endangered or threatened species that could be impacted by the license extension for Pilgrim – neither were done. Despite outstanding environmental and safety appeals, the NRC staff recommended relicensing Pilgrim for an additional 20 years of operations on May 8, 2012. The next month, Ecolaw asked NOAA Fisheries to reinitiate consultation. NOAA Fisheries failed to respond.

Since Pilgrim went online in 1972, and even since it was relicensed in 2012, the distribution of protected species may be changing.⁴⁹ Recent information indicates an increase in sea turtle strandings in Cape Cod Bay from about 20 per year in the 1980s to 250 per year between 2009 and 2012 - increases that could be attributed to warming ocean temperatures as a result of climate change.⁵⁰ In January 2013, eight months after Pilgrim was relicensed, a North Atlantic right whale mother and her newborn calf swam within 500 yards of Pilgrim's discharge canal. This was the first mother-calf right whale pair sighted in Cape Cod Bay in January in twenty-seven years of observation, and the only mother-calf pair ever documented occurring near Pilgrim. The fact that the environmental impact analyses developed for Pilgrim's 2012 relicensing did not account for changes in the distribution of rare and protected species and populations over time has raised concerns about whether Pilgrim could have negative impacts on protected species and populations due to permit conditions that are outdated or not protective enough.⁵¹

Critical Habitat for Right Whales

The North Atlantic right whale (*Eubalaena glacialis*) is one of the rarest large whales on the planet, with an estimated 500 individuals left.⁵² Right whales use Cape Cod Bay primarily during winter and early spring to feed, socialize and nurse calves, although individuals can be found in the Bay year round.⁵³

Under Section 4 of the Federal ESA, most of Cape Cod Bay was designated as critical foraging habitat for right whales in 1994. Cape Cod Bay is one of four critical habitat areas in the Gulf of Maine.⁵⁴ In 2010, NOAA Fisheries announced it would review and revise critical habitat designations for right whales, possibly expanding designated habitat in the northeast (including Cape Cod Bay), mid-Atlantic and southeast regions. In 2015, NOAA Fisheries published a proposed rule to expand and replace the 1994 critical habitat designations with new areas of critical habitat – including an expanded area in Cape Cod Bay.

Despite Cape Cod Bay being listed as a critical feeding area in 1994, Pilgrim has still been allowed to operate without any mitigation measures whatsoever to protect this important habitat. Pilgrim's operations have potential and uncalculated cumulative impacts on copepods (the primary food source for right whales) or other important foraging habitat features due to entrainment, and chemical, thermal and radioactive discharges.

Birds

Cape Cod Bay, particularly the area surrounding Pilgrim (Plymouth and Duxbury Bays), support protected birds: nesting least terns and common terns as well as a significant number of the state's nesting piping plovers. In past years, roseate terns and Arctic terns nested in this area and may again as populations rebound. Huge numbers of common and roseate terns also use the area in the late summer to stage in preparation for migration south.⁵⁵ In 2014, a snowy owl also utilized the Pilgrim site for a short time.⁵⁶

Arctic, common, and least terns are listed as species of "special concern" under the state ESA. Piping plovers are listed as threatened by both the state and Federal ESA. Roseate terns are listed as endangered at the federal and state levels, and will be the focus of this section.

The roseate tern is currently threatened by Pilgrim's operations due to the high fish mortalities that occur as a result of Pilgrim's intake of seawater for cooling. Roseate terns feed on small marine fish, such as blueback herring and Atlantic menhaden.⁵⁷ These are the same fish that are regularly impinged on Pilgrim's intake screens. According to Entergy's annual Marine Ecology Studies, Pilgrim has impinged more than 20,000 blueback herring from 1995 to 2012 and nearly 777,000 Atlantic menhaden from 1980 to 2012.⁵⁸

The roseate tern uses Long Beach in Plymouth from about July to September as a staging ground (where they gather, rest and roost), which is a critical period in their lifespan. They also utilize Long Beach for nesting, and have been doing so since at least the 1950s. Pilgrim is only about 4 miles (6.4 km) away from Long Beach, and is reducing the fish that the roseate terns rely on for foraging during their time in Plymouth.

During Pilgrim's relicensing before the NRC, in 2012, local groups challenged the NRC's failure to comply with the Federal ESA with regard to the roseate tern and other protected birds. The NRC's hearing board denied the challenge on procedural grounds, but said the citizen groups had raised legitimate substantive issues about the terns. The hearing board stated:

"...we remind the NRC Staff that it is ultimately their obligation to comply with NEPA and the ESA. Petitioners have raised genuine concerns that appropriate procedures were not followed in this case. For example, although the NRC Staff may be correct that the FSEIS [Final Supplemental Environmental Impact Statement] is the functional equivalent of a BA [Biological Assessment], there is no evidence that the FSEIS was ever submitted to the USFWS as required by the ESA regulations. In addition, although the roseate tern population nesting at the LBP [Long Beach Plymouth] site has increased in recent years, Dr. Nisbet (who clearly has significant expertise on the roseate tern and how it may be affected by environmental considerations) presents extensive additional information and considerations that may warrant further attention by NRC Staff."⁵⁹

Entergy wrongly asserted, in a February 3, 2005 letter to USFWS, that Pilgrim's continued operations would have "no effect on threatened or endangered species," including the roseate tern.⁶⁰ In the letter, Entergy states that the only time roseate terns might be present near Pilgrim is when they "may move through the site in late spring...and late summer..." This is incorrect because, as discussed above, roseate terns spend extended periods of time at Plymouth Long Beach in great numbers. On September 6, 2007, 4,776 roseate terns (about half of the total North American population) were found staging on Plymouth Long Beach. Just because roseate terns do not nest or stage *directly on* Pilgrim's property, as Entergy has based its assertions on, it

doesn't mean that the facility is causing "no effect, especially considering the high mortality of prey species due to Pilgrim's cooling water intake operations."⁶¹

Winter Flounder

Winter Flounder (*Pseudopleuronectes americanus*) is a recreationally and commercially important species in Cape Cod Bay. The area near Pilgrim is a nursery and feeding ground for winter flounder. Before Pilgrim began operating, marine scientists and fisheries experts had serious concerns about the impacts of impingement and entrainment of winter flounder to the sustainability of this important fish.

Entergy's NPDES permit requires Entergy to carry out studies of the winter flounder population in Plymouth and Duxbury Bays. Initial assessments of entrained larvae began in the mid-1970s and various studies have been carried out over the years: area-swept trawls, larval-to-larval studies, a tag and release program, and more.

Despite all the studies of winter flounder and the negative impacts described for decades by federal and state scientists, as described above, Entergy continues to entrain flounder larvae.

Notes and Citations

- ¹ The water passes through trash racks (a grid of vertical metal bars), then through four mesh intake, or traveling, screens (1/2 x1/4 inch mesh); Normandeau Associates. Oct. 2014. *Impingement of organisms on the intake screens at Pilgrim Nuclear Power Station, Jan. – Jun. 2014*. Submitted to Entergy Nuclear PNPS, Semi-annual Marine Ecology Studies.
- ² Hanson C.H., White J.R., and H.W. Li. Oct. 1977. *Entrapment and impingement of fishes by power plant cooling-water intakes: an overview*. Marine Fisheries Review. 11 pp.
- ³ Stressful conditions can result in increases lactic acid in tissues leading to muscle fatigue and suffocation. Dominy C.L. 1971. *Changes in blood lactic acid concentrations in alewives (Alosa pseudoharellgus) during passage through a pool and weir fishway*. J. Fish. Res. Board Can. 28: 1215-1217.
- ⁴ River herring is an umbrella term for alewife, *Alosa pseudoharengus*, and blueback herring, *A. aestivalis*. River herring play an important role in the culture, ecology and economies of coastal towns in Mass. River herring are in decline along the Atlantic coast primarily due to overfishing, predation and habitat loss. The Mass. Division of Marine Fisheries established a three-year moratorium on the sale and harvest of river herring throughout the state in 2005. In 2008 the moratorium was extended through 2011 because of a lack of recovery of river herring. Since 2012 the moratorium has been extended under the oversight of the Atlantic States Marine Fisheries Commission. In addition, NOAA Fisheries currently lists blueback herring and alewife as “species of concern.”
- ⁵ Normandeau Associates. Apr. 2013. *Impingement of organisms on the intake screens at Pilgrim Nuclear Power Station, Jan. – Dec. 2012*. In: Entergy Nuclear – Pilgrim Station. 2013. Marine Ecology Studies Jan. 2012 – Dec. 2012, Report No. 81, Section 2.3.; In 2012, the most commonly impinged fish were Atlantic silversides, blueback herring, Atlantic menhaden, butterfish, alewife, Atlantic tomcod, grubby, red hake, winter flounder, black seabass, northern puffer, making up 85% of the total number of fish impinged.
- ⁶ Entergy. Jan. 20, 2015. Discharge Monitoring Report – December 2014.
- ⁷ Normandeau Associates. Apr. 2013. *Impingement of organisms on the intake screens at Pilgrim Nuclear Power Station, Jan. – Dec. 2012*. In: Entergy Nuclear – Pilgrim Station. 2013. Marine Ecology Studies Jan. 2012 – Dec. 2012, Report No. 81, Section 2.3.
- ⁸ Normandeau Associates. Oct. 2008. Impingement monitoring, Section 3.3. In: Entergy Nuclear – Pilgrim Station. 2008. Marine Ecology Studies Jan. 2012 – Dec. 2007, Report No. 71.

- ⁹ Section 4.1.2.1 of the DSEIS. See page A-92: NRC. Generic Environmental Impact Statement for license renewal of nuclear plants. Supplement 29 regarding Pilgrim Nuclear Power Station. NUREG-1437, Supplement 29. Vol. II (Appendices). 642 pp.
- ¹⁰ Normandeau Associates. Mar. 2007. Impingement monitoring, Section 3.3. In: Entergy Nuclear – Pilgrim Station. 2007. Marine Ecology Studies Jan. 2006 – Dec. 2006, Report No. 69.
- ¹¹ The percentages provided in this section represent the number of impinged individuals within a species relative to the estimated extrapolated total number of all fish impinged and reported by Entergy. Percentages representing the impinged individuals within a species relative to estimated natural population sizes are not available.
- ¹² Taxon (pl. taxa) is often used to refer to a number of distinct forms within a family, or other taxonomic grouping, when there is ambiguity as to whether some of those forms are species or subspecies.
- ¹³ Normandeau Associates. Oct. 2008. Impingement monitoring, Section 3.3. In: Entergy Nuclear – Pilgrim Station. 2008. Marine Ecology Studies Jan. 2007 – Dec. 2007, Report No. 71.
- ¹⁴ Letter to EPA and MassDEP from Entergy, Sept. 20, 2007. Re: Pilgrim Fish Impingement Incident – Sept. 14-15, 2007, NPDES Permit Number MA0003557.
- ¹⁵ Normandeau Associates. Apr. 2009. Impingement monitoring, Section 3.3. In: Entergy Nuclear – Pilgrim Station. 2008. Marine Ecology Studies Jan. 2008 – Dec. 2008, Report No. 73.
- ¹⁶ Entergy. Nov. 2014. Discharge Monitoring Report – October 2014.
- ¹⁷ Entergy. Jan. 20, 2015. Discharge Monitoring Report – December 2014.
- ¹⁸ Memo to Jones River Watershed Association, Kingston, Massachusetts from Charles "Stormy" Mayo, Ph.D., Senior Scientist, Director, Right Whale Habitat Studies, Senior Advisor, Whale Disentanglement Program, Center for Coastal Studies, Provincetown, Massachusetts. Apr. 12, 2012.
- ¹⁹ Toner R.C. *Zooplankton of western Cape Cod Bay*; Toner R.C. *Phytoplankton of western Cape Cod Bay*. Both in: *Observations on the ecology and biology of western Cape Cod Bay, Massachusetts*. 1984. Eds, Davis, J.D. and D. Merriman. Springer-Verlag.
- ²⁰ Normandeau Associates. Apr. 2013. *Impingement of organisms on the intake screens at Pilgrim Nuclear Power Station, Jan. – Dec. 2012*. In: Entergy Nuclear – Pilgrim Station. 2013. Marine Ecology Studies Jan. 2012 – Dec. 2012, Report No. 81, Section 2.3.

- ²¹ Lawton R., et al. 2000. *Winter flounder (Pseudopleuronectes americanus) studies (1993-1999) in relation to impact assessment of Pilgrim Station on the local population*. PNPS Marine Environmental Monitoring Program Report Series No. 10. Dpt. of Fisheries, Wildlife and Environmental Law Enforcement. Mass. Division of Marine Fisheries. 51 pp.
- ²² Entergy. 2000. Pilgrim Nuclear Power Station Supplemental §316 Demonstration.
- ²³ Letter to EPA from MassCZM, Jun. 27, 2000. Re: MCZM review of the Entergy-Pilgrim Station §316 Demonstration Report.
- ²⁴ Letter to EPA from Szal G.M. (PATC), Dec. 8, 1998. Re: Pilgrim Nuclear Power Plant.
- ²⁵ Entergy's 1983 NPDES permit
- ²⁶ Lawton B., Maietta R., Paar J., and G. Szal. Jan 3, 2000. Memo: Recommendations and concerns of federal and state representatives on the Pilgrim Station modeling sub-committee for 2000.
- ²⁷ PATC. Jan. 6, 2000. Meeting minutes from the 93rd meeting of Pilgrim's Administrative-Technical Committee.
- ²⁸ Lawton B., Maietta R., Paar J., and G. Szal. Jan. 3, 2000. Memo: Recommendations and concerns of federal and state representatives on the Pilgrim Station modeling sub-committee for 2000.
- ²⁹ EPA. Feb. 28, 2007. Comments to NRC regarding the Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 29 Regarding the Pilgrim Nuclear Power Station, Draft Report for Comment (CEQ #20060510).
- ³⁰ NRC. Generic Environmental Impact Statement for license renewal of nuclear plants. Supplement 29 regarding Pilgrim Nuclear Power Station. NUREG-1437, Supplement 29. Vol. II (Appendices). 642 pp. (See page E-132).
- ³¹ EPA. Feb. 28, 2007. Comments to NRC regarding the Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 29 Regarding the Pilgrim Nuclear Power Station, Draft Report for Comment (CEQ #20060510).
- ³² NRC. Generic Environmental Impact Statement for license renewal of nuclear plants. Supplement 29 regarding Pilgrim Nuclear Power Station. NUREG-1437, Supplement 29. Vol. II (Appendices). 642 pp. (See page E-15 for NOAA Fisheries Comments).
- ³³ Dominy C.L. 1971. *Evaluation of a pool and weir fishway for passage of alewife (Alosa pseudoharengus) at White Rock, Gaspereau River, Nova Scotia*. Canada Department of Fisheries and Forestry, Resource Development Branch, Progress Report No. 3, Halifax, Canada.
- ³⁴ EPA. March 2001. *Essential fish habitat assessment for reissuance of the discharge permit for the Pilgrim Nuclear Power Plant*. Draft Report submitted to NOAA National Marine Fisheries Service. 14 pp.

- ³⁵ Letter to EPA from Szal G.M. (PATC), Dec. 8, 1998. Re: Pilgrim Nuclear Power Plant.
- ³⁶ For example, Pilgrim’s annual capacity factor for 2010 was 98.5%, 77.8% in 2011 (Jan.-Jun only), and 98.0% in 2012. See Entergy’s Marine Ecology Studies for Pilgrim Nuclear Power Station, Report No. 77 (2010 Annual Report), No. 78 (2011 Semi-annual Report), and No. 81 (2012 Annual Report).
- ³⁷ According to a report commissioned by Entergy, recapture rates remained low in subsequent years: 0.12% in 2001, 0.13% in 2002, and 1.2% in 2003.
- ³⁸ Crossman J.A., et al. 2011. *Hatchery rearing environment and age affect survival and movements of stocked juvenile lake sturgeon*. Fisheries Management and Ecology. 18: 132-144.
- ³⁹ <<https://www.pilgrimpower.com/environment/local-environment.html>>
- ⁴⁰ Marine Research, Inc. Feb. 2005. *Hatchery production study young-of-the-year winter flounder post-release collections 2000 - 2004*. 52 pp.
- ⁴¹ Barnstable and Plymouth counties only, includes flora and fauna. Based on data requested from the Natural Heritage and Endangered Species Program of the MA Division of Fisheries and Wildlife.
<<http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/esa-list/list-of-rare-species-in-massachusetts.html>>
- ⁴² Letter to NRC from NOAA Fisheries, Jan. 28, 2004. Re: Docket No. 52-009.; NOAA Fisheries. Feb. 6, 2012. Final Rule. Endangered and Threatened Wildlife and Plants; Threatened and Endangered Status for Distinct Population Segments of Atlantic Sturgeon in the Northeast Region.
- ⁴³ NOAA Fisheries. Technical Expert Working Group for River Herring.
<<http://www.greateratlantic.fisheries.noaa.gov/protected/riverherring/tewg/index.html>>
- ⁴⁴ Normandeau Associates. Apr. 2013. *Impingement of organisms on the intake screens at Pilgrim Nuclear Power Station, Jan. – Dec. 2012*. In: Entergy Nuclear – Pilgrim Station. 2013. Marine Ecology Studies Jan. 2012 – Dec. 2012, Report No. 81, Section 2.3.
- ⁴⁵ NOAA Fisheries works with USFWS to manage ESA-listed species. Generally, NOAA Fisheries manages marine species, while USFWS manages land and freshwater species.
- ⁴⁶ Whale and Dolphin Conservation, Jones River Watershed Association, Congressman Ed Markey, and others sent letters to NOAA Fisheries and/or the NRC regarding issues with the NRC’s 2006 Biological Assessment for Pilgrim as well as problems with NRC Staff 2007 Generic Environmental Impact Statement.

- ⁴⁷ JRWA petitions for leave to intervene and file new contentions under 10 C.F.R. § 2.309(a)/(d) or in the alternative 10 C.F.R. § 2.309(e) and JRWA and Pilgrim Watch motion to reopen under 10 C.F.R. § 2.326 and request for a hearing under 10 C.F.R. §2.309(a)/(d). Mar. 8, 2012. Docket #50-293 LR.
- ⁴⁸ Jones River Watershed Association and Pilgrim Watch motion to reopen, request for hearing, and permission to file new contention in the above captioned license renewal proceeding on violations of the endangered species act with regard to the roseate tern. Docket #50-293 LR. May 2, 2012.
- ⁴⁹ Association to Preserve Cape Cod. Position Statement on Pilgrim Nuclear Power Station. Mar. 17, 2014.
<<http://www.apcc.org/positionstatements/statements/2014/March/Pilgrim-3-17-14.pdf>>
- ⁵⁰ Mass. Audubon. <<http://blogs.massaudubon.org/wellfleetbaycitizenscience/another-big-sea-turtle-season-ahead/>>
- ⁵¹ Association to Preserve Cape Cod. Position Statement on Pilgrim Nuclear Power Station. Mar. 17, 2014.
<<http://www.apcc.org/positionstatements/statements/2014/March/Pilgrim-3-17-14.pdf>>
- ⁵² Pettis H. 2013. *North Atlantic Right Whale Consortium 2013 annual report card*. Report to the North Atlantic Right Whale Consortium, Nov. 2013.
- ⁵³ MA Ocean Management Task Force Technical Report. 2004. Estuarine and Marine Habitat. p. 101-127.; Mayo C.A., et al. 2004. *Surveillance, monitoring, and management of North Atlantic right whales in Cape Cod Bay and adjacent waters – 2004*. Final report submitted to the Commonwealth of Mass., Division of Marine Fisheries. Center for Coastal Studies.; Delorenzo A.S. 2005. *An assessment of the habitat quality and nutritional intake of North Atlantic right whales in Cape Cod Bay*. Dissertations and Master's Theses from the University of RI. Paper AAI3186903.
- ⁵⁴ Cape Cod Bay, Great South Channel, Bay of Fundy, and Roseway Basin; Pendleton D.E., et al. 2012. *Weekly predictions of North Atlantic right whale Eubalaena glacialis habitat reveal influence of prey abundance and seasonality of habitat preferences*. *Endangered Species Research*. 18: 147-161.
- ⁵⁵ MA Audubon. <[http://www.massaudubon.org/our-conservation-work/wildlife-research-conservation/statewide-bird-monitoring/massachusetts-important-bird-areas-iba/important-bird-area-sites/\(id\)/77](http://www.massaudubon.org/our-conservation-work/wildlife-research-conservation/statewide-bird-monitoring/massachusetts-important-bird-areas-iba/important-bird-area-sites/(id)/77)>; Affidavit of I.C.T Nisbet. Apr. 30, 2012. From: JRWA and Pilgrim Watch request to reopen, for a hearing, and to file new contentions and JRWA motion to intervene on issues of: (1) violations of state and federal clean water laws; (2) lack of valid state §401 Water Quality Certification; (3) violations of state Coastal Zone Management policy; and (4) violation of NEPA.

- ⁵⁶ Project SNOWstorm. Feb. 2, 2014 – Duxbury 2013-2014 map. <<http://www.projectsnowstorm.org/maps/duxbury/>>; Although the snowy owl is not a federally-listed species, it is protected by the Migratory Bird Treaty Act (as are all the bird species discussed in this section).
- ⁵⁷ Gochfeld, M., Burger J., and I.C. Nisbet. 1998. *Roseate Tern (Sterna dougallii), the birds of North America online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <<http://bna.birds.cornell.edu/bna/species/370>>
- ⁵⁸ See for example: Normandeau Associates. Apr. 2011. *Impingement of organisms on the intake screens at Pilgrim Nuclear Power Station Jan. - Dec. 2010*. In: Entergy Nuclear – Pilgrim Station. 2011. Marine Ecology Studies Jan. 2010 – Dec. 2010, Report No. 77, Section 3.3.
- ⁵⁹ NRC Atomic Safety and Licensing Board. Order Denying Petition for Intervention and Request to Reopen Proceeding and Admit New Contention, June 18, 2012. <<http://pbadupws.nrc.gov/docs/ML1217/ML12170A914.pdf>>
- ⁶⁰ Entergy. Feb. 3, 2005. Letter to USFWS. Re: Pilgrim Nuclear Power Station, request for Information on threatened and endangered species.
- ⁶¹ Affidavit of I.C.T Nisbet. Apr. 30, 2012. From: JRWA and Pilgrim Watch request to reopen, for a hearing, and to file new contentions and JRWA motion to intervene on issues of: (1) violations of state and federal clean water laws; (2) lack of valid state §401 Water Quality Certification; (3) violations of state Coastal Zone Management policy; and (4) violation of NEPA.