4 ENVIRONMENTAL IMPACTS

This chapter provides an evaluation of the potential direct, indirect, and cumulative impacts to the affected environment described in Chapter 3, resulting from implementing vessel operational measures to reduce ship strikes of North Atlantic right whales under any of the five action alternatives being considered by NMFS. With regard to Alternative 6, the proposed action, because under this alternative the proposed operational measures would expire five years after they become effective, the annual economic impacts described in this chapter (Section 4.4) would only last five years. The major positive impacts on right whales described in Section 4.1.6 also would occur only during the five-year period the measures would be in effect.

4.1 Biological Impacts on the North Atlantic Right Whale

NMFS has designed the proposed vessel operational measures to reduce the threat of ship strikes as a major cause of right whale mortality and serious injury. During the period these measures would be in effect, NMFS expects that implementation of the proposed action will result in fewer right whale deaths, and therefore, could facilitate population growth and recovery.[1]

Because the population of North Atlantic right whales is small and the population growth rate has declined from an estimated 1.05 in 1980 to 0.92 in 1997[2] (at a 1.00 rate, the population would be stable), a more favorable growth rate could be achieved by preventing even a small number of right whale deaths (Caswell *et al*., 1999). In addition to a decline in the population growth rate, Kraus *et al.* (2005) indicated that the mortality rate had increased between 1980 and 1998 to a level of 4 percent (±1 percent). If survivorship continues to decline at current rates, the Caswell *et al*. (1999) model predicts extinction in less than 200 years. Protective measures will help reverse this declining trend by reducing the number of right whale deaths, and in time, the population growth rate would rise. In addition, if it were to rise and remain above 1.00 – that is, replacement level – the population would no longer be facing extinction in the long term.

Fujiwara and Caswell (2001) predicted that preventing the death of just one whale a year could have a positive impact on the population. If this "saved" whale were a female, then it would have an even more substantial impact on the population. Preventing the death of two female whales per year would result in an increasing population growth rate. This study also indicates that the decline in population growth rate is linked to reduced survival probability rates for mother whales. Vessel operational measures proposed for the SEUS region in particular – the only known calving ground for right whale mothers and calves – would play an essential role in reducing the number of female (and juvenile) deaths, a key component to the recovery of the population.

While the actual number of ship strikes that could be prevented by implementing each alternative cannot be calculated at this time, it is reasonable to assume that each action alternative has some

[1] An increase in population growth rate based on ship strike reduction measures assumes that mortalities from entanglement or natural deaths remain the same or decrease as well.
[2] These population growth rate values were computed by a model that utilized estimates of survival probability and reproductive rate (Caswell *et al*., 1999).

potential to prevent at least one death or serious injury per year, which would have a positive impact on the population. Preventing nonnatural mortalities will bring right whales closer to the potential biological removal (PBR) levels for the population (Section 1.1.1), and ultimately help the population grow toward its optimum sustainable population (OSP).

All of the action alternatives – Alternatives 2, 3, 4, 5 and 6 – would result in a reduction in the number and/or severity of right whale “takes” (Sections 1.5.1 and 1.5.2) under the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA). This reduction would have minor to significant, direct, positive effects on the population, depending upon the alternative. This would also result in an indirect positive impact on NOAA’s mandate under these statutes to reduce the taking of right whales and to aid in the recovery of an endangered species.

The remainder of this section describes the potential biological impacts on the North Atlantic right whale that would result from implementing the No Action Alternative and each of the action alternatives. The impacts are analyzed by region (the boundaries of the regions are described in Section 1.4):

- Southeastern US (SEUS)
- Mid-Atlantic US (MAUS)
- Northeastern US (NEUS)

The following discussions of the biological impacts of the proposed changes to vessel operations are by alternative, and the analysis is largely qualitative. Some limitations and uncertainties in current knowledge do not allow development of an accurate quantitative model to project the number or percentage of ship strikes that would be prevented by the proposed action and alternatives or how much this decrease in ship strikes would increase the population growth rate.[3] Creating such a model would require, among other things, real-time information on the exact location and number of vessels and the exact locations, numbers, and depths of right whales in the water column. In addition, sufficient historical data on the fates of the whales with respect to the speed and type of vessel implicated would also be needed, as well as data on whale behavior, including reactions to approaching vessels based on various activities such as feeding, mating, resting, and the role of vessel speed on a whale’s ability to avoid an oncoming vessel. NMFS funding for studies of these factors may be available in the future.

Some of the criteria and information used to qualitatively evaluate the effects of the measures identified in each of the alternatives on the right whale population include:

- Right whale distribution and occurrence.
- Vessel operating speeds.
- Ability of the whales to avoid vessels.
- Vessel size and hydrodynamic effects at various speeds.

[3] As stated earlier, the positive impacts resulting from the operational measures are expected to reduce the likelihood and severity of ship strikes at current shipping levels. However, the number of large vessels in the world’s oceans are expected to double over the next two to three decades to keep up with increased volumes of traded cargo (NMFS, 2005d).

4.1.1 Alternative 1 – No Action Alternative

The No Action Alternative would have significant, direct, long-term, negative effects on the North Atlantic right whale population because no actions beyond those already in place would be taken to reduce the threat of ship strikes. The number of ship strikes in recent years indicates that current measures are not sufficient to protect right whales. Under the No Action Alternative, ship strikes would likely continue at the same rate, or – perhaps more likely – increase with the predicted increase in commercial shipping. Applying the predictions by Caswell *et al.* (1999), if ship strikes were to continue at current rates or increase, the western population of the North Atlantic right whale would be extinct within 200 years.

4.1.1.1 Northeastern United States (NEUS)

The NEUS contains several key feeding areas, including the designated critical habitat in Cape Cod Bay, where right whales feed, socialize, and mate. Right whale behavior in this region makes the animals particularly susceptible to ship strikes. When right whales are feeding, mating, and socializing, they appear to be less aware of oncoming vessels (Mayo et al., 2004; Nowacek *et al*., 2004). Given that relatively high densities of both right whales and ships occur in this area, the likelihood of ship strikes is high. Of all recorded ship strikes internationally, the majority (over 70 percent) occurred in the North Atlantic (US and Canadian waters). While this could be a function of the amount of traffic, it may also be a reflection of higher reporting rates in these areas (Jensen and Silber, 2003). Without new operational measures to protect whales in this region, vessel strikes would continue, thereby threatening the small population.

As in the other geographic regions, current conservation measures would continue under the No Action Alternative. Current measures have proven to be insufficient to protect right whales from ships strikes, as is indicated by the number of recorded ship strikes that have occurred over the last few years. For instance, eight known right whale deaths from ship strikes occurred between 2001 and 2005 (Nelson *et al*., 2007). Taking no additional actions would lead to significant, direct, long-term, negative impacts in the NEUS by hindering the survival and recovery of the western population of the North Atlantic right whale.

4.1.1.2 Mid-Atlantic United States (MAUS)

The MAUS includes waters along the coast where whales tend to occur close to shore at certain times of the year. The majority of the whales that occur in this area are migrating from feeding grounds in the north and calving grounds in the south, although nonmigratory whales have been sighted in this area on occasion. Ships must pass through this habitat to get to port, which places right whales in danger of ship strikes. The general north-south direction of migrating right whales intersects with the east-west direction of vessels traveling in and out of ports in this region, which intensifies the need for action in the MAUS, where current right whale protection measures are minimal.

With the exception of mariner education and other voluntary measures, there are virtually no active ship strike reduction measures in the MAUS. Therefore, the No Action Alternative, which would continue to rely on these measures alone, would have a potentially significant, direct, long-term, negative impact on the western population of North Atlantic right whales. Without the recommended protective operational measures, ships would continue to use a broad choice of routes at customary sea speeds to enter each port and the chances of striking a right whale would remain high because ship traffic in and out of ports is heavy in the MAUS (Section 3.4.1.4).

Any vessel strike, especially one resulting in serious injury or death, would have a significant, direct, long-term, negative effect on the small, critically endangered right whale population. Because most right whales using coastal MAUS waters are presumably pregnant females, mothers, juveniles, calves, or members of the population representing the population's reproductive potential and therefore most important to recovery, failure to implement the recommended operational measures in the MAUS, as in the SEUS, would result in continued ship strikes, and severely hinder the population's capacity to recover.

4.1.1.3 Southeastern United States (SEUS)

The SEUS is the only known calving ground for North Atlantic right whales, i.e., it is a location vital to the population. It is a very high-risk area for pregnant females, new mothers, and calves.

The No Action Alternative would have a significant, direct, long-term, negative impact on the right whale population because it would allow the threat of ship strikes to remain at current levels or increase with the expected increase in ship traffic (NMFS, 2005d). Without protective measures, ship strikes are expected to continue, which could result in continued, negative impacts to pregnant females, new mothers, calves, and juveniles – all vital reproductive components of the population.

Whale calves and juveniles are much more susceptible than adults to serious injury or death from ship strikes; one reason for this may be that they spend more time at the surface than adults do. Calves are also slower swimmers than adults, do not dive as deep or as long, and spend more time at the surface while nursing. Of 16 right whale mortalities by ship strikes recorded between 1970 and 1999, almost one-third – 31 percent, or five individuals – were calves and juveniles, and three others were no more than two years old (Knowlton and Kraus, 2001). Over the same period, of 56 documented right whales seriously injured (as defined by Knowlton and Kraus, 2001) by ship strikes or entanglement, more than one-third were calves or juveniles; the others were adults (Knowlton and Kraus, 2001). Vessels of all sizes can seriously harm calves and juveniles. In addition, a vessel strike to a new mother leaves a calf alone, which is most likely to lead to the death of the calf. The death of any one member of the population would seriously hinder recovery of the population and, in fact, could contribute directly to the extinction of the western stock of the North Atlantic right whale within the next 200 years (Section 1.1.1).

4.1.2 Alternative 2 – Mandatory Dynamic Management Areas

Implementing speed restrictions in Dynamic Management Areas (DMAs) under Alternative 2 would have minor, direct, long-term, positive effects on the right whale population because it would lower the potential for ship strikes of right whales throughout the range of the species within US waters and the EEZ. However, because the only operational measure proposed under Alternative 2 is the use of DMAs, this alternative is less likely than the other action alternatives to reduce ship strikes sufficiently to promote population recovery. Speed restrictions associated with DMAs are expected to reduce the severity of ship strikes, although unlike Alternatives 4, 5, and 6, which include recommended shipping routes, this alternative does not reduce the co-occurrence of whales and vessels unless mariners choose to route around a DMA. Furthermore, whereas the other alternatives are based on the known occurrence of whales at certain times of the year, DMAs would only occur where and when unexpected aggregations are sighted. The probability of whales being sighted is contingent on the several conditions, including the ability to fly aerial surveys (which are weather-limited), the availability of adequate funding, and the capacity to survey the entire range of the population on any day (Section 1.1.1). Sightings reported from non-NMFS vessels or aircraft would either trigger a Dynamic Area Management (DAM) measure under the Atlantic Large Whale Take Reduction Plan (ALWTRP) or a DMA under the ship strike reduction program. However, there are only two institutions (Provincetown Center for Coastal Studies and Whale Center New England) whose reports NMFS would be able to rely on to implement a DAM or a DMA without verifying the sighting. From 2002, (when the ALWTRP DAM program began) through November 2006, half the implemented DAMs resulted from sightings from sources other than NMFS surveys. Even though there are mechanisms through which DMA may be implemented even with limited resources, funding limitation on the number of aerial surveys flown by NMFS would still limit the effectiveness of DMAs as a protection measure.

When right whales are sighted and a DMA is implemented, ships would be required to adhere to speed restrictions while in the designated area, which may allow the whales and mariners to avoid collision and reduce the severity of a ship strike: research indicates that ship strikes recorded at speeds under 14 knots tend to result in minor to serious injuries; ship strikes that occurred at 14 knots and greater tend to result in serious injury or death (Laist *et al*., 2001; Jensen and Silber, 2003). Alternatively, mariners may opt to route around the defined area, thus minimizing the chance for a collision. DMAs provide temporary measures to protect right whales when they are sighted in aggregations of three or more individuals. When right whale sightings trigger a DMA, the restrictions are expected to be in place for 15 days and lifted if whales are no longer sighted or extended if whales are re-sighted. Therefore, these temporary restrictions would provide short-term protective measures during times and in areas where no other measures (i.e., SMAs) are in place.

4.1.2.1 NEUS

Implementing Alternative 2 would have minor, direct, long-term, positive effects on right whales in the NEUS. The effectiveness of DMAs in protecting right whales in the NEUS is limited by the difficulty to locate them by aerial surveys in rough seas or poor weather conditions. Routine aerial surveys are flown over this area to locate right whales, but the Northeast is more prone to rough seas than the other regions. Rough seas limit detectability of whales, and submerged whales also go undetected. As a result, DMAs may not occur at all due, in some cases, to the low probability of detection. Finally, aerial surveys are expensive, logistically difficult, and cannot assure 100 percent coverage of all areas at all times.

4.1.2.2 MAUS

Implementing a DMA program in the MAUS would have minor, direct, long-term, positive effects on right whales. Aerial surveys to identify aggregations of right whales are not conducted as frequently throughout the entire MAUS as in the NEUS and SEUS; without the ability to identify right whales aggregations that might trigger DMAs, this operational measure would not prove effective as a management measure. Implementing DMAs as the sole operational measure in the MAUS, without increasing survey efforts, would provide a low level of protection to right whales.

4.1.2.3 SEUS

Implementing actions identified in Alternative 2 would have minor, direct, long-term, positive effects on right whales in the SEUS. Aerial surveys are conducted systematically during the season when right whales utilize the SEUS as a calving ground. Although implementing a DMA program as an independent operational measure would have an overall positive impact on right whales, this alternative may not provide sufficient conservation value to reduce ship strikes and meet the ultimate goal of aiding the recovery of the right whale population, due to limitations of the effectiveness of aerial surveys as described in the preceding sections.

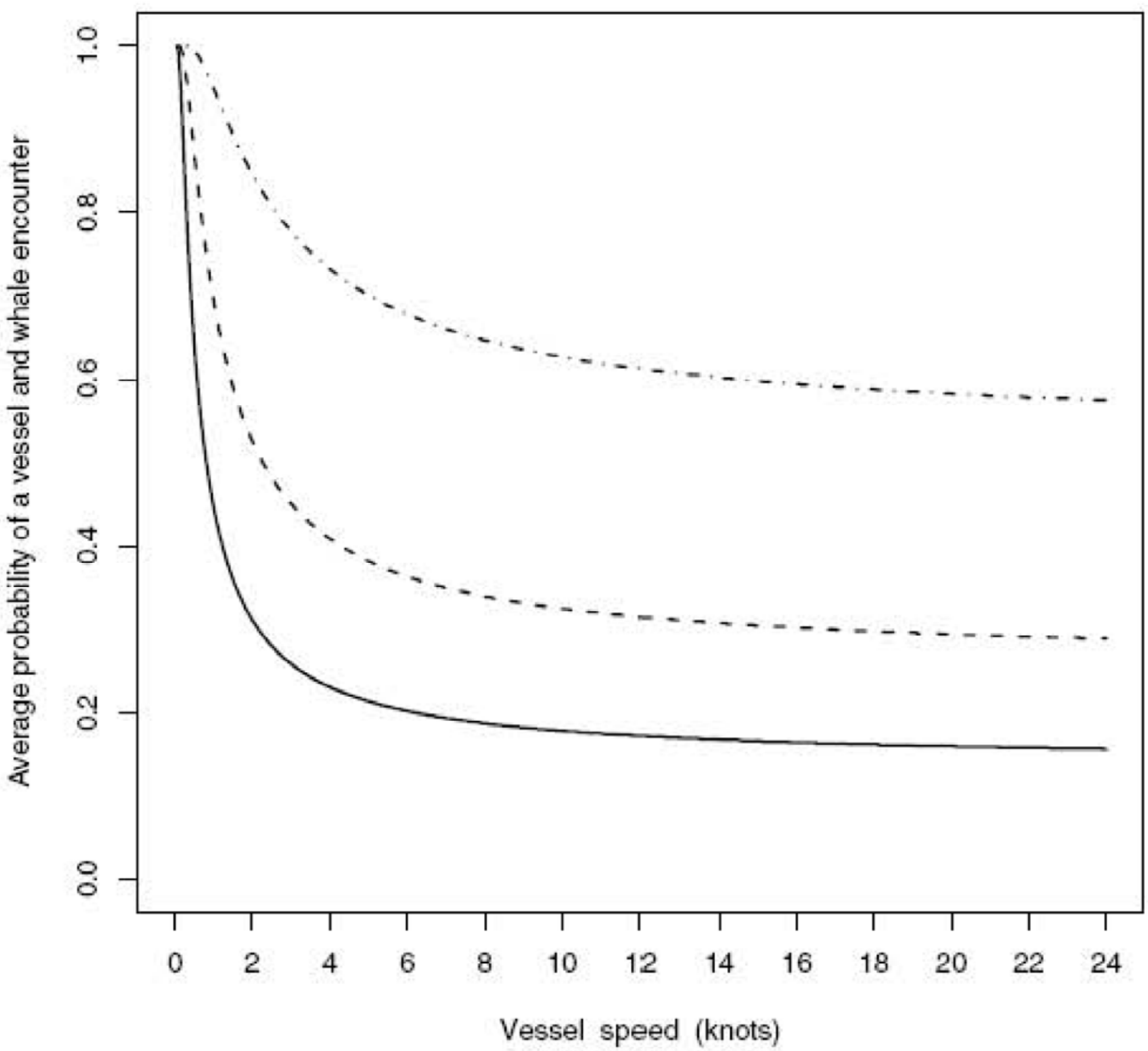
4.1.3 Alternative 3 – Speed Restrictions in Designated Areas

Implementing the ship-speed restrictions considered under Alternative 3 would result in direct, long-term benefits to the right whale population. This FEIS analyzes establishing ship-speed restrictions of 10, 12, and 14 knots. Generally, lower speed restrictions would result in a decreased probability of serious injury or death. A comparison of the impacts on right whales at each of these speed restrictions is provided after the background information on the relationship between vessel speed and the severity and occurrence of ship strikes presented in the following paragraphs.

Records of right whale ship strikes (Knowlton and Kraus, 2001) and large whale ship strike records (Laist *et al*., 2001; Jensen and Silber, 2003) have been compiled, and all indicate vessel speed is a principal factor in ship strikes. In assessing records in which vessel speed was known Laist *et al*. (2001) found "a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision." The authors concluded that most deaths occurred when a vessel was traveling in excess of 14 knots.

Vanderlaan and Taggart (2007) asserted the probability of a vessel–whale encounter as a function of speed using a random walk model. This model addressed the question of whether slower vessels that spend more time in an area pose more of a risk to right whales than those traveling faster and, therefore, spending less time in the area. The model demonstrates that the encounter probability increases with decreasing speed, but only at speeds of six knots or less. Therefore, a vessel reducing its speed from 24 knots (or any other speed between 24 and 10 knots) to 10 knots would not increase the encounter probability (see Figure 4-1). The encounter probability changes with the number of vessels, and would show different results if this model used multiple whales and various sizes or speeds for the whale and vessel. To ensure that these variables would not increase encounter probability at 10 knots, NMFS independently conducted a sensitivity analysis using a random walk model, and tested the additional variables mentioned above. The outputs of this sensitivity analysis agreed with the findings of the Vanderlaan and Taggart (2007) random walk model. In conclusion, slower vessels do not increase the risk of ship strike simply by transiting through an area for a longer time, unless the vessel is traveling at a speed of six knots or less.

Probability of a Vessel-Whale Encounter as a Function of Speed



Source: Vanderlaan and Taggart (2007), Encounter probability within a 1 km² domain estimated using a random walk model in two dimensions of a 16.5 m whale swimming at 1.5 ms^{-1} in the presence of an example vessel (125 m length and 20 m beam). The lines represent the domain with one whale and one vessel (solid), two vessels (dash), and five vessels (dash dot).

Figure 4-1

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Jensen and Silber (2003) identified 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. In 58 of the records, ship speed at the time of collision was known: it ranged from two to 51 knots, with an average of 18.1 knots. The majority (79 percent) of the strikes occurred at speeds of 13 knots or greater. When the 58 records are grouped by speed, vessels traveling at 13-15 knots made up the largest group, followed by those traveling at 16-18 knots, then those traveling at 22-24 knots (Jensen and Silber, 2003).

Of the 58 cases where speed was known, 19 (32.8 percent) resulted in serious injury to the whale (as determined by blood in the water, propeller gashes or severed tailstock, and fractured skull, jaw, vertebrae, hemorrhaging, massive bruising, or other injuries noted during necropsy) and 20 (34.5 percent) resulted in death. Therefore, in total, 39 (67.3 percent) ship strikes in which ship speed was known resulted in serious injury or death. The mean vessel speed that resulted in serious injury or death to the whale was 18.6 knots (Jensen and Silber, 2003).

Using a total of 64 records of ship strikes in which vessel speed was known, Pace and Silber (2005) tested speed as a predictor of the probability of death or serious injury. The authors concluded that there was strong evidence that the probability of death or serious injury increased rapidly with increasing speed. Specifically, the predicted probability of serious injury or death increased from 45 percent to 75 percent as vessel speed increased from 10 to 14 knots, and exceeded 90 percent at 17 knots (see Figure 4-2). Interpretation of the logistic regression curve used to obtain these probabilities indicates that there is a 100 percent probability of serious injury or death around 25 knots and faster. In a related study, Vanderlaan and Taggart (2007) analyzed all published historical data on vessels striking large whales. The authors found that the probability of a lethal injury resulting from a strike ranged from 20 percent at nine knots to 80 percent at 15 knots and 100 percent at 21 knots or more (Figure 4-2).

Related studies of the occurrence and severity of strikes relative to vessel speed have been conducted for other species and locations. Panigada *et al*. (2006) concluded that vessel speed restrictions and the relocation of vessel routes in high cetacean density areas would reduce the likelihood of ship strikes of fin whales in the Mediterranean Sea. Speed zones were adopted in Florida in the early 2000s to reduce manatee injuries resulting from collisions with boats. Laist and Shaw (2006) assessed the effectiveness of these speed zones at reducing watercraft-related manatee deaths. Watercraft-related manatee deaths did decline in the areas assessed in the paper, and the authors reported that this decline reflected the fact that well-designed speed restrictions could be effective if properly enforced. They further stated that “reduced speed allows time for animals to detect and avoid oncoming boats, and that similar measures may be useful for other marine mammal species vulnerable to collision impacts with vessels (e.g., North Atlantic right whales)” (Laist and Shaw, 2006). Another study involving laboratory impact tests examined the energy levels required to break manatee bones. The study found that ship strikes can cause bone fractures capable of inflicting fatal injuries to manatees at 13-15 miles per hour (15-17.3 knots) (Clifton, 2005). The boats analyzed in this research were the small recreational boats typically found in Florida waters, in contrast to the large commercial vessels generally implicated in right whale ship strikes. However, manatee bones are generally not as strong as other mammalian bones (Clifton, 2005), so it would be difficult to apply these results to right whales.

Although there is uncertainty regarding the behavior of whales in the path of approaching ships, documented cases suggest last-second flight responses when the ship is within 100 yds (91 m) or less of the whale. If a whale attempts to avoid an oncoming vessel at the last minute, a burst of speed coupled with a push from the bow wave could mean that mere seconds might determine whether the whale is struck (Laist *et al*., 2001). A reduction in speed from 18 knots to 10 knots would give whales an additional 8.6 seconds (at a distance of 100 m) to avoid the vessel in this flight response. A decrease from 18 to 12 knots would provide 5.2 seconds; with a decrease from 18 to 14 knots, the whale would only have 3.1 extra seconds to react (Laist, 2005, *unpublished data*).

In a separate study involving whale behavior, Kite-Powell *et al*. (2007), developed a model that analyzed ship strike risk with respect to vessel speed and whale avoidance behavior. In summary, the authors assert that ship strike risk decreases as speed decreases and the distance that the whale detects the vessel increases. Assuming certain whale behavior, the model suggests that the ship strike risk posed by a conventional ship (e.g., container ship) traveling at 20 to 25 knots can be reduced by 30 percent at a speed of 12 or 14 knots and by 40 percent at 10 knots, due to the whales' increased ability to detect and avoid approaching vessels. If a whale detects and reacts to an oncoming vessel at a distance of 820 ft (250 m) or longer, it will likely avoid a ship strike, whereas at detection distances less than 328 ft (100 m), the probability of ship strike is almost one at speeds of 15 knots or faster. Cumulatively, model results suggest that more than half the right whales swimming into the path of an oncoming ship traveling at 15 knots or faster are likely to be struck even if they do take evasive action (Kite-Powell *et al*., 2007).

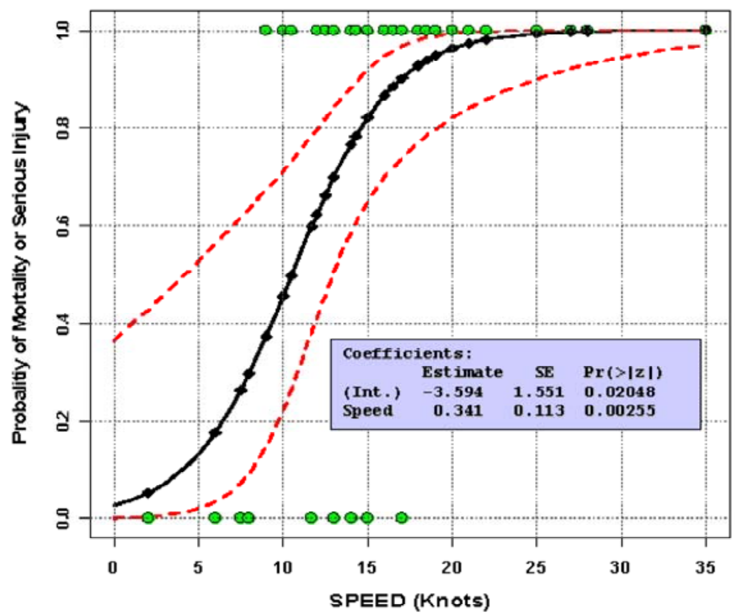
Another factor in the likelihood and severity of a vessel-whale collision is the hydrodynamic forces affecting a whale in the path of an oncoming vessel.[4] Knowlton *et al.* (1998) developed a model that considered the effect of ship speeds of 10, 15, and 20 knots on a moving whale that was 10 ft (3 m) forward of the bow. They found that a collision occurred at 20 knots, while the whale was able to avoid collision at the lesser speeds. Hydrodynamic forces from a passing ship would not draw an inactive whale into a ship because the pressure wave in front of the ship tends to push objects away from the hull before drawing them back toward the ship, amidships and near the stern. However, if a whale appears – that is, surfaces from a dive – after this initial flow of water away from the boat, it can be drawn into the ship along the hull or close to the propeller. Therefore, if a whale is trying to avoid an approaching ship, reduced ship speed would increase its ability to avoid collision (Knowlton *et al*., 1998).

In a more recent study, Slutsky (2007) measured the hydrodynamic forces involved in whale-vessel collisions using whale and ship models in a tow tank. The author determined that the magnitude of forces exerted on the whale increased linearly with vessel speed (Slutsky, 2007). A separate study examined the effects of these forces by examining the biomechanical properties of right whale mandibles as related to blunt force trauma inflicted by a vessel (Campbell-Malone, 2007). Citing Kite-Powell *et al*. (2007), Campbell-Malone (2007) indicated that there are compound (both behavioral and force of impact) benefits to implementing speed restrictions; both studies predicted a reduction of right whale deaths as a result of vessel speed limits in right whale habitat.

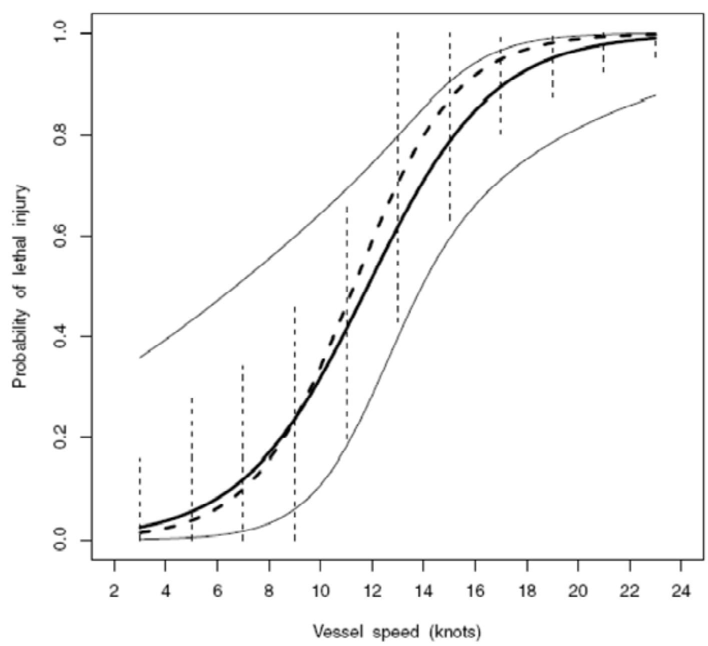
Reduced speeds can also have a positive impact on mariner safety and reduce the amount of damage a vessel incurs following a collision with a whale. Thirteen records in the ship strike database reported vessel damage resulting from a vessel collision with a whale. Three of these cases occurred at speeds between 10 to 15 knots and the remaining reports occurred at speeds over 20 knots. Physical damage to vessels results in repair costs and economic loss due to lost

[4] Hydrodynamic refers to the dynamics of a fluid in motion, and for the purpose of this FEIS, the forces imposed on a whale by a passing ship are referred to as sway, surge, and yaw.

Probability of Mortality or Serious/Lethal Injury as a Function of Vessel Speed



Source: Pace and Silber (2005), Fitted logistic regression showing the relationship between serious injury and vessel speed. (Green dots are observed, black diamonds are predicted and red-dashed lines are the 95% CI about the individual prediced values).



Source: Vanderlaan and Taggart (2007), Simple logistic regression (solid heavy line) and 95% CI (solid thin lines) and the logistic fitted to the bootstrapped predicted probability distributions (heavy dashed line) and 95% CI for each distribution (vertical dashed line).

Figure 4-2

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profits from dry-docking the vessel and not utilizing it for business operations. Several cases also involved human injury from the force of the strike. Therefore, reduced speeds would potentially lessen the extent of damage to the vessel and risks to human health and safety during a collision.

Impact of a 10-Knot Speed Limit

Research on vessel-whale collisions indicates that of the three speeds considered – 10, 12, and 14 knots – adopting a speed limit of 10 knots would be the most beneficial to the recovery of the right whale population. Historically, only a small percentage of ship strikes occurred at 10 knots, and those that did usually resulted in injury rather than death (Laist *et al*., 2001). However, while a 10-knot speed restriction would be most effective at reducing the risk of ship strikes, it would not eliminate the risk; there is still a 45 percent predicted probability of serious injury or mortality at 10 knots (Pace and Silber, 2005).

Impact of a 12-knot Speed Limit

A speed limit of 12 knots would also benefit right whales. Only a small percentage (11 percent) of ship strikes that result in serious injury or mortality occurred at speeds between 10 and 14 knots (Laist *et al*., 2001). Through interpretation of the logistic regression graph of the relationship between serious injury and vessel speed, there is approximately a 60 percent predicted probability of serious injury or mortality at 12 knots (Pace and Silber, 2005).

Impact of a 14-knot Speed Limit

Adopting a speed limit of 14 knots would be less beneficial to right whales than adopting speed limits of 10 or 12 knots because ship strikes that occurred at 14 knots or higher generally resulted in death or serious injury. The majority (89 percent) of known collisions occurred at speeds of 14 knots or faster (Laist *et al*., 2001). Further, there is a 75 percent predicted probability of serious injury or mortality at 14 knots (Pace and Silber, 2005).

In summary, speed restrictions are proposed as a stand-alone measure under Alternative 3 because they are expected to reduce both the severity and occurrence of ship strikes in certain locations where whales are known to occur. Based on the discussions above, this alternative affords a moderate level of protection to right whales.

4.1.3.1 NEUS

Alternative 3 proposes year-round speed restrictions in specific areas in the NEUS, which would have a direct, long-term, positive impact on the right whale population for the reasons previously described. The geographical area where these speed restrictions would apply includes all waters in the expanded SAM zones and critical habitat as designated in the proposed rule and DEIS for amending the ALWTRP (see Section 2.2.3).

Speed restrictions are especially important in the NEUS because this region includes right whale feeding habitat, and whales that are actively feeding may be less responsive to approaching ships (Laist *et al*., 2001). They also may be skim feeding at the surface, which may reduce their awareness of approaching ships and, because the whales are at the surface, increase their vulnerability to vessel collisions.

Speed restrictions in the NEUS under Alternative 3 differ from those under Alternative 6 because they are year-round instead of seasonal. However, Alternative 3 does not include establishing DMAs, and therefore lacks a mechanism to protect whales occurring outside of the SAM zones.

Alternative 3 also does not include recommended routes[5], as do alternatives 4, 5, and 6, so this Alternative does not spatially separate vessel traffic from whales and their habitat. Therefore, as a stand-alone measure, the speed restrictions proposed in Alternative 3 would reduce the severity and occurrence of ships strikes but this alternative does not include two key measures (DMAs and routing measures) that would provide additional protection.

4.1.3.2 MAUS

Alternative 3, which proposes a SMA off the US mid-Atlantic coast effective from October 1 through April 30, would have direct, long-term, positive impacts on the recovery of the right whale population by reducing the number and severity of ship strikes in this migratory corridor (Section 4.1.3). The SMA would encompass all waters extending out 25 nm (46 km) from the US coastline from Providence/New London (Block Island Sound) south to Savannah, Georgia. Many ports in the mid-Atlantic host a high volume of vessel traffic. As this region is also a high-use area for migrating right whales, the whales transit this region twice a year.

The proposed MAUS SMA under Alternative 3 include the entire coastline out to 25 nm (46 km), whereas Alternative 6 only proposes speed restrictions in 20-nm (37-km)-wide SMAs around several important port areas. Therefore, compared to Alternative 6, Alternative 3 would provide additional protection for right whales traveling in waters from 20- to 25-nm (37- to 46-km) offshore. Although Alternative 3 includes waters between major port areas the additional coverage may not result in a much greater reduction in vessel strikes because large commercial vessels are concentrated in the vicinity of port areas (as they arrive and depart these ports) more than surrounding waters. However, Alternative 3 provides an additional month of restrictions during October while Alternative 6 only has restrictions in place from November 1 through April 30. Alternative 3 does not include DMAs to provide protection to whales occurring in May to September or in waters from 25 to 200 nm (46 to 370 km). Therefore, Alternative 3 may not provide sufficient protection to reduce the occurrence of ship strikes and aid the recovery of the right whale population.

4.1.3.3 SEUS

Reducing ship strikes in this region is particularly important because it is a calving area. Alternative 3, with a proposed SMA and associated speed restrictions effective from November 15 through April 15, would have a direct, long-term, positive impact on the recovery of the right whale population by reducing the number and severity of ship strikes in this habitat. The proposed SMA would include all waters in the Southeast Mandatory Ship Reporting System (MSRS) area (described in Section 2.2.3) and the Southeast critical habitat for right whales.

The Alternative 3 SMA encompasses the MSRS area and the critical habitat whereas Alternative 6 only proposes speed restrictions within the Southeast SMA (which extends just south of the MSRS area), but not in the critical habitat. Speed restrictions proposed under Alternative 3 are effective for five months, like under Alternative 6. However, Alternative 3 does not involve routing ships away from high right whale densities through identified shipping lanes. Alternative

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[5] A recommended route is defined by the IMO as a route of undefined width, for the convenience of ships in transit, which is often marked by centerline buoys. The USCG adopted this IMO definition, which identifies the type of routing measure used in the alternatives. Recommended routes have been identified as an important ship strike risk-reduction tool, and are therefore discussed in this and other alternatives; they are sometimes referred to as shipping lanes.

3 only includes one ship strike reduction measure – vessel speed – and does not account for the distribution of whales that overlap with vessel traffic. Whales sighted outside the MSRS area or the critical habitat would not be protected under this alternative because DMAs are not included. For these reasons, Alternative 3 may not provide sufficient protection to significantly reduce the risk of ships strikes to aid the recovery of the right whale population.

4.1.4 Alternative 4 – Recommended Shipping Routes

Alternative 4 would have direct, long-term, positive effects on right whales in the SEUS and NEUS regions, and direct, long-term, adverse effects on right whales in the MAUS region.

4.1.4.1 NEUS

Implementing Alternative 4 would have direct, long-term impacts on the right whale population in the NEUS region. Alternative 4 proposes the year-round, voluntary use of recommended shipping routes for all vessels 65 ft (19.8 m) and longer. Year-round routes would afford protection to the high densities of right whales in Cape Cod bay from January through May and to the whales that are occasionally sighted during other months of the year. The recommended routes were established in November 2006; NOAA would monitor mariners' use of the routes, and consider making them mandatory if compliance is low. If utilized, recommended routes would move vessels away from aggregations of feeding right whales in the Cape Cod Bay critical habitat area, where density is high and whales are particularly vulnerable to ship strikes due to their behavior: Cape Cod Bay is an important feeding ground for right whales and research suggests that although right whales should be able to hear vessels, they may not avoid them when engaged in feeding or socializing behavior (Mayo *et al*., 2004; Nowacek *et al*., 2004).

In the NEUS, the recommended routes are generally consistent with current vessel traffic patterns, and with one exception, are located near the boundary of the critical habitat. While the two-way recommended track from the Cape Cod Canal to Provincetown routes vessels through the right whale critical habitat, the number of vessels currently using this route is minimal. Further, this traffic generally consists of slower-than-average vessels, including tugs and barges, and vessels entering Cape Cod Bay and/or the Canal from the Northeast and vice versa.

Nichols and Kite-Powell (2005) conducted a risk analysis of proposed recommended routes in Cape Cod Bay based on right whale sightings from 1998 to 2002 and vessel traffic data in Cape Cod Bay. The authors devised a model to estimate the number of ship/whale encounters that might occur assuming the whales remained at the surface and neither the ships nor the whales attempted to avoid collision. An encounter was considered to have occurred when a known number of vessels passed through an area of estimated right whale density. This model predicted that approximately 1.5 ship/whale encounters would occur in Cape Cod Bay annually. The proposed shipping lanes in Cape Cod Bay were then incorporated into the model to assess their effectiveness at reducing the potential for ship strikes. The authors concluded that the proposed lanes would reduce the potential for ship/whale encounters by 45 percent, from 1.5 to about 0.9 a year. They noted that the encounter rate and any reduction in the rate cannot be translated directly into actual ship *strikes* because diving and avoidance actions by whales and/or mariners were not included in the model. Therefore, these values are presented for informational purposes and are most likely an elevated estimate of annual ship strikes in Cape Cod Bay, as they assume whales are at the surface and neither the ships nor the whales seek to avoid a collision.

Although implementing the measures identified in Alternative 4 would reduce the risk of ship strikes from ships transiting through areas of high whale densities, it would only account for one factor of several that affect the occurrence and severity of ship strike. This alternative would not require vessels to reduce speed when traveling in shipping lanes, and, therefore, would not include the advantages associated with speed restrictions. Alternative 4 also does not include the use of DMAs, so it does not account for right whale sightings outside designated seasons and areas. Implementing only the measures identified in Alternative 4 likely would not reduce risk of ship strikes sufficiently to lead to an increase in the population growth rate.

4.1.4.2 MAUS

Recommended routes are not proposed in the approaches to mid-Atlantic ports, so conditions under Alternative 4 would be those identified for the No Action Alternative. Taking no action would have direct, long-term, adverse effects on right whales in the MAUS. With no proactive measures in place, right whales would remain vulnerable to collisions with ships.

4.1.4.3 SEUS

Implementing the measures identified in Alternative 4 would have direct, long-term, positive effects on right whales in the SEUS region. Year-round recommended routes in the SEUS are designed to separate vessel traffic from right whale aggregations, thus reducing vessel collisions. The routes were identified based on the following data: (1) viable approaches to the pilot buoys for the ports of Brunswick, Georgia and Jacksonville and Fernandina, Florida that avoid areas with relatively high densities of right whales and (2) right whale distribution and congregating areas around the approaches to the ports based on aerial survey data (Garrison, 2005).

Implementation of the actions identified in Alternative 4 for the SEUS would amount to the use and monitoring of the recommended shipping routes for the ports of Jacksonville, Fernandina, and Brunswick, which were established in November 2006. These ports currently have no officially- designated shipping lanes, though there are identifiable “high use” approaches. Traffic route patterns are derived from MSRS data from 1999 to 2001 (Ward-Geiger *et al*., 2005). The majority of traffic approaching Jacksonville enters from a southeast route, with considerable traffic also approaching from the northeast. Traffic patterns in Fernandina and Brunswick exhibit heavy vessel use primarily from the southeast to due east of the pilot buoy (Garrison, 2005).

A series of potential approaches into each of the ports was analyzed for a reduction in risk of a vessel-whale interaction based on modeled right whale density and distribution, and current vessel traffic patterns (Garrison, 2005). This risk factor was measured against the “status quo” risk level for each port. These proposed routes were submitted to the USCG for consideration of navigational safety and environmental risk reduction in its PARS. The USCG conducted the study and issued a report. Following release of the PARS report, slight changes were made to the routes to account for navigational hazards associated with fish havens, among others.

Figure 2-2 shows the final recommended routes for all three ports. When combined, it is estimated that the routes would reduce the risk of a vessel-whale interaction by approximately 40 percent and generally reduce the distance traveled when entering and exiting the ports. That is, whale exposure to ships would be reduced by virtue of the reduction in actual travel distances.

The final recommended routes for Jacksonville are just north of the prevailing traffic patterns into this port as reported to the MSRS in the 2000/2001 season. As a result, significant changes to vessel traffic patterns for those calling on Jacksonville are not expected.

Recommended routes into Fernandina are from the east-southeast. The majority of the traffic into Fernandina during the 2000/2001 season approached from the east or northeast; therefore, the lanes that provide the most protection for right whales would also result in a significant change in existing traffic patterns.

Recommended routes into Brunswick from due east and southeast would constitute a slight shift from existing traffic patterns. A high volume of vessel traffic approached the port from the southeast in 2000/2001 and only the due-east route would alter existing traffic patterns.

Reducing the number of vessels that transit in areas where right whales aggregate in the SEUS is important because this is a right whale calving and nursing area. Females are a vital reproductive component of the population. In 2004 and 2005 there were three instances where one ship strike resulted in the death of both a pregnant female and her fetus (Kraus *et al*., 2005). The death of a mother may result in two deaths, as a calf is unlikely to survive on its own. The reproductive potential of the mother for the remainder of her life – as well as that of the calf – is also lost to the population. Laist (2005, *unpublished data*) found that calves and juvenile whales were hit more often than adults, so the SEUS calving ground is a particularly important habitat to protect. Because Jacksonville has higher vessel traffic volumes than Brunswick or Fernandina, the shipping lanes for the port of Jacksonville have a higher relative conservation value than the other recommended routes. While the routing measures contained in Alternative 4 may have an overall positive effect on the right whale population, without speed restrictions and DMAs they may not provide sufficient protection as stand-alone measures to effectively reduce the occurrence of ship strikes.

4.1.5 Alternative 5 – Combination of Alternatives

Implementing Alternative 5, which combines the measures included in Alternatives 1 through 4, would have significant, direct, long-term benefits on the right whale population. This alternative includes the continuation of current measures, recommended shipping routes, large-scale speed restrictions, and DMAs. The positive impacts of these combined measures on the right whale population would be significant. Routing measures would shift traffic away from areas of relatively high whale density; speed restrictions in SMAs and DMAs would reduce the occurrence and severity of a ship strike; and DMAs would provide protective measures for unpredicted whale occurrences.

Of all action alternatives, Alternative 5 would provide the highest level of protection. It would significantly reduce the incidence and/or severity of ship strikes. If deaths and serious injuries are reduced, a higher probability exists that the population growth rate would increase, and as a result, bring the population closer to recovery.

4.1.5.1 NEUS

Implementing the measures identified in Alternative 5 in the NEUS would have direct, long-term, positive effects on the status of the population. All known right whale feeding grounds are located within the NEUS, and right whale densities can be relatively high in certain areas. While in the NEUS, right whales engage in feeding, socializing, and mating behavior that may reduce their awareness of certain threats and increase their susceptibility to ship strikes. For example, whales engaged in certain behaviors, such as skim feeding on the surface, may be less responsive to approaching ships (Laist *et al*., 2001). Both males and females utilize these feeding grounds year-round, but densities are highest from winter to fall. Implementing the combination of operational measures proposed under Alternative 5 would decrease the conflicts inherent between vessel traffic and high whale density areas and increase the chance of whale survival or avoidance by reducing ship speeds. The conservation value of the individual measures combined in Alternative 5 is described in Sections 4.1.2.1, 4.1.3.1, and 4.1.4.1. These measures would reduce the occurrence and/or severity of ship strikes, facilitating recovery.

DMAs would provide measures to protect right whales if they occur outside periods and/or locations of seasonal restrictions. DMAs may have greater conservation benefit to right whales in the NEUS than in the MAUS or SEUS because they are the only measures proposed for waters north of Massachusetts.

4.1.5.2 MAUS

Implementing the measures proposed in Alternative 5 would have direct, long-term, positive effects on right whales that occur in waters off the MAUS. Continuing existing protective actions, the use of DMAs, and speed restrictions with the proposed continuous 25-nm SMA would reduce the risk of ship strikes and facilitate population recovery. The conservation value of the individual measures combined in Alternative 5 is described in Sections 4.1.2.2, 4.1.3.2, and 4.1.4.2. The Alternative 5 measure likely to be the most beneficial to whales migrating through the MAUS would be proposed 25-nm SMA, in effect from October 1 to April 30. The majority of right whale sightings occur within 20 to 30 nm (37-56 km) of the coast; therefore, these restrictions would provide protective measures in whale high-use areas. As discussed in Section 4.1.3, fewer ship strikes occur at vessel speeds of 14 knots and less, and those that do occur usually result in fewer severe injuries than those that occur at speeds greater than 14 knots.

Implementing DMAs in the MAUS would benefit right whales when and where the proposed 25-nm SMA is not in effect. Survey effort has recently been expanded in the MAUS region, although these aerial surveys do not cover the entire region. Systematic surveys are flown off the coasts of Georgia, the Carolinas, Rhode Island, and part of Long Island, although the waters off Virginia north to New York are not covered. For DMAs to be effective in this region, an increase in survey effort would be necessary. Without the ability to detect right whales that might trigger DMAs, this operational measure might not prove effective as a management measure.

4.1.5.3 SEUS

Implementing the measures proposed in Alternative 5 would have major, direct, long-term, positive effects on right whales by providing protection in their only known calving and nursery area. As previously mentioned, females and their calves are two vital segments of the population. Preventing the death of one female could result in a larger boost to the population than saving a male (mature males are not generally found in the calving grounds), because of the female's reproductive potential, and its importance to recovery.

The conservation value of the individual measures combined in Alternative 5 for the SEUS is described in Sections 4.1.2.3, 4.1.3.3, and 4.1.4.3. Speed restrictions in the proposed SMA would reduce the number and severity of ship strikes to females and calves. The recommended routes into the ports of Brunswick, Fernandina, and Jacksonville would shift vessel traffic away from areas where right whales typically aggregate.

DMAs would provide temporary measures to protect right whales when they occur outside of the times, or locations, of seasonal restrictions. DMAs are of particular importance in the SEUS with respect to protecting whales that occur around approaches to or in the vicinity of Port Canaveral, which is south of the MSRS and critical habitat, and would not have seasonal speed restrictions.

4.1.6 Alternative 6 – Proposed Action (Preferred Alternative)

Implementing the measures identified in Alternative 6, the proposed action, would have major, direct positive impacts on the North Atlantic right whale population during the five-year period the measures would be in effect. Voluntary DMAs are proposed for all areas in Alternative 6 (see Section 2.1.4), so the effects of this operational measure are discussed in this introduction rather than repeated for each of the three regions.

DMAs would apply where and when no SMA is in effect. Mariners would be notified about the establishment of a DMA via electronic and other customary maritime communication systems immediately following verification. Requesting vessels to reduce speed while transiting through a DMA or routing around a DMA would reduce the threat of ship strikes for the same reasons as discussed in Section 4.1.2.

The benefits of ship speed restrictions are similar for all areas where they are proposed (see Section 4.1.3). As mentioned earlier, this EIS analyzes three alternative speed restrictions – 10, 12, and 14 knots. For all alternatives, a 10-knot speed restriction would result in a greater reduction in the severity and occurrence of ship strikes; 12 knots would result in a moderate reduction; and 14 knots would result in the least reduction of the three speeds because data indicate that the probability of death or serious injury is less at lower speeds (Section 4.1.3). Speed restrictions would also reduce the likelihood that a whale would be pulled into the side or stern of the vessel by hydrodynamic forces because such forces are weaker at slower speeds. Whales would have additional time to avoid a vessel collision in a last-second flight response.

4.1.6.1 NEUS

Implementing Alternative 6 would have major, direct positive effects on the western population of North Atlantic right whales in the NEUS while the measures are in effect. The seasonal speed restrictions in the NEUS SMAs correspond to periods when there are predictable, high-density concentrations of right whales (Merrick, 2005b). This section describes the benefits of Alternative 6 to right whales in the different areas of the NEUS.

Cape Cod Bay

In the Cape Cod Bay area, the recommended shipping routes to and from the Cape Cod Canal, Boston, and Provincetown are expected to reduce the risk to whales by minimizing ship traffic in whale high-use areas. In addition, a speed restriction of 10, 12, or 14 knots throughout the CCB SMA from January 1 to May 15 would incrementally lessen the severity and occurrence of ship strikes. Reduction of ship strikes in the Cape Cod Bay area would contribute substantially to population recovery.

Off Race Point

Implementing the proposed measures under Alternative 6 would have positive effects on the right whale population, particularly feeding right whales, in the Off Race Point area. This area is of particular concern for vessel collisions because the Boston TSS concentrates ship traffic through this SMA. A speed restriction of 10, 12, or 14 knots from March 1 to April 30 would reduce the likelihood of serious injury or death, and whales would have additional time to avoid a vessel in a last-second flight response. If mariners elect to route around the Off Race Point area rather than limit their speed through it, this would further minimize ship strikes. Right whales congregate in the Off Race Point area for feeding and when traveling from Cape Cod Bay to the Great South Channel and other areas.

Great South Channel

Implementation of the proposed GSC SMA under Alternative 6 would significantly reduce the threat of ship strikes to feeding and socializing right whales. Large feeding aggregations of right whales are sighted routinely in this area, which is also designated critical habitat. Speed restrictions in the Great South Channel management area and critical habitat from April 1 to July 31 would result in major, positive effects on right whales. Data strongly suggest that vessels traveling at under 14 knots are less likely to seriously injure or kill whales during a collision than those traveling at 14 knots or faster (Laist *et al*., 2001; Pace and Silber, 2005).

Gulf of Maine

The Gulf of Maine includes all US waters north of other management areas for Cape Cod Bay, Off Race Point, and Great South Channel. It is anticipated that the proposed voluntary DMAs in this area would have a positive impact on the North Atlantic right whale population. DMAs provide measures to protect right whales if they occur outside the times or geographical boundaries of management areas, shipping lanes, or critical habitat. This measure is particularly important in the Gulf of Maine because DMAs would be the only operational measure in this area. Diversions around the DMAs or speed restrictions through them would reduce the threat of ship strikes, thereby aiding in the recovery of the population.

4.1.6.2 MAUS

Implementation of Alternative 6 in the MAUS would reduce the likelihood that right whales are struck or killed by vessels entering and leaving the following ports/areas:

- South and East of Block Island Sound
- New York/New Jersey
- Philadelphia, Pennsylvania, and Wilmington, Delaware
- Baltimore, Maryland
- Hampton Roads, Virginia
- Morehead City, Beaufort, and Wilmington, North Carolina
- Georgetown and Charleston, South Carolina
- Savannah, Georgia.

As a result, Alternative 6 would have major, direct positive effects on the western population of the North Atlantic right whale. The MAUS includes an area near the coast used by whales to travel between the northern and southern aggregation areas. Ships pass through the right whale high-use area to ports in this region, which places migrating right whales in danger of ship strikes. The general north-south direction of migrating right whales is in conflict with the east-west direction of vessels traveling to and from ports.

Operational measures proposed for the MAUS would reduce the threat of ship strikes by establishing speed restrictions in SMAs off several ports in the region (see Table 2-1). As previously noted, the level of protection would increase as the mandatory speed decreases: greatest at 10 knots and least at 14 knots. The speed restrictions would be in place from November 1 through April 30 to encompass the period when the whales, both northbound and southbound, typically migrate through the mid-Atlantic corridor. In Block Island Sound, the designated area is a rectangle with a 30-nm (56-km) width extending south and east of the mouth of the Sound. This SMA corresponds to the area where approximately 90 percent of all whale sightings occurred from 1972-2000 (NMFS, 2008, *unpublished*). South of Block Island Sound, the restrictions would cover waters within a 20-nm (37-km) radius from the COLREGS demarcation lines for the ports of New York/New Jersey, Philadelphia and Wilmington (Delaware Bay), Hampton Roads and Baltimore (Chesapeake Bay), and Morehead City and Beaufort, North Carolina. From Wilmington, North Carolina south to Brunswick, Georgia, there would be a continuous SMA extending 20-nm (37-km) from the shore. These SMAs include approximately 83 percent of right whale sightings (NMFS, 2008, *unpublished*). This continuous SMA (see Section 2.1.2.1) would provide significant conservation value for an aggregation of right whale sightings along the South Carolina coastline. Speed restrictions in the MAUS are important to reducing ship strikes because this region has the highest level of vessel traffic among the three regions. Almost 50 percent of the total vessel arrivals on the East Coast occur during the right whale migration season, when speed restrictions would be in place. Therefore, these restrictions would have a direct positive effect on the migrating right whale population.

4.1.6.3 SEUS

Implementation of Alternative 6 in the SEUS would have major direct positive effects on the western population of the North Atlantic right whale because it would reduce the threat of ship strikes in their only known calving and nursery area. Mothers and calves appear to be more prone to ship strikes than other individuals because they spend more time at the surface and because calves are not accomplished swimmers. This calving area is very important to the growth of the population. By reducing ship strikes of right whales in the SEUS, there is an enhanced probability of reducing deaths and the population would grow to a sustainable level because more calves and juveniles would live long enough to reach reproductive maturity. Given the right whale's low fecundity, implementation of the operational measures in the critical habitat for calving is crucial to the survival of the species.

Under this alternative, recommended shipping routes near Jacksonville and Fernandina, Florida and Brunswick, Georgia would shorten travel times and avoid specific right whale aggregation areas. By limiting ship travel to specific shipping lanes into these ports, the probability of ships striking whales would be lowered. The recommended routes have been designed to cross areas with low densities of right whales. Therefore, it is expected that implementation of Alternative 6 would increase the survival rate of right whales by routing ships away from aggregation areas, especially critical in this calving area for pregnant females, mothers, juveniles, and calves. As discussed earlier, if compliance with the recommended routes is low, NMFS would consider making them mandatory.

Implementation of speed restrictions throughout the Southeast SMA and the recommended routes within the SMA also would help prevent ship strikes. The SEUS region has the second-highest level of vessel traffic among the three regions – 30 percent of total vessel arrivals on the East Coast occur when whales are present in this region during periods when SMAs would be in affect. The maximum speed allowed would be 10, 12, or 14 knots. The level of protection would increase as the mandatory speed decreases: greatest at 10 knots and least at 14 knots. Data suggest that vessels traveling at under 14 knots are less likely to seriously injure or kill whales in a collision than those traveling at 14 knots and faster (Laist *et al*., 2001; Pace and Silber, 2005). Moreover, whales would have additional time to avoid a vessel collision in a last-second flight response (Laist *et al*., 2001) (Section 4.1.3). The speed restrictions in the SEUS would be in effect from November 15 to April 15, consistent with the calving season.

4.2 Impacts on Other Marine Species

This section discusses the potential impacts of implementing the proposed vessel operational measures on living marine resources other than the western stock of the North Atlantic right whale. Potential impacts to several of the species described in Section 3.2 are not analyzed in this section for the following reasons. Impacts on the healthy marine mammal stocks listed in Section 3.2.1 are not analyzed, either because they are not affected by ship strikes or their range does not overlap with that of the right whale. For example, whereas minke and pilot whales and Atlantic white-sided dolphins occur in Cape Cod Bay in winter and spring, they are not high-risk species for ship strikes. While the coastal stock of bottlenose dolphins is depleted – and in some locations overlaps with right whales spatially and temporally (Section 3.2.2) – there are minimal records of serious injury and mortality from ship strikes, and this threat is not as well-pronounced or well-documented as are fisheries interactions for this species. Seabirds and protected anadromous and marine fish are not addressed in this section, as they would not be affected by the proposed operational measures. Seabirds are capable of avoiding oncoming vessels and there are no records of vessel strikes to seabirds. Likewise, fish are capable of avoiding oncoming vessels, and there are no records of vessel strikes to fish.

4.2.1 Alternative 1 – No Action Alternative

4.2.1.1 Other Marine Mammals

Alternative 1, the No Action Alternative, would continue to have indirect, long-term, negative impacts on marine mammals other than North Atlantic right whales. Ship strikes pose a threat to other large whales in the western North Atlantic (see Section 3.2.1), including endangered fin, humpback, sei, and sperm whales occurring in or near North Atlantic right whale habitat. The No Action Alternative would provide no further protection against ship strikes; therefore, other large whales would continue to be seriously injured or killed by ship strikes.

4.2.1.2 Sea Turtles

Although sea turtles, like whales, are subject to ship strikes (see Section 3.2.2), data are limited with respect to the relationship between vessel speed and the occurrence and severity of ship strike injuries. However as noted in the action alternatives, it is possible that under certain conditions, speed restrictions may reduce ship strikes to sea turtles. Under the No Action Alternative, this potential positive impact would not would occur. Ship strikes would be expected to continue causing injury and death. Data are unavailable on which of the five species of sea turtles occurring in or near North Atlantic right whale habitat are most susceptible to ship strikes.

4.2.2 Alternative 2 – Mandatory Dynamic Management Areas

4.2.2.1 Other Marine Mammals

Because DMAs are based specifically on sightings of right whale aggregations, implementation of a DMA would not significantly benefit other marine mammals, unless the animals occurred coincidentally within the waters of an established DMA. As the operational measures contained in Alternative 2 are not specifically designed to protect other marine mammals that occur in right whale habitat, they would only provide minimal spatial protective measures to reduce ship strikes to other marine mammal species.

4.2.2.2 Sea Turtles

Because DMAs are not specifically designed to protect sea turtles, the proposed measures contained in Alternative 2 would not significantly benefit sea turtles, unless they occur within the waters of a DMA. Vessels would either route around a DMA or transit at a specific speed through the DMA, reducing the potential for a collision with right whales. The chances of sea turtles occurring within a DMA are expected to be low due to differences in seasonal occurrence; therefore, any benefit would be minimal.

4.2.3 Alternative 3 – Speed Restrictions in Designated Areas

4.2.3.1 Other Marine Mammals

The measures proposed in Alternative 3 would have minor, indirect, long-term positive effects on other marine mammal species. Reduced vessel speeds would provide protection for other species whose habitats overlap with right whales. Humpback, fin, sei, and sperm whales are at risk of ship strikes and in some areas utilize similar habitats; therefore, speed reduction measures could also reduce ship strikes to other whale species to the extent that individuals of these species occur in the proposed speed restriction areas. Blue whales are also affected by ship strikes, although they are rarely found in the waters inhabited by right whales. Implementation of the proposed SAM East and West year-round speed restrictions areas would have a positive effect on humpback, fin, and sei whales, which are sighted frequently in Off Race Point and Great South Channel. Sperm whales tend to occur in deep, offshore waters, and generally would not be affected by speed restrictions in the NEUS.

In the MAUS, speed restrictions in the continuous 25-nm SMA would have a minor positive effect on humpback whales, as some individuals aggregate in waters off the mid-Atlantic as opposed to migrating to the subtropics in the winter. Fin whales also occur in mid-Atlantic waters in fall and winter, although they are typically found in deeper offshore waters than are right whales, and are unlikely to be affected by speed restrictions in the MAUS (NMFS, 2005f). Sperm whales generally occur in deeper, offshore waters than do right whales. This species may benefit from speed restrictions in the MAUS because the shelf break is closer to shore in the mid-Atlantic (near Cape Hatteras, North Carolina) than in the Northeast.

There have been a number of humpback whale sightings in coastal waters off the southeastern US in winter (NMFS, 2006). Therefore, humpback whales may benefit from measures in the SEUS. Sperm and fin whale habitat is primarily north of Cape Hatteras, and sei whales do not occur in waters south of Massachusetts. The northern portion of the Florida manatee range coincides with the SEUS, although in winter, when speed restrictions would be in place in this region, manatees are concentrated in areas off the coast of south Florida. Even though the speed restrictions identified in Alternative 3 extend further south than under Alternative 6 and include the southeast critical habitat for right whales, it is unlikely that this would result in a measurable benefit to manatees.

4.2.3.2 Sea Turtles

The measures proposed under Alternative 3 would have minor, indirect, long-term, positive effects on sea turtles if they happen to occur in designated speed-restricted areas. Except for Hazel *et al*. (2007) (Section 3.2.2), there is no known data on the severity and occurrence of ship collisions with sea turtles relative to vessel speed; however it is likely that any benefits right whales would derive from speed restrictions would also apply to sea turtles (Section 4.1.3). As the Hazel *et al*. (2007) study only focused on one species, the green turtle, utilized a significantly smaller 20-ft (6-m) aluminum boat, and recorded avoidance behavior, these results were not used as the basis for assessing impacts on sea turtles.

4.2.4 Alternative 4 – Recommended Shipping Routes

4.2.4.1 Other Marine Mammals

On balance, the potential positive and negative effects of the recommended routes under Alternative 4 would result in minimal impacts on other marine mammals. Other marine mammal species would be affected only to the extent that their habitat co-occurs with right whales in or around the established shipping routes. Recommended routes redistribute ship traffic to decrease the overlap between vessels and high right whale densities. However, because these measures are specifically designed to reduce the risk to right whales, benefits would be less likely for other species.

Humpback and fin whales occur seasonally within and north of Cape Cod Bay (NCCOS, 2006), and sei whales have occasionally been sighted in Cape Cod Bay (which likely corresponds with years of copepod abundance). Although the recommended routes are in place year-round, it is assumed that this protection would be maximized during the months when right whales are present (January 1 to May 15), as use of the routes is expected to be greatest when NOAA publicizes the presence of whales in Cape Cod Bay. In general, the recommended routes reduce the area in which vessels travel, thus reducing the risk of ship strikes in waters outside of the shipping lanes. Therefore, impacts on humpback, fin, and sei whales would be positive.

However, by the same logic, if a particular species aggregates within a shipping lane, the risk of ship strike within the lane may actually increase. Humpback and fin whales generally occur in the northern and eastern areas of Cape Cod Bay from January 1 to May 15, which overlaps with the Boston/Provincetown segment of the routes (Jaquet *et al*., 2005). However, Provincetown is not a busy commercial port – in 2004, there were 36 vessel arrivals in Provincetown, and only 11 of these arrivals occurred from January 1 through May 15, when use of the routes is expected to be greatest. Moreover, the majority of these vessels are relatively slow-moving tankers – their typical travel speeds are between 13 and 15 knots – so if they were involved in a ship strike, the severity would be less than with a relatively faster vessel. Therefore, the probability of net positive effects for whales outside the routes or net negative effects inside the routes is relatively low, and Alternative 4 is not expected to significantly affect other marine mammal populations as a whole.

Blue and sperm whales generally occur offshore, and are therefore unlikely to be affected by Alternative 4. The recommended routes in the SEUS would not affect humpback, fin, or sei whales, because they either do not occur in inshore waters in this region or their range does not extend this far south. Manatees would not benefit from the recommended shipping routes in the SEUS under Alternative 4, primarily because they occur inshore and are rarely sighted in northern Florida or Georgia in winter, when use of the shipping lanes is expected to be greater than in those months when right whales are not present.

4.2.4.2 Sea Turtles

Implementation of the recommended shipping routes included in Alternative 4 would have minimal effects on sea turtles that also occur in these areas. Of the sea turtles mentioned in Section 3.2.2, loggerheads, leatherbacks, Kemp's ridleys, and green turtles have been sighted in Cape Cod Bay, and the hawksbill would not be affected (C. Upite, e-mail communication, January 29, 2007). Typically, sea turtles inhabit Massachusetts waters from June to November, and although the recommend routes are in place year-round, this period does not overlap with the presence of right whales in Cape Cod Bay from January to May, when use of the routes is expected to be greatest. Thus, it is unlikely that these four species of sea turtles would be affected at all. However, they are occasionally sighted in January, at which time the shipping lanes in Cape Cod Bay would potentially benefit those present in the area but outside these lanes and, conversely, adversely affect individuals transiting waters inside the lanes. Therefore, the positive and negative impacts are likely to balance out, so that the measures in Alternative 4 are not expected to significantly affect sea turtles. The same logic applies for sea turtles in the SEUS. Alternative 4 would not affect sea turtles in waters of the MAUS, because there are no measures proposed there.

4.2.5 Alternative 5 – Combination of Alternatives

4.2.5.1 Other Marine Mammals

Implementation of the measures in Alternative 5 would have major, indirect, long-term, positive effects on marine mammal species other than right whales because they involve broad spatial and temporal vessel-speed restrictions that could potentially reduce the risk of vessel collisions with other marine mammals to the extent that their habitat overlaps with right whale habitat and/or restricted areas. As mentioned above, humpback, fin, and sei whales, and, to a lesser extent, sperm whales would benefit from the combination of measures in each alternative. Blue whales and manatees would not be affected by the measures in Alternative 5.

4.2.5.2 Sea Turtles

The combined measures described in Alternative 5 have the potential to have indirect, long-term, positive effects on sea turtles. Except for Alternative 1, the remaining Alternatives – 2, 3, and 4 – would have a modest positive impact on sea turtles, as each alternative includes one ship strike reduction measure. Therefore, the combination of these measures under Alternative 5 would potentially benefit endangered sea turtle species that have similar ranges as right whales. This is based on the assumption that sea turtles are less likely to be killed by a ship strike at lower vessel speeds, or have more time to avoid an oncoming vessel.

4.2.6 Alternative 6 – Proposed Action (Preferred Alternative)

4.2.6.1 Other Marine Mammals

Alternative 6, the proposed action, would have indirect, positive effects on other marine mammals during the five-year period when the measures would be in effect because it includes the following protection measures: SMAs, DMAs, and routing measures. Endangered fin and humpback whales would benefit the most from the implementation of the vessel operational measures because available records indicate that these are among the most commonly struck large whale species that occur in the western North Atlantic and because their ranges overlap with those of right whales. Sei whales would also benefit from the measures in the NEUS. Sperm whales would potentially benefit from speed restrictions in the MAUS; blue whales would not be affected.

Surveys from the Cetacean and Sea Turtle Assessment Program (1978-1985) and Manomet Center for Conservation Sciences (1980-1987), found fin whale presence in relatively high numbers north and east of Cape Cod and Great South Channel in spring and summer (Mahaffey, 2006). Therefore, the Off Race Point and Great South Channel SMAs in Alternative 6 would offer seasonal protection to fin whales. However, fin whales occurring off the coasts of Portsmouth and Portland in summer and fall would not be affected by Alternative 6. Humpback whales have also been seen in relatively high numbers near the Boston TSS in the Off Race Point and Great South Channel SMAs in all seasons except winter (Mahaffey, 2006). Thus, humpback whales would benefit from these SMAs from April through July, but would remain at risk from August through December, and around Stellwagen Bank and points north (Mahaffey, 2006). The recommended routes in Cape Cod Bay are not expected to significantly affect either species (Section 4.2.4.1).

As mentioned in Section 4.2.3.1 (Alternative 3), humpback, fin, and sperm whales would potentially benefit from seasonal speed restrictions in the 20-nm (37-km)-wide SMAs in the MAUS, although fin and sperm whales generally occur in deeper, offshore waters than do right whales.

Similar to Alternative 3, humpback whales may benefit from speed restrictions in the SEUS, while fin and sei whales have rarely, if ever, been sighted in waters slated for SMAs in the SEUS. The recommended routes are not expected to affect humpback whales because coastal Georgia and Florida are not typically-used habitat for the species. The northern reaches of Florida manatee habitat coincides with the SEUS region, although in winter, when speed restrictions are in place in this region, manatees are concentrated off the coast of south Florida.

4.2.6.2 Sea Turtles

As with Alternative 5, implementing the operational measures contained in Alternative 6 could potentially have indirect, positive effects on sea turtles during the five-year period when the measures would be in effect. The measures in Alternative 5 would result in a greater reduction in the risk of vessel collisions with sea turtles because speed restrictions are in place in larger areas and for longer time frames than would be provided under Alternative 6. However, the measures in Alternative 6 would provide some level of protection to sea turtles because it is likely that the factors reducing serious injuries and deaths of right whales would likely also benefit sea turtles.

4.3 Impacts on the Physical Environment

The following sections describe the impacts of the actions contained in each of the alternatives on bathymetry and substrate; water quality; air quality; and ocean noise. Assessment of the impacts on ocean noise is based on the assumption that engine noise levels generally decrease at reduced speeds. However, the relationship is not necessarily linear and is dependent on vessel class and engine type. Also, even if the total energy (or sound) emitted is lower at reduced speeds, the vessels are transiting a given space for a longer time, and more noise may be introduced into the ocean overall. However, measuring this would be difficult prior to establishing speed restrictions. Therefore, the impacts on ocean noise are reasonable expectations within the context of these assumptions.

4.3.1 Alternative 1 – No Action Alternative

4.3.1.1 Bathymetry and Substrate

The No Action Alternative would have no impact on ocean bathymetry and substrate. This alternative maintains NOAA's current mitigation measures and does not propose any new regulatory measures. The current measures – aerial surveys, MSRS, outreach and education – have no effect on ocean bathymetry and substrate.

4.3.1.2 Water Quality

Implementing the No Action Alternative would have no impact on existing water quality as described in Section 3.3.2. Alternative 1 does not propose any new regulatory measures that could affect water quality.

4.3.1.3 Air Quality

Implementing Alternative 1 would not alter the air quality parameters described in Section 3.3.3. Emissions from vessels would remain the same, with neither improvement nor degradation. Total vessel emissions are expected to increase over time with the predicted increases in commercial shipping. Under the No Action Alternative, the minor, positive improvements in air quality that would accrue from reductions in ship speed in specified areas (as under Alternatives 2, 3, 5 and 6) would not occur.

4.3.1.4 Ocean Noise

Alternative 1 would have no impact on ocean noise because none of the nonregulatory ship strike mitigation measures included in this alternative would result in increases in introduced ocean noise levels relative to the status quo. Furthermore, most future research techniques or technological aids to prevent ship strikes are unlikely to generate significant negative environmental impacts on ocean noise levels. However, if steps are taken to use active sonar or otherwise introduce new noise sources to detect or deter right whales, then the requisite NMFS permitting process would be adhered to, which would address any environmental impacts at that time.

4.3.2 Alternative 2 – Mandatory Dynamic Management Areas

4.3.2.1 Bathymetry and Substrate

None of the measures proposed in Alternative 2 would have an impact on bathymetry and substrate because right whale protection measures all occur at the ocean surface. DMAs are temporary restrictions triggered when a certain concentration of right whales is sighted. Vessels would either route around these areas or transit at reduced speed through the DMA. There are no physical restrictions associated with DMAs, and the restricted area only occurs on the water surface.

4.3.2.2 Water Quality

Implementing right whale conservation measures identified in Alternative 2 would have negligible impacts on ocean water quality levels. Implementing a DMA would result in vessels changing course to navigate around the identified protection area or reducing speed through the area. Most right whales occur within 20 to 30 nm (37 to 56 km) of the coast (Knowlton *et al*., 2002). Therefore, most DMAs would be implemented within US territorial waters where Federal regulations prohibit vessels from dumping untreated sewage, and state regulations may restrict vessels from dumping gray water. Both types of waste could reduce local water quality (as described in Section 3.3.2.3 and summarized in Table 3-5; US territorial seas extend to 12 nm [22 km] and the contiguous zone to 24 nm [44 km] from the coastline). Given that vessels would be in the same general area with or without the DMA; that DMAs are relatively small in area (15 nm [28 km]); that effective periods are temporary (15 days); and that changes in vessel operations and/or routes are minimal, it can be concluded that implementing DMAs will have little or no impact on water quality.

While creation of a DMA might result in vessels leaving US territorial seas to route around a DMA, the presence of the DMA would not increase the likelihood that the vessel captain would dump waste into the ocean. Unless traveling along the coast within territorial waters, the vessel navigating around a DMA would be steaming outbound from ports where the captain could have disposed of wastes or inbound from zones where the captain would have been able to dump wastes in accordance with US and MARPOL regulations.

There is a slight chance that vessels traveling along the coast within territorial waters might elect to dispose waste beyond territorial waters and the contiguous zone (24 nm [44 km]) if a DMA extended outside the limits. Beyond 24 nm (44 km), ships can discharge black water (sewage) and gray water (non-sewage wastewater). Discharging large quantities of untreated sewage in estuarine or shallow coastal waters might cause eutrophication, or an influx of high levels of nutrients that can lead to excessive plant growth, which depletes oxygen in the water. However, a small quantity of discharge offshore in the open ocean would have minimal effects on nutrient levels in the surrounding waters. Changes in water quality due to wastewater discharge would be limited to the immediate area of discharge, and effects would be short-term because the effluent would be diluted and dispersed (NPS, 2003).

There are several types of pollutants from marine engines that are released into the ocean. However, these pollutants would be widely dispersed in the ocean because the vessels are moving sources and water currents would transport and disperse the pollutants, thereby diluting the amount of pollutants in any given area. The effects of discharging oil are variable depending on the type, quantity and location of the spill, and can result in fatal or nonfatal long-term effects on animals and their habitat. Discharging bilge and ballast water that may include residual oil, lubricants, and fuel could potentially have a minor short-term effect on water quality, but discharge of these wastes is regulated (Section 3.3.2.3) (NPS, 2003).

Certain types of solid wastes may be disposed of outside of the 12-nm (22-km) territorial limit (Section 3.3.2.3), and should not have an adverse effect on water quality under this alternative, as there is a limited probability that implementing DMAs would result in an increase in the disposal of solid waste.

4.3.2.3 Air Quality

Implementing Alternative 2 would have minor, direct, short-term, positive impacts on air quality at sea. If a DMA is established, vessels would either transit around the area or reduce speed through the area. If the vessel reduces speed through the DMA, there would be a temporary reduction in smokestack emissions, or ship plume, emanating from the ships' engines. While slowing a ship's speed linearly increases the time of impact of a marine plume on a receptor and the emissions per mile, the amount of energy required to propel the ship through the water decreases as the cube of the speed (Section 3.3.3.3). Thus, the net effect of speed reductions would be to reduce the air emissions from each vessel affected as well as the total air emissions near the DMA precautionary area.

Another effect of reducing ship speed is that it increases the effective release height of the ship plume. This occurs because air movement around the stack tip is influenced by speed. The Briggs plume rise formula used by the EPA in its regulatory air quality models indicates that the final height of the emissions is dependent on the inverse wind speed under unstable air dispersion conditions and the inverse cube root of wind speed under stable air mass conditions (Briggs, 1972; Briggs, 1975). That is, the slower the ship moves, the higher the final effective release height of emissions. For ground-/sea-based receptors, this translates into lowered concentrations of smokestack emissions from ships operating at slower speeds.

An ongoing pollution prevention program in Los Angeles, California, demonstrates that slowing vessels down reduces the amount of certain pollutants emitted during vessels operations. The Port of Los Angeles and the Port's No Net Increase Task Force compiled a document that reviews initiatives and technologies to limit emissions from port-related activities. One of these measures is a voluntary speed reduction program (VSRP) that was implemented in 2001. A voluntary speed reduction (12 knots) within 20 nm (37 km) of the port is broadcast to captains calling at the Port of Los Angeles. Compliance in the first year was 48 percent, although this compliance represents any speed reduction from 22 knots (average speed without VSR), not necessarily a reduction to 12 knots. In 2005, approximately 70 percent of shipping lines calling at the ports were participating in the program (Port of Los Angeles, 2005).

With 100 percent compliance, the estimated reduction in nitrogen oxide (NO_x) emissions would be about 58 percent for the main engine, although the auxiliary engine emissions are estimated to increase (by approximately 7 percent). The reduction for particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}) would be 57 percent for the main engine, and an increase again for the auxiliary engine by 8 percent. Auxiliary engine emissions increase due to increased transit time because of slower speeds. In a press release dated August 17, 2005, the Port of Los Angeles announced that the VSRP decreased daily NO_x emissions by about 1 ton, or 100 tons during the first quarter of 2005. There are plans to increase the compliance zone from 20 to 40 nm (37 to 74 km) (Port of Los Angeles, 2005).

Vessels routing around a DMA rather than slowing to go through it may add distance to their route but would remain at their customary speeds. This may cause the vessels to remain in the area longer, emitting engine exhausts; however, DMAs are temporary and should not occur more than several times a year in a particular area. Therefore, if vessels route around the DMA, overall impacts on air quality over the affected parts of the ocean should be short term and minimal.

4.3.2.4 Ocean Noise

Implementing the measures contained in Alternative 2 would potentially have minor, direct, short-term, positive effects on ocean noise levels. Implementation of a DMA would either temporarily redistribute noise around the precautionary area or reduce the level of noise if vessels transit through the area at a reduced speed. Depending on the type of engine, lower speeds generally result in lower noise emissions. An EIS prepared by the National Park Service (NPS) on cruise ship quotas and operating requirements in Glacier Bay, Alaska, cited a study[6] that found that underwater noise levels were considerably less when vessel speed limits were 10 knots, rather than 20 knots (Naval Surface Warfare Center [NSWC], 2000 *in* NPS, 2003).

4.3.3 Alternative 3 – Speed Restrictions in Designated Areas

4.3.3.1 Bathymetry and Substrate

None of the measures proposed in Alternative 3 would have an impact on bathymetry and substrate since they all take place on the ocean's surface. Slowing vessels down would result in less impact to surface water (slower speeds reduce the wake and bow wave), but this change would not affect the ocean floor.

4.3.3.2 Water Quality

Implementing the speed restrictions proposed in Alternative 3 would have negligible impacts on ocean water quality, as described in Section 4.3.2.2. Except for the seaward boundaries of the ALWTRP SAM East SMA (which covers the same area as the Great South Channel SMA), the MAUS continuous 25-nm SMA and the SMA in the SEUS region, most of the speed restrictions

[6] Kipple, B. 2002. *Glacier Bay Underwater Noise - Interim Report.* Naval Surface Warfare Center. Technical Report NSWCCD-71-TR-2002/579.

in Alternative 3 would be within the US territorial sea and the contiguous zone where discharges of wastes are regulated by international and domestic laws and policies, as described in Section 3.3.2.3. In addition, slowing vessels would not cause vessels to discharge greater volumes of effluent than they would at normal sea speeds. Vessels would be present in speed-restricted areas for a slightly longer time, and this might result in a slight increase in the number of times that wastes could be released in the speed-restricted areas. However, this slight increase is not expected to result in greater concentration of wastes in speed-restricted areas because it is expected that pollutants would disperse fairly rapidly, as ships are moving sources and pollutants would be dispersed by normal ocean processes such as currents, temperature gradients, and upwelling.

4.3.3.3 Air Quality

As described for Alternative 2 (Section 4.3.2.3), speed restrictions would have direct, short-term, positive impacts on air quality in the affected areas of the ocean. While speed restrictions would result in vessels transiting the proposed areas for a longer period, the overall impact still would lead to reductions in vessel emissions. This was demonstrated in the Glacier Bay EIS air quality analysis, where daily and annual emissions from speed-restricted vessels were measured relative to existing ambient air quality levels (NPS, 2003).

4.3.3.4 Ocean Noise

Implementing the operational measures and associated speed restrictions identified in Alternative 3 would potentially have direct, short- and long-term, positive impacts on the levels of ocean noise by reducing noise levels in the immediate areas when and where restrictions are proposed. As described in Section 4.3.2.4, most engines operate more quietly at lower-than-customary speeds. As a result, underwater noise levels would be reduced in the NEUS year-round, temporarily in the MAUS from October 1 to April 30, and in the SEUS from November 15 to April 15.

Although reduced speeds would increase the amount of time vessels are transiting in shipping lanes and other speed-restricted areas, the area of ocean affected by underwater noise would be smaller than if speed restrictions were not enacted. For example, a vessel traveling 10 to 14 knots is expected to generate sound over a smaller area than a vessel traveling 20 knots or faster because elevated noise energy radiates farther (NPS, 2003). Reduced speeds would directly benefit right whales (as well as other marine mammals) because quieter conditions would result in a reduced likelihood for disturbance and a reduction in the potential for masking. Masking (described in Section 3.1.6.2) can interfere with right whales' ability to communicate, which in turn could adversely affect various types of social behavior.

4.3.4 Alternative 4 – Recommended Shipping Routes

4.3.4.1 Bathymetry and Substrate

Implementing Alternative 4 would have no effect on bathymetry and substrate. Shifting the vessel traffic in Cape Cod Bay and the ports of Brunswick, Fernandina, and Jacksonville to several recommended shipping routes would only affect surface waters and would not alter the seafloor or substrate.

4.3.4.2 Water Quality

Implementing Alternative 4 would not have an impact on water quality in the NEUS, although the shipping routes outside of the 12-nm (22-km) territorial seas and the 24-nm (44-km) contiguous zone for the ports of Jacksonville, Fernandina, and Brunswick could potentially have minor adverse impacts on water quality in the SEUS. While this alternative would not cause any net increase in the discharge of pollutants, the vessels and their discharges would be more concentrated in the shipping routes in the NEUS and SEUS. Overall water quality in the port approach areas would not change but pollutants could be slightly more concentrated in the recommended shipping routes.

With respect to the proposed action, the main concern associated with an increase in water pollution is that it could affect right whale food sources and lead to increased levels of contaminants such as metals and toxic substances collecting in right whale tissues. (This would only be an issue in the NEUS, as right whales do not feed in the SEUS.) Increased levels of contaminants can have a direct effect on cetacean physiological systems, including reproduction, immune defense, endocrine functions, and possibly neural functions that control social and migratory behavior (NMFS, 2005a), although no study has indicated contaminant levels are sufficiently high to compromise these systems in right whales. Indirect effects could include the presence of pollutants in right whale prey. However, the recommended shipping routes are designed to avoid areas with high densities of right whales, and include the areas where their prey is most likely to occur and to attract the whales. Therefore, the slight potential increase in the concentration of pollutants in the recommended shipping routes is not expected to adversely affect right whale food sources or to lead to the bioaccumulation of pollutants in the right whales themselves. Any changes to water quality due to wastewater discharges would be limited to the area of discharge and would be short-term in nature because of the likely rapid dilution and dispersion.

Recommended shipping routes would not increase the risk of vessel-to-vessel collisions or accidental oil spills because the proposed lanes would be wide enough to allow vessels to avoid one another. This conclusion is supported by USCG analysis of the lanes for navigational safety in its PARS.

NEUS

Existing vessel traffic patterns in Cape Cod Bay would be altered[7] as a result of the recommended shipping routes. However, the recommended routes are within the territorial sea (12 nm [22 km]) where Federal law regulates the discharge of sewage and other waste into the ocean (see Section 3.3.2.3). Therefore, the discharge of untreated wastes in the recommended routes in Cape Cod Bay is prohibited, and there would be no adverse effects on water quality in the NEUS region.

SEUS

Implementing the measures proposed in Alternative 4 could potentially have minimal, direct, short-term, adverse effects on water quality in the approaches to the ports of Brunswick, Fernandina, and Jacksonville. There is potential for a temporary increase in the concentration of

[7] Northbound traffic enroute to Boston, the Gulf of Maine or Canada would be shifted west, along with southbound traffic traveling to the Cape Cod Canal (Russell *et al*., 2005), although traffic enroute to Provincetown from the Cape Cod Canal and vice versa closely follows current vessel traffic.

pollution in portions of the recommended routes seaward of waters with pollution restrictions, (beyond the 12-nm [22-km] and 24-nm [44-km] limits) where pollution regulations are less stringent than in waters inshore of these limits. This would result from higher vessel traffic in the lanes during the right whale calving season. Although the shipping lanes would concentrate vessel traffic, it is unlikely that mariners would intentionally release waste in the lanes instead of in other places and at other times during their voyage. As with recommended routes in Cape Cod Bay, the routes in the SEUS are designed to avoid areas of high right whale density, so that any potential increase in pollution or decrease in water quality would be outside important right whale aggregation areas.

4.3.4.3 Air Quality

Implementing the measures proposed in Alternative 4 would not have a significant impact on air quality. If recommended shipping routes are heavily utilized, then local air pollution may be concentrated at sea in these shipping lanes instead of dispersed throughout various routes. However, vessels are moving sources, and any emissions would be dispersed along with the forward motion of the vessel and other factors (see Section 3.3.3.3) would influence the transport and dispersion of emissions.

Any increase in emission concentrations resulting from nearby ships would last only a few minutes until either the ship or the plume centerline moves away. The magnitude of the transient emissions is directly dependent on the distance from the ship. For average concentrations from ship emissions to increase, the shipping density would have to increase significantly in a sustained manner to the point where there would be a large aggregation of ships in the immediate area. Because vessels would be traveling in shipping lanes, the rules of navigation would prevent vessels from traveling or passing too close to one another. Therefore, there should not be a significant change in air quality resulting from shipping lanes. Air quality in the ports would remain the same because the speed restrictions are only required seaward of the COLREGS line. There are more air quality issues in port areas, where vessels are stationary and there is additional machinery that can pollute the air.

4.3.4.4 Ocean Noise

Implementing the measures proposed in Alternative 4 would potentially have minimal, direct, short-term, adverse effects on ambient ocean noise levels in the recommended shipping routes, but would have minor, positive, short-term, direct effects on ocean noise levels outside the shipping routes where the vessels now transit in a more dispersed pattern. While the measures identified in this alternative would not alter the overall amount of underwater noise, vessels would be channeled into certain routes, which would redistribute (i.e., increase) vessel noise into those routes. Conversely, this alternative would decrease vessel noise levels outside the routes, where the whales are present. Therefore, this alternative would benefit right whales, because relatively high right whale densities occur outside the recommended routes, where vessel noise levels would be diminished as a result of use of the routes. A decrease in ambient noise would lessen the effects of potential disturbance and of the masking of right whale communication.

4.3.5 Alternative 5 – Combination of Alternatives

4.3.5.1 Bathymetry and Substrate

Alternative 5, which combines the measures from Alternatives 1, 2, 3, and 4, would not have an impact on bathymetry and substrate. The combination of current mitigation measures, DMAs, speed restrictions, and recommended shipping routes would not affect the seafloor because all actions occur at the ocean surface.

4.3.5.2 Water Quality

The measures in Alternative 5 would have negligible to minor adverse impacts on water quality. Implementing the combination of alternatives that comprise Alternative 5 would have similar effects on water quality to those described for Alternatives 2, 3, and 4. Water quality impacts would be negligible, with the exception of the proposed segments of shipping lanes in Brunswick, Fernandina, and Jacksonville that are seaward of 12 nm (22 km) and have the potential to concentrate vessel pollution instead of the pollutants' being distributed throughout various routes. This could have minor, adverse, short-term, direct effects on water quality in portions of the lanes that are located outside of waters with pollution regulations during the season when speed restrictions are proposed (see Section 3.3.2.3 for a description of the regulations).

While there may be an increase in the concentration of pollutants in portions of the shipping lanes, the number of vessels transiting the area would not change as a result of the operational measures in Alternative 5, and therefore there would be no net increase in pollutants – only the distribution of pollutants would change. As previously described, shifting vessel traffic away from areas with relatively-high right whale densities would have a positive impact on right whales by shifting the marine pollutants away from the whales and their habitat. Section 4.3.4.2 describes the impacts on animals resulting from decreased water quality.

Existing regulations, DMAs, and speed restrictions would have a negligible impact on water quality for the reasons discussed with regard to Alternatives 1, 2, and 3. The recommended shipping routes in Cape Cod Bay are within the 12-nm (22-km) territorial sea, and therefore impacts on water quality in this area would be negligible.

4.3.5.3 Air Quality

Implementing Alternative 5 would have minor, direct, long-term, positive effects on air quality. Alternatives 2 and 3 have the potential to actually reduce vessel emissions by slowing vessels, which would improve air quality. Alternative 4 would have neutral effects on air quality because even though emissions would be concentrated in the shipping lanes instead of being dispersed throughout various approaches to the ports, there would be no change in the actual amount of emissions. Therefore, there is a potential for minor positive effects on air quality. Furthermore, because Alternative 5 involves speed restrictions within the SEUS, and because research shows that lowering vessel speed can reduce emissions from certain vessel types, the reduced emissions at lower speeds may counter the increase in concentration of emissions in the recommended routes (Section 4.3.2.3).

4.3.5.4 Ocean Noise

On balance, implementing measures contained in Alternative 5 would potentially have minimal, direct, long-term, slightly positive effects on ocean noise levels. The DMAs proposed under Alternative 2 would have no impact or a slight positive impact on noise levels. Speed restrictions in Alternative 3 would have a positive effect by reducing noise levels, potentially canceling out the minor adverse effect of recommended routes in the SEUS (Alternative 4). Any changes in ocean noise levels resulting from implementing Alternative 5 would be minor.

4.3.6 Alternative 6 – Proposed Action (Preferred Alternative)

4.3.6.1 Bathymetry and Substrate

Measures proposed under Alternative 6 include voluntary DMAs, SMAS in the NEUS, MAUS, and SEUS regions, and recommended shipping routes in the NEUS and SEUS regions. Implementing these measures would not affect bathymetry and substrate in the areas affected because all of the operational measures occur at the ocean surface.

4.3.6.2 Water Quality

Implementing Alternative 6 measures would have negligible effects on water quality, with the exception of the proposed segments of shipping lanes in Brunswick, Fernandina, and Jacksonville that are seaward of 12 nm (22 km) and have the potential to concentrate vessel pollution instead of the pollutants' being distributed throughout various routes. This could have minor, direct, short-term, adverse effects on water quality in portions of the lanes that are located outside of waters with pollution regulations during the season when speed restrictions are proposed (see Section 3.3.2.3 for a description of the regulations).

While there may be an increase in the concentration of pollutants in portions of the recommended routes, the number of vessels transiting the area is not changing, therefore there would be no net increase in pollutants – it is only the distribution of pollutants that would change. As previously described, shifting vessel traffic away from important right whale aggregation areas would have a positive impact on right whales by shifting the marine pollutants away from whales and their habitat. Section 4.3.4.2 describes the impacts decreased water quality has on animals.

Existing regulations, DMAs, and speed restrictions would not have a measurable impact on water quality for the reasons discussed above for Alternatives 1, 2, and 3. The recommended shipping routes in Cape Cod Bay are within the 12-nm (22-km) territorial sea, and therefore no impacts on water quality are foreseen in this area.

4.3.6.3 Air Quality

The speed restrictions proposed under Alternative 6 would have minor, direct positive impacts on air quality in the vicinity of the proposed SMAs, DMAs, critical habitat, and recommended routes by reducing vessel air emissions for the duration of the measures. Research shows that slowing vessels can reduce emissions from certain vessel types and that the reduced emissions at slower speeds might counter the increase in concentration of emissions in the shipping lanes (Section 4.3.2.3).

There may be localized effects on air quality in some locations if vessels divert to alternate ports, depending on what mode of secondary transportation is needed to transfer cargo to its destination. However, as discussed in Section 4.4.3, only a small percentage of vessels are estimated to divert to other ports. Vessel operators can minimize potential adverse effects on air quality with engine modifications.

4.3.6.4 Ocean Noise

Implementing Alternative 6 measures would potentially lower noise levels in areas where ship speeds would be reduced, resulting in minor, direct positive impacts on ocean noise levels in the affected areas for the duration of the proposed measures. The speed restrictions proposed in the 20 nm (37 km) continuous SMA and the 20-nm- (37-km)-radius half circles around ports in the MAUS, and the 30 nm (56 km) SMA off Block Island Sound would have a direct positive effect on ocean noise. Vessels would slow to 10, 12, or 14 knots in these areas, effectively reducing the amount of introduced noise. Because SMAs would not concentrate ships into lanes, ship noise would remain widely distributed but lower in volume. Although reduced speeds would increase the amount of transit time in SMAs, the magnitude of underwater noise at any one point would be less than that associated with customary speeds.

As described in Section 4.3.2.4, DMAs would not adversely affect introduced vessel noise. Vessels 65 ft (19.8 m) and longer would reduce speed through the Great South Channel management area and critical habitat, which would reduce levels of ocean noise in these particular areas.

Alternative 6 would result in vessel noise being redistributed in the areas that have recommended routes for shipping traffic: Cape Cod Bay off Massachusetts, Jacksonville and Fernandina in Florida, and Brunswick, Georgia. Vessel noise would be concentrated in shipping lanes. However, because Alternative 6 proposes speed restrictions in the lanes located within SMAs, the overall level of noise would be reduced because engines operating at less-than-customary speeds will introduce less underwater noise. Alternative 6 would also reduce noise levels in areas outside shipping lanes where the vessels previously transited. Furthermore, noise would be substantially reduced in areas outside the shipping lanes, where right whale density is higher.

4.4 Impacts on the Socioeconomic Environment

This section describes the potential impacts to the maritime community from establishing the operational measures proposed under the various alternatives, including impacts to port areas and vessel operations. The analysis uses 2003 and 2004 vessel arrival data[8] and reflects the annual costs associated with the proposed measure as if they had been in place in 2003 and 2004.

[8] Vessel arrival data for 2005 through 2007 became available only after most of the work on the economic analysis had been completed. However, vessel arrival data for 2003 and 2004 continue to provide a suitable basis for identifying economic impacts, because annual variations in the composition and volume of vessel traffic are relatively modest. For example, while new and larger vessels come into service each year, these new vessels would not significantly alter the average vessel operating costs used in this analysis by type and size of vessel. Also, any annual growth in overall traffic would affect all the alternatives analyzed and pale in significance when compared to the large differences among the alternatives analyzed.

However, for the purposes of the FEIS, operating costs have been updated using 2008 fuel prices. As a result, in absolute terms, the economic impacts of all alternatives are higher than they were in the DEIS: this is primarily a result of the significant increase in the cost of fuel, not of any changes in the proposed operational measures (see Section 3.4.1.4). The discussion is divided into the following sections:

Section 4.4.1 describes the economic impacts on the maritime shipping industry of the US East Coast. The analysis in this section focuses on vessels that have one port of call on the East Coast. Port areas and vessel operations are discussed concurrently because the impacts are shared by both the shipping companies and port facilities.

Section 4.4.2 describes the additional direct economic impacts associated with vessels that make two to three stops along the East Coast in one trip or are involved in coastwise shipping. Only Alternatives 3, 5, and 6 would have effect associated with these multi-port vessel strings; Alternatives 2 and 4 would not have such additional direct impacts.

Section 4.4.3 describes potential indirect impacts, including diversion of traffic to other ports, increased intermodal costs due to missed rail and truck connections, and impacts on local economies.

Sections 4.4.4 to 4.4.9 describe impacts on commercial fishing vessels, passenger vessels, whale-watching vessels, charter vessels, all sectors, and environmental justice communities, respectively.

As previously noted, the analysis considers three alternative speeds: 10, 12, and 14 knots. However, because 10 knots is NMFS' proposed restriction, all economic impacts reflect a 10-knot speed restriction unless otherwise stated. Generally, the total impacts at 12 and 14 knots are also provided in the discussion for each alternative and details of the direct impacts of alternate speeds on the shipping industry by port area and alternative are provided in Section 4.4.1.8. A summary of the direct and indirect impacts on all maritime sectors is provided in Section 4.4.8.

4.4.1 Direct Impacts on Port Areas and Vessel Operations

The following pages summarize the findings of the economic analysis conducted for this FEIS. The details of the analysis are found in a separate *Economic Impact Report*. Several important assumptions apply to the analysis and are introduced at the appropriate points in the discussion.

Some industry representatives have commented that increased fuel consumption for vessels having to go faster to make up for time lost due to the proposed measures should be factored into the analysis. However, the analysis, by assuming that vessels would not speed up to make up time, includes maximum estimates for the delays incurred and, therefore, provides an upper limit estimate for the impacts. If vessel captains adjust voyages to make up for the delay by speeding up, the estimated economic impacts would need to be revised to reduce or exclude the cost applied for the time delayed.

Another comment was that vessels may burn less fuel operating at slower speeds and that these savings may offset some of the costs of delays. However, for economic reasons, vessel operators already operate at close to the vessel's optimal fuel efficiency and any savings in fuel costs can be assumed to be minimal and negligible.

4.4.1.1 Alternative 1 – No Action Alternative

Under the No Action Alternative, the shipping industry would be unaffected beyond the measures already in place and would not incur any additional economic impacts. The MSRS would remain in place to inform mariners of the presence of whales and NMFS would continue to provide right whale sighting and avoidance information to the National Ocean Service (NOS), to update the *US Coast Pilots* annually. Hence, there is no direct economic impact associated with this alternative.

The No Action Alternative would have no impact on port operations in any of the three regions. The MSRS and local notice to mariners are the only existing actions that are port-related, but they have no economic or other impacts on port operations. Although reporting is mandatory, speed advisories are voluntary and announcements broadcasted via the local notice to mariners are used at the mariner's discretion.

4.4.1.2 Alternative 2 – Mandatory Dynamic Management Areas

Alternative 2 would have a direct, long-term negative economic impact on vessel operations, estimated at $25.0 million annually based on 2003 data and $27.6 million annually based on 2004 data. The criteria for triggering a DMA and the resulting precautionary area are described in Section 2.1.4. DMAs could be established at any time of the year and in any location depending on whale occurrence. Assumptions were made to estimate the number of days per year that DMAs would be effective in each port area based on the frequency, timing, and location of whale sightings. The following two paragraphs describe the studies on which these assumptions are based.

Russell *et al*. (2005) estimated the annual expected duration of DMAs in the Northeast region and the Block Island Sound portions of the MAUS.[9] However, in calculating the incidence of DMAs, this report assumed that seasonal speed restrictions in designated areas, including SMAs, would be in effect.[10] Hence, DMAs in the report are only those that would occur outside the SMAs. For the southern Gulf of Maine, the report estimated an average of 2.3 DMAs per year. The economic analysis for this FEIS rounded this estimate up to an expected incidence of three DMAs per year (45 effective days) outside of the assumed speed restriction periods. A review of DAMs implemented as a part of the ALWTRP confirms the Russell *et al.* (2005) analysis: from 2002 to 2006, no more than three DAMs were implemented outside the SMA speed-restriction periods.[11] It was also assumed for the analysis that DMAs would be implemented for 50 percent of the time that the report assumed the SMA speed restrictions for the Boston shipping lanes near Race Point to be in effect (April 1 to May 15), or an additional 23 days. (While it could have been assumed that DMAs would be implemented for 100 percent of the time that these speed restrictions would be in place, the location-specific nature of the DMAs means that some DMAs would not fall within normal shipping lanes, and so traffic would not be affected. A study of right whale sightings from 1978 to 2003 shows that many of the sightings after May are more

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[9] This reference is based on the May 2005 revised report, although there are also references to the original report (Russell *et al*., 2003).

[10] The report assumed the following seasonal speed-restricted periods: Great South Channel, April 1 to July 31; Cape Cod Bay critical habitat, January 1 to April 30; portion of Boston shipping lanes near Race Point, April 1 to May 15; offshore approaches to Block Island Sound, September and October and February to April; approaches to the ports of NY/NJ, September and October and February to April.

[11] http://www.nero.noaa.gov/whaletrp/plan/dam/index.html

centrally located within the Great South Channel critical habitat and would be west of current traffic patterns [Merrick, 2005b]). Thus, the economic impact analysis assumes 68 effective days per year for DMAs in the Northeast region, excluding Cape Cod Bay.

For Cape Cod Bay, the Russell *et al*. (2005) report predicts an average of 0.8 DMAs per year outside the period January 1 to April 30, the period when the report assumes an SMA to be in effect. This number has been rounded up to one per year (15 days). It was also assumed that DMAs would be implemented during the report's SMA period January 1 to April 30, for 75 percent of the time, or an additional 90 days. Therefore, a total of 105 effective DMA days have been assumed for Cape Cod Bay.

For the MAUS, a report by Knowlton *et al*. (2002) provided information on the spatial and temporal distribution of right whale sightings. Data from 1970 through 2002 were used for that study. With the exception of Savannah, all port areas showed an average of less than one right whale sighting per year. For the economic impact analysis, this was rounded up to one DMA period per year (15 days) for each port in the mid-Atlantic region except for Savannah. For Savannah, 75 days per year are assumed, as described below.

For the SEUS (here including Savannah), a recent NMFS internal draft report identified the incidence of DMAs in shipping lanes. The report uses data on right whale sightings from 1992 to 2001. The observed concentration of right whale sightings is consistent with proposed seasonal speed restrictions from November 15 to April 15. However, as previously discussed for the NEUS, not all DMAs would affect vessels traveling in shipping lanes into Southeast ports. Therefore, for the SEUS and Savannah, it has been assumed that DMAs would be implemented for 50 percent of the November 15-April 15 period, or 75 days per year.

These assumptions are summarized in Table 4-1.

Table 4-1
Effective DMA Days by Port Area

Port Area	Effective DMA Days
NEUS (excepting Cape Cod Bay)	68
NEUS Cape Cod Bay	105
MAUS (excepting Savannah, GA)	15
SEUS and Savannah, GA	75
Source: Nathan and Associates	

Direct Economic Impacts of Alternative 2

In all regions, mariners would be required to either proceed through a DMA at a restricted speed or route around the DMA. The direct impact of a DMA on vessel operations is the increased time required to transit through the DMA at the restricted speed.

Because NMFS would draw a square around each circular DMA buffer zone (in order to issue coordinates of the corners to mariners), the position of the DMA relative to the vessel routing would affect the effective distance to be traveled through the DMA. For example, a vessel that would route diagonally through the DMA square would have to traverse 56 nm (104 km) at the restricted speed; one crossing the square at mid-point on each side would travel 39.6 nm (73.3 km). In other cases, a vessel's route would require traversing a much smaller portion of a DMA square. For the purposes of the economic analysis, it was assumed that vessels would have to traverse an average of 39.6 nm (73.3 km) for each DMA, which reflects the diameter of a DMA for the base case scenario for a group of three whales. [12]

For a vessel typically traveling at an operating speed of 14 knots, it would be possible to cover the 39.6 nm (73.3 km) of a DMA in 170 minutes, a little under three hours. With a speed restriction of 10 knots, covering the distance would take 238 minutes, ,or nearly four hours, 68 minutes more than at 14 knots. In addition, vessels would need time to slow to the restricted speed prior to entering the DMA and time to speed up after leaving the DMA. A vessel normally traveling at an operating speed of 14 knots would take 18 minutes to slow down to 10 knots and speed up again to 14 knots, for a total delay of 86 minutes.

For the economic impact analysis, it has been assumed that most vessels would opt to proceed through a DMA with a speed restriction of 10 knots rather than to route around the DMA. A vessel normally traveling at an average speed of 14 knots would incur a delay of 170 minutes to travel the extra 39.6 nm (73.3 km) around the two sides of the square that circumscribes a DMA,[13] as compared to the 86-minute delay to go through the 39.6 nm (73.3 km) of the DMA at the restricted speed. (With a 10-knot speed restriction, vessels with an average operating speed in excess of 18 knots could benefit from routing around the DMA. Routing around the DMA would take an additional 132 minutes (39.6 nm divided by 18 knots), whereas going through the DMA at 10 knots would take an additional 106 minutes [238 minutes, versus the normal 132 minutes] plus 26 minutes for slowdown and speedup, for a total delay of 132 minutes, the same as routing around.)

Data Chart 4-1 presents the direct annual economic impact of Alternative 2 on the shipping industry with a 10-knot speed restriction based on 2003 conditions, using the estimated effective DMA days shown in Table 4-1. The total direct economic impact is estimated at $25.0 million annually, with the port area of Savannah being the most affected, at $6.9 million. Port Canaveral is second, at $3.9 million, followed by the port areas of New York/New Jersey and Jacksonville at $2.9 million. The direct economic impact for these four port areas totals $16.5 million annually, or 65.8 percent of the total for this alternative. In the NEUS, the port area of Boston has the greatest direct economic impact, estimated at $0.8 million in 2003. The port area of Portland has the second highest impact in the NEUS, estimated at $0.7 million.

Overall, under Alternative 2, containerships account for 47.0 percent of the total direct economic impact, with an estimate of $11.8 million annually. The vessel type with the next-largest economic impact is passenger vessels, at $5.1 million, followed by ro-ro (roll-on-roll-off) cargo ships, at $2.8 million. The port area of Port Canaveral accounts for 69.2 percent of the economic impact incurred by passenger vessels, at $3.5 million.

Data Chart 4-2 presents the direct annual economic impact of Alternative 2 at a 10-knot speed restriction based on 2004 conditions.

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[12] The 39.6 nm (73.3 km) distance is based on a core area with a radius of 4.8 nm (8.9 km), for a group of three whales, plus the buffer with a radius of 15 nm (27.8 km), for a total radius of 19.8 nm (36.7).

[13] While the two sides of a square that circumscribe a DMA are each 39.6 nm (73.3 km), the extra distance is only equal to one side of the square because if the vessel is in the area of a DMA, then it was already planning on sailing the 39.6 nm (73.3 km) through the DMA at regular speed.

Data Chart 4-1
Alternative 2: Direct Economic Impact on the Shipping Industry by Port Area and Type of Vessel, 2003 ($000s)

Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	7.7	-	13.4	-	30.4	-	-	-	-	-	-	-	51.6
Searsport, ME	6.0	0.8	-	-	-	371.8	-	0.5	16.0	71.4	0.8	-	467.4
Portland, ME	35.9	15.2	19.3	0.9	39.5	119.5	-	38.2	4.0	400.2	4.5	0.5	677.7
Portsmouth, NH	37.6	2.0	-	-	15.0	3.6	-	-	1.4	97.6	0.4	0.5	158.1
Northeastern US - Off Race Point													
Boston, MA	18.4	0.6	229.5	0.7	6.1	336.4	7.9	22.7	-	178.4	0.4	0.9	802.1
Salem, MA	4.8	-	-	-	-	3.6	-	-	-	1.0	-	-	9.3
Northeastern US - Cape Cod Bay	-	-	-	-	-	11.7	-	-	-	4.0	-	-	15.7
Mid-Atlantic Block Island Sound													
New Bedford, MA	8.7	-	0.1	-	3.1	-	4.8	-	0.5	1.8	-	-	18.9
Providence, RI	9.9	0.3	0.4	-	4.3	43.0	1.9	23.6	0.4	23.0	0.3	0.0	107.2
New London, CT	2.6	-	1.4	-	5.3	25.3	-	-	8.9	1.5	0.1	0.0	45.0
New Haven, CT	6.9	0.4	0.8	0.4	11.1	3.9	-	-	35.8	35.3	1.3	0.1	96.0
Bridgeport, CT	4.8	-	0.0	0.2	0.0	3.2	6.2	-	26.1	7.7	-	-	48.4
Long Island, NY	-	0.4	-	0.1	-	25.3	-	-	77.3	40.6	0.3	0.1	144.1
Mid-Atlantic Ports of New York/New Jersey	48.1	7.8	1,826.0	0.1	15.3	311.9	20.3	314.3	4.0	312.4	1.8	0.4	2,862.5
Mid-Atlantic Delaware Bay	37.4	3.8	200.7	2.8	37.9	29.8	261.1	45.0	1.9	210.3	1.5	0.1	832.3
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	43.9	1.5	235.1	-	59.8	51.3	3.0	274.2	0.9	38.0	1.4	1.7	710.8
Hampton Roads, VA	46.3	6.2	1,340.4	0.1	34.8	38.8	0.6	113.2	0.3	42.4	0.5	0.9	1,624.4
Mid-Atlantic Morehead City and Beaufort, NC	3.5	-	7.1	-	7.8	-	0.7	0.6	-	7.5	-	0.1	27.2
Mid-Atlantic Wilmington, NC	12.2	1.1	64.5	-	44.6	-	0.4	14.7	2.7	46.7	0.1	0.1	187.2
Mid-Atlantic Georgetown, SC	5.1	-	0.4	-	9.9	-	-	-	-	-	-	0.1	15.5
Mid-Atlantic Charleston, SC	20.3	0.3	1,180.9	-	39.8	47.3	3.2	89.6	2.4	41.4	1.3	0.3	1,426.8
Mid-Atlantic Savannah, GA	157.1	10.6	5,482.0	-	359.3	29.5	99.7	398.5	3.0	309.7	2.7	0.7	6,852.9
Southeastern US													
Brunswick, GA	41.2	-	81.8	-	100.9	3.9	37.0	484.5	-	3.8	-	-	753.1
Fernandina, FL	6.2	-	82.6	0.5	115.5	7.9	104.7	6.0	-	1.5	4.5	-	329.4
Jacksonville, FL	113.5	3.0	949.9	159.2	221.6	61.9	30.7	898.9	7.6	290.3	123.2	2.1	2,861.9
Port Canaveral, FL	56.3	1.3	39.0	3.1	89.1	3,529.6	94.0	52.0	2.6	27.2	6.3	0.5	3,901.1
Total	734.4	55.4	11,755.4	168.1	1,251.0	5,059.2	676.2	2,776.7	196.1	2,193.5	151.5	8.9	25,026.5

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-2
Alternative 2: Direct Economic Impact on the Shipping Industry by Port Area and Type of Vessel, 2004 ($000s)

Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	10.6	-	13.5	-	63.2	-	-	-	-	-	-	-	87.3
Searsport, ME	4.1	-	10.9	0.9	1.6	424.6	-	1.0	7.8	66.3	3.3	-	520.4
Portland, ME	38.5	4.4	10.7	0.9	40.5	167.6	-	26.2	18.3	417.5	19.2	0.4	744.3
Portsmouth, NH	30.3	1.8	0.5	-	24.0	3.6	-	-	0.7	72.8	3.7	1.1	138.4
Northeastern US - Off Race Point													
Boston, MA	18.4	0.6	229.5	0.7	6.1	336.4	7.9	22.7	-	178.4	0.4	0.9	802.1
Salem, MA	6.0	-	-	-	-	29.4	-	-	-	-	-	-	35.4
Northeastern US - Cape Cod Bay	-	-	-	-	-	22.7	-	-	0.2	6.2	0.1	-	29.3
Mid-Atlantic Block Island Sound													
New Bedford, MA	8.2	-	-	-	2.8	1.6	3.5	0.2	-	1.6	-	-	17.9
Providence, RI	10.2	0.3	-	-	4.5	56.5	-	19.3	0.8	17.7	0.5	0.3	110.0
New London, CT	2.2	-	5.5	-	15.3	46.7	-	-	8.8	2.0	0.3	-	80.9
New Haven, CT	5.4	-	2.4	0.2	10.1	-	-	-	67.2	27.2	2.0	-	114.5
Bridgeport, CT	9.6	-	-	0.0	0.1	3.2	2.5	-	37.7	4.6	-	0.0	57.8
Long Island, NY	-	-	-	0.4	-	30.0	-	-	89.1	41.7	-	0.0	161.3
Mid-Atlantic Ports of New York/New Jersey	46.9	4.8	1,899.1	-	23.5	503.5	21.5	320.4	3.4	301.7	4.2	0.2	3,129.3
Mid-Atlantic Delaware Bay	44.3	1.5	193.2	4.0	56.7	38.8	243.3	45.4	0.5	226.8	4.9	0.2	859.6
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	56.4	1.1	261.7	-	63.1	94.0	5.4	281.0	0.8	58.4	1.2	0.7	823.9
Hampton Roads, VA	63.8	5.0	1,320.6	0.5	39.6	74.4	9.9	104.0	1.2	47.7	2.0	0.9	1,669.4
Mid-Atlantic Morehead City and Beaufort, NC	5.9	0.1	7.8	-	5.2	5.5	-	-	-	10.0	-	0.1	34.7
Mid-Atlantic Wilmington, NC	15.4	0.5	59.5	0.4	48.8	4.7	0.4	17.3	1.4	48.3	0.5	0.4	197.7
Mid-Atlantic Georgetown, SC	4.9	0.3	1.4	-	7.2	0.8	-	-	-	-	-	-	14.7
Mid-Atlantic Charleston, SC	19.5	0.4	1,241.1	0.8	52.1	62.8	3.7	83.8	1.9	40.6	3.5	0.4	1,510.3
Mid-Atlantic Savannah, GA	165.9	8.5	5,581.4	1.0	357.6	196.3	141.3	443.4	2.5	361.5	3.6	0.5	7,263.4
Southeastern US													
Brunswick, GA	45.8	-	29.2	-	109.3	31.6	33.5	481.1	-	0.9	-	0.9	732.1
Fernandina, FL	14.3	-	89.9	1.0	129.7	75.0	45.9	5.4	-	-	10.8	-	372.1
Jacksonville, FL	130.8	5.4	976.6	140.9	248.5	502.1	34.4	931.0	14.7	297.2	165.9	8.8	3,456.3
Port Canaveral, FL	76.3	-	43.9	8.0	122.1	4,125.3	79.1	71.3	12.8	46.4	29.7	0.9	4,615.7
Total	833.8	34.9	11,978.6	159.7	1,431.5	6,837.0	632.3	2,853.4	269.8	2,275.5	255.6	16.6	27,578.8

a/ Includes recreational vessels
b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.
Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

The total estimated economic impact would be about $27.6 million annually, roughly 10 percent higher than in 2003. This difference is due to the overall increase in US East Coast vessel arrivals of 7.3 percent in 2004, and particularly the 12.3 percent growth in vessel arrivals in the SEUS, which would be more affected by DMAs than the other regions. The rankings by port area and vessel type are the same as described for 2003 above, except that Jacksonville moved slightly ahead of New York/New Jersey. Figure 4-3 presents the impacts graphically.

At a 12-knot speed restriction, Alternative 2 would result in an economic impact of $17.7 million annually based on 2004 data. At a 14–knot speed restriction, the annual economic impact was estimated at $10.8million (2004 arrivals). See Data Chart 4-22 for the annual economic impact of 10, 12, and 14 knots by port area.

4.4.1.3 Alternative 3 – Speed Restrictions in Designated Areas

Implementing the speed restrictions specified in Alternative 3 would have a direct, long-term, adverse economic impact on vessel operations. Based on shipping industry activity in 2003 and 2004, with a 10-knot speed restriction, annual direct economic impacts would total an estimated $133.0 million and $142.5 million, respectively. The geographic areas and times at which speed restrictions would be implemented in each region are detailed in the description of Alternative 3 in Section 2.1. The effective proposed speed-restriction periods for each port area are depicted in Figure 4-4. In the NEUS region, restrictions would be effective year-round (365 days). Speed restrictions would be in place for 212 days per year in the MAUS, and 151 days per year for port areas in the SEUS.

As discussed in Chapter 3, the USCG Vessel Arrival database and ancillary data sets provide information on all vessel arrivals of 150 GRT or greater at US ports. Information in the database regarding the date of vessel arrival was used to determine the number of vessel arrivals in 2003 and 2004 that would have occurred during the proposed speed-restriction periods for each port area.

Data Chart 4-3 presents US East Coast arrivals of vessels for 2003 during the periods when speed restrictions would be in effect for each port area. In 2003 there were 14,935 vessel arrivals during such periods, approximately 58 percent of the total of 25,532 arrivals for 2003. While there is some seasonality in US East Coast vessel arrivals, the times at which speed restrictions would be effective include both peak and non-peak periods of vessel traffic; therefore, the percentage of restricted arrivals corresponds closely to the percentage of speed-restricted days per year.

The port area of New York/New Jersey had the greatest number of vessel arrivals during periods in which speed restrictions would be in place, with 3,103 arrivals in 2003, followed by the port areas of Hampton Roads (1,529 arrivals), Philadelphia (1,521 arrivals), Savannah (1,368 arrivals), Charleston (1,343 arrivals) and Baltimore (1,085 arrivals).[14] These six port areas accounted for 66.6 percent of the total US vessel arrivals during speed-restricted periods.

In terms of vessel type, containerships led in vessel arrivals during the proposed speed-restricted periods, with 4,937 arrivals in 2003. Tankers were the next most frequent, with 3,483 arrivals, followed by ro-ro cargo ships, with 1,713 arrivals, and bulk carriers, with 1,660 arrivals.

[14] In the tables in this chapter, the port area of Philadelphia, which includes Wilmington, Delaware, is included in the data presented for the port region of Mid-Atlantic Delaware Bay.

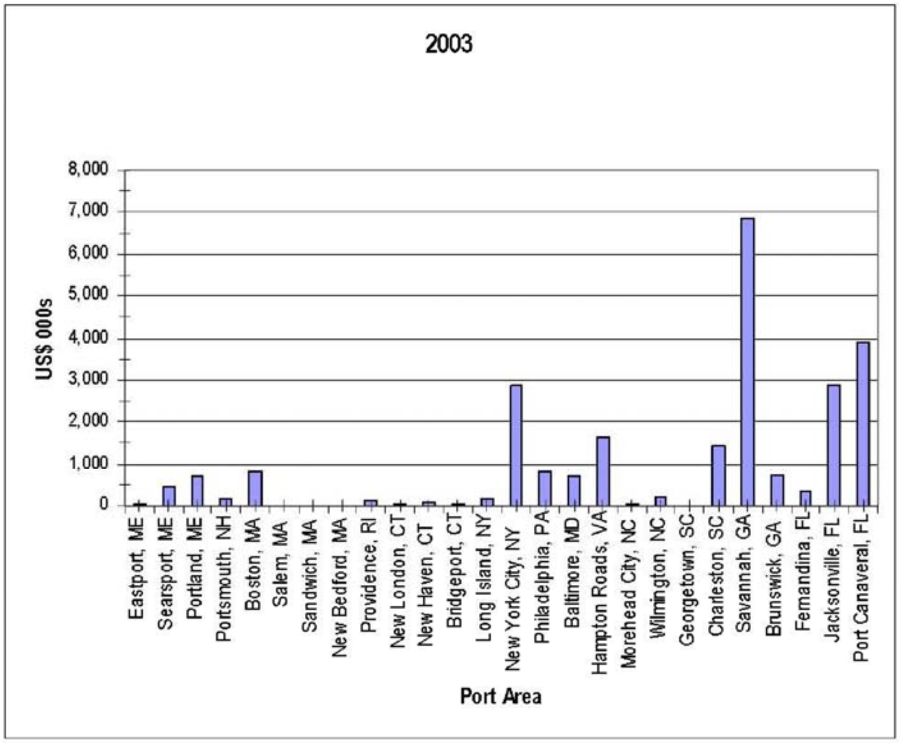
Data Chart 4-3
Alternative 3: US East Coast Restricted Vessel Arrivals by Port Area and Vessel Type, 2003

Port Area	Vessel Type												Total
	Bulk Carrier	Combination Carrier	Container Ship	Freight Barge	General Dry Cargo Ship	Passenger Ship	Refrigerated Cargo Ship	Ro-Ro Cargo Ship	Tank Barge	Tanker	Towing Vessel	Other a/	
Northeastern US - Gulf of Maine													
Eastport, ME	16	-	5	-	19	-	-	-	-	-	-	-	40
Searsport, ME	14	1	-	-	-	66	-	1	23	89	2	-	196
Portland, ME	66	14	9	1	38	19	-	58	6	396	11	2	620
Portsmouth, NH	63	3	-	-	10	1	-	-	2	117	1	2	199
Northeastern US - Off Race Point													
Salem, MA	7	-	-	-	-	1	-	-	-	1	-	-	9
Boston, MA	34	1	77	2	8	94	4	33	-	225	1	4	483
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	9	-	-	-	13	-	-	22
Mid-Atlantic Block Island Sound													
New Bedford, MA	36	-	1	-	16	-	5	-	4	7			69
Providence, RI	49	1		-	13	14	3	45	1	74	1	1	202
New London, CT	12	-	2	-	4	20	-	-	47	5	1	-	91
New Haven, CT	38	-	1	1	17	2	-	-	152	110	10	-	331
Bridgeport, CT	17	-	-	2	2	1	32	-	108	30	-	-	192
Long Island, NY	-	1	-	2	-	19	-	-	318	144	2	1	487
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	209	19	1,381	1	31	53	14	405	25	950	11	4	3,103
Mid-Atlantic Delaware Bay													
Philadelphia, PA	206	7	287	6	131	16	266	85	11	493	12	1	1,521
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	188	6	217	-	107	22	3	401	2	122	5	12	1,085
Hampton Roads, VA	193	14	1,006	1	76	14	1	92	1	122	2	7	1,529
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	15	-	9	-	20	-	1	2	-	22	-	2	71
Mid-Atlantic Wilmington, NC													
Wilmington, NC	66	4	54	-	76	-	1	12	13	142	1	-	369
Mid-Atlantic Georgetown, SC													
Georgetown, SC	26	-	1	-	6	-	-	-	-	-	-	1	34
Mid-Atlantic Charleston, SC													
Charleston, SC	100	-	873	-	58	28	3	136	13	118	12	2	1,343
Mid-Atlantic Savannah, GA													
Savannah, GA	166	7	769	-	137	4	5	94	4	177	3	2	1,368
Southeastern US													
Brunswick, GA	33	-	11	-	14	1	5	112	-	2	-	-	178
Fernandina, FL	4	-	43	1	42	1	13	-	-	-	7	-	111
Jacksonville, FL	62	1	185	80	102	8	2	222	7	114	117	5	905
Port Canaveral, FL	40	-	6	8	37	223	26	15	3	10	8	1	377
All Port Regions	**1,660**	**79**	**4,937**	**105**	**964**	**616**	**384**	**1,713**	**740**	**3,483**	**207**	**47**	**14,935**

a/ Other includes fishing vessels, industrial vessels, research vessels, school ships.

Source: Prepared by Nathan Associates based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports, 2003-2004.

Alternative 2: Direct Economic Impact on the
Shipping Industry by Port Area, 2003 and 2004 ($000s)



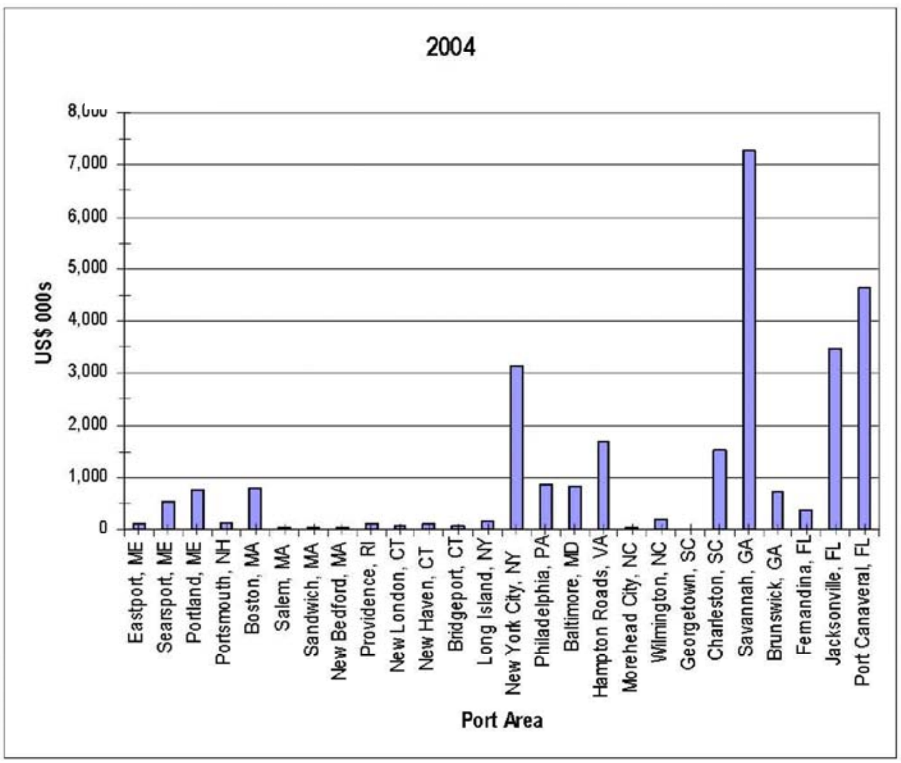


Figure 4-3

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Alternative 3: Proposed Speed Restrictions by Port Area

Source: NOAA

Figure 4-4

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In 2004, there were 15,815 vessel arrivals at US East Coast ports during the periods when speed restrictions are proposed for each port area, an increase of 5.9 percent over 2003 (Data Chart 4-4). The increase is less than the 7.3 percent for total US East Coast vessel arrivals in Chapter 3 (Section 3.4.1.4) for several reasons. First, the SEUS region, which recorded an increase of 12.3 percent in total vessel arrivals in 2004, is the region with the fewest speed-restricted days. Second, the port area of New York/New Jersey, with the largest number of annual vessel arrivals, recorded a growth of less than 0.4 percent in vessel arrivals during the proposed speed-restricted periods. Details on restricted-period US and foreign flag vessel arrivals by port area, vessel type, and vessel DWT size category are presented in Appendix E of the Economic Report.

Data Chart 4-5 presents the basis for determining the effective distance at which speed restrictions would apply for each port area. The locations of these areas are described in Section 2.2.3. The following paragraphs discuss the effective distance for the different port areas.

For port areas in the mid-Atlantic region, the speed restrictions would extend 25 nm (46 km) from the coast. However, independent researchers and stakeholders have indicated that due to vessel operating practices, the effective distance (i.e., the distance at which actual time delays would be incurred) may be less than distances specified in the operational measures. This is because at most port areas, vessels already slow down to approximately 8 to 10 knots at the pilot buoy for the pilot to board the vessel. In some instances, the proximity of the pilot buoys to the shore makes it impractical for the vessel to resume normal operating speed. Thus, the effective distance for speed restrictions, and the actual time delays, are lessened by the distance of the pilot buoy from the shore. The location of the pilot buoy relative to the harbor baseline or closing line is shown in Data Chart 4-5. For example, the pilot buoy for the port area of New York/New Jersey is 6.8 nm (12.6 km) from the harbor baseline. Thus, the distance from the edge of the speed-restricted area to the pilot buoy is only 18.2 nm (33.7 km).

It should be noted, however, that for the port area of New York/New Jersey and most other US East Coast port areas, vessels do not approach the port directly perpendicular to the coastline. Rather, mariners approaching from the north or south approach the port along the shortest possible track. For purposes of the economic impact analysis, it was assumed that vessels would travel through the speed-restricted areas on a typical 45-degree routing relative to the port entrance, until they reach the pilot buoy. Thus, for the port area of New York/New Jersey it is assumed that vessels would traverse 25.7 nm (47.6 km) through the speed-restricted area. This concept was applied to all port areas in the mid-Atlantic region.

Data Chart 4-5 indicates an additional effective distance of 54.9 nm (101.7 km) miles for the port area of New York/New Jersey. This is due to the year-round speed-restricted area – the combination of the expanded ALWTRP SAM West and SAM East zones – established in the NEUS region that some vessels would have to traverse either coming to the port area of New York/New Jersey from the north or departing to the north. It is estimated that vessels affected will need to traverse 54.9 nm (101.7 km) of speed-restricted area in the NEUS. This factor, though, only affects vessel arrivals into the port area of New York/New Jersey from the north or departures to north.

Data Chart 4-4
Alternative 3: US East Coast Restricted Vessel Arrivals by Port Area and Vessel Type, 2004

Port Area	Vessel Type												Total
	Bulk Carrier	Combination Carrier	Container Ship	Freight Barge	Dry Cargo Ship	Passenger Ship	Refrigerated Cargo Ship	Ro-Ro Cargo Ship	Tank Barge	Tanker	Towing Vessel	Other a/	
Northeastern US - Gulf of Maine													
Eastport, ME	22	-	4	-	17	-	-	-	-	-	-	-	43
Searsport, ME	10	-	2	2	3	81	-	1	11	78	8	-	196
Portland, ME	71	4	4	1	28	26	-	37	26	395	47	2	641
Portsmouth, NH	51	3	1	-	16	1	-	-	1	87	9	4	173
Northeastern US - Off Race Point													
Salem, MA	9	-	-	-	-	6	-	-	-	-	-	-	15
Boston, MA	34	1	77	2	8	94	4	33	-	225	1	4	483
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	13	-	-	1	21	1	-	36
Mid-Atlantic Block Island Sound													
New Bedford, MA	31	-	-	-	14	-	4	1	-	6	-	-	56
Providence, RI	45	1	-	-	14	25	-	42	1	68	5	2	203
New London, CT	8	-	5	-	14	17	-	-	39	7	1	-	91
New Haven, CT	21	-	3	-	19	-	-	-	286	94	17	-	440
Bridgeport, CT	35	-	-	1	2	-	17	-	178	28	-	1	262
Long Island, NY	-	-	-	5	-	23	-	-	379	157	-	1	565
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	199	14	1,436	-	49	95	16	404	9	868	20	4	3,114
Mid-Atlantic Delaware Bay													
Philadelphia, PA	200	2	261	13	171	12	242	86	3	547	35	2	1,574
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	223	5	229	-	121	38	4	386	2	160	10	7	1,185
Hampton Roads, VA	254	13	986	3	93	37	5	90	1	133	12	11	1,638
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	23	1	9	-	13	4	-	-	-	32	-	1	83
Mid-Atlantic Wilmington, NC													
Wilmington, NC	67	3	48	-	73	4	-	17	9	152	2	2	377
Mid-Atlantic Georgetown, SC													
Georgetown, SC	26	2	2	-	12	1	-	-	-	-	-	-	43
Mid-Atlantic Charleston, SC													
Charleston, SC	84	1	949	2	66	51	3	128	4	117	19	6	1,430
Mid-Atlantic Savannah, GA													
Savannah, GA	174	8	760	-	124	35	10	107	1	206	5	1	1,431
Southeastern US													
Brunswick, GA	33	-	7	-	23	4	5	113	-	-	-	3	188
Fernandina, FL	12	-	30	2	50	6	6	1	-	-	11	-	118
Jacksonville, FL	66	2	204	74	91	43	2	231	9	120	154	14	1,010
Port Canaveral, FL	54		7	10	46	224	17	21	2	14	23	2	420
All Port Regions	**1,752**	**60**	**5,024**	**115**	**1,067**	**840**	**335**	**1,698**	**962**	**3,515**	**380**	**67**	**15,815**

a/ Other includes fishing vessels, industrial vessels, research vessels, school ships.

Source: Prepared by Nathan Associates based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports, 2003-2004.

Data Chart 4-5
Alternative 3: Effective Distance of Speed Restrictions in Designated Areas

Port Area	Location of pilot buoy relative to harbor baseline or closing line	Distance Stated in NOI	Distance to pilot buoy	Diagonal of distance to pilot buoy	Additional effective distance a/	Slow down/speed up time
Northeastern US - Gulf of Maine						
Eastport, ME	n.a.	n.a.	n.a.	n.a.	54.9	Included
Searsport, ME	n.a.	n.a.	n.a.	n.a.	54.9	Included
Portland, ME	n.a.	n.a.	n.a.	n.a.	54.9	Included
Portsmouth, NH	n.a.	n.a.	n.a.	n.a.	54.9	Included
Northeastern US - Off Race Point						
Boston, MA	n.a.	n.a.	n.a.	n.a.	72.4	n.a.
Salem, MA	n.a.	n.a.	n.a.	n.a.	72.4	n.a.
Northeastern US - Cape Cod Bay	5.0	n.a.	n.a.	n.a.	59.2	n.a.
Mid-Atlantic Block Island Sound						
New Bedford, MA	n.a.	25	25	35.4	54.9	Included
Providence, RI	n.a.	25	25	35.4	54.9	Included
New London, CT	n.a.	25	25	35.4	54.9	Included
New Haven, CT	n.a.	25	25	35.4	54.9	Included
Bridgeport, CT	n.a.	25	25	35.4	54.9	Included
Long Island, NY	n.a.	25	25	35.4	54.9	Included
Mid-Atlantic Ports of New York/New Jersey	6.8	25	18.2	25.7	54.9	Included
Mid-Atlantic Delaware Bay	2.5	25	22.5	31.8	54.9	Included
Mid-Atlantic Chesapeake Bay						
Baltimore, MD	2.8	25	22.2	31.3	54.9	Included
Hampton Roads, VA	2.8	25	22.2	31.3	54.9	Included
Mid-Atlantic Morehead City and Beaufort, NC	6.7	25	18.3	25.9	n.a.	n.a.
Mid-Atlantic Wilmington, NC	4.1	25	20.9	29.6	n.a.	n.a.
Mid-Atlantic Georgetown, SC	5.6	25	19.4	27.4	n.a.	n.a.
Mid-Atlantic Charleston, SC	12.5	25	12.5	17.7	6.3	n.a.
Mid-Atlantic Savannah, GA	9.7	25	15.3	21.6	4.9	n.a.
Southeastern US						
Brunswick, GA	6.7	n.a.	n.a.	26.4	3.4	n.a.
Fernandina, FL	10.9	n.a.	n.a.	32.9	5.5	n.a.
Jacksonville, FL	4.2	n.a.	n.a.	30.9	n.a.	n.a.
Port Canaveral, FL	n.a.	n.a.	n.a.	4.5	n.a.	n.a.

a/ Defined and described in text for each port area.
Source: Nathan Associates as descibed in text.

Data on the actual number of vessel arrivals at the port area of New York/New Jersey by direction of approach and departure were not available for this study. These data would allow the economic analysis to evaluate the impacts on the actual percentage of vessels arriving from the north or departing to the north from the port of New York/New Jersey. Therefore, pursuant to Section 1502.22 of CEQ regulations, in the absence of complete data (these fields in the USCG vessel arrival database were incomplete), the economic analysis provides an estimate of the number of arrivals and departures from/to the north based on general knowledge of shipping patterns in the area and of movements along the US East Coast. For example, on some liner container trades, the port area of New York/New Jersey is the end of a northern string for routes that serve the Far East and the US East Coast via the Panama Canal. Once these vessels unload/load at the port area of New York/New Jersey, they depart to the south for the return trip. On the other hand, most liner vessels that call at the port area of New York/New Jersey from Europe arrive from the north and depart to the south for calls at other US East Cost ports before heading back. Based on these types of routing considerations, this analysis assumes that the measures would affect 30 percent of vessel arrivals in the port area of New York/New Jersey.[15]

The mid-Atlantic port areas of Philadelphia, Baltimore and Hampton Roads have been assumed to be equally affected by the year-round speed-restricted area established in the NEUS. Port areas south of Hampton Roads are assumed to be unaffected by this area, as vessels normally travel to the east of the SAMs in the NEUS.

Port areas in Block Island Sound are assumed to have 40 percent of their vessel arrivals affected by the SAMs in the NEUS.[16]

As discussed with respect to Alternative 2 (Section 4.4.1.2), another factor is the time for vessels to slow down from sea speed to restricted speed and later to return to sea speed. This would affect vessel arrivals at the port area of New York/New Jersey that would traverse the year-round speed-restricted area in the NEUS. Extra time has been included in the economic impact analysis for these vessels to slow down to restricted speed and to resume sea speed.

The additional distance shown in Data Chart 4-5 for the mid-Atlantic port areas of Charleston and Savannah was calculated as half of the distance of the pilot buoy to the harbor baseline. Pilots at these ports have indicated that without speed restrictions vessels would regain some speed (not sea speed) prior to entering the harbor baseline. Applying the speed restriction to more than half of this distance should approximate the extra delay incurred from the pilot buoy to the harbor baseline at these port areas.

[15] The determination of 30 percent is based on the following assumptions: 45 percent of vessels arrive from the south and depart to the south (no trips through the northeast speed-restricted area); 40 percent arrive from the north and depart to the south (one trip through the northeast speed-restricted area), 10 percent arrive from the south and depart to the north (one trip through the northeast speed-restricted area), and 5 percent arrive from the north and depart to the north (two trips through the northeast speed-restricted area). This results in a total factor of 60 percent, which is divided by two to account for vessel arrivals only. Later in the economic impact analysis the estimated impact on vessel arrivals is doubled to account for the impact on vessel departures.

[16] This assumption is premised on consideration of maritime shipping patterns similar to the discussion above for the port area of New York/New Jersey. The determination of 40 percent is based on the following assumptions: 45 percent of vessels arrive from the north and depart to the south (one trip through the northeast speed-restricted area); 30 percent arrive from the south and depart to the south (no trips through the northeast speed-restricted area), 15 percent arrive from the north and depart to the south (one trip through the northeast speed-restricted area), and 10 percent arrive from the north and depart to the north (two trips through the northeast speed-restricted area). This results in a total factor of 80 percent, which is cut in half to apply to vessel arrivals only.

For port areas in the NEUS region, year-round speed reductions are proposed within the expanded ALWTRP SAM zones, which have the same boundaries as the Off Race Point and Great South Channel SMAs. With the exception of Cape Cod Bay, vessels arriving at port areas in the NEUS region from the north would not be affected by the SAM zones. Primarily, the portion of the restricted area referred to as expanded SAM West zone would affect vessels arriving from the south. It is assumed that vessels arriving from the south and destined for Northeast port areas will attempt to minimize the impact of the speed restrictions by entering the existing Boston TSS at a point east of the southern tip of Cape Cod. From there, vessels will route at restricted speeds through the TSS (65 nm [120.4 km]). Vessels destined for Boston may regain some speed (but not sea speed) from the western end of the restricted area to the Boston pilot buoy (15 nm [27.8 km]). Similar to the treatment of Charleston and Savannah, it is assumed that applying speed restrictions to half of this distance should approximate the extra delay incurred by the vessel. Vessels arriving from the south and destined for Gulf of Maine ports will need to route 54.9 nm (101.7 km) through the SAM West area. These vessels will also be affected by the time to slow down prior to entering and upon leaving the SAM West area.

For Alternative 3, the effective distance of speed restrictions for port areas in the Southeast was determined by identifying typical access routes for each port and the distance from the intersection of those routes with the eastern edge of the MSRS WHALESSOUTH area to each port's pilot buoy. For the port area of Brunswick, two routes were considered typical (as these routes were generally utilized prior to the establishment of the recommended routes) – one to the northeast of 21.8 nm (40.4 km) and one to the southeast of 28.4 nm (52.6 km). The southeast route was assumed to account for 70 percent of vessel traffic, resulting in a weighted average distance of 26.4 nm (49 km). An additional effective distance of 3.4 nm (6.3 km) was assumed to account for vessels not returning to sea speed over the 6.7 nm (12.4 km) from the pilot buoy to the coastline.

Two routes were typically used for the port area of Fernandina – a northeast route of 39.5 nm (73.1 km) and a southeast route of 26.3 nm (48.7 km). Traffic was assumed to be equally divided between the two routes, for an average distance of 32.9 nm (61 km). An additional effective distance of 5.5 nm (10.2 km) was assumed to account for vessels not returning to sea speed over the 10.9 nm (20.2 km) from the pilot buoy to the coastline. Three routes were typically used for the port area of Jacksonville – a northeast route of 39.4 nm (73 km) (10 percent of vessels), an easterly route of 26.3 nm (48.7 km) (30 percent), and a southeast route of 31.7 nm (58.7 km) (60 percent). The weighted average distance is 30.9 nm (57.2 km). For the port area of Port Canaveral, vessels utilized a single route of 4.5 nm (8.3 km) that passed through the right whale critical habitat area.

Data Chart 4-6
Alternative 3: Average Minutes of Delay per Vessel Arrival by Port Area and Type of Vessel, 2003

Port Area	Bulk Carriers	Combinat ion Carriers	Containers hips	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Weighted Average
Northeastern US - Gulf of Maine													
Eastport, ME	44.9	-	112.0	-	85.2	-	-	-	-	-	-	-	72.4
Searsport, ME	40.3	63.4	-	-	-	94.8	-	50.6	61.1	65.5	37.0	-	72.7
Portland, ME	48.7	64.6	110.2	84.5	78.2	97.4	-	57.3	59.8	68.9	37.0	37.0	66.8
Portsmouth, NH	52.2	55.3	-	-	85.8	83.3	-	-	62.3	66.5	37.0	37.0	62.4
Northeastern US - Off Race Point													
Boston, MA	63.6	67.7	149.0	68.4	85.1	110.0	107.9	78.2	-	85.0	48.9	48.9	97.8
Salem, MA	75.0	-	-	-	-	110.0	-	-	-	92.6	-	-	80.9
Northeastern US - Cape Cod Bay	-	-	-	-	-	93.5	-	-	-	75.4	-	-	82.8
Mid-Atlantic Block Island Sound													
New Bedford, MA	85.4	-	78.4	-	107.9	-	126.6	-	86.4	98.0	-	-	94.8
Providence, RI	79.9	100.1	-	-	122.5	149.2	133.0	150.6	84.3	103.4	57.4	57.4	112.5
New London, CT	79.7	-	185.3	-	146.1	129.0	-	-	91.4	102.2	57.4	-	102.8
New Haven, CT	78.5	-	188.7	58.5	136.3	129.0	-	-	93.8	100.8	57.4	-	95.8
Bridgeport, CT	92.4	-	-	43.1	-	108.7	-	-	75.9	75.4	-	-	63.7
Long Island, NY	-	100.1	-	58.5	-	129.0	-	-	91.7	98.3	57.4	57.4	94.7
Mid-Atlantic Ports of New York/New Jersey	59.1	71.8	134.1	75.1	80.5	111.5	118.0	116.4	66.9	77.1	42.2	42.2	106.9
Mid-Atlantic Delaware Bay	62.8	84.3	129.3	102.2	100.0	120.8	122.2	124.5	79.9	92.1	48.3	48.3	102.7
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	69.0	77.7	149.0	-	107.8	124.8	116.3	132.9	78.9	87.4	47.8	47.8	115.5
Hampton Roads, VA	69.3	83.4	152.1	85.0	103.2	127.5	121.7	144.6	80.5	88.0	47.8	47.8	132.1
Mid-Atlantic Morehead City and Beaufort, NC	32.5	-	73.7	-	49.2	-	35.4	68.5	-	46.5	-	25.9	47.7
Mid-Atlantic Wilmington, NC	37.2	46.6	92.1	-	66.1	-	65.2	90.1	49.9	52.5	29.6	-	59.4
Mid-Atlantic Georgetown, SC	36.1	-	82.5	-	74.8	-	-	-	-	-	-	27.4	44.0
Mid-Atlantic Charleston, SC	32.1	-	77.2	-	58.0	59.4	55.5	66.8	41.9	43.9	23.9	23.9	67.7
Mid-Atlantic Savannah, GA	32.5	39.3	84.6	-	55.6	62.4	89.0	73.8	43.6	47.9	26.5	26.5	69.3
Southeastern US													
Brunswick, GA	33.9	-	94.2	-	67.6	66.9	73.7	81.3	-	53.7	-	-	71.6
Fernandina, FL	62.6	-	84.5	39.1	69.2	86.3	97.6	-	-	-	38.4	-	76.2
Jacksonville, FL	43.9	47.0	82.6	64.6	54.2	74.4	73.4	82.9	54.5	56.5	30.9	30.9	64.6
Port Canaveral, FL	4.8	-	14.3	4.6	9.0	11.8	10.1	10.8	7.9	8.3	4.5	4.5	10.2
Total	55.0	69.6	117.4	61.9	77.3	72.5	101.2	106.2	84.8	76.5	34.1	40.9	91.1

a/ Includes recreational vessels

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Using the economic impact model, the minutes of delay incurred in each port area were identified, taking into account the distribution of vessel arrivals, normal vessel operating speeds, and the effective distance over which the restriction would apply. Data Chart 4-6 and Figure 4-5 present the average minutes of delay for a speed restriction of 10 knots per vessel arrival for each affected port area and vessel type in 2003.[17] The overall weighted average delay for all vessels in 2003 is 91 minutes per arrival.[18]

The longest average delay is experienced at the port area of Hampton Roads, with an average delay of 132 minutes per arrival. This is due to the predominance of large and fast containerships at the port area coupled with the relatively few arrivals of smaller and slower vessel types. The port areas of Baltimore (116 minutes), Providence (113 minutes), New York/New Jersey (107 minutes), Delaware Bay (103 minutes), and New London (103 minutes) are the other port areas with average delays in excess of 100 minutes. The port area of Port Canaveral, at 10 minutes, has the shortest average delay per vessel arrival, as the speed restriction would only be effective for 4.5 nm (8.3 km) from the eastern edge of the right whale critical habitat to the pilot buoy.

Containerships incur the longest average delay, with an average of 118 minutes per vessel arrival followed by ro-ro cargo ships (108 minutes), and refrigerated cargo vessels (102 minutes).

Alternative 3 would not have adverse, direct effects on port operations because all of the speed restrictions in designated areas would be in place over a fixed time period. Therefore, mariners would be able to schedule their arrival time at port ahead of time, based on whether or not restrictions are in place for a particular port region. This would require advanced schedule planning; the rulemaking process would allow sufficient time for schedule revisions prior to implementation in order to avoid delays in arriving at a port.

Direct Economic Impacts of Alternative 3

Data Chart 4-7 presents the estimated annual direct economic impact on the shipping industry of Alternative 3 with a 10-knot speed restriction based on 2003 conditions. The total direct economic impact is estimated at $133.0 million annually, with the largest impact on the port area of New York/New Jersey, at $36.6 million. The impact on the port area of Hampton Roads is second, at $24.5 million, followed by the port areas of Philadelphia at $13.5 million, Baltimore at $11.0 million, Savannah at $10.2 million, Charleston at $9.9 million, Boston at $4.2 million, Jacksonville at $3.6 million, and Portland at $3.4 million. The direct economic impact for these nine port areas totals $117.0 million, or 87.9 percent of the total for this alternative.

Containerships account for 54.1 percent of the total direct economic impact of Alternative 3, with an estimated $71.9 million. The next largest economic impact by vessel type is tankers, at $16.4 million, followed by ro-ro cargo ships, at $14.7 million, and passenger vessels, at $10.9 million.

Data Chart 4-8 presents the annual direct economic impact of a 10-knot speed restriction for Alternative 3 based on 2004 conditions.

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[17] The average delay includes slowdown/speedup time for port areas in the Gulf of Maine divided by the number of vessel arrivals by type of vessel for each port area during proposed speed-restriction periods. It does not include slowdown/speedup time for port areas in the mid-Atlantic, as those delays would need to be divided into annual vessel arrivals at each port.

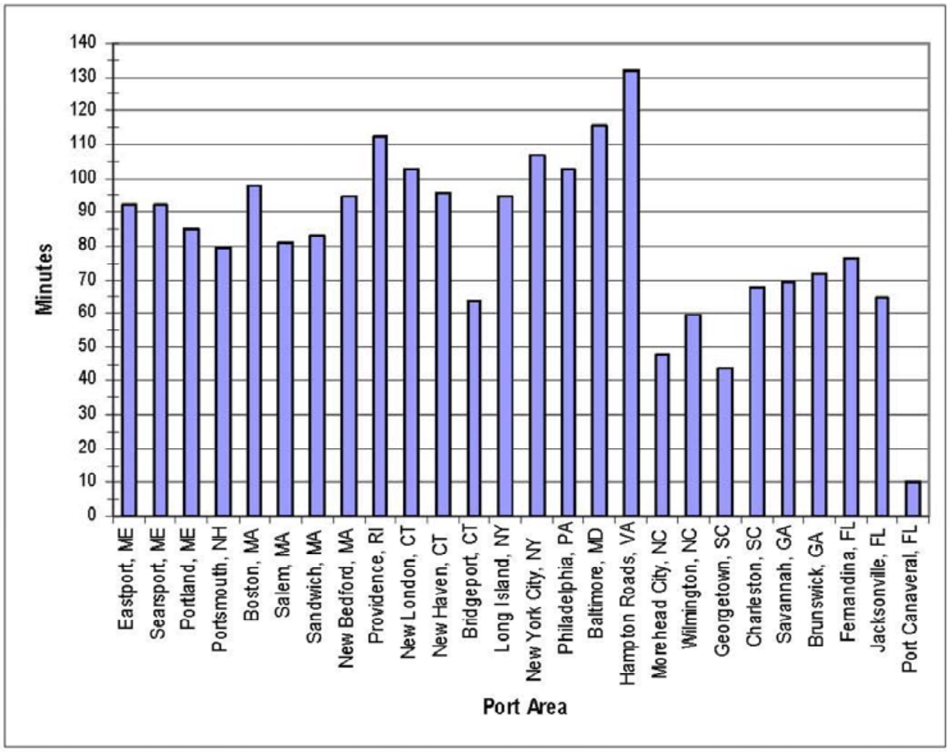
[18] As will be discussed later, vessels are assumed to incur similar delays when leaving each port area.

Data Chart 4-7
Alternative 3: Direct Economic Impact on the Shipping Industry by Port Area and Type of Vessel, 2003 ($000s)

Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	39.3	-	68.4	-	154.6	-	-	-	-	-	-	-	262.3
Searsport, ME	30.7	4.2	-	-	-	1,891.2	-	2.7	81.2	363.4	4.1	-	2,377.5
Portland, ME	182.6	77.4	98.3	4.6	201.1	607.7	-	194.5	20.6	2,035.3	22.8	2.4	3,447.2
Portsmouth, NH	191.3	10.4	-	-	76.1	18.2	-	-	7.3	496.3	2.1	2.4	804.1
Northeastern US - Off Race Point													
Boston, MA	97.6	3.2	1,214.7	3.6	32.5	1,780.2	41.8	119.9	-	944.1	2.2	4.5	4,244.4
Salem, MA	25.2	-	-	-	-	18.9	-	-	-	5.2	-	-	49.4
Northeastern US - Cape Cod Bay	-	-	-	-	-	161.8	-	-	-	54.7	-	-	216.5
Mid-Atlantic Block Island Sound													
New Bedford, MA	166.5	-	3.4	-	74.7	-	69.1	-	17.3	36.0	-	-	366.9
Providence, RI	202.2	6.5	-	-	77.5	581.1	45.7	434.0	4.2	439.6	2.9	1.5	1,795.2
New London, CT	49.3	-	44.2	-	60.6	500.9	-	-	218.9	28.8	2.9	-	905.4
New Haven, CT	152.7	-	25.3	1.5	189.2	50.1	-	-	731.3	623.0	28.5	-	1,801.7
Bridgeport, CT	90.2	-	-	2.3	-	20.9	-	-	413.3	120.7	-	-	647.4
Long Island, NY	-	6.5	-	3.1	-	475.8	-	-	1,485.2	872.6	5.7	1.8	2,850.6
Mid-Atlantic Ports of New York/New Jersey	646.2	89.2	24,866.6	2.4	138.4	1,775.4	303.5	4,221.3	85.1	4,441.1	23.2	4.4	36,596.9
Mid-Atlantic Delaware Bay	649.8	41.5	3,257.1	26.4	651.4	503.6	4,450.6	692.5	44.9	3,200.2	28.5	1.3	13,547.8
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	705.8	28.7	3,648.1	-	768.5	743.9	41.3	4,413.0	8.0	641.9	11.8	23.9	11,034.9
Hampton Roads, VA	743.4	77.9	20,353.1	2.7	476.4	557.6	14.9	1,588.6	4.1	662.0	4.7	14.6	24,500.1
Mid-Atlantic Morehead City and Beaufort, NC	21.6	-	57.9	-	51.1	-	3.0	7.9	-	50.5	-	1.2	193.2
Mid-Atlantic Wilmington, NC	109.5	9.7	550.9	-	386.6	-	6.3	111.7	29.9	372.3	1.3	-	1,578.3
Mid-Atlantic Georgetown, SC	42.0	-	5.9	-	49.5	-	-	-	-	-	-	0.8	98.2
Mid-Atlantic Charleston, SC	147.3	-	8,095.7	-	288.0	375.6	16.9	641.2	25.8	268.3	12.7	1.1	9,872.6
Mid-Atlantic Savannah, GA	235.5	13.6	8,190.7	-	513.5	48.6	144.0	564.2	7.9	428.6	3.5	1.2	10,151.3
Southeastern US													
Brunswick, GA	48.6	-	98.3	-	68.1	11.5	39.6	576.8	-	5.3	-	-	848.3
Fernandina, FL	12.2	-	165.5	0.9	186.2	14.9	139.4	-	-	-	11.8	-	530.9
Jacksonville, FL	127.8	2.4	1,141.6	193.1	320.4	122.1	15.2	1,124.4	18.3	332.4	159.5	3.6	3,560.7
Port Canaveral, FL	8.2	-	8.4	0.9	18.5	650.1	25.9	9.0	1.1	4.4	1.6	0.1	728.0
Total	4,725.6	371.0	71,894.0	241.5	4,783.0	10,910.1	5,357.4	14,701.5	3,204.3	16,426.8	329.7	64.9	133,009.9

a/ Includes recreational vessels.
b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.
Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Alternative 3: Average Minutes of Delay per Vessel Arrival by Port Area and Type of Vessel, 2003



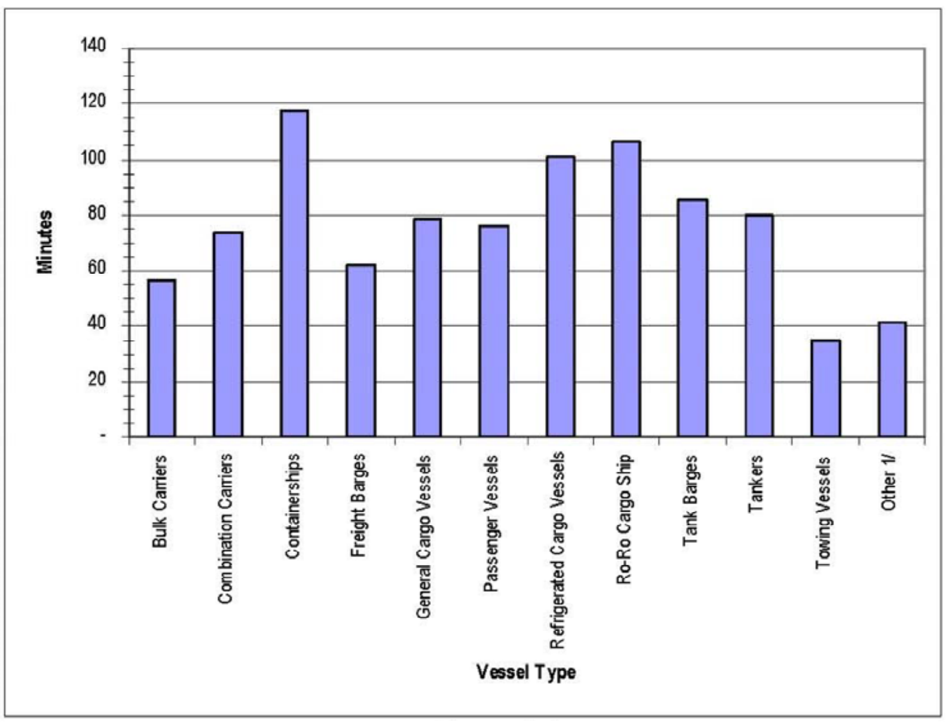


Figure 4-5

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Data Chart 4-8
Alternative 3: Direct Economic Impact on the Shipping Industry by Port Area and Type of Vessel, 2004 ($000s)

Port Area	Bulk Carriers	Combinat ion Carriers	Containers hips	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	54.0	-	68.6	-	321.4	-	-	-	-	-	-	-	444.0
Searsport, ME	20.8	-	55.3	4.5	8.2	2,159.9	-	4.9	39.6	337.3	16.6	-	2,647.1
Portland, ME	196.1	22.2	54.3	4.6	206.1	852.5	-	133.4	93.2	2,123.5	97.4	2.2	3,785.5
Portsmouth, NH	153.9	9.3	2.4	-	122.1	18.2	-	-	3.6	370.1	18.7	5.3	703.7
Northeastern US - Off Race Point													
Boston, MA	97.6	3.2	1,214.7	3.6	32.5	1,780.2	41.8	119.9	-	944.1	2.2	4.5	4,244.4
Salem, MA	31.8	-	-	-	-	155.4	-	-	-	-	-	-	187.2
Northeastern US - Cape Cod Bay	-	-	-	-	-	314.4	-	-	3.1	86.2	1.8	-	405.5
Mid-Atlantic Block Island Sound													
New Bedford, MA	145.1	-	-	-	46.3	-	55.3	6.8	-	31.3	-	-	284.7
Providence, RI	170.7	6.8	-	-	103.3	939.9	-	410.0	5.0	407.3	14.3	5.5	2,062.8
New London, CT	32.2	-	109.8	-	235.0	444.2	-	-	186.4	39.7	2.9	-	1,050.2
New Haven, CT	86.9	-	49.7	-	155.4	-	-	-	1,381.0	537.6	48.5	-	2,259.1
Bridgeport, CT	157.2	-	-	1.1	-	-	-	-	668.4	100.2	-	0.6	927.5
Long Island, NY	-	-	-	7.7	-	576.0	-	-	1,791.1	886.8	-	1.5	3,263.1
Mid-Atlantic Ports of New York/New Jersey	579.5	60.2	25,641.7	-	399.4	3,501.7	301.8	4,439.0	31.2	4,138.4	42.2	4.4	39,139.5
Mid-Atlantic Delaware Bay	642.0	9.9	3,006.5	60.4	940.7	296.6	4,216.7	702.1	13.5	3,495.3	83.2	2.8	13,469.7
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	844.1	24.8	3,883.8	-	974.0	1,196.5	78.0	4,384.6	8.2	893.0	23.6	11.3	12,321.9
Hampton Roads, VA	971.0	64.6	19,812.9	9.3	675.4	1,222.2	129.2	1,591.5	4.1	735.4	28.3	14.8	25,258.7
Mid-Atlantic Morehead City and Beaufort, NC	39.3	1.7	61.8	-	41.5	40.1	-	-	-	72.4	-	0.6	257.4
Mid-Atlantic Wilmington, NC	108.0	5.5	487.1	-	413.3	45.8	-	150.9	20.2	402.8	2.6	3.0	1,639.1
Mid-Atlantic Georgetown, SC	39.1	2.8	5.2	-	75.0	10.6	-	-	-	-	-	-	132.7
Mid-Atlantic Charleston, SC	138.8	0.8	8,469.2	4.7	330.1	554.7	29.8	592.6	8.0	266.6	20.1	3.6	10,418.9
Mid-Atlantic Savannah, GA	248.7	15.1	8,388.1	-	578.0	366.6	216.9	665.5	2.6	516.3	5.8	0.6	11,004.1
Southeastern US													
Brunswick, GA	48.0	-	50.3	-	120.8	46.1	41.5	606.6	-	-	-	2.5	915.9
Fernandina, FL	22.9	-	132.8	3.9	186.0	89.1	59.3	20.4	-	-	18.6	-	533.0
Jacksonville, FL	140.9	4.7	1,197.6	166.2	311.8	708.0	17.3	1,173.3	23.6	354.4	209.9	10.0	4,317.9
Port Canaveral, FL	13.1	-	10.7	1.1	27.5	708.0	16.3	14.5	0.8	6.4	4.6	0.2	803.2
Total	4,981.8	231.6	72,702.5	267.0	6,303.9	16,026.7	5,204.0	15,016.0	4,283.6	16,745.2	641.0	73.6	142,476.8

a/ Includes recreational vessels
b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.
Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

The total economic impact is $142.5 million annually based on 2004 data, roughly 7.1 percent higher than for 2003, which reflects the overall increase in US East Coast vessel arrivals. The rankings for the major vessel types are similar to those for 2003. The rankings for the leading port areas in 2004 are similar to those as described for 2003 above except that Jacksonville has moved ahead of Boston. Figure 4-6 presents the impacts graphically.

The annual direct economic impact of Alternative 3 (2004 data) at 12 knots would be $89.2 million, and, at 14 knots, $52.5 million. See Data Chart 4-22 for the economic impacts of 10, 12, and 14 knots for Alternative 3 by port area.

4.4.1.4 Alternative 4 – Recommended Shipping Routes

The implementation of Alternative 4 would have direct, long-term, adverse economic impacts on the shipping industry. Based on shipping industry activity in 2003, direct economic impacts would have totaled an estimated $2.3 million annually. The impact would have increased slightly in 2004, to $2.8 million. The impacts for Alternative 4 would be the same for 10, 12, and 14 knots, as no speed restrictions are included. This alternative would have the lowest economic impact of all the proposed alternatives.

The recommended routes and other operational measures included in Alternative 4 are described in Section 2.2.4. Figure 2-2 depicts the recommended routes in the SEUS, and Figure 2-14 depicts the routes in Cape Cod Bay. In general, Alternative 4 alters current vessel routing patterns to direct vessels away from areas where whales are known to aggregate.

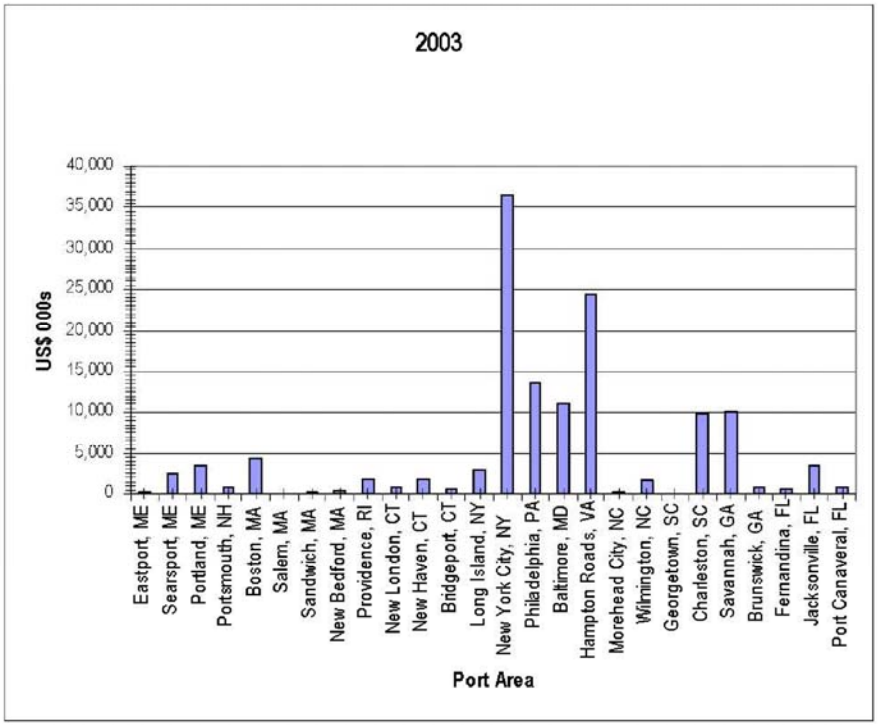
Section 4.4.1.3 summarizes existing vessel approach patterns for each port area. Because vessels arriving at these ports generally approach from the south or north, the approaches to the pilot buoys are approximately 40-65 degrees and 135-160 degrees from a line parallel to the coastline. Under Alternative 4, the preferred northeast and southeast access routes to each port are more level. Vessels are assumed to have to route parallel to the eastern boundary of the MSRS WHALESSOUTH until the intersection with the recommended route. The difference in the total distance between the current route and the use of the recommended route is then divided by the average operating speed of each type and size of vessel to determine the additional time associated with the use of the recommended shipping route. The economic impact is estimated by multiplying the additional time by the hourly operating cost for each type and size of vessel.

For the port area of Brunswick, the weighted-average additional distance from using the recommended access route is 6 nm (11 km); for the port area of Fernandina it is 10.5 nm (19.5 km); and for the port area of Jacksonville it is 10 nm (18.5 km).

The recommended shipping routes for Cape Cod Bay would not measurably affect shipping industry vessel operations because the recommended routes are not different from existing north-south shipping routes via the Cape Cod Canal to Boston. The economic impact of the recommended shipping routes for Cape Cod Bay on passenger and other vessels, particularly to Provincetown, is addressed later in the FEIS.

Alternative 4 would not have adverse effects on port operations because the exact location of the recommended routes are reflected in nautical charts that would be utilized during voyage planning. The recommended routes have already been established and are in effect year-round. Therefore, while these measures may add miles to a vessels' route, the restrictions would be known well ahead of time to allow for incorporation into vessel schedules and transit routes.

Alternative 3: Direct Economic Impact on the
Shipping Industry by Port Area, 2003 and 2004 ($000s)



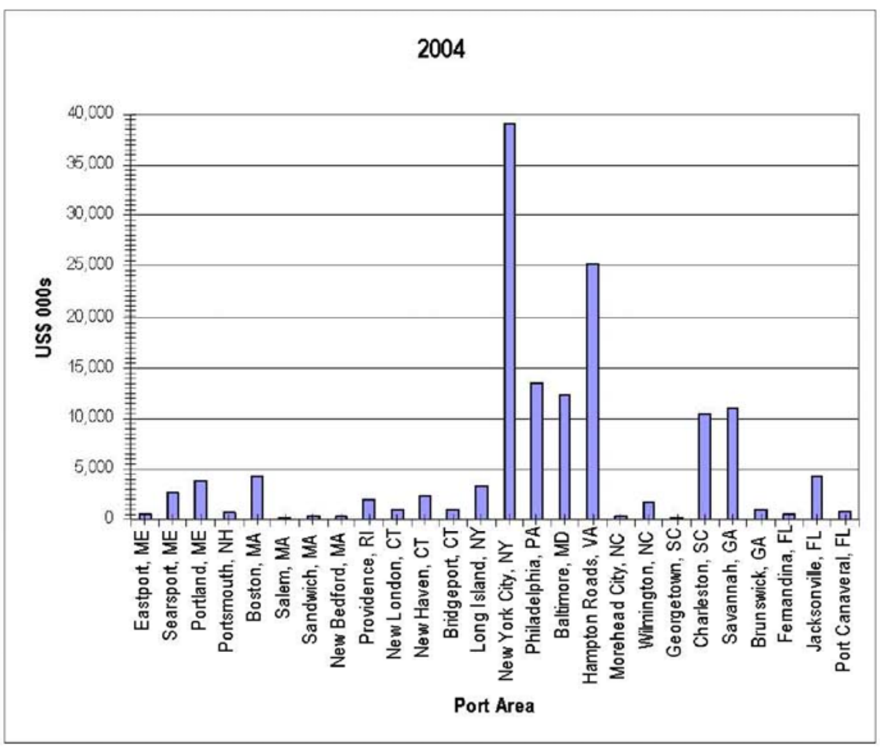


Figure 4-6

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Direct Economic Impacts of Alternative 4

Data Chart 4-9 presents the annual direct economic impact of Alternative 4 on the shipping industry based on 2003 conditions. For the Southeast port areas of Brunswick, Fernandina, and Jacksonville, the economic analysis assumed that all vessels would use the recommended routes between November 15 and April 15, when whales are present. The economic analysis also assumed that outside these dates, vessel operators would choose to sail via the most direct and economical access route to each port. The total direct economic impact of Alternative 4 is estimated at $2.3 million annually, with the port area of Jacksonville having the largest impact, at $1.9 million. The other port areas affected under this alternative – Brunswick and Fernandina – each had an economic impact of under $250,000.

Ro-ro cargo ships and containerships would have the highest direct economic impact, at approximately $0.6 million and $0.5 million, respectively, followed by towing vessels, general cargo vessels, and tankers, at roughly $0.3 million each.

Data Chart 4-10 presents the annual direct economic impact of Alternative 4 for 2004 conditions. The impact is estimated at $2.8 million, representing a 20-percent increase over 2003. This is due to the overall increase in vessel arrivals in the SEUS region and particularly in passenger vessels at Jacksonville. The ranking by port area is the same as described for 2003.

4.4.1.5 Alternative 5 – Combination of Alternatives

Implementation of Alternative 5 would have direct, long-term, adverse economic impacts on the shipping industry. These impacts would have totaled an estimated $137.0 million annually based on 2003 conditions and $147.2 million annually based on 2004 conditions.

Impact on Vessel Operations

Data Chart 4-11 presents the key assumptions used to analyze the impact of Alternative 5 on vessel operations. As Alternative 5 combines the measures included in alternatives 2, 3, and 4, some of these assumptions are discussed in the impacts section for these alternatives; the remaining assumptions are described in the following paragraphs. The data chart presents the basis for determining the effective distance at which speed restrictions would apply for each port area in a way that is similar to that previously done for Alternative 3. The diagonal distances to the buoy for the port areas of Brunswick, Fernandina, and Jacksonville differ from those of Alternative 3, however, because of the inclusion of the Alternative 4 recommended shipping routes, which reduces the distance traveled through the speed-restricted WHALESSOUTH reporting area of the MSRS. The speed restrictions were applied to the calculated distances to determine the additional time incurred by vessels.

The other new element for the three southeast port areas is the additional distance traveled parallel to the eastern boundary of the WHALESSOUTH area of the MSRS to the intersection with the recommended shipping routes, which generally have an east-west heading. In other words, vessels may transit longer distances to enter a recommended route. These distances are shown in Data Chart 4-11 as “Extra PARS”, which refers to the recommended routes. Speed restrictions do not apply to these distances and the additional time incurred is calculated using the average operating speed for each type and size of vessel.

Data Chart 4-9
Alternative 4: Direct Economic Impact on the Shipping Industry by Port Area and Type of Vessel, 2003 ($000s)

Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	-	-	-	-	-	-	-	-	-	-	-	-	-
Searsport, ME	-	-	-	-	-	-	-	-	-	-	-	-	-
Portland, ME	-	-	-	-	-	-	-	-	-	-	-	-	-
Portsmouth, NH	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Off Race Point													
Boston, MA	-	-	-	-	-	-	-	-	-	-	-	-	-
Salem, MA	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Cape Cod Bay	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Block Island Sound													
New Bedford, MA	-	-	-	-	-	-	-	-	-	-	-	-	-
Providence, RI	-	-	-	-	-	-	-	-	-	-	-	-	-
New London, CT	-	-	-	-	-	-	-	-	-	-	-	-	-
New Haven, CT	-	-	-	-	-	-	-	-	-	-	-	-	-
Bridgeport, CT	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Island, NY	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Ports of New York/New Jersey	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Delaware Bay	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	-	-	-	-	-	-	-	-	-	-	-	-	-
Hampton Roads, VA	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Morehead City and Beaufort, NC	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Wilmington, NC	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Georgetown, SC	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Charleston, SC	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Savannah, GA	-	-	-	-	-	-	-	-	-	-	-	-	-
Southeastern US													
Brunswick, GA	40.6	-	17.6	-	19.3	3.9	11.3	136.3	-	2.5	-	-	231.4
Fernandina, FL	8.9	-	75.6	1.2	83.6	6.8	51.9	-	-	-	16.2	-	244.2
Jacksonville, FL	130.9	2.2	401.5	114.0	180.0	57.5	7.5	441.5	14.2	244.8	258.0	5.8	1,857.8
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	180.3	2.2	494.7	115.2	282.8	68.1	70.7	577.8	14.2	247.3	274.2	5.8	2,333.4

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-10
Alternative 4: Direct Economic Impact on the Shipping Industry by Port Area and Type of Vessel, 2004 ($000s)

Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	-	-	-	-	-	-	-	-	-	-	-	-	-
Searsport, ME	-	-	-	-	-	-	-	-	-	-	-	-	-
Portland, ME	-	-	-	-	-	-	-	-	-	-	-	-	-
Portsmouth, NH	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Off Race Point													
Boston, MA	-	-	-	-	-	-	-	-	-	-	-	-	-
Salem, MA	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Cape Cod Bay	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Block Island Sound													
New Bedford, MA	-	-	-	-	-	-	-	-	-	-	-	-	-
Providence, RI	-	-	-	-	-	-	-	-	-	-	-	-	-
New London, CT	-	-	-	-	-	-	-	-	-	-	-	-	-
New Haven, CT	-	-	-	-	-	-	-	-	-	-	-	-	-
Bridgeport, CT	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Island, NY	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Ports of New York/New Jersey	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Delaware Bay	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	-	-	-	-	-	-	-	-	-	-	-	-	-
Hampton Roads, VA	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Morehead City and Beaufort, NC	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Wilmington, NC	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Georgetown, SC	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Charleston, SC	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Savannah, GA	-	-	-	-	-	-	-	-	-	-	-	-	-
Southeastern US													
Brunswick, GA	40.5	-	9.8	-	33.2	15.5	11.5	139.9	-	-	-	2.6	253.0
Fernandina, FL	25.3	-	54.8	2.5	89.5	40.7	23.7	4.4	-	-	25.5	-	266.3
Jacksonville, FL	139.6	4.5	437.4	102.8	167.4	320.3	7.6	458.7	18.3	258.9	339.6	16.3	2,271.3
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	205.3	4.5	502.0	105.3	290.1	376.5	42.7	603.1	18.3	258.9	365.1	18.8	2,790.6

a/ Includes recreational vessels
b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.
Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

The DMA effective days assumed for each port area under Alternative 5 are presented in the last column of Data Chart 4-11. The implementation of one DMA per port area has been assumed for the NEUS region, taking into consideration the sighting of right whales in the Gulf of Maine outside of the speed-restricted SAM west (or Off Race Point) area. In the SEUS region, the implementation of one DMA per port area has also been assumed, taking into consideration the sighting of whales outside of the time periods established for speed-restricted designated areas.

Data Chart 4-11
Alternative 5: Effective Distance of Speed Restrictions in Designated Areas, Duration of DMAs and Extra PARS Distance by Port Area

Port Area	Location of pilot buoy relative to harbor baseline or closing line	Distance stated in NOI	Distance to pilot buoy	Diagonal distance to pilot buoy	Additional effective distance a/	Extra PARS	PARS Effective Days b/	Slow down/speed up time	DMA effective days
Northeastern US - Gulf of Maine									
Eastport, ME	n.a.	n.a.	n.a.	n.a.	54.9	0	0	Included	15
Searsport, ME	n.a.	n.a.	n.a.	n.a.	54.9	0	0	Included	15
Portland, ME	n.a.	n.a.	n.a.	n.a.	54.9	0	0	Included	15
Portsmouth, NH	n.a.	n.a.	n.a.	n.a.	54.9	0	0	Included	15
Northeastern US - Off Race Point									
Boston, MA	n.a.	n.a.	n.a.	n.a.	72.4	0	0	n.a.	15
Salem, MA	n.a.	n.a.	n.a.	n.a.	72.4	0	0	n.a.	15
Northeastern US - Cape Cod Bay	5.0	n.a.	n.a.	n.a.	59.2	0	365	n.a.	15
Mid-Atlantic Block Island Sound									
New Bedford, MA	n.a.	25	25	35.4	54.9	0	0	Included	0
Providence, RI	n.a.	25	25	35.4	54.9	0	0	Included	0
New London, CT	n.a.	25	25	35.4	54.9	0	0	Included	0
New Haven, CT	n.a.	25	25	35.4	54.9	0	0	Included	0
Bridgeport, CT	n.a.	25	25	35.4	54.9	0	0	Included	0
Long Island, NY	n.a.	25	25	35.4	54.9	0	0	Included	0
Mid-Atlantic Ports of New York/New Jersey	6.8	25	18.2	25.7	54.9	0	0	Included	0
Mid-Atlantic Delaware Bay	2.5	25	22.5	31.8	54.9	0	0	Included	0
Mid-Atlantic Chesapeake Bay									
Baltimore, MD	2.8	25	22.2	31.3	54.9	0	0	Included	0
Hampton Roads, VA	2.8	25	22.2	31.3	54.9	0	0	Included	0
Mid-Atlantic Morehead City and Beaufort, NC	6.7	25	18.3	25.9	n.a.	0	0	n.a.	0
Mid-Atlantic Wilmington, NC	4.1	25	20.9	29.6	n.a.	0	0	n.a.	0
Mid-Atlantic Georgetown, SC	5.6	25	19.4	27.4	n.a.	0	0	n.a.	0
Mid-Atlantic Charleston, SC	12.5	25	12.5	17.7	6.3	0	0	n.a.	0
Mid-Atlantic Savannah, GA	9.7	25	15.3	21.6	4.9	0	0	n.a.	0
Southeastern US									
Brunswick, GA	6.7	n.a.	n.a.	23.5	3.4	6.0	151	n.a.	15
Fernandina, FL	10.9	n.a.	n.a.	26.0	5.5	10.5	151	n.a.	15
Jacksonville, FL	4.2	n.a.	n.a.	27.0	n.a.	10.0	151	n.a.	15
Port Canaveral, FL	n.a.	n.a.	n.a.	4.5	n.a.	0	0	n.a.	15

a/ Defined and described in text for each port area.
b/ PARS effective days as described in the text for Alternative 4.
Source: Nathan Associates as descibed in text.

No DMAs for port areas in the mid-Atlantic region have been assumed outside of the period of speed restriction. The slowdown/speedup time for each port is as specified for Alternative 3. While not shown separately in Data Chart 4-11, each DMA also includes slowdown/speedup times as described for Alternative 2.

Direct Economic Impacts of Alternative 5

Data Chart 4-12 presents the annual direct economic impact on the shipping industry of Alternative 5 with a 10-knot speed restriction, based on 2003 conditions. The total direct economic impact is estimated at $137.0 million annually, with the port area of New York/New Jersey having the largest impact ($36.6 million). The port area of Hampton Roads is second at $24.5 million, followed by the port areas of Philadelphia at $13.5 million, Baltimore at $11.0 million, Savannah at $10.2 million, and Charleston at $9.9 million. The direct economic impact for these six port areas totals $105.7 million annually, or 77.2 percent of the total for this alternative.

Containerships account for 53 percent of the total direct economic impact of Alternative 5, with an estimated $72.6 million. The vessel type with the next-largest economic impact is tankers, at $16.9 million, followed by ro-ro cargo ships at $15.5 million and passenger vessels, at $11.9 million.

Data Chart 4-13 presents the annual direct economic impact of Alternative 5 based on 2004 conditions. The impact is $147.2 million, roughly 7.4 percent higher than 2003, which reflects the overall increase in US East Coast vessel arrivals. The rankings for the major vessel types are similar to 2003. The rankings for the leading port areas are the same as for 2003. Figure 4-7 presents the impacts graphically.

Under Alternative 5, the direct economic impact of a 12-knot speed restriction would be $92.8 million annually; with a 14-knot restriction, it would be $55.2 million (both are estimates based on 2004 conditions). (See Data Chart 4-22 for the economic impacts of 10, 12, and 14 knots by port area).

4.4.1.6 Alternative 6 – Proposed Action (Preferred Alternative)

Implementation of Alternative 6 would have direct adverse economic impacts on the shipping industry. With a 10-knot speed restriction, these impacts would have totaled an estimated $53.2 million in 2003 and $57.6 million in 2004.

Impact on Vessel Operations

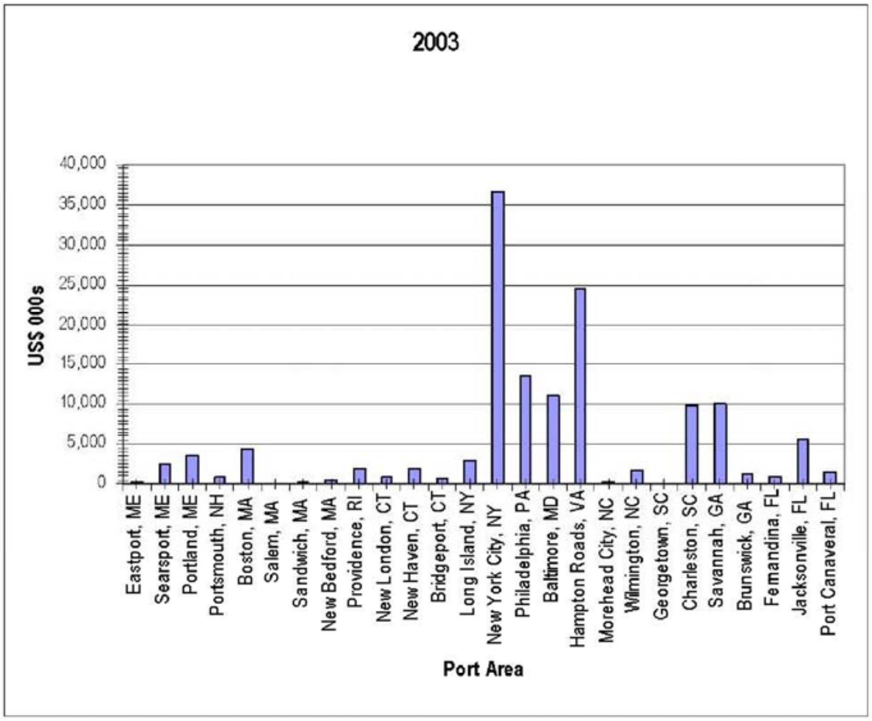
Figure 4-8 presents the months during which restrictions would apply under this alternative. SMAs are not proposed for specific port areas in the NEUS region; instead, the SMAs correspond with right whale feeding habitat. However, the analysis assumes that seasonal speed restrictions for the expanded Off Race Point management area would affect vessel arrivals at the port areas in the Northeast region. Alternative 6 does not include speed restrictions for the port area of Port Canaveral. DMAs would be implemented in all areas outside of the proposed seasonal speed-restricted periods.

Data Chart 4-12
Alternative 5: Direct Economic Impact on the Shipping Industry by Port Area and Type of Vessel, 2003 ($000s)

Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	41.0	-	71.4	-	161.3	-	-	-	-	-	-	-	273.7
Searsport, ME	32.1	4.4	-	-	-	1,973.2	-	2.8	84.8	379.1	4.3	-	2,480.6
Portland, ME	190.5	80.7	102.6	4.8	209.8	634.1	-	202.9	21.4	2,123.6	23.8	2.5	3,596.7
Portsmouth, NH	199.6	10.9	-	-	79.4	19.0	-	-	7.6	517.8	2.2	2.5	838.9
Northeastern US - Off Race Point													
Boston, MA	101.7	3.4	1,265.3	3.8	33.8	1,854.4	43.5	124.9	-	983.5	2.2	4.7	4,421.4
Salem, MA	26.3	-	-	-	-	19.7	-	-	-	5.4	-	-	51.4
Northeastern US - Cape Cod Bay	-	-	-	-	-	163.5	-	-	-	55.2	-	-	218.7
Mid-Atlantic Block Island Sound													
New Bedford, MA	166.5	-	3.4	-	74.7	-	69.1	-	17.3	36.0	-	-	366.9
Providence, RI	202.2	6.5	-	-	77.5	581.1	45.7	434.0	4.2	439.6	2.9	1.5	1,795.2
New London, CT	49.3	-	44.2	-	60.6	500.9	-	-	218.9	28.8	2.9	-	905.4
New Haven, CT	152.7	-	25.3	1.5	189.2	50.1	-	-	731.3	623.0	28.5	-	1,801.7
Bridgeport, CT	90.2	-	-	2.3	-	20.9	-	-	413.3	120.7	-	-	647.4
Long Island, NY	-	6.5	-	3.1	-	475.8	-	-	1,485.2	872.6	5.7	1.8	2,850.6
Mid-Atlantic Ports of New York/New Jersey	646.2	89.2	24,866.6	2.4	138.4	1,775.4	303.5	4,221.3	85.1	4,441.1	23.2	4.4	36,596.9
Mid-Atlantic Delaware Bay	649.8	41.5	3,257.1	26.4	651.4	503.6	4,450.6	692.5	44.9	3,200.2	28.5	1.3	13,547.8
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	705.8	28.7	3,648.1	-	768.5	743.9	41.3	4,413.0	8.0	641.9	11.8	23.9	11,034.9
Hampton Roads, VA	743.4	77.9	20,353.1	2.7	476.4	557.6	14.9	1,588.6	4.1	662.0	4.7	14.6	24,500.1
Mid-Atlantic Morehead City and Beaufort, NC	21.6	-	57.9	-	51.1	-	3.0	7.9	-	50.5	-	1.2	193.2
Mid-Atlantic Wilmington, NC	109.5	9.7	550.9	-	386.6	-	6.3	111.7	29.9	372.3	1.3	-	1,578.3
Mid-Atlantic Georgetown, SC	42.0	-	5.9	-	49.5	-	-	-	-	-	-	0.8	98.2
Mid-Atlantic Charleston, SC	147.3	-	8,095.7	-	288.0	375.6	16.9	641.2	25.8	268.3	12.7	1.1	9,872.6
Mid-Atlantic Savannah, GA	235.5	13.6	8,190.7	-	513.5	48.6	144.0	564.2	7.9	428.6	3.5	1.2	10,151.3
Southeastern US													
Brunswick, GA	93.7	-	124.6	-	102.3	15.3	55.3	765.4	-	8.2	-	-	1,164.8
Fernandina, FL	20.4	-	231.3	2.1	263.3	20.8	190.0	1.2	-	0.3	27.1	-	756.6
Jacksonville, FL	272.7	5.0	1,655.5	325.8	522.9	183.7	27.8	1,669.2	32.8	612.7	431.3	9.6	5,748.9
Port Canaveral, FL	19.4	0.3	16.2	1.5	36.3	1,356.0	44.7	19.4	1.7	9.8	2.8	0.2	1,508.2
Total	4,959.3	378.1	72,565.7	376.3	5,134.7	11,873.2	5,456.8	15,460.1	3,224.0	16,881.4	619.4	71.4	137,000.4

a/ Includes recreational vessels.
b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.
Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Alternative 5: Direct Economic Impact on the
Shipping Industry by Port Area, 2003 and 2004 ($000s)



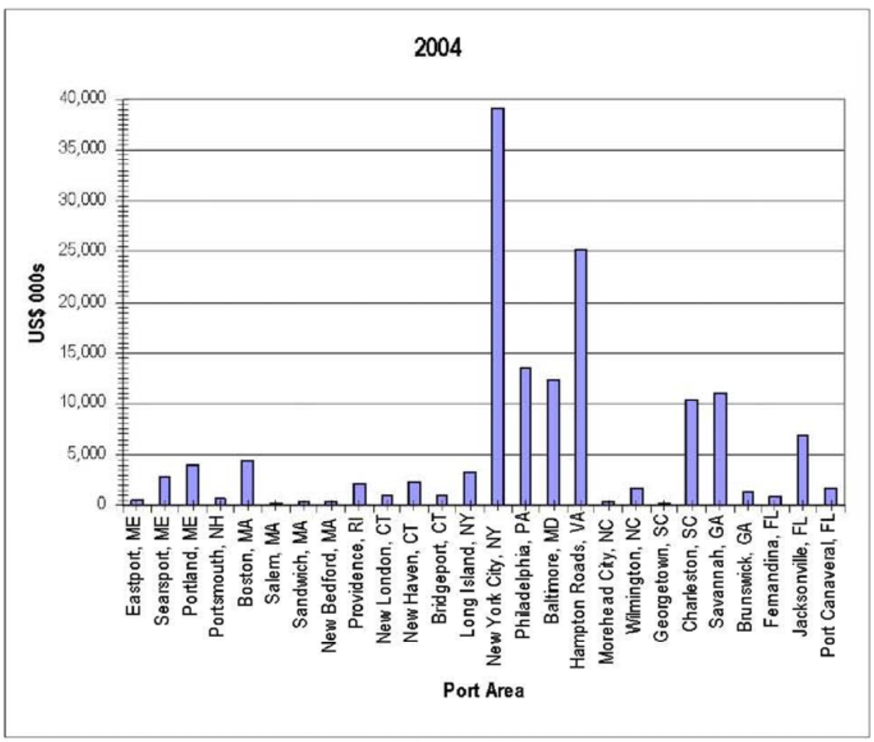


Figure 4-7

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Alternative 6: Proposed Seasonal Speed Restrictions by Port Area

a/ While seasonal speed restrictions are not proposed for the Northeastern US- Gulf of Maine, vessels approaching or departing these port areas are assumed to be affected by the seasonal speed restrictions proposed for the Northeastern US- Off Race Point.
Source: NOAA

Figure 4-8

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Data Chart 4-13
Alternative 5: Direct Economic Impact on the Shipping Industry by Port Area and Type of Vessel, 2004 ($000s)

Port Area	Bulk Carriers	Combinat ion Carriers	Containers hips	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	56.4	-	71.5	-	335.4	-	-	-	-	-	-	-	463.3
Searsport, ME	21.7	-	57.7	4.7	8.5	2,253.5	-	5.1	41.4	352.0	17.3	-	2,761.9
Portland, ME	204.6	23.2	56.7	4.8	215.1	889.5	-	139.2	97.2	2,215.6	101.7	2.3	3,949.7
Portsmouth, NH	160.6	9.7	2.5	-	127.4	19.0	-	-	3.8	386.1	19.5	5.6	734.2
Northeastern US - Off Race Point													
Boston, MA	101.7	3.4	1,265.3	3.8	33.8	1,854.4	43.5	124.9	-	983.5	2.2	4.7	4,421.4
Salem, MA	33.2	-	-	-	-	161.9	-	-	-	-	-	-	195.0
Northeastern US - Cape Cod Bay	-	-	-	-	-	317.7	-	-	3.1	87.1	1.8	-	409.7
Mid-Atlantic Block Island Sound													
New Bedford, MA	145.1	-	-	-	46.3	-	55.3	6.8	-	31.3	-	-	284.7
Providence, RI	170.7	6.8	-	-	103.3	939.9	-	410.0	5.0	407.3	14.3	5.5	2,062.8
New London, CT	32.2	-	109.8	-	235.0	444.2	-	-	186.4	39.7	2.9	-	1,050.2
New Haven, CT	86.9	-	49.7	-	155.4	-	-	-	1,381.0	537.6	48.5	-	2,259.1
Bridgeport, CT	157.2	-	-	1.1	-	-	-	-	668.4	100.2	-	0.6	927.5
Long Island, NY	-	-	-	7.7	-	576.0	-	-	1,791.1	886.8	-	1.5	3,263.1
Mid-Atlantic Ports of New York/New Jersey	579.5	60.2	25,641.7	-	399.4	3,501.7	301.8	4,439.0	31.2	4,138.4	42.2	4.4	39,139.5
Mid-Atlantic Delaware Bay	642.0	9.9	3,006.5	60.4	940.7	296.6	4,216.7	702.1	13.5	3,495.3	83.2	2.8	13,469.7
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	844.1	24.8	3,883.8	-	974.0	1,196.5	78.0	4,384.6	8.2	893.0	23.6	11.3	12,321.9
Hampton Roads, VA	971.0	64.6	19,812.9	9.3	675.4	1,222.2	129.2	1,591.5	4.1	735.4	28.3	14.8	25,258.7
Mid-Atlantic Morehead City and Beaufort, NC	39.3	1.7	61.8	-	41.5	40.1	-	-	-	72.4	-	0.6	257.4
Mid-Atlantic Wilmington, NC	108.0	5.5	487.1	-	413.3	45.8	-	150.9	20.2	402.8	2.6	3.0	1,639.1
Mid-Atlantic Georgetown, SC	39.1	2.8	5.2	-	75.0	10.6	-	-	-	-	-	-	132.7
Mid-Atlantic Charleston, SC	138.8	0.8	8,469.2	4.7	330.1	554.7	29.8	592.6	8.0	266.6	20.1	3.6	10,418.9
Mid-Atlantic Savannah, GA	248.7	15.1	8,388.1	-	578.0	366.6	216.9	665.5	2.6	516.3	5.8	0.6	11,004.1
Southeastern US													
Brunswick, GA	94.0	-	62.1	-	166.5	64.3	56.5	795.9	-	0.2	-	5.1	1,244.5
Fernandina, FL	47.3	-	184.4	6.0	271.9	130.6	82.7	22.6	-	-	43.3	-	788.9
Jacksonville, FL	297.0	10.0	1,748.9	285.9	507.7	1,080.6	30.6	1,738.5	43.3	648.7	568.5	27.4	6,987.0
Port Canaveral, FL	28.4	-	19.4	2.7	51.9	1,533.1	32.2	28.8	3.4	15.7	10.5	0.4	1,726.3
Total	5,247.5	238.4	73,384.5	390.9	6,685.6	17,499.4	5,273.2	15,797.9	4,311.8	17,211.9	1,036.1	94.1	147,171.3

a/ Includes recreational vessels

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

For all port areas in the NEUS except Cape Cod Bay, the seasonal speed restrictions associated with the Off Race Point management area would be effective 61 days per year. For Cape Cod Bay, the seasonal speed restrictions within the management area would be effective 135 days. Speed restrictions associated with SMAs would be in place for 181 days per year for port areas in the MAUS region, and 151 days per year for the three affected port areas in the SEUS region.

Data Chart 4-14 presents arrivals of vessels for 2003 during the periods for which speed restrictions are proposed. In 2003 there were 11,498 vessel arrivals during speed-restricted periods, representing approximately 45 percent of the total of 25,532 arrivals for 2003. Although total arrivals increased in 2004, the percentage of arrivals during speed-restricted periods slightly decreased, to 43.4 percent. In both years, less than half the vessels calling at US East Coast ports would have been affected by the regulations. While there is some seasonality in US East Coast vessel arrivals, the proposed periods of speed restrictions include both peak and nonpeak periods of vessel traffic, so that the percentage of restricted arrivals corresponds closely to the percentage of speed-restricted days per year.

In terms of regions, NEUS vessel-arrival data indicate that vessel traffic is not at a peak period during the times when whales are present in the NEUS. Only 17 percent of the total vessel arrivals in the northeast occurred during a restricted period in 2004. (As previously stated, this is also influenced by the lower number of restricted days in the NEUS than in the other regions; 61 days in the Gulf of Maine and Off Race Point and 135 days in Cape Cod Bay). Therefore, only a small percentage of vessels and port areas in this region would be affected. In the MAUS, just about half – 49 percent – of the total vessel arrivals occur during restricted periods (181 days/year), hence this region would be the most affected by the proposed operational measures. The SEUS falls in between the other two regions, with one-third of the total vessel arrivals occurring during restricted periods, which also corresponds to the 151 days/year that speed restrictions are in place in the SEUS.

The port area of New York/New Jersey has the most vessel arrivals during speed-restricted periods, with 2,618 arrivals in 2003, followed by the port areas of Philadelphia (1,315 arrivals), Hampton Roads (1,298 arrivals), Savannah (1,157 arrivals), Charleston (1,140 arrivals), Baltimore (913 arrivals) and Jacksonville (905 arrivals). These seven port areas accounted for 81.3 percent of the total US vessel arrivals during periods with speed restrictions.

In terms of vessel type, containerships recorded the most vessel arrivals during proposed speed-restricted periods, with 4,165 arrivals in 2003. Tankers were the next most frequent, with 2,473 arrivals, followed by ro-ro cargo ships, with 1,444 arrivals, and bulk carriers, with 1,243 arrivals.

In 2004, there were 12,189 vessel arrivals at US East Coast ports during the periods when speed restrictions are proposed for each port area (Data Chart 4-15), an increase of 6.0 percent over 2003. The increase is lower than the 7.3 percent increase for total US East Coast vessel arrivals for several reasons. First, the SEUS region that recorded an increase of 12.3 percent in total vessel arrivals in 2004 is the region with the fewest speed-restricted days. Second, the port area of New York/New Jersey, which has the largest number of annual vessel arrivals, recorded no increase in vessel arrivals during proposed speed-restricted periods.

Data Chart 4-14
Alternative 6: US East Coast Restricted Vessel Arrivals by Port Area and Vessel Type, 2003

	Vessel Type												
Port Area	Bulk Carrier	Combination Carrier	Container Ship	Freight Barge	General Dry Cargo Ship	Passenger Ship	Refrigerated Cargo Ship	Ro-Ro Cargo Ship	Tank Barge	Tanker	Towing Vessel	Other a/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	3	-	1	-	3	-	-	-	-	-	-	-	7
Searsport, ME	2	-	-	-	-	-	-	-	-	18	-	-	20
Portland, ME	14	1	1	-	2	-	-	10	1	78	-	-	107
Portsmouth, NH	9	-	-	-	2	-	-	-	1	25	-	-	37
Northeastern US - Off Race Point													
Salem, MA	3	-	-	-	-	-	-	-	-	-	-	-	3
Boston, MA	7	-	20	-	2	-	-	10	-	72	-	1	112
Subtotal	10	0	20	0	2	0	0	10	0	72	0	1	115
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	3	-	-	-	6	-	-	9
Mid-Atlantic Block Island Sound													
New Bedford, MA	29	-	1	-	14	-	3	-	4	6	-	-	57
Providence, RI	41	1	-	-	11	-	3	38	1	62	1	-	158
New London, CT	9	-	2	-	4	17	-	-	41	4	1	-	78
New Haven, CT	31	-	1	1	14	1	-	-	136	96	8	-	288
Bridgeport, CT	13	-	-	-	1	1	29	-	94	25	-	-	163
Long Island, NY	-	1	-	-	-	15	-	-	281	122	2	1	422
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	172	17	1,172	1	28	14	10	347	25	820	9	3	2,618
Mid-Atlantic Delaware Bay													
Philadelphia, PA	179	7	246	5	116	1	246	72	11	420	12	-	1,315
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	153	4	183	-	95	12	3	347	2	101	4	9	913
Hampton Roads, VA	161	11	857	1	66	4	1	79	1	112	1	4	1,298
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	11	-	7	-	17	-	1	1	-	19	-	2	58
Mid-Atlantic Wilmington, NC													
Wilmington, NC	59	4	44	-	63	-	1	11	11	120	1	-	314
Mid-Atlantic Georgetown, SC													
Georgetown, SC	23	-	1	-	5	-	-	-	-	-	-	1	30
Mid-Atlantic Charleston, SC													
Charleston, SC	85	-	735	-	49	21	3	117	13	103	12	2	1,140
Mid-Atlantic Savannah, GA													
Savannah, GA	140	7	655	-	113	3	5	78	4	148	2	2	1,157
Southeastern US													
Brunswick, GA	33	-	11	-	14	1	5	112	-	2	-	-	178
Fernandina, FL	4	-	43	1	42	1	13	-	-	-	7	-	111
Jacksonville, FL	62	1	185	80	102	8	2	222	7	114	117	5	905
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	0
All Port Regions	**1,243**	**54**	**4,165**	**89**	**763**	**102**	**325**	**1,444**	**633**	**2,473**	**177**	**30**	**11,498**

a/ Other includes fishing vessels, industrial vessels, research vessels, school ships.

Source: Prepared by Nathan Associates based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports, 2003-2004.

Data Chart 4-15
Alternative 6: US East Coast Restricted Vessel Arrivals by Port Area and Vessel Type, 2004

Port Area	Vessel Type: Bulk Carrier	Combination Carrier	Container Ship	Freight Barge	General Dry Cargo Ship	Passenger Ship	Refrigerated Cargo Ship	Ro-Ro Cargo Ship	Tank Barge	Tanker	Towing Vessel	Other a/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	5	-	2	-	1	-	-	-	-	-	-	-	8
Searsport, ME	1	-	-	-	-	-	-	-	4	14	-	-	19
Portland, ME	13	-	-	-	2	1	-	11	10	69	5	-	111
Portsmouth, NH	8	1	-	-	3	-	-	-	-	11	1	2	26
Northeastern US - Off Race Point													
Salem, MA	-	-	-	-	-	-	-	-	-	-	-	-	0
Boston, MA	7	-	20	-	2	-	-	10	-	72	-	1	112
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	1	-	-	-	10	-	-	11
Mid-Atlantic Block Island Sound													
New Bedford, MA	26	-	-	-	11	-	4	1	-	5	-	-	47
Providence, RI	33	1	-	-	12	7	-	34	1	57	2	2	149
New London, CT	8	-	4	-	13	10	-	-	36	6	1	-	78
New Haven, CT	14	-	3	-	17	-	-	-	257	83	13	-	387
Bridgeport, CT	34	-	-	1	2	-	13	-	163	21	-	1	235
Long Island, NY	-	-	-	4	-	20	-	-	339	143	-	1	507
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	163	14	1,226	-	43	41	14	345	8	738	20	2	2,614
Mid-Atlantic Delaware Bay													
Philadelphia, PA	163	2	225	13	142	6	223	71	3	470	27	2	1,347
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	190	4	194	-	104	16	3	323	1	140	7	6	988
Hampton Roads, VA	219	13	840	2	81	24	5	76	1	116	11	9	1,397
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	18	1	8	-	13	4	-	-	-	28	-	-	72
Mid-Atlantic Wilmington, NC													
Wilmington, NC	53	3	42	-	66	3	-	14	9	129	1	-	320
Mid-Atlantic Georgetown, SC													
Georgetown, SC	22	1	2	-	11	1	-	-	-	-	-	-	37
Mid-Atlantic Charleston, SC													
Charleston, SC	67	1	798	-	56	42	3	108	4	101	16	5	1,201
Mid-Atlantic Savannah, GA													
Savannah, GA	136	7	648	-	99	33	10	93	1	176	3	1	1,207
Southeastern US													
Brunswick, GA	33	-	7	-	23	4	5	113	-	-	-	3	188
Fernandina, FL	12	-	30	2	50	6	6	1	-	-	11	-	118
Jacksonville, FL	66	2	204	74	91	43	2	231	9	120	154	14	1,010
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	0
All Port Regions	**1,291**	**50**	**4,253**	**96**	**842**	**262**	**288**	**1,431**	**846**	**2,509**	**272**	**49**	**12,189**

a/ Other includes fishing vessels, industrial vessels, research vessels, school ships.

Source: Prepared by Nathan Associates based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports, 2003-2004.

Data Chart 4-16 presents the key assumptions that were used to analyze the impact of Alternative 6 on vessel operations, including the basis for determining the effective distance over which speed restrictions would apply for each port area. The method used is similar to that used for Alternative 5; however, for Alternative 6, port area buffers would have a radius of 20 nm (37 km), except for the 30-nm (56 km) SMA off Block Island Sound, and, aside from the Wilmington, North Carolina to Savannah, Georgia segment, would not be parallel to the coastline. Hence, there was no need to determine the diagonal distance of recommended routes, as was done for Alternatives 3 and 5. The effective distance and days of seasonal speed restrictions and the extra distance resulting from the recommended routes that are shown in Data Chart 4-16 for the port areas of Brunswick, Fernandina and Jacksonville are the same as described for Alternative 5.

Data Chart 4-16
Alternative 6: Effective Distance of Seasonal Speed Restrictions and Duration of DMAs

Port Area	Location of pilot buoy relative to harbor	Distance Stated in Rule	Effective distance to pilot buoy	Diagonal of effective distance	Additional effective distance a/	Extra PARS Distance	PARS Effective Days b/	Slow down/speed up time	DMA effective days
Northeastern US - Gulf of Maine									
Eastport, ME	n.a.	n.a.	n.a.	n.a.	48.7	0	0	Included	45
Searsport, ME	n.a.	n.a.	n.a.	n.a.	48.7	0	0	Included	45
Portland, ME	n.a.	n.a.	n.a.	n.a.	48.7	0	0	Included	45
Portsmouth, NH	n.a.	n.a.	n.a.	n.a.	48.7	0	0	Included	45
Northeastern US - Off Race Point									
Boston, MA	n.a.	n.a.	n.a.	n.a.	62.4	0	0	n.a.	45
Salem, MA	n.a.	n.a.	n.a.	n.a.	62.4	0	0	n.a.	45
Northeastern US - Cape Cod Bay	5.0	n.a.	n.a.	n.a.	39.9	0	0	n.a.	45
Mid-Atlantic Block Island Sound									
New Bedford, MA	n.a.	30	30	n.a.	68.7	0	0	Included	0
Providence, RI	n.a.	30	30	n.a.	68.7	0	0	Included	0
New London, CT	n.a.	30	30	n.a.	54.9	0	0	Included	0
New Haven, CT	n.a.	30	30	n.a.	54.9	0	0	Included	0
Bridgeport, CT	n.a.	30	30	n.a.	54.9	0	0	Included	0
Long Island, NY	n.a.	30	30	n.a.	54.9	0	0	Included	0
Mid-Atlantic Ports of New York/New Jersey	6.8	20	13.2	n.a.	54.9	0	0	Included	0
Mid-Atlantic Delaware Bay	2.5	20	17.5	n.a.	54.9	0	0	Included	0
Mid-Atlantic Chesapeake Bay									
Baltimore, MD	2.8	20	17.15	n.a.	54.9	0	0	Included	0
Hampton Roads, VA	2.8	20	17.15	n.a.	54.9	0	0	Included	0
Mid-Atlantic Morehead City and Beaufort, NC	6.7	20	13.3	n.a.	n.a.	0	0	n.a.	0
Mid-Atlantic Wilmington, NC	4.1	20	15.9	n.a.	n.a.	0	0	n.a.	0
Mid-Atlantic Georgetown, SC	5.6	20	14.4	n.a.	n.a.	0	0	n.a.	0
Mid-Atlantic Charleston, SC	12.5	20	7.5	n.a.	6.3	0	0	n.a.	0
Mid-Atlantic Savannah, GA	9.7	20	10.3	n.a.	4.9	0	0	n.a.	0
Southeastern US									
Brunswick, GA	6.7	n.a.	n.a.	23.5	3.4	6.0	151	n.a.	15
Fernandina, FL	10.9	n.a.	n.a.	26.0	5.5	10.5	151	n.a.	15
Jacksonville, FL	4.2	n.a.	n.a.	27.0	n.a.	10.0	151	n.a.	15
Port Canaveral, FL	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	n.a.	15

a/ Defined and described in text for each port area.
b/ PARS effective days as described in the text for Alternative 4.
Source: Nathan Associates as descibed in text.

The additional effective distance shown for port areas in the northeast and for some port areas in the mid-Atlantic is based on the calculation that vessel arrivals at these port areas would have to sail 54.9 nm (101.7 km) through the large speed-restricted area of a combined Off Race Point and Great South Channel SMAs. Both SMAs would be in effect from April 1 to April 30. Under Alternatives 3 and 5 this element was effective year-round, whereas under Alternative 6 it would be effective for 30 days only.[19]

For the port areas of Providence and New Bedford, an additional effective distance of 13.8 nm (25.6 km) was calculated from the northern boundary of the Block Island SMA to the pilot buoy for Narragansett Bay, as vessels would not be able to regain sea speed after passing through the SMA at a reduced speed. Combined with the 54.9 nm (101.7 km) distance for the Off Race Point and Great South Channel SMAs, this results in a total additional effective distance of 68.7 nm (127.2 km) as shown in Data Chart 4-16.

For the NEUS region, the additional effective distance shown in Data Chart 4-16 is based on an average of the effective distance from March 1 to March 30 (when only the Off Race Point management area is implemented) and the effective distance from April 1 to April 30 (when both the Off Race Point and Great South Channel management areas are implemented). For the Gulf of Maine port areas, the effective distance during March is estimated at 36.9 nm (68.3 km) and for April at 60.5 nm (112 km), resulting in an average effective distance of 48.7 nm (90.2 km). For the port areas of Boston and Salem, the effective distance for March is estimated at 52.4 nm (97 km) and for April at 72.4 nm (134 km), which yields the average effective distance of 62.4 nm (115.6 km) listed in Data Chart 4-16.

The DMA effective days assumed for each port area under Alternative 6 are presented in the last column of Data Chart 4-16. The implementation of three DMAs per port area was assumed for the NEUS region, taking into consideration the sighting of right whales in the Gulf of Maine, and for time periods outside of those specified for speed restrictions in the Off Race Point SMA. In the SEUS region, the implementation of one DMA per port area has been assumed, taking into consideration the sighting of whales outside of the time periods established for the Southeast SMA. No DMAs for port areas in the MAUS region have been assumed outside of the periods established for SMAs. While not shown separately in Data Chart 4-16, each DMA includes slowdown/speedup times as described in Alternative 2.

Data Chart 4-17 presents the average minutes of delay from speed restrictions associated with recommended shipping routes in the NEUS and SEUS and with SMAs in all three regions. The delays were estimated based on a 10-knot restriction per vessel arrival for each affected port area and vessel type in 2003.[20] The overall weighted average delay for all vessels is 53 minutes per arrival.

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[19] See the discussion under Alternative 3 regarding assumptions as to the percentage of vessel arrivals at mid-Atlantic port areas that would be affected.

[20] The average delay is based on the total minutes of delays for speed restrictions, extra PARS distance and slow-down/speed-up time, divided by the number of vessel arrivals by type of vessel for each port area during proposed seasonal speed-restriction periods. It does not include delays for DMAs, as those delays would need to be divided by the number of vessels affected by DMAs.

Data Chart 4-17
Alternative 6: Average Minutes of Delay for SMA Speed Restrictions at 10 knots per Vessel Arrival by Port Area and Type of Vessel, 2003

Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Weighted Average
Northeastern US - Gulf of Maine													
Eastport, ME	52.7	-	138.7	-	80.7	-	-	-	-	-	-	-	77.0
Searsport, ME	51.5	-	-	-	-	-	-	-	-	77.1	-	-	74.5
Portland, ME	58.2	74.8	94.7	-	95.7	-	-	68.8	69.4	79.8	-	-	76.3
Portsmouth, NH	61.8	-	-	-	106.1	-	-	-	72.3	77.1	-	-	74.8
Northeastern US - Off Race Point													
Boston, MA	52.8	-	129.4	-	65.6	-	-	62.7	-	75.3	-	42.2	81.9
Salem, MA	67.4	-	-	-	-	-	-	-	-	-	-	-	67.4
Northeastern US - Cape Cod Bay	-	-	-	-	-	89.8	-	-	-	75.5	-	-	80.3
Mid-Atlantic Block Island Sound													
New Bedford, MA	73.0	-	66.1	-	94.3	-	106.8	-	72.9	82.8	-	-	80.9
Providence, RI	68.4	84.4	-	-	102.5	-	112.2	127.5	71.1	86.9	48.4	-	93.1
New London, CT	48.2	-	111.6	-	88.0	77.8	-	-	55.0	61.0	34.6	-	62.4
New Haven, CT	47.6	-	113.7	35.3	83.5	77.8	-	-	56.6	60.9	34.6	-	57.9
Bridgeport, CT	55.4	-	-	-	-	49.3	-	-	34.1	33.8	-	-	29.6
Long Island, NY	-	60.3	-	-	-	77.8	-	-	55.2	59.1	34.6	34.6	57.0
Mid-Atlantic Ports of New York/New Jersey	24.5	29.8	55.9	31.3	33.8	47.7	50.1	48.3	27.9	32.1	17.6	17.6	44.5
Mid-Atlantic Delaware Bay	28.6	38.2	58.3	45.6	45.2	58.4	55.2	56.8	36.2	41.7	21.9	-	46.5
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	31.3	33.7	67.3	-	48.3	57.5	52.4	59.8	35.6	39.3	21.6	21.6	52.3
Hampton Roads, VA	31.1	37.6	68.5	38.3	46.5	57.0	54.8	65.2	36.3	39.6	21.6	21.6	59.5
Mid-Atlantic Morehead City and Beaufort, NC	16.3	-	36.4	-	25.0	-	18.2	36.6	-	23.8	-	13.3	24.0
Mid-Atlantic Wilmington, NC	20.2	25.1	49.3	-	35.0	-	35.1	48.2	26.9	28.3	15.9	-	31.7
Mid-Atlantic Georgetown, SC	19.2	-	43.3	-	39.4	-	-	-	-	-	-	14.4	23.2
Mid-Atlantic Charleston, SC	18.4	-	44.4	-	33.1	33.4	31.9	38.4	24.1	25.2	13.8	13.8	38.8
Mid-Atlantic Savannah, GA	18.5	22.5	48.3	-	31.6	34.1	50.9	42.2	24.9	27.4	15.2	15.2	39.6
Southeastern US													
Brunswick, GA	59.8	-	102.0	-	83.4	82.9	87.6	93.0	-	73.7	-	-	86.2
Fernandina, FL	97.2	-	109.2	84.4	100.8	110.1	116.3	-	-	-	84.0	-	104.6
Jacksonville, FL	84.2	85.9	105.4	95.5	89.8	100.9	100.4	105.6	90.0	91.1	77.0	77.0	95.6
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	34.1	34.9	59.1	90.5	54.0	62.1	53.9	65.9	50.1	44.0	60.8	29.8	53.1

a/ Includes recreational vessels
b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.
Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

The longest average delays would be experienced at the southeast port areas of Fernandina (105 minutes) and Jacksonville (96 minutes), with Brunswick also showing a relatively long average delay (86 minutes); all are attributable to the combination of speed restrictions and recommended shipping routes. The port areas of Providence (93 minutes) and other port areas in Block Island Sound have above average delays due to the 30-nm (56-km) rectangular SMA proposed for that region. Boston (82 minutes) and other port areas in the northeast also have above average delays due to the longer period that the additional effective distance would apply (two months in the NEUS as compared to one month for the MAUS port areas).

Freight barges incur the longest average delay, with an average of 91 minutes per vessel arrival (see Figure 4-9). This is due to the specialized higher-speed freight barge service from Jacksonville to Puerto Rico. Other vessel types with above-average delays are ro-ro cargo ships (66 minutes), passenger vessels (62 minutes), towing vessels (61 minutes), containerships (59 minutes), general cargo, and refrigerated cargo vessels (both at 54 minutes).

It is important to note that the timing and duration of the proposed seasonal speed restrictions would be well known and that vessel itineraries for containerships and cruise vessels would be developed taking the delays into account. For example, shipping lines providing liner service to several East Coast ports would likely adjust their rotation of port calls and number of vessels deployed on that service to optimize vessel utilization while maintaining a weekly service.

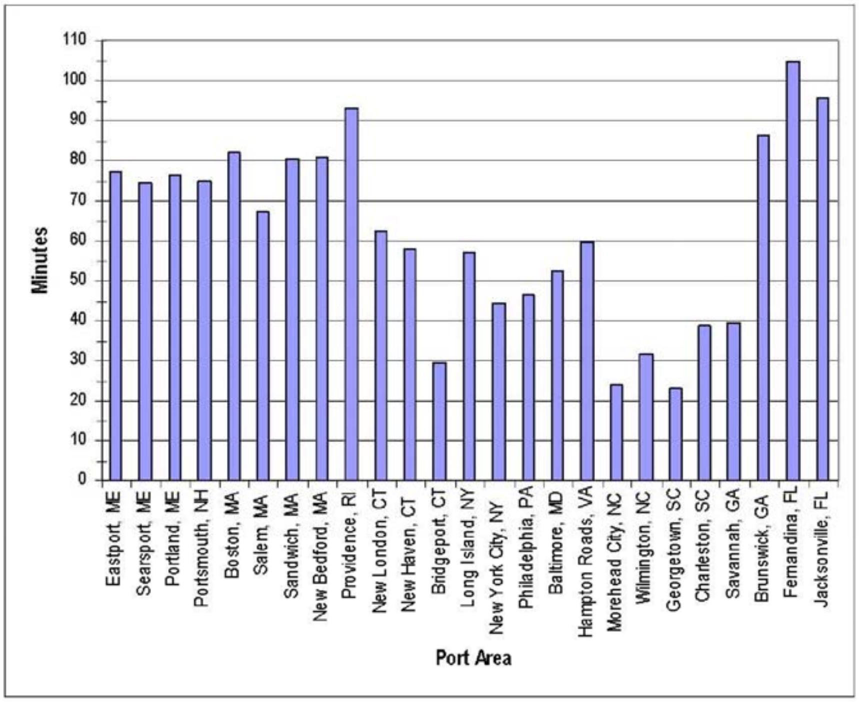
Cruise vessels would also adjust vessel itineraries, as necessary, to optimize vessel utilization. This could involve reducing the duration of port calls at offshore destinations or the elimination of an offshore port of call. For example, a seven-day cruise from Norfolk to Bermuda could easily adjust the scheduled time spent at ports of call in Bermuda, such as Hamilton, Saint George or King's Wharf. Similarly, four-day cruises from Jacksonville to the Bahamas or five-day cruises to the western Caribbean could make minor adjustments to the durations of stays at the corresponding ports of call.

Direct Economic Impacts of Alternative 6

Data Chart 4-18 presents the annual direct economic impact of Alternative 6 on the shipping industry based on 2003 conditions and with a 10-knot speed restriction. The impact is estimated at $53.2 million annually, with the port area of New York/New Jersey having the largest impact at $11.1 million. The port area of Hampton Roads is second at $8.3 million, followed by the port areas of Jacksonville at $5.5 million, Savannah at $4.9 million, Charleston at $4.8 million, Philadelphia at $4.7 million, and Baltimore at $3.7 million. The direct economic impact for these seven port areas totals $43.1 million annually, or 81.0 percent of the total for this alternative. No other port area had a direct economic impact over $1.3 million.

Containerships account for 52.4 percent of the total direct economic impact of Alternative 6, with an estimate of $27.9 million. The vessel type with the next-largest economic impact is ro-ro cargo ships at $7.0 million, followed by tankers at $6.5 million, passenger vessels at $2.6 million, general cargo vessels at $2.5 million, and refrigerated cargo vessels at $2.2 million.

Alternative 6: Average Minutes of Delay for SMA Speed Restrictions per Vessel Arrival by Port Area and Type of Vessel, 2003



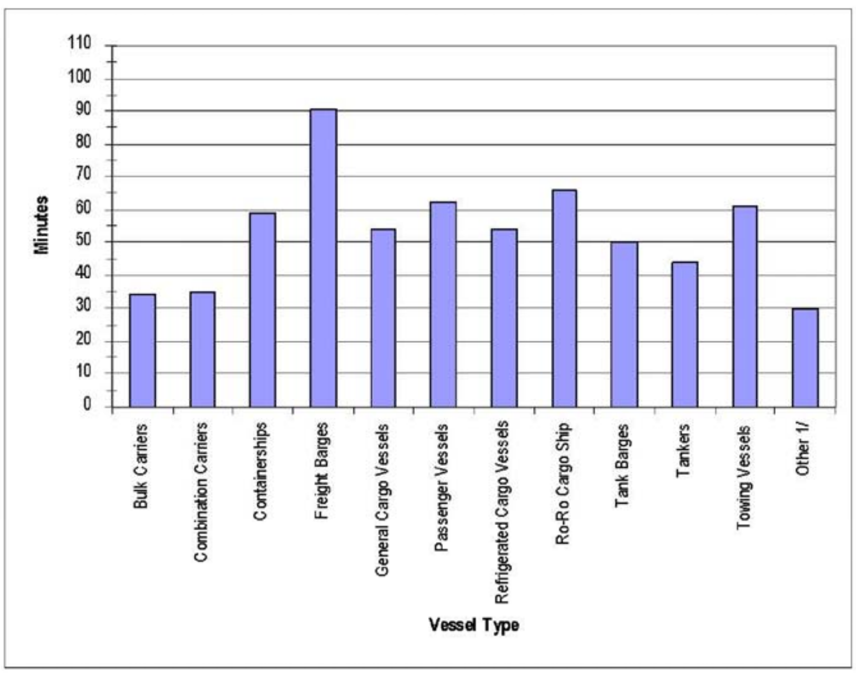


Figure 4-9

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Data Chart 4-18
Alternative 6: Direct Economic Impact of a 10-knot Speed Restriction on the Shipping Industry by Port Area and Type of Vessel, 2003 ($000s)

Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	11.9	-	23.4	-	27.6	-	-	-	-	-	-	-	62.9
Searsport, ME	8.4	0.5	-	-	-	246.1	-	0.3	10.6	117.1	0.5	-	383.5
Portland, ME	60.7	15.1	16.9	0.6	39.4	79.1	-	56.6	5.8	632.0	3.0	0.3	909.5
Portsmouth, NH	50.8	1.4	-	-	22.2	2.4	-	-	4.3	161.1	0.3	0.3	242.7
Northeastern US - Off Race Point													
Boston, MA	28.4	0.4	431.7	0.5	8.1	222.6	5.2	42.4	-	389.6	0.3	1.5	1,130.8
Salem, MA	13.2	-	-	-	-	2.4	-	-	-	0.6	-	-	16.2
Northeastern US - Cape Cod Bay	-	-	-	-	-	51.4	-	-	-	27.1	-	-	78.4
Mid-Atlantic Block Island Sound													
New Bedford, MA	102.3	-	2.5	-	52.3	-	31.0	-	12.9	23.2	-	-	224.2
Providence, RI	129.0	4.8	-	-	43.1	-	34.2	276.8	3.1	274.5	2.1	-	767.6
New London, CT	19.8	-	23.6	-	32.4	227.6	-	-	101.8	12.0	1.5	-	418.7
New Haven, CT	67.2	-	13.5	0.8	91.7	13.4	-	-	349.8	291.9	12.2	-	840.5
Bridgeport, CT	36.6	-	-	-	-	8.5	-	-	144.6	40.4	-	-	230.2
Long Island, NY	-	3.5	-	-	-	200.8	-	-	701.1	389.9	3.0	1.0	1,299.3
Mid-Atlantic Ports of New York/New Jersey	194.7	29.2	7,780.0	0.9	48.3	183.5	88.4	1,310.0	31.3	1,406.2	7.0	1.2	11,080.7
Mid-Atlantic Delaware Bay	230.9	16.9	1,117.6	8.6	232.0	14.7	1,665.6	239.7	18.2	1,107.9	11.6	-	4,663.8
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	233.8	7.2	1,259.8	-	271.2	173.7	16.7	1,530.8	3.2	212.9	3.8	6.7	3,719.8
Hampton Roads, VA	249.4	24.4	7,015.0	1.1	170.0	61.1	6.0	544.0	1.7	244.3	1.0	3.2	8,321.1
Mid-Atlantic Morehead City and Beaufort, NC	7.9	-	20.7	-	21.7	-	1.6	2.2	-	22.2	-	0.6	76.9
Mid-Atlantic Wilmington, NC	53.4	5.2	241.8	-	166.3	-	3.4	54.2	13.7	169.1	0.7	-	707.7
Mid-Atlantic Georgetown, SC	19.9	-	3.1	-	22.3	-	-	-	-	-	-	0.4	45.7
Mid-Atlantic Charleston, SC	71.5	-	3,963.2	-	132.6	147.0	9.7	316.2	14.8	134.7	7.3	0.6	4,797.6
Mid-Atlantic Savannah, GA	113.0	7.8	3,991.4	-	235.3	17.6	82.4	266.1	4.5	205.4	1.3	0.7	4,925.5
Southeastern US													
Brunswick, GA	92.7	-	122.7	-	100.9	15.1	54.5	753.8	-	8.0	-	-	1,147.7
Fernandina, FL	20.1	-	227.9	2.1	259.4	20.5	187.1	1.2	-	0.3	26.8	-	745.5
Jacksonville, FL	265.2	4.9	1,589.0	314.5	504.3	176.5	26.9	1,603.7	31.7	593.3	422.0	9.4	5,541.5
Port Canaveral, FL	11.3	0.3	7.8	0.6	17.8	705.9	18.8	10.4	0.5	5.4	1.3	0.1	780.2
Total	2,092.2	121.5	27,851.6	329.7	2,498.8	2,569.9	2,231.6	7,008.5	1,453.6	6,469.2	505.7	26.1	53,158.3

a/ Includes recreational vessels.
b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.
Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-19 presents the annual direct economic impact of Alternative 6 based on 2004 conditions. The total impact is $57.6 million annually, roughly 8.3 percent more than for 2003 conditions, which reflects the overall increase in US East Coast vessel arrivals. The rankings for the major vessel types are similar to those for 2003, except for bulk carriers moving ahead of refrigerated cargo vessels. The rankings for the leading port areas also are the same as described for 2003. Figure 4-10 presents the impacts graphically. Based on 2004 conditions, the total direct economic impact of Alternative 6 with a 12-knot speed restriction would be $36.1 million annually; with a 14-knot restriction, it would be $21.5 million. See Data Chart 4-22 for the economic impacts of 10, 12, and 14 knots by port area for Alternative 6.

Data Chart 4-19
Alternative 6: Direct Economic Impact of a 10-knot Speed Restriction on the Shipping Industry by Port Area and Type of Vessel, 2004 ($000s)

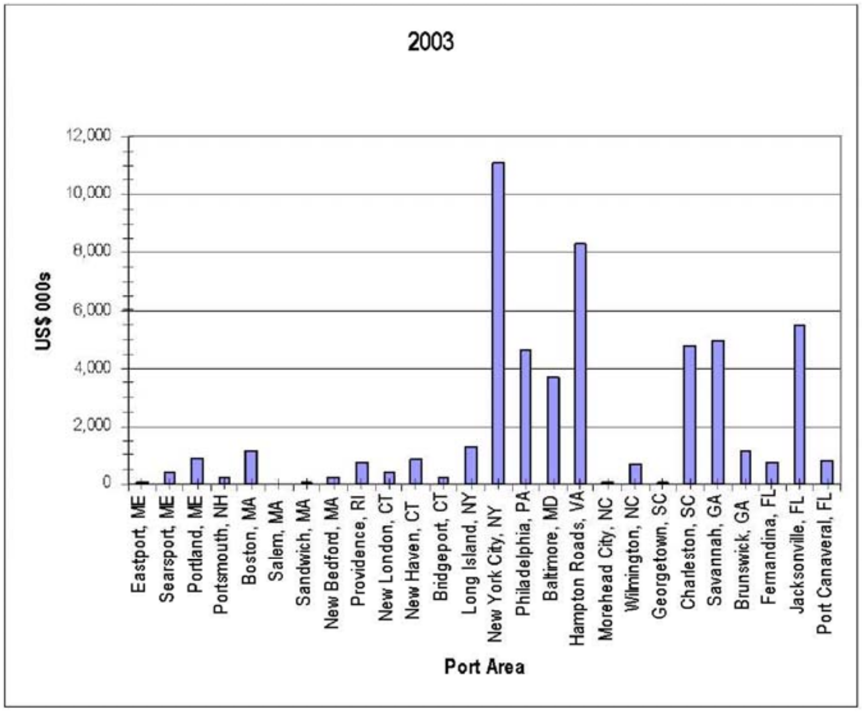
Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	19.5	-	40.2	-	59.1	-	-	-	-	-	-	-	118.8
Searsport, ME	5.8	-	7.2	0.6	1.1	281.0	-	0.6	18.2	99.6	2.2	-	416.2
Portland, ME	56.1	2.9	7.1	0.6	33.1	127.5	-	53.8	44.0	608.0	22.1	0.3	955.4
Portsmouth, NH	43.3	4.0	0.3	-	34.9	2.4	-	-	0.5	89.7	4.3	3.1	182.5
Northeastern US - Off Race Point													
Boston, MA	28.4	0.4	431.7	0.5	8.1	222.6	5.2	42.4	-	389.6	0.3	1.5	1,130.8
Salem, MA	4.0	-	-	-	-	19.4	-	-	-	-	-	-	23.4
Northeastern US - Cape Cod Bay	-	-	-	-	-	36.5	-	-	0.1	43.5	0.1	-	80.2
Mid-Atlantic Block Island Sound													
New Bedford, MA	88.8	-	-	-	27.5	-	41.3	5.1	-	19.7	-	-	182.4
Providence, RI	92.1	5.1	-	-	70.2	172.4	-	247.8	3.7	254.6	4.3	4.1	854.3
New London, CT	17.2	-	48.6	-	121.3	133.9	-	-	91.9	18.4	1.5	-	432.9
New Haven, CT	32.3	-	26.6	-	71.9	-	-	-	664.7	252.6	19.8	-	1,067.9
Bridgeport, CT	81.0	-	-	0.4	-	-	-	-	246.1	30.6	-	0.3	358.4
Long Island, NY	-	-	-	3.3	-	267.8	-	-	856.6	432.9	-	0.8	1,561.3
Mid-Atlantic Ports of New York/New Jersey	175.6	22.2	8,051.6	-	127.1	605.5	101.2	1,394.5	9.8	1,296.4	15.5	0.8	11,800.3
Mid-Atlantic Delaware Bay	211.1	4.0	1,051.6	24.5	315.5	69.6	1,573.4	236.5	5.5	1,219.8	26.1	1.1	4,738.8
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	289.1	8.0	1,338.3	-	357.7	213.3	26.9	1,477.6	1.7	315.6	6.7	4.0	4,038.7
Hampton Roads, VA	337.4	26.1	6,835.1	2.2	232.0	316.8	52.1	545.6	1.7	257.2	10.5	4.8	8,621.5
Mid-Atlantic Morehead City and Beaufort, NC	16.3	0.9	27.3	-	21.3	20.6	-	-	-	32.5	-	-	118.8
Mid-Atlantic Wilmington, NC	44.8	3.0	230.1	-	206.5	18.5	-	66.7	10.9	182.9	0.7	-	763.9
Mid-Atlantic Georgetown, SC	17.4	0.5	2.7	-	34.7	5.6	-	-	-	-	-	-	61.0
Mid-Atlantic Charleston, SC	63.3	0.5	4,118.8	-	162.1	247.1	17.1	285.4	4.6	132.4	9.7	1.7	5,042.7
Mid-Atlantic Savannah, GA	110.3	7.6	4,063.3	-	269.0	197.9	124.0	329.8	1.5	250.6	2.0	0.4	5,356.5
Southeastern US													
Brunswick, GA	93.0	-	61.1	-	164.0	63.4	55.7	783.6	-	0.2	-	5.0	1,226.0
Fernandina, FL	46.9	-	181.7	5.9	268.0	128.7	81.5	22.2	-	-	42.9	-	777.8
Jacksonville, FL	288.8	9.7	1,679.2	276.2	489.5	1,039.4	29.6	1,670.2	41.9	628.0	556.2	26.8	6,735.5
Port Canaveral, FL	15.3	-	8.8	1.6	24.4	825.1	15.8	14.3	2.6	9.3	5.9	0.2	923.1
Total	2,177.9	94.8	28,211.2	315.7	3,099.0	5,015.1	2,123.9	7,176.1	2,005.8	6,563.9	730.7	55.0	57,569.2

a/ Includes recreational vessels

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Alternative 6: Direct Economic Impact on the
Shipping Industry by Port Area, 2003 and 2004 ($000s)



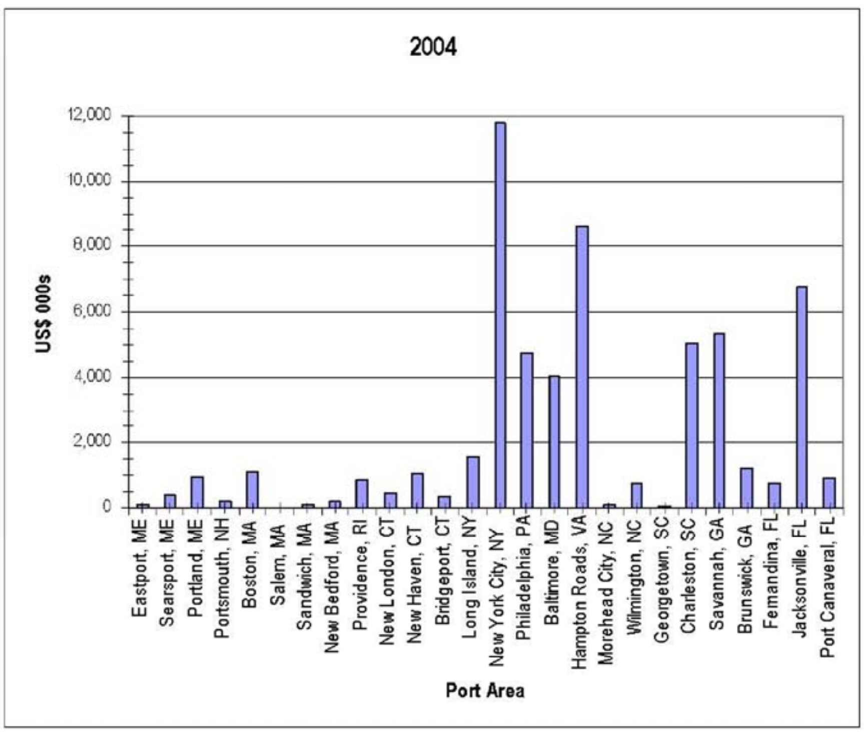


Figure 4-10

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4.4.1.7 Comparison of Direct Economic Impacts by Alternative

This section compares the direct economic impacts on the shipping industry by alternative for 2004 conditions with a 10-knot speed restriction, starting with the alternative with the largest impacts. Data Charts 4-20 and 4-21 present a comparison of the direct economic impacts by port area for each alternative based on 2003 and 2004 conditions, respectively. Impacts with 12- and 14-knot speed restrictions are addressed in Section 4.4.1.8.

- **Alternative 5 – Combination of Alternatives** would have the highest direct economic impact on the shipping industry, with an estimated $147.2 million annually. This alternative also would have the highest direct economic impact on US-flag vessels, at $17.9 million annually, and foreign-flag vessels, at $129.3 million annually. With the exception of Port Canaveral[21], this alternative would result in the highest direct economic impact on the shipping industry for each port area.
- **Alternative 3 – Speed Restrictions in Designated Areas** would have the second-highest direct economic impact on the shipping industry, with an estimated $142.5 million annually. This alternative also would have the second-highest direct economic impact on US-flag vessels, at $16.8 million annually, and foreign-flag vessels, at $125.7 million annually. This alternative would result in the second-highest direct economic impact on the port areas in the NEUS, and the highest economic impact (same as under Alternative 5) on the port areas in the MAUS. Economic impacts in the SEUS rank third or fourth.
- **Alternative 6 – Proposed Action** would have the third-highest direct economic impact on the shipping industry, with an estimated $57.6 million annually. This is more than half the direct economic impact of Alternative 5. Alternative 6 would have the third-highest direct economic impact on US-flag vessels, at $8.5 million annually, and foreign-flag vessels, at $49.0 million annually. This alternative would have the second-highest direct economic impact of all action alternatives for the southeast port areas of Brunswick, Fernandina and Jacksonville. For all other port areas, Alternative 6 ranks third, except Savannah, Salem, and Searsport, which all rank fourth. However, all economic impacts would cease when the measures expire, five years after their date of effectiveness.
- **Alternative 2 – Mandatory Dynamic Management Areas** ranks fourth in terms of direct economic impact on the shipping industry, with an estimated $27.6 million annually. This alternative also would have the fourth-highest direct economic impact on US-flag vessels, at $2.7 million annually, and foreign-flag vessels, at $24.9 million annually. For Port Canaveral, Alternative 2 results in the highest direct economic impact of all action alternatives, at $4.6 million annually. For the port areas of Savannah, Searsport, and Salem, this alternative ranks third; for all other port areas, it ranks fourth.

[21] Alternative 2 results in the highest direct economic impact for Port Canaveral, as the effective distance for the DMAs is 39.6 nautical miles for an assumed 75 days per year. Under Alternative 5, the effective distance for the seasonal speed restriction is limited to 4.5 nautical miles through the right whale critical habitat area and the DMAs are assumed to occur for only 15 days per year outside the seasonal speed-restriction periods.

Data Chart 4-20
Direct Economic Impact on the Shipping Industry for US and Foreign Flag Vessels by Port Area and Alternative, 2003 ($000s)

	Alternative 2			Alternative 3			Alternative 4			Alternative 5			Alternative 6		
Port Area	US	Foreign	Total	US	Foreign	Total	US	Foreign	Total	US	Foreign	Total	US	Foreign	Total
Northeastern US - Gulf of Maine															
Eastport, ME	-	51.6	51.6	-	262.3	262.3	-	-	-	-	273.7	273.7	-	62.9	62.9
Searsport, ME	24.1	443.3	467.4	122.7	2,254.8	2,377.5	-	-	-	128.0	2,352.6	2,480.6	24.1	359.5	383.5
Portland, ME	29.2	648.5	677.7	148.6	3,298.5	3,447.2	-	-	-	155.1	3,441.6	3,596.7	51.0	858.5	909.5
Portsmouth, NH	9.3	148.8	158.1	47.3	756.8	804.1	-	-	-	49.3	789.6	838.9	15.0	227.7	242.7
Northeastern US - Off Race Point															
Boston, MA	6.8	795.3	802.1	35.8	4,208.7	4,244.4	-	-	-	37.3	4,384.1	4,421.4	9.3	1,121.4	1,130.8
Salem, MA	0.6	8.7	9.3	3.1	46.3	49.4	-	-	-	3.2	48.2	51.4	0.4	15.9	16.2
	-	-	-	-	-	-	-	-	-	-	-	-			
Northeastern US - Cape Cod Bay	-	15.7	15.7	-	216.5	216.5	-	-	-	-	218.7	218.7	-	78.4	78.4
Mid-Atlantic Block Island Sound															
New Bedford, MA	2.8	16.1	18.9	72.5	294.3	366.9	-	-	-	72.5	294.3	366.9	48.1	176.1	224.2
Providence, RI	3.3	103.9	107.2	70.9	1,724.3	1,795.2	-	-	-	70.9	1,724.3	1,795.2	47.6	720.0	767.6
New London, CT	34.7	10.3	45.0	727.8	177.5	905.4	-	-	-	727.8	177.5	905.4	333.7	85.0	418.7
New Haven, CT	48.4	47.6	96.0	956.0	845.7	1,801.7	-	-	-	956.0	845.7	1,801.7	444.5	396.0	840.5
Bridgeport, CT	34.2	14.2	48.4	512.6	134.8	647.4	-	-	-	512.6	134.8	647.4	179.6	50.5	230.2
Long Island, NY	118.8	25.4	144.1	2,292.4	558.2	2,850.6	-	-	-	2,292.4	558.2	2,850.6	1,055.0	244.3	1,299.3
Mid-Atlantic Ports of New York/New Jersey	177.4	2,685.1	2,862.5	2,423.2	34,173.7	36,596.9	-	-	-	2,423.2	34,173.7	36,596.9	749.1	10,331.7	11,080.7
Mid-Atlantic Delaware Bay	17.1	815.2	832.3	242.5	13,305.4	13,547.8	-	-	-	242.5	13,305.4	13,547.8	86.3	4,577.5	4,663.8
Mid-Atlantic Chesapeake Bay															
Baltimore, MD	25.8	684.9	710.8	409.4	10,625.5	11,034.9	-	-	-	409.4	10,625.5	11,034.9	138.6	3,581.2	3,719.8
Hampton Roads, VA	159.4	1,465.0	1,624.4	2,412.3	22,087.8	24,500.1	-	-	-	2,412.3	22,087.8	24,500.1	835.3	7,485.8	8,321.1
Mid-Atlantic Morehead City and Beaufort, NC	2.5	24.7	27.2	12.7	180.6	193.2	-	-	-	12.7	180.6	193.2	4.7	72.2	76.9
Mid-Atlantic Wilmington, NC	17.1	170.0	187.2	130.9	1,447.4	1,578.3	-	-	-	130.9	1,447.4	1,578.3	57.4	650.4	707.7
Mid-Atlantic Georgetown, SC	0.1	15.4	15.5	0.8	97.4	98.2	-	-	-	0.8	97.4	98.2	0.4	45.3	45.7
Mid-Atlantic Charleston, SC	276.2	1,150.5	1,426.8	1,943.8	7,928.8	9,872.6	-	-	-	1,943.8	7,928.8	9,872.6	961.5	3,836.1	4,797.6
Mid-Atlantic Savannah, GA	171.3	6,681.6	6,852.9	260.1	9,891.2	10,151.3	-	-	-	260.1	9,891.2	10,151.3	142.6	4,782.9	4,925.5
Southeastern US															
Brunswick, GA	64.1	689.1	753.1	94.4	754.0	848.3	22.6	208.8	231.4	122.5	1,042.3	1,164.8	120.6	1,027.1	1,147.7
Fernandina, FL	9.5	319.9	329.4	27.6	503.3	530.9	24.2	220.0	244.2	49.3	707.3	756.6	48.7	696.8	745.5
Jacksonville, FL	878.3	1,983.5	2,861.9	1,082.9	2,477.9	3,560.7	691.6	1,166.2	1,857.8	1,876.6	3,872.3	5,748.9	1,813.5	3,728.0	5,541.5
Port Canaveral, FL	42.3	3,858.8	3,901.1	11.0	717.0	728.0	-	-	-	19.5	1,488.8	1,508.2	8.5	771.8	780.2
Total	2,153.4	22,873.1	25,026.5	14,041.2	118,968.7	133,009.9	738.4	1,595.0	2,333.4	14,908.6	122,091.8	137,000.4	7,175.4	45,982.9	53,158.3

Source: Nathan Associates Inc.

Data Chart 4-21
Direct Economic Impact on the Shipping Industry for US and Foreign Flag Vessels by Port Area and Alternative, 2004 ($000s)

	Alternative 2			Alternative 3			Alternative 4			Alternative 5			Alternative 6		
Port Area	US	Foreign	Total	US	Foreign	Total	US	Foreign	Total	US	Foreign	Total	US	Foreign	Total
Northeastern US - Gulf of Maine															
Eastport, ME	-	87.3	87.3	-	444.0	444.0	-	-	-	-	463.3	463.3	-	118.8	118.8
Searsport, ME	65.4	455.1	520.4	332.5	2,314.6	2,647.1	-	-	-	346.9	2,415.0	2,761.9	53.0	363.2	416.2
Portland, ME	70.0	674.3	744.3	355.9	3,429.6	3,785.5	-	-	-	371.3	3,578.4	3,949.7	93.6	861.8	955.4
Portsmouth, NH	5.8	132.5	138.4	29.6	674.1	703.7	-	-	-	30.9	703.4	734.2	3.8	178.6	182.5
Northeastern US - Off Race Point															
Boston, MA	6.8	795.3	802.1	35.8	4,208.7	4,244.4	-	-	-	37.3	4,384.1	4,421.4	9.3	1,121.4	1,130.8
Salem, MA	7.1	28.3	35.4	37.4	149.8	187.2	-	-	-	39.0	156.0	195.0	4.7	18.7	23.4
	-	-	-	-	-	-	-	-	-	-	-	-			
Northeastern US - Cape Cod Bay	2.2	27.1	29.3	30.9	374.6	405.5	-	-	-	31.2	378.4	409.7	1.0	79.2	80.2
Mid-Atlantic Block Island Sound															
New Bedford, MA	3.4	14.5	17.9	32.6	252.2	284.7	-	-	-	32.6	252.2	284.7	21.3	161.1	182.4
Providence, RI	10.2	99.9	110.0	141.7	1,921.1	2,062.8	-	-	-	141.7	1,921.1	2,062.8	68.7	785.7	854.3
New London, CT	51.6	29.2	80.9	612.4	437.8	1,050.2	-	-	-	612.4	437.8	1,050.2	236.5	196.4	432.9
New Haven, CT	74.6	39.9	114.5	1,538.1	721.0	2,259.1	-	-	-	1,538.1	721.0	2,259.1	737.1	330.8	1,067.9
Bridgeport, CT	45.1	12.6	57.8	765.1	162.4	927.5	-	-	-	765.1	162.4	927.5	275.4	83.1	358.4
Long Island, NY	136.0	25.3	161.3	2,781.7	481.4	3,263.1	-	-	-	2,781.7	481.4	3,263.1	1,328.5	232.8	1,561.3
Mid-Atlantic Ports of New York/New Jersey	179.0	2,950.3	3,129.3	2,414.6	36,724.9	39,139.5	-	-	-	2,414.6	36,724.9	39,139.5	721.9	11,078.4	11,800.3
Mid-Atlantic Delaware Bay	25.9	833.7	859.6	413.8	13,055.8	13,469.7	-	-	-	413.8	13,055.8	13,469.7	133.2	4,605.6	4,738.8
Mid-Atlantic Chesapeake Bay															
Baltimore, MD	35.3	788.6	823.9	493.4	11,828.5	12,321.9	-	-	-	493.4	11,828.5	12,321.9	157.8	3,880.9	4,038.7
Hampton Roads, VA	166.6	1,502.8	1,669.4	2,529.4	22,729.3	25,258.7	-	-	-	2,529.4	22,729.3	25,258.7	880.8	7,740.8	8,621.5
Mid-Atlantic Morehead City and Beaufort, NC	7.1	27.6	34.7	54.0	203.4	257.4	-	-	-	54.0	203.4	257.4	26.5	92.4	118.8
Mid-Atlantic Wilmington, NC	18.1	179.6	197.7	175.2	1,463.9	1,639.1	-	-	-	175.2	1,463.9	1,639.1	83.4	680.5	763.9
Mid-Atlantic Georgetown, SC	0.9	13.8	14.7	10.6	122.1	132.7	-	-	-	10.6	122.1	132.7	5.6	55.4	61.0
Mid-Atlantic Charleston, SC	317.2	1,193.1	1,510.3	2,191.7	8,227.3	10,418.9	-	-	-	2,191.7	8,227.3	10,418.9	1,076.7	3,966.1	5,042.7
Mid-Atlantic Savannah, GA	219.5	7,043.9	7,263.4	369.5	10,634.6	11,004.1	-	-	-	369.5	10,634.6	11,004.1	206.4	5,150.0	5,356.5
Southeastern US															
Brunswick, GA	109.8	622.3	732.1	155.5	760.3	915.9	42.0	211.0	253.0	207.4	1,037.1	1,244.5	204.3	1,021.7	1,226.0
Fernandina, FL	75.0	297.1	372.1	111.6	421.4	533.0	68.7	197.6	266.3	177.5	611.4	788.9	175.2	602.6	777.8
Jacksonville, FL	953.1	2,503.2	3,456.3	1,193.4	3,124.5	4,317.9	793.4	1,477.9	2,271.3	2,096.4	4,890.6	6,987.0	2,026.8	4,708.6	6,735.5
Port Canaveral, FL	92.7	4,523.0	4,615.7	13.1	790.1	803.2	-	-	-	31.6	1,694.7	1,726.3	18.5	904.6	923.1
Total	2,678.4	24,900.4	27,578.8	16,819.3	125,657.5	142,476.8	904.0	1,886.5	2,790.6	17,893.1	129,278.2	147,171.3	8,550.0	49,019.2	57,569.2

Source: Nathan Associates Inc.

- **Alternative 4 – Recommended Routes** would have the lowest direct economic impact of all the action alternatives, with an estimated $2.8 million annually. This alternative would have the lowest direct economic impact on US-flag vessels, at $0.9 million annually, and foreign-flag vessels, at $1.9 million annually.

4.4.1.8 Impacts of Alternative Speeds

In addition to the 10-knot speed restriction, the economic analysis also considered restrictions to 12 and 14 knots for each action alternatives. The findings of the analysis on the direct impacts to the shipping industry if these alternative speed restrictions were applied are summarized in this section. The estimated impacts were determined through a sensitivity analysis based on the range of speed restrictions. The dollar amounts refer to annual economic impact.

Data Chart 4-22 presents the results of the sensitivity analysis by port area based on 2004 conditions. The ranking of the alternatives in terms of economic impact relative to each other does not change with restricted speeds of 12 knots or 14 knots. A change in the speed restriction from 10 knots to 12 knots would generally reduce the direct economic impact of each alternative by 37 percent, whereas a change in the restricted speed from 10 knots to 14 knots would generally lower the direct economic impact of each alternative by more than 60 percent.[22]

The sensitivity analysis show that the level of speed restriction dramatically alters the level of direct economic impacts. For example, under Alternative 5, the impact would be $147.2 million annually with a 10-knot restriction and $55.2 million with a 14-knot restriction. For Alternative 6, the range is from $57.6 million to $21.5 million.

At a restricted speed of 12 knots, the annual direct economic impact on the shipping industry would be $92.8 million for Alternative 5; $89.2 million for Alternative 3; $36.0 million for Alternative 6; $17.7 million for Alternative 2; and $2.8 million for Alternative 4.

At a restricted speed of 14 knots, the annual direct economic impact on the shipping industry would be $55.2 million for Alternative 5; $52.5 million for Alternative 3; $21.5 million for Alternative 6; $10.8 million for Alternative 2; and $2.8 million for Alternative 4.

Data Chart 4-23 shows the sensitivity analysis results for each alternative using the economic impact of the 10-knot speed restriction as an index, i.e., the percentage of the direct economic impact of a 12-knot or 14-knot speed restriction relative to the that for a 10-knot speed restriction. The changes in economic impacts due to alternative speed restrictions are not uniformly incurred by all port areas. Port areas that are characterized by arrivals of slower vessels show a disproportionate decrease in economic impact when the restricted speed is changed from 10 knots to 12 knots, as fewer vessels would be affected at the higher limit. The port areas within Block Island Sound demonstrate this phenomenon. Other port areas, such as Charleston and Hampton Roads, where faster vessels make up a larger proportion of arrivals, do not show as dramatic a decrease in direct economic impacts at alternate restricted speeds of 12 knots. These port areas do not have many slower vessels that would only be affected at the slower restricted speed.

[22] The exception is Alternative 4, for which the impacts do not change with restricted speeds, as this alternative uses the time to cover the increased distance of recommended routes at normal vessel operating speed.

Data Chart 4-22
Direct Economic Impact on the Shipping Industry at Restricted Speeds of 10, 12 and 14 knots, 2004 ($000s)

	Alternative 2			Alternative 3			Alternative 4			Alternative 5			Alternative 6		
	Restriction speed in knots			Restriction speed in knots			Restriction speed in knots			Restriction speed in knots			Restriction speed in knots		
Port Area	10	12	14	10	12	14	10	12	14	10	12	14	10	12	14
Northeastern US - Gulf of Maine															
Eastport, ME	87.3	54.0	33.4	444.0	275.5	170.6	-	-	-	463.3	287.4	178.0	118.8	73.2	45.7
Searsport, ME	520.4	313.2	161.3	2,647.1	1,596.6	823.7	-	-	-	2,761.9	1,665.7	859.3	416.2	240.3	110.5
Portland, ME	744.3	380.4	136.3	3,785.5	1,938.7	696.4	-	-	-	3,949.7	2,022.6	726.4	955.4	464.6	138.0
Portsmouth, NH	138.4	60.9	13.9	703.7	310.5	70.9	-	-	-	734.2	323.9	74.0	182.5	79.6	18.2
Northeastern US - Off Race Point															
Boston, MA	802.1	460.0	217.7	4,244.4	2,339.7	1,065.9	-	-	-	4,421.4	2,441.2	1,113.9	1,130.8	630.8	291.6
Salem, MA	35.4	20.4	10.0	187.2	103.9	48.8	-	-	-	195.0	108.4	51.0	23.4	13.5	6.6
Northeastern US - Cape Cod Bay	29.3	20.4	11.6	405.5	234.9	114.3	-	-	-	409.7	237.8	116.0	80.2	44.5	18.0
Mid-Atlantic Block Island Sound															
New Bedford, MA	17.9	8.0	1.8	284.7	118.8	19.8	-	-	-	284.7	118.8	19.8	182.4	75.1	13.5
Providence, RI	110.0	63.0	31.4	2,062.8	1,144.2	534.5	-	-	-	2,062.8	1,144.2	534.5	854.3	438.8	176.4
New London, CT	80.9	46.5	21.6	1,050.2	585.3	261.6	-	-	-	1,050.2	585.3	261.6	432.9	234.1	101.3
New Haven, CT	114.5	49.2	6.3	2,259.1	944.3	106.2	-	-	-	2,259.1	944.3	106.2	1,067.9	441.4	48.9
Bridgeport, CT	57.8	23.0	2.1	927.5	332.1	3.1	-	-	-	927.5	332.1	3.1	358.4	125.1	1.3
Long Island, NY	161.3	71.0	11.2	3,263.1	1,397.3	208.0	-	-	-	3,263.1	1,397.3	208.0	1,561.3	655.4	94.9
Mid-Atlantic Ports of New York/New Jersey	3,129.3	2,118.0	1,375.0	39,139.5	26,088.1	16,704.8	-	-	-	39,139.5	26,088.1	16,704.8	11,800.3	7,743.8	4,891.4
Mid-Atlantic Delaware Bay	859.6	504.4	253.3	13,469.7	7,766.7	3,842.3	-	-	-	13,469.7	7,766.7	3,842.3	4,738.8	2,700.3	1,322.3
Mid-Atlantic Chesapeake Bay															
Baltimore, MD	823.9	530.3	319.5	12,321.9	7,773.2	4,601.6	-	-	-	12,321.9	7,773.2	4,601.6	4,038.7	2,511.4	1,469.6
Hampton Roads, VA	1,669.4	1,153.5	779.2	25,258.7	17,123.4	11,360.5	-	-	-	25,258.7	17,123.4	11,360.5	8,621.5	5,755.6	3,765.1
Mid-Atlantic Morehead City and Beaufort, NC	34.7	18.1	7.4	257.4	132.2	52.8	-	-	-	257.4	132.2	52.8	118.8	61.8	24.8
Mid-Atlantic Wilmington, NC	197.7	115.7	61.1	1,639.1	926.5	472.1	-	-	-	1,639.1	926.5	472.1	763.9	435.1	223.8
Mid-Atlantic Georgetown, SC	14.7	7.2	3.5	132.7	64.6	30.1	-	-	-	132.7	64.6	30.1	61.0	30.1	14.1
Mid-Atlantic Charleston, SC	1,510.3	1,053.2	717.3	10,418.9	6,979.3	4,566.4	-	-	-	10,418.9	6,979.3	4,566.4	5,042.7	3,379.2	2,212.4
Mid-Atlantic Savannah, GA	7,263.4	5,008.1	3,384.6	11,004.1	7,292.1	4,742.0	-	-	-	11,004.1	7,292.1	4,742.0	5,356.5	3,552.0	2,309.0
Southeastern US															
Brunswick, GA	732.1	459.4	273.7	915.9	556.9	321.2	253.0	253.0	253.0	1,244.5	839.4	560.3	1,226.0	828.2	553.8
Fernandina, FL	372.1	207.6	104.8	533.0	282.0	136.5	266.3	266.3	266.3	788.9	519.5	330.1	777.8	513.6	327.2
Jacksonville, FL	3,456.3	2,011.4	1,106.7	4,317.9	2,429.2	1,294.9	2,271.3	2,271.3	2,271.3	6,987.0	4,575.6	3,094.2	6,735.5	4,434.1	3,018.8
Port Canaveral, FL	4,615.7	2,943.9	1,737.1	803.2	493.5	281.2	-	-	-	1,726.3	1,082.3	628.6	923.1	588.8	347.4
Total	27,578.8	17,700.7	10,781.8	142,476.8	89,229.6	52,530.3	2,790.6	2,790.6	2,790.6	147,171.3	92,772.0	55,237.8	57,569.2	36,050.4	21,544.6

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-23
Direct Economic Impact on the Shipping Industry at Restricted Speeds of 10, 12 and 14 knots, 2004 (Indexed 10 Knots = 100)

	Alternative 2			Alternative 3			Alternative 4			Alternative 5			Alternative 6		
	Restriction speed in knots			Restriction speed in knots			Restriction speed in knots			Restriction speed in knots			Restriction speed in knots		
Port Area	10	12	14	10	12	14	10	12	14	10	12	14	10	12	14
Northeastern US - Gulf of Maine															
Eastport, ME	100.0	61.9	38.3	100.0	62.0	38.4	-	-	-	100.0	62.0	38.4	100.0	61.7	38.4
Searsport, ME	100.0	60.2	31.0	100.0	60.3	31.1	-	-	-	100.0	60.3	31.1	100.0	57.7	26.6
Portland, ME	100.0	51.1	18.3	100.0	51.2	18.4	-	-	-	100.0	51.2	18.4	100.0	48.6	14.4
Portsmouth, NH	100.0	44.0	10.0	100.0	44.1	10.1	-	-	-	100.0	44.1	10.1	100.0	43.6	10.0
Northeastern US - Off Race Point															
Boston, MA	100.0	57.3	27.1	100.0	55.1	25.1	-	-	-	100.0	55.2	25.2	100.0	55.8	25.8
Salem, MA	100.0	57.7	28.2	100.0	55.5	26.1	-	-	-	100.0	55.6	26.2	100.0	57.7	28.2
Northeastern US - Cape Cod Bay	100.0	69.5	39.4	100.0	57.9	28.2	-	-	-	100.0	58.0	28.3	100.0	55.5	22.5
Mid-Atlantic Block Island Sound															
New Bedford, MA	100.0	44.8	10.0	100.0	41.7	7.0	-	-	-	100.0	41.7	7.0	100.0	41.2	7.4
Providence, RI	100.0	57.3	28.6	100.0	55.5	25.9	-	-	-	100.0	55.5	25.9	100.0	51.4	20.7
New London, CT	100.0	57.5	26.8	100.0	55.7	24.9	-	-	-	100.0	55.7	24.9	100.0	54.1	23.4
New Haven, CT	100.0	42.9	5.5	100.0	41.8	4.7	-	-	-	100.0	41.8	4.7	100.0	41.3	4.6
Bridgeport, CT	100.0	39.8	3.6	100.0	35.8	0.3	-	-	-	100.0	35.8	0.3	100.0	34.9	0.4
Long Island, NY	100.0	44.0	7.0	100.0	42.8	6.4	-	-	-	100.0	42.8	6.4	100.0	42.0	6.1
Mid-Atlantic Ports of New York/New Jersey	100.0	67.7	43.9	100.0	66.7	42.7	-	-	-	100.0	66.7	42.7	100.0	65.6	41.5
Mid-Atlantic Delaware Bay	100.0	58.7	29.5	100.0	57.7	28.5	-	-	-	100.0	57.7	28.5	100.0	57.0	27.9
Mid-Atlantic Chesapeake Bay															
Baltimore, MD	100.0	64.4	38.8	100.0	63.1	37.3	-	-	-	100.0	63.1	37.3	100.0	62.2	36.4
Hampton Roads, VA	100.0	69.1	46.7	100.0	67.8	45.0	-	-	-	100.0	67.8	45.0	100.0	66.8	43.7
Mid-Atlantic Morehead City and Beaufort, NC	100.0	52.0	21.2	100.0	51.4	20.5	-	-	-	100.0	51.4	20.5	100.0	52.0	20.9
Mid-Atlantic Wilmington, NC	100.0	58.5	30.9	100.0	56.5	28.8	-	-	-	100.0	56.5	28.8	100.0	57.0	29.3
Mid-Atlantic Georgetown, SC	100.0	49.0	24.1	100.0	48.7	22.7	-	-	-	100.0	48.7	22.7	100.0	49.4	23.1
Mid-Atlantic Charleston, SC	100.0	69.7	47.5	100.0	67.0	43.8	-	-	-	100.0	67.0	43.8	100.0	67.0	43.9
Mid-Atlantic Savannah, GA	100.0	68.9	46.6	100.0	66.3	43.1	-	-	-	100.0	66.3	43.1	100.0	66.3	43.1
Southeastern US															
Brunswick, GA	100.0	62.7	37.4	100.0	60.8	35.1	100.0	100.0	100.0	100.0	67.4	45.0	100.0	67.5	45.2
Fernandina, FL	100.0	55.8	28.2	100.0	52.9	25.6	100.0	100.0	100.0	100.0	65.9	41.8	100.0	66.0	42.1
Jacksonville, FL	100.0	58.2	32.0	100.0	56.3	30.0	100.0	100.0	100.0	100.0	65.5	44.3	100.0	65.8	44.8
Port Canaveral, FL	100.0	63.8	37.6	100.0	61.4	35.0	-	-	-	100.0	62.7	36.4	100.0	63.8	37.6
Total	100.0	64.2	39.1	100.0	62.6	36.9	100.0	100.0	100.0	100.0	63.0	37.5	100.0	62.6	37.4

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

4.4.2 Additional Direct Economic Impacts on the Shipping Industry

This section describes additional direct economic impacts on the shipping industry relevant to vessels making multiple port calls on the US East Coast and to coastwise shipping vessels. The end of this section ties all of the direct economic costs on the shipping industry together, and describes the impacts relative to the value of US East Cost trade and ocean-freight costs.

Impacts on Vessels with Multiple Port Calls on the East Coast

Many of the vessels arrivals at US East Coast ports are part of a “string” of port calls by the vessel. For containerships, ro-ro cargo ships, and some specialty tankers, these multi-port calls constitute a scheduled cargo service offered by the shipping lines. Other types of vessels may have multiple US East Coast port calls as part of a coastwise cabotage service for delivering specialty chemicals or other products, or to lighten or top off in order to maximize vessel utilization.

Shipping industry representatives and port officials raised concerns during the stakeholder meetings regarding the cumulative effect of the proposed action and alternatives on vessels calling at multiple East Coast ports during speed-restricted periods. This section identifies the number of vessel arrivals at each port area that are part of a multi-port string during proposed restriction periods and estimates the additional direct economic impact on the shipping industry.

The USCG Vessel Arrival Database described in Chapter 3 was used to determine which vessels made multiple port calls along the US East Coast in 2003 and 2004. For purposes of this analysis, if a vessel arrived at another US East Coast port area within the two days following its arrival at the preceding US East Coast port, that arrival was considered to be a part of a multi-port string.[23]

Data Chart 4-24 lists sets of multi-port strings that occurred at least 20 times in 2003. Of the total of 4,278 occurrences of multi-port strings in 2003, those strings with at least 20 occurrences made up 2,760, or 65 percent, of the total observed. The multi-port string of New York/New Jersey–Hampton Roads–Charleston was the most frequent, with 293 occurrences, followed by the string of New York/New Jersey–Hampton Roads–Savannah, with 194 occurrences. The string of New York/New Jersey–Hampton Roads was third, with 151 occurrences.

Data Chart 4-25 presents a similar listing of US East Coast multi-port strings in 2004. Those strings with 20 or more occurrences accounted for 63 percent of the 4,461 total occurrences of multi-port strings that year. While some of the rankings change slightly, it is interesting to note that the port areas of New York/New Jersey or Hampton Roads are part of each of the top ten multi-port strings in both 2003 and 2004.

Other port areas with significant participation in multi-port strings each year include Charleston, Savannah, Baltimore, and Philadelphia.

[23] Vessels making multiple port calls within the same port area were not considered as part of a multi-port string, as they would not be passing through a speed-restricted area for the second port call.

Data Chart 4-24
US East Coast: Most Frequent Multi-Port Strings, 2003

Port Area 1	Port Area 2	Port Area 3	Port Area 4	Occurrences
New York City, NY	Hampton Roads, VA	Charleston, SC		293
New York City, NY	Hampton Roads, VA	Savannah, GA		194
New York City, NY	Hampton Roads, VA			151
Hampton Roads, VA	New York City, NY			143
New York City, NY	Baltimore, MD			139
New York City, NY	Philadelphia, PA			104
Charleston, SC	Hampton Roads, VA	New York City, NY		93
Baltimore, MD	New York City, NY			92
Savannah, GA	Hampton Roads, VA	New York City, NY		84
Savannah, GA	Hampton Roads, VA			76
Charleston, SC	Hampton Roads, VA			69
Charleston, SC	Jacksonville, FL			67
Savannah, GA	New York City, NY			65
Savannah, GA	Charleston, SC			58
Baltimore, MD	Hampton Roads, VA			54
Philadelphia, PA	Hampton Roads, VA			54
Charleston, SC	Wilmington, NC			53
Brunswick, GA	Charleston, SC			46
New York City, NY	Savannah, GA			46
Charleston, SC	New York City, NY			45
New York City, NY	Charleston, SC			43
Charleston, SC	Savannah, GA			41
Philadelphia, PA	New York City, NY			38
Hampton Roads, VA	Savannah, GA			38
Savannah, GA	Charleston, SC	Hampton Roads, VA	New York City, NY	37
Hampton Roads, VA	Charleston, SC			36
Jacksonville, FL	New York City, NY			36
Jacksonville, FL	Charleston, SC			35
Wilmington, NC	Savannah, GA			35
New York City, NY	Hampton Roads, VA	Charleston, SC	New York City, NY	33
Long Island, NY	New York City, NY			33
Philadelphia, PA	Baltimore, MD			28
Savannah, GA	Philadelphia, PA			28
New York City, NY	Baltimore, MD	Hampton Roads, VA		27
Jacksonville, FL	Baltimore, MD	New York City, NY		27
New York City, NY	Baltimore, MD	Savannah, GA		26
Hampton Roads, VA	Philadelphia, PA			26
Jacksonville, FL	Savannah, GA			26
New York City, NY	Baltimore, MD	Hampton Roads, VA	Charleston, SC	25
Hampton Roads, VA	Baltimore, MD			24
Portland, ME	Searsport, ME			24
New York City, NY	Savannah, GA	Hampton Roads, VA	New York City, NY	23
Jacksonville, FL	New York City, NY	Baltimore, MD		22
New York City, NY	Port Canaveral, FL			22
Savannah, GA	Jacksonville, FL			21
New York City, NY	Baltimore, MD	Charleston, SC		20
Hampton Roads, VA	Baltimore, MD	New York City, NY		20
Portland, ME	Boston, MA			20
New Haven, CT	New York City, NY			20
Subtotal				2,760
Other Strings				1,518
Total				**4,278**

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in the text.

Data Chart 4-25
US East Coast: Most Frequent Multi-Port Strings, 2004

Port Area 1	Port Area 2	Port Area 3	Port Area 4	Occurrences
New York City, NY	Hampton Roads, VA	Charleston, SC		279
New York City, NY	Hampton Roads, VA	Savannah, GA		223
New York City, NY	Hampton Roads, VA			187
Charleston, SC	Hampton Roads, VA	New York City, NY		183
New York City, NY	Baltimore, MD			162
Baltimore, MD	New York City, NY			119
Charleston, SC	Hampton Roads, VA			100
New York City, NY	Philadelphia, PA			99
Hampton Roads, VA	New York City, NY			86
Savannah, GA	New York City, NY			83
Philadelphia, PA	Hampton Roads, VA			69
Savannah, GA	Charleston, SC			65
Charleston, SC	Jacksonville, FL			64
Savannah, GA	Hampton Roads, VA	New York City, NY		58
Jacksonville, FL	New York City, NY			51
Wilmington, NC	Savannah, GA			49
Charleston, SC	Savannah, GA			47
Savannah, GA	Charleston, SC	New York City, NY		45
New York City, NY	Charleston, SC			42
New York City, NY	Hampton Roads, VA	Charleston, SC	New York City, NY	42
New York City, NY	Savannah, GA			40
Hampton Roads, VA	Charleston, SC			39
Charleston, SC	Wilmington, NC			39
New York City, NY	Baltimore, MD	Hampton Roads, VA	Charleston, SC	38
Baltimore, MD	Hampton Roads, VA			38
Philadelphia, PA	New York City, NY			38
New York City, NY	Baltimore, MD	Hampton Roads, VA	New York City, NY	37
Savannah, GA	Philadelphia, PA			37
Hampton Roads, VA	Baltimore, MD			35
Hampton Roads, VA	Savannah, GA			35
Jacksonville, FL	Baltimore, MD	New York City, NY		31
Charleston, SC	Brunswick, GA			31
New York City, NY	Port Canaveral, FL			31
Savannah, GA	Hampton Roads, VA			30
Jacksonville, FL	Savannah, GA			29
New York City, NY	Baltimore, MD	Hampton Roads, VA		28
New York City, NY	Savannah, GA	Hampton Roads, VA	New York City, NY	28
Hampton Roads, VA	Baltimore, MD	New York City, NY		25
Brunswick, GA	Charleston, SC			23
Hampton Roads, VA	Philadelphia, PA			22
Portland, ME	Searsport, ME			22
New York City, NY	Wilmington, NC	Savannah, GA		22
Baltimore, MD	Philadelphia, PA			21
Long Island, NY	New York City, NY			20
Subtotal				2,792
Other Strings				1,669
Total				**4,461**

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in the text.

The occurrences of multi-port strings presented above were based on total US East Coast vessel movements in 2003 and 2004. Additional economic impacts related to these strings are discussed below for each alternative. The main analysis is based on a speed restriction of 10 knots. Impacts with restrictions to 12 or 14 knots were also estimated and are summarized in Data Chart 4-43.

4.4.2.1 Alternative 1 – No Action Alternative

There would be no impacts on vessels making multiple port calls under Alternative 1.

4.4.2.2 Alternative 2 – Mandatory Dynamic Management Areas

There would be no impacts on vessels making multiple US East Coast port calls under Alternative 2. Due to its limited geographic scope at any one time, Alternative 2 would not generate an additional direct economic impact due to multi-port strings.

4.4.2.3 Alternative 3 – Speed Restrictions in Designated Areas

The additional direct economic impact on vessels making multiple US East Coast port calls under Alternative 3 was estimated at $11.3 million annually under 2003 conditions and $11.9 million annually under 2004 conditions[24].

Speed restrictions under Alternative 3 include restrictions that would be in place year-round in the NEUS, from October 1 through April 30 in the MAUS, and from November 15 through April 15 in the SEUS.

Data Chart 4-26 presents vessel arrivals in 2003 for port areas that are part of multi-port strings when at least two port areas in the string would have speed restrictions under Alternative 3. In 2003, 6,080 vessel arrivals fall into this category, with the 3,337 containership arrivals accounting for 55 percent of the total multi-port vessel arrivals during speed-restricted periods. Ro-ro cargo ships, with 1,052 arrivals (17 percent), and tankers, with 921 arrivals (15 percent), are the other vessel types with the most port calls as part of multi-port strings during restricted periods.

The 6,080 multi-port string restricted-period arrivals under 2003 conditions (see Data Chart 4-26) represent roughly 41 percent of total US East Coast Alternative 3 restricted-period arrivals (see Data Chart 4-3). For containerships, the multi-port string restricted arrivals represent 68 percent of the total containership restricted-period arrivals. For ro-ro cargo ships, the multi-port string restricted-period arrivals represent 61 percent of their total restricted-period arrivals in 2003.

The port area of New York/New Jersey has the greatest number of multi-port string restricted-period arrivals, with 1,489. The port area of Hampton Roads is second, with 1,083 arrivals, followed by the port areas of Charleston (737 arrivals), Savannah (631 arrivals), Baltimore (575 arrivals), and Philadelphia (345 arrivals).

[24] The same is true of Alternative 5, which includes the Alternative 3 speed restrictions and has no other source of multi-string additional impacts; therefore, the findings for Alternative 3 presented here also hold true for Alternative 5.

Data Chart 4-26
Alternatives 3 and 5: US East Coast Restricted Vessel Arrivals that are a part of a Multi-Port String, by Port Area and Vessel Type, 2003

Port Area	Vessel Type: Bulk Carriers	Combination Carriers	Container ships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	5	-	-	-	6	-	-	-	-	-	-	-	11
Searsport, ME	-	1	-	-	-	56	-	1	-	32	-	-	90
Portland, ME	6	-	-	-	6	12	-	19	-	65	1	-	109
Portsmouth, NH	2	1	-	-	-	1	-	-	-	35	1	-	40
Northeastern US - Off Race Point													
Boston, MA	1	-	21	-	1	57	-	21	-	50	-	-	151
Salem, MA	1	-	-	-	-	1	-	-	-	1	-	-	3
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	8	-	-	-	5	-	-	13
Mid-Atlantic Block Island Sound													
New Bedford, MA	5	-	-	-	4	-	-	-	-	6	-	-	15
Providence, RI	3	1	-	-	3	14	2	25	-	25	-	-	73
New London, CT	5	-	2	-	2	1	-	-	1	3	-	-	14
New Haven, CT	10	-	1	-	6	-	-	-	11	36	2	-	66
Bridgeport, CT	3	-	-	-	-	-	7	-	9	13	-	-	32
Long Island, NY	-	1	-	-	-	1	-	-	8	51	-	-	61
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	14	5	965	-	5	25	8	263	6	194	4	-	1,489
Mid-Atlantic Delaware Bay													
Philadelphia, PA	32	-	122	1	21	7	7	48	2	99	6	-	345
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	24	-	195	-	14	14	-	271	-	53	2	2	575
Hampton Roads, VA	24	2	898	-	25	8	-	82	-	42	-	2	1,083
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	2	-	5	-	5	-	-	1	-	6	-	1	20
Mid-Atlantic Wilmington, NC													
Wilmington, NC	19	4	41	-	19	-	1	6	6	55	1	-	152
Mid-Atlantic Georgetown, SC													
Georgetown, SC	4	-	1	-	3	-	-	-	-	-	-	-	8
Mid-Atlantic Charleston, SC													
Charleston, SC	12	-	554	-	13	10	-	77	3	66	2	-	737
Mid-Atlantic Savannah, GA													
Savannah, GA	22	5	464	-	37	4	5	45	2	46	-	1	631
Southeastern US													
Brunswick, GA	7	-	6	-	3	1	-	70	-	-	-	-	87
Fernandina, FL	1	-	6	-	10	1	-	-	-	-	-	-	18
Jacksonville, FL	7	-	53	1	6	2	-	115	4	37	3	-	228
Port Canaveral, FL	3	-	3	-	7	5	-	8	1	1	1	-	29
All Port Regions	**212**	**20**	**3,337**	**2**	**196**	**228**	**30**	**1,052**	**53**	**921**	**23**	**6**	**6,080**

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-27 presents multi-port string restricted-period arrivals under 2004 conditions. Compared to 2003 conditions, the total number of multi-port string restricted-period arrivals is higher by 5.5 percent, to 6,412 arrivals. The ranking by vessel type remains unchanged, with the exception of general cargo vessels moving ahead of bulk carriers into fifth place. In terms of vessel arrivals by port area, the rankings for the top eight port areas remain unchanged from 2003.

There are several way in which the cumulative effect of multiple port calls at restricted ports could affect a vessel. First, the delays incurred from speed restrictions at one port when combined with speed restrictions at a subsequent port may diminish the ability of the vessel to maintain its schedule and could result in missed tidal windows. Second, even brief delays in arrival at the second port could result in increased costs for scheduled, but unused, port labor. Third, some shipping lines suggested that the cumulative impact of three or four port calls at port areas with restrictions could cause them to rework vessel itineraries and could result in dropping one of the port calls in order to maintain a weekly service without having to add an additional vessel to the service.

However, these cumulative factors would not affect every vessel making multiple port calls at restricted ports. In addition, the impact may vary from an eight-hour delay due to a missed tidal window to incurring charges for unused labor if a vessel is late arriving at the port.[25] It is realistic to assume that shippers will revise their itineraries to account for the delays imposed by the speed restrictions and that occurrences of missed tidal widows will be rare. The economic analysis assumes an average additional delay of 36 minutes for each vessel arrival that is part of a multi-port string to account for this cumulative impact.[26] The economic value of this additional time has been calculated for each port area based on June 2008 vessel operating costs by type and size of vessel. The results by port area and type of vessel at a 10-knot speed restriction are presented in Data Chart 4-28 for 2003 conditions and Data Chart 4-29 for 2004 conditions.

As previously noted, the additional direct economic impact of multi-port strings on the shipping industry under 2003 conditions was estimated at $11.3 million annually. The port area of New York/New Jersey would have had the largest impact, at $2.9 million annually, followed by Hampton Roads, at $2.2 million, Charleston, at $1.5 million, Savannah, at $1.3 million, and Baltimore, at $0.9 million. Containerships account for 65 percent of the additional economic impact of multi-port strings.

[25] While tides occur on 12-hour cycles, it is assumed that a tidal window is open for two hours before and after high tide. This results in an 8-hour waiting period between tidal windows.

[26] Only a small proportion of vessel arrivals should be affected by this additional delay. It is estimated that 7.5 percent of vessels could be affected by as much as an additional 8-hour delay due to missing the tidal window. This results in an average additional delay per vessel of 36 minutes.

Data Chart 4-27
Alternatives 3 and 5: US East Coast Restricted Vessel Arrivals that are a Part of a Multi-Port String, by Port Area and Vessel Type, 2004

	Vessel Type												
Port Area	Bulk Carriers	Combination Carriers	Container ships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	9	-	-	-	4	-	-	-	-	-	-	-	13
Searsport, ME	-	-	-	-	1	35	-	-	1	41	3	-	81
Portland, ME	13	-	-	-	7	16	-	14	2	59	6	-	117
Portsmouth, NH	4	2	-	-	2	1	-	-	-	24	1	-	34
Northeastern US - Off Race Point													
Boston, MA	1	-	6	-	-	19	-	15	-	29	-	-	70
Salem, MA	6	-	-	-	-	5	-	-	-	-	-	-	11
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	11	-	-	-	5	-	-	16
Mid-Atlantic Block Island Sound													
New Bedford, MA	10	-	-	-	3	-	-	-	-	6	-	-	19
Providence, RI	8	-	-	-	1	22	-	27	-	19	1	-	78
New London, CT	1	-	3	-	3	1	-	-	2	3	-	-	13
New Haven, CT	2	-	3	-	2	-	-	-	45	36	-	-	88
Bridgeport, CT	4	-	-	-	-	-	7	-	43	17	-	-	71
Long Island, NY	-	-	-	-	-	-	-	-	29	52	-	-	81
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	14	5	1,003	-	20	40	8	264	1	189	2	1	1,547
Mid-Atlantic Delaware Bay													
Philadelphia, PA	13	1	113	2	27	10	7	51	-	99	5	-	328
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	15	-	216	-	24	18	2	281	-	60	4	1	621
Hampton Roads, VA	24	3	921	-	33	14	4	82	-	48	2	2	1,133
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	3	1	3	-	3	4	-	-	-	12	-	1	27
Mid-Atlantic Wilmington, NC													
Wilmington, NC	16	2	40	-	31	4	-	12	-	66	1	1	173
Mid-Atlantic Georgetown, SC													
Georgetown, SC	7	-	-	-	2	1	-	-	-	-	-	-	10
Mid-Atlantic Charleston, SC													
Charleston, SC	4	-	616	-	23	23	2	76	-	70	1	1	816
Mid-Atlantic Savannah, GA													
Savannah, GA	11	4	463	-	30	18	8	50	-	58	1	1	644
Southeastern US													
Brunswick, GA	6	-	6	-	11	4	-	80	-	-	-	-	107
Fernandina, FL	1	-	15	-	9	5	1	1	-	-	-	-	32
Jacksonville, FL	5	-	54	2	10	6	-	110	-	56	2	-	245
Port Canaveral, FL	2	-	5	-	7	9	-	9	-	4	1	-	37
All Port Regions	**179**	**18**	**3,467**	**4**	**253**	**266**	**39**	**1,072**	**123**	**953**	**30**	**8**	**6,412**

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-28
Alternatives 3 and 5: Additional Direct Economic Impact of Multi-Port Strings on the Shipping Industry, by Port Area and Vessel Type, 2003 ($000s)

Port Area	Vessel Type												Total
	Bulk Carriers	Combination Carriers	Container ships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	
Northeastern US - Gulf of Maine													
Eastport, ME	3.9	-	-	-	7.0	-	-	-	-	-	-	-	10.9
Searsport, ME	-	0.9	-	-	-	241.7	-	0.8	-	30.7	-	-	274.1
Portland, ME	4.5	-	-	-	4.9	53.0	-	14.3	-	62.0	1.3	-	140.0
Portsmouth, NH	1.5	0.9	-	-	-	4.6	-	-	-	32.8	1.3	-	41.2
Northeastern US - Off Race Point													
Boston, MA	0.8	-	46.5	-	0.6	176.6	-	16.7	-	47.3	-	-	288.5
Salem, MA	1.0	-	-	-	-	3.1	-	-	-	1.0	-	-	5.1
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	26.2	-	-	-	5.0	-	-	31.3
Mid-Atlantic Block Island Sound													
New Bedford, MA	6.1	-	-	-	2.5	-	-	-	-	5.6	-	-	14.2
Providence, RI	2.4	1.0	-	-	1.9	61.3	3.7	26.4	-	25.2	-	-	121.8
New London, CT	4.1	-	3.8	-	3.2	4.6	-	-	1.3	3.3	-	-	20.4
New Haven, CT	8.2	-	2.1	-	9.6	-	-	-	14.8	39.9	2.6	-	77.3
Bridgeport, CT	2.6	-	-	-	-	-	13.9	-	12.1	16.3	-	-	44.8
Long Island, NY	-	1.0	-	-	-	4.6	-	-	10.7	61.0	-	-	77.4
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	11.4	4.9	2,142.3	-	4.1	108.9	23.5	377.8	8.1	207.4	5.2	-	2,893.7
Mid-Atlantic Delaware Bay													
Philadelphia, PA	25.3	-	211.4	1.2	21.0	28.1	32.6	51.2	2.7	103.3	7.9	-	484.6
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	19.3	-	358.4	-	12.8	59.2	-	371.4	-	51.3	2.6	2.8	877.8
Hampton Roads, VA	21.8	2.1	1,956.4	-	23.0	37.6	-	157.4	-	41.5	-	2.8	2,242.6
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	2.1	-	8.8	-	4.5	-	-	1.6	-	6.0	-	0.7	23.7
Mid-Atlantic Wilmington, NC													
Wilmington, NC	15.6	3.7	86.7	-	30.9	-	1.7	12.4	8.3	54.9	1.3	-	215.7
Mid-Atlantic Georgetown, SC													
Georgetown, SC	3.2	-	1.3	-	5.9	-	-	-	-	-	-	-	10.4
Mid-Atlantic Charleston, SC													
Charleston, SC	9.6	-	1,289.7	-	19.9	43.1	-	100.2	4.2	68.7	2.6	-	1,538.0
Mid-Atlantic Savannah, GA													
Savannah, GA	17.6	4.5	1,105.0	-	53.1	15.4	29.1	64.2	2.7	47.8	-	0.7	1,340.1
Southeastern US													
Brunswick, GA	5.5	-	10.9	-	5.2	4.6	-	88.4	-	-	-	-	114.5
Fernandina, FL	0.9	-	5.8	-	16.3	4.6	-	-	-	-	-	-	27.6
Jacksonville, FL	5.4	-	100.1	1.2	9.6	9.3	-	127.2	5.6	36.8	3.9	-	299.0
Port Canaveral, FL	2.3	-	5.7	-	8.4	22.9	-	7.7	1.4	0.9	1.3	-	50.6
All Port Regions	**175.0**	**19.2**	**7,334.6**	**2.4**	**244.3**	**909.5**	**104.5**	**1,417.6**	**72.0**	**948.7**	**30.2**	**7.0**	**11,265.1**

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-29
Alternatives 3 and 5: Additional Direct Economic Impact of Multi-Port Strings on the Shipping Industry, by Port Area and Vessel Type, 2004 ($000s)

	Vessel Type												
Port Area	Bulk Carriers	Combination Carriers	Containerships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	6.8	-	-	-	10.3	-	-	-	-	-	-	-	17.1
Searsport, ME	-	-	-	-	0.5	143.3	-	-	1.3	39.0	2.9	-	187.1
Portland, ME	10.0	-	-	-	10.9	79.4	-	10.5	2.6	56.5	5.3	-	175.3
Portsmouth, NH	3.3	1.7	-	-	2.8	4.6	-	-	-	21.6	0.8	-	34.8
Northeastern US - Off Race Point													
Boston, MA	0.7	-	13.9	-	-	58.9	-	11.3	-	25.9	-	-	110.7
Salem, MA	6.7	-	-	-	-	19.8	-	-	-	-	-	-	26.6
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	48.4	-	-	-	4.8	-	-	53.3
Mid-Atlantic Block Island Sound													
New Bedford, MA	11.3	-	-	-	1.9	-	-	-	-	5.1	-	-	18.2
Providence, RI	7.3	-	-	-	0.6	94.0	-	29.1	-	17.6	0.8	-	149.6
New London, CT	0.8	-	5.9	-	7.8	4.5	-	-	2.6	3.3	-	-	25.0
New Haven, CT	1.6	-	4.5	-	1.8	-	-	-	60.4	40.0	-	-	108.3
Bridgeport, CT	3.4	-	-	-	-	-	13.6	-	57.3	22.1	-	-	96.4
Long Island, NY	-	-	-	-	-	-	-	-	38.6	63.3	-	-	101.9
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	10.8	4.4	2,191.0	-	24.0	182.0	18.6	408.1	1.3	199.6	2.6	0.7	3,043.1
Mid-Atlantic Delaware Bay													
Philadelphia, PA	10.1	0.9	188.1	2.0	24.1	32.4	36.7	55.8	-	108.2	6.6	-	464.9
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	14.4	-	390.4	-	27.2	71.6	5.8	386.2	-	62.5	4.2	0.5	962.9
Hampton Roads, VA	22.4	2.6	1,985.6	-	33.5	60.7	11.6	163.3	-	46.2	2.6	1.2	2,329.7
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	2.8	0.8	5.7	-	3.9	18.6	-	-	-	10.9	-	0.7	43.4
Mid-Atlantic Wilmington, NC													
Wilmington, NC	13.3	1.8	79.8	-	50.3	17.0	-	23.9	-	66.3	1.3	0.7	254.4
Mid-Atlantic Georgetown, SC													
Georgetown, SC	5.6	-	-	-	2.3	4.6	-	-	-	-	-	-	12.6
Mid-Atlantic Charleston, SC													
Charleston, SC	3.1	-	1,371.1	-	31.7	90.6	5.8	98.5	-	69.8	0.8	0.7	1,672.0
Mid-Atlantic Savannah, GA													
Savannah, GA	8.9	3.6	1,116.0	-	54.5	77.3	40.7	72.4	-	58.1	1.3	0.7	1,433.4
Southeastern US													
Brunswick, GA	4.6	-	9.2	-	19.2	18.6	-	104.0	-	-	-	-	155.5
Fernandina, FL	0.8	-	14.4	-	17.7	23.2	2.0	2.8	-	-	-	-	61.0
Jacksonville, FL	3.9	-	95.0	2.0	10.8	26.3	-	122.8	-	56.0	2.6	-	319.4
Port Canaveral, FL	1.7	-	9.4	-	9.7	39.4	-	11.0	-	3.6	1.3	-	76.1
All Port Regions	**154.4**	**15.8**	**7,480.1**	**4.0**	**345.5**	**1,115.2**	**134.8**	**1,499.8**	**164.3**	**980.4**	**33.1**	**5.1**	**11,932.6**

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

The additional direct economic impact of multi-port strings under 2004 conditions was estimated at $11.9 million annually. The ranking of the top six port areas in terms of largest impact is the same as under 2003 conditions.

The additional annual direct economic impact of multi-port strings in 2004 at a speed restriction of 12 knots would be $9.9 million, and, at 14 knots, $8.4 million. The impacts by alternative and restricted speed are presented in Data Chart 4-43.[27]

4.4.2.4 Alternative 4 – Recommended Shipping Routes

Under Alternative 4, there would be no impacts on vessels making multiple US East Coast port calls. Because of the limited geographic scope of the proposed measures at any time, Alternative 4 would not generate additional direct economic impacts.

4.4.2.5 Alternative 5 – Combination of Alternatives

The additional direct economic impact on vessels making multiple US East Coast port calls under Alternative 5 with a 10-knot speed restriction was estimated at $11.3 million annually for 2003 conditions and $11.9 million annually for 2004 conditions. With a 12-knot restriction, the impact would be $9.9 million (2004 conditions); with a 14-knot restriction, it would be $8.4 million (also 2004 conditions). See Section 4.4.2.3 for details.

4.4.2.6 Alternative 6 – Proposed Action (Preferred Alternative)

The additional annual direct economic impact on vessels making multiple US East Coast port calls under Alternative 6 was estimated at $8.7 million under 2003 conditions and $9.4 million under 2004 conditions.

Seasonal speed restrictions by port area under Alternative 6 would occur during March and April in the Off Race Point area, from January 1 through May 15 in Cape Cod Bay; and from April 1 through July 31 in Great South Channel; from November 1 through April 30 in the MAUS region; and from November 15 through April 15 in the SEUS region.

Data Chart 4-30 shows 2003 vessel arrivals for port areas with speed restrictions that are part of multi-port strings, when at least two port areas in the string would have speed restrictions under Alternative 6. In 2003, there were 4,829 such arrivals, with 2,870 containership arrivals accounting for 59 percent of the total. Ro-ro cargo ships, with 1,075 arrivals (22 percent), and tankers with 722 arrivals (15 percent), were the other vessel types with the most port calls as parts of multi-port strings during restricted periods.

The 4,829 multi-port string restricted-period arrivals in 2003 represented roughly 41 percent of the total US East Coast restricted-period vessel arrivals under Alternative 6 (see Data Chart 4-15). For containerships, the multi-port string restricted-period arrivals represented 69 percent of the total containership restricted-period arrivals. For ro-ro cargo ships the multi-port string restricted-period arrivals represented 73 percent of the total restricted-period arrivals.

[27] The impact at 12 knots was assumed to be 17 percent lower than the estimate at 10 knots. The impact at 14 knots was assumed to be 30 percent lower than the estimate at 10 knots. As explained above, it is realistic to assume that the shipping industry would revise itineraries to account for the known delays due to speed restrictions. The additional impact for multi-port vessel calls applies to more unknown delays that may occur. At a restricted speed of 12 or 14 knots, the overall known delays are shorter, thereby creating less opportunity for the unknown delays to occur. This factor was judged to be proportionate to the change in the restricted speed.

Data Chart 4-30
Alternative 6: US East Coast Restricted Vessel Arrivals that are a Part of Multi-Port String, by Port Area and Vessel Type, 2003

Port Area	Vessel Type: Bulk Carriers	Combination Carriers	Container ships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	1	-	-	-	-	-	-	-	-	-	-	-	1
Searsport, ME	-	-	-	-	-	-	-	-	-	9	-	-	9
Portland, ME	1	-	-	-	-	-	-	5	-	20	-	-	26
Portsmouth, NH	-	-	-	-	-	-	-	-	-	15	-	-	15
Northeastern US - Off Race Point													
Boston, MA	1	-	9	-	1	-	-	7	-	26	-	-	44
Salem, MA	1	-	-	-	-	-	-	-	-	-	-	-	1
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	-	-	-	-	4	-	-	4
Mid-Atlantic Block Island Sound													
New Bedford, MA	3	-	-	-	4	-	-	-	-	5	-	-	12
Providence, RI	3	1	-	-	3	-	2	20	-	17	-	-	46
New London, CT	3	-	2	-	2	1	-	-	1	2	-	-	11
New Haven, CT	7	-	1	-	5	-	-	-	11	30	1	-	55
Bridgeport, CT	2	-	-	-	-	-	6	-	9	10	-	-	27
Long Island, NY	-	1	-	-	-	1	-	-	8	42	-	-	52
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	11	5	814	-	5	1	7	226	6	159	2	-	1,236
Mid-Atlantic Delaware Bay													
Philadelphia, PA	25	-	103	1	19	1	7	40	2	86	5	-	289
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	17	-	164	-	14	4	-	236	-	44	1	1	481
Hampton Roads, VA	18	2	764	-	22	1	-	69	-	35	-	1	912
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	2	-	3	-	3	-	-	1	-	4	-	1	14
Mid-Atlantic Wilmington, NC													
Wilmington, NC	18	4	33	-	12	-	1	5	6	46	1	-	126
Mid-Atlantic Georgetown, SC													
Georgetown, SC	4	-	1	-	2	-	-	-	-	-	-	-	7
Mid-Atlantic Charleston, SC													
Charleston, SC	10	-	459	-	10	4	-	75	3	57	2	-	620
Mid-Atlantic Savannah, GA													
Savannah, GA	16	5	387	-	29	2	5	37	2	39	-	1	523
Southeastern US													
Brunswick, GA	7	-	6	-	3	1	-	70	-	-	-	-	87
Fernandina, FL	1	-	6	-	10	1	-	-	-	-	-	-	18
Jacksonville, FL	5	-	53	1	6	-	-	107	3	36	2	-	213
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	0
All Port Regions	**169**	**18**	**2,870**	**3**	**169**	**19**	**28**	**1,075**	**54**	**722**	**16**	**4**	**4,829**

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

The port area of New York/New Jersey had the greatest number of 2003 multi-port string restricted-period arrivals, with 1,236 arrivals. The port area of Hampton Roads was second, with 912 arrivals, followed by the port areas of Charleston (620 arrivals), Savannah (523 arrivals), Baltimore (481 arrivals), and Philadelphia (289 arrivals).

Data Chart 4-31 presents the same data for 2004. The total number of multi-port string restricted arrivals increased by 6.6 percent to 5,147 arrivals. The ranking by type of vessel remained unchanged from 2003 with the exception of general cargo vessels moving ahead of bulk carriers for fourth place. In terms of vessel arrivals by port area, the rankings for the top eight port areas remained unchanged from 2003.

The additional direct economic impact of multi-port strings on the shipping industry based on 2003 conditions was estimated at $8.7 million annually (Data Chart 4-32). The port area of New York/New Jersey would have had the largest additional economic impact, at $2.4 million, followed by Hampton Roads at $1.9 million, Charleston at $1.3 million, Savannah at $1.1 million, and Baltimore at $0.7 million. Containerships accounted for 71 percent of the additional economic impact of multi-port strings.

The additional annual direct economic impact of multi-port strings in 2004 was estimated at $9.4 million (Data Chart 4-33). The ranking of the top six port areas in terms of largest impact is similar for 2004 to what it is for 2003.

With a 12-knot speed restriction, the additional annual direct economic impact of multi-port strings would be $7.8 million (2004 conditions); with a 14-knot restriction, it would be $6.6 million (2004 conditions). These impacts are included in Data Chart 4-43.

Re-routing of Southbound Coastwise Shipping

Alternatives 3, 5, and 6 would also have a direct effect on coastwise shipping. There would be no such impacts under Alternatives 1, 2, or 4.

Coastwise shipping, or cabotage trade, along the US East Coast has always been an important segment of the nation’s maritime heritage. In recent years, attention focused on the development of coastwise shipping (also referred to as short-sea shipping) as a means of reducing highway congestion on the eastern seaboard. The benefits of coastwise shipping also include lowering transport and environmental costs and reducing demand for imported fuel. For these reasons, it is important that the speed restrictions not unduly affect the development of increased coastwise shipping.

However, for commercial and navigation purposes, it appears unlikely that speed restrictions would significantly affect coastwise shipping. Northbound vessels prefer to use the Gulf Stream further offshore and benefit from the enhanced operating speed and fuel efficiency. Southbound traffic routes closer to the East Coast – generally within 7 to 10 nm (13 to 18.5 km) of the shoreline. During the proposed seasonal management periods, masters of southbound vessels would likely route outside the seasonal speed-restricted areas, thereby incurring an overall increase in distance. This would affect southbound vessels between the entrance to the Chesapeake Bay and Port Canaveral.

Under Alternatives 3 and 5, the proposed speed restrictions would be in effect for a distance of 25 nm (46 km) from the coast along the entire mid-Atlantic coastline. Containerships and ro-ro cargo ships are the vessel types that would be most affected.

Data Chart 4-31
Alternative 6: US East Coast Restricted Vessel Arrivals that are a Part of Multi-Port String, by Port Area and Vessel Type, 2004

	Vessel Type												
Port Area	Bulk Carriers	Combination Carriers	Container ships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	3	-	-	-	-	-	-	-	-	-	-	-	3
Searsport, ME	-	-	-	-	-	-	-	-	1	10	-	-	11
Portland, ME	3	-	-	-	1	-	-	5	2	19	-	-	30
Portsmouth, NH	-	1	-	-	-	-	-	-	-	6	-	-	7
Northeastern US - Off Race Point													
Boston, MA	-	-	3	-	-	-	-	5	-	11	-	-	19
Salem, MA	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	1	-	-	-	3	-	-	4
Mid-Atlantic Block Island Sound													
New Bedford, MA	8	-	-	-	2	-	-	-	-	5	-	-	15
Providence, RI	5	-	-	-	-	5	-	22	-	15	-	-	47
New London, CT	1	-	3	-	3	-	-	-	2	3	-	-	12
New Haven, CT	2	-	3	-	2	-	-	-	39	33	-	-	79
Bridgeport, CT	3	-	-	-	-	-	6	-	42	12	-	-	63
Long Island, NY	-	-	-	-	-	-	-	-	24	46	-	-	70
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	9	4	843	-	16	5	7	224	1	151	2	-	1,262
Mid-Atlantic Delaware Bay													
Philadelphia, PA	8	1	100	2	22	4	7	41	-	88	5	-	278
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	10	-	182	-	23	6	2	240	-	49	2	-	514
Hampton Roads, VA	19	3	779	-	28	8	4	69	-	40	2	-	952
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	3	1	3	-	3	4	-	-	-	10	-	-	24
Mid-Atlantic Wilmington, NC													
Wilmington, NC	13	2	33	-	23	3	-	10	-	58	1	-	143
Mid-Atlantic Georgetown, SC													
Georgetown, SC	6	-	-	-	2	1	-	-	-	-	-	-	9
Mid-Atlantic Charleston, SC													
Charleston, SC	4	-	519	-	20	14	2	69	-	60	-	1	689
Mid-Atlantic Savannah, GA													
Savannah, GA	8	4	390	-	23	15	8	42	-	52	1	1	544
Southeastern US													
Brunswick, GA	6	-	6	-	11	4	-	80	-	-	-	-	107
Fernandina, FL	-	-	15	-	9	5	1	1	-	-	-	-	31
Jacksonville, FL	5	-	54	2	10	6	-	103	-	53	1	-	234
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	-
All Port Regions	127	16	3,008	6	228	96	38	1,095	111	777	15	2	5,147

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-32
Alternative 6: Additional Direct Economic Impact on the Shipping Industry by Port Area and Vessel Type, 2003 ($000s)

	Vessel Type												
Port Area	Bulk Carriers	Combination Carriers	Container ships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	0.7	-	-	-	-	-	-	-	-	-	-	-	0.7
Searsport, ME	-	-	-	-	-	-	-	-	-	8.9	-	-	8.9
Portland, ME	0.7	-	-	-	-	-	-	3.8	-	19.9	-	-	24.4
Portsmouth, NH	-	-	-	-	-	-	-	-	-	13.8	-	-	13.8
Northeastern US - Off Race Point													
Boston, MA	0.8	-	19.1	-	0.6	-	-	5.5	-	24.2	-	-	50.2
Salem, MA	1.0	-	-	-	-	-	-	-	-	-	-	-	1.0
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	-	-	-	-	4.0	-	-	4.0
Mid-Atlantic Block Island Sound													
New Bedford, MA	3.7	-	-	-	2.5	-	-	-	-	4.7	-	-	10.9
Providence, RI	2.4	1.0	-	-	1.9	-	3.7	21.3	-	17.7	-	-	48.0
New London, CT	2.4	-	3.8	-	3.2	4.6	-	-	1.3	2.3	-	-	17.7
New Haven, CT	5.8	-	2.1	-	7.1	-	-	-	14.8	33.0	1.3	-	64.1
Bridgeport, CT	1.7	-	-	-	-	-	11.9	-	12.1	13.1	-	-	38.8
Long Island, NY	-	1.0	-	-	-	4.6	-	-	10.7	49.7	-	-	66.1
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	8.9	4.9	1,813.1	-	4.1	4.5	21.5	317.1	8.1	168.7	2.6	-	2,353.7
Mid-Atlantic Delaware Bay													
Philadelphia, PA	20.0	-	177.8	1.2	18.6	4.5	32.6	42.5	2.7	87.8	6.6	-	394.4
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	13.7	-	305.4	-	12.8	18.1	-	321.4	-	41.7	1.3	1.4	715.8
Hampton Roads, VA	16.1	2.1	1,667.9	-	20.4	4.5	-	131.9	-	34.2	-	1.4	1,878.5
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	2.1	-	5.1	-	3.6	-	-	1.6	-	4.2	-	0.7	17.2
Mid-Atlantic Wilmington, NC													
Wilmington, NC	14.9	3.7	69.9	-	20.5	-	1.7	10.4	8.3	45.6	1.3	-	176.4
Mid-Atlantic Georgetown, SC													
Georgetown, SC	3.2	-	1.3	-	4.2	-	-	-	-	-	-	-	8.7
Mid-Atlantic Charleston, SC													
Charleston, SC	8.0	-	1,080.0	-	15.0	16.7	-	97.5	4.2	59.2	2.6	-	1,283.2
Mid-Atlantic Savannah, GA													
Savannah, GA	12.8	4.5	930.8	-	41.2	7.7	29.1	52.7	2.7	40.9	-	0.7	1,123.2
Southeastern US													
Brunswick, GA	5.5	-	10.9	-	5.2	4.6	-	88.4	-	-	-	-	114.5
Fernandina, FL	0.9	-	5.8	-	16.3	4.6	-	-	-	-	-	-	27.6
Jacksonville, FL	3.9	-	100.1	1.2	9.6	-	-	119.4	4.2	35.8	2.6	-	276.8
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	-
All Port Regions	**129.1**	**17.4**	**6,193.0**	**2.4**	**186.9**	**74.7**	**100.6**	**1,213.3**	**69.2**	**709.5**	**18.4**	**4.2**	**8,718.7**

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

Data Chart 4-33
Alternative 6: Additional Direct Economic Impact on the Shipping Industry by Port Area and Vessel Type, 2004 ($000s)

	Vessel Type												
Port Area	Bulk Carriers	Combination Carriers	Container ships	Freight Barges	General Cargo Vessels	Passenger Vessels a/	Refrigerated Cargo Vessels	Ro-Ro Cargo Ship	Tank Barges	Tankers	Towing Vessels	Other b/	Total
Northeastern US - Gulf of Maine													
Eastport, ME	2.2	-	-	-	-	-	-	-	-	-	-	-	2.2
Searsport, ME	-	-	-	-	-	-	-	-	1.3	9.1	-	-	10.5
Portland, ME	2.2	-	-	-	0.6	-	-	3.8	2.6	19.1	-	-	28.3
Portsmouth, NH	-	0.9	-	-	-	-	-	-	-	5.4	-	-	6.2
Northeastern US - Off Race Point													
Boston, MA	-	-	6.9	-	-	-	-	3.8	-	10.0	-	-	20.6
Salem, MA	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Cape Cod Bay													
Cape Cod, MA	-	-	-	-	-	4.5	-	-	-	2.8	-	-	7.4
Mid-Atlantic Block Island Sound													
New Bedford, MA	9.1	-	-	-	1.3	-	-	-	-	4.2	-	-	14.6
Providence, RI	4.4	-	-	-	-	19.8	-	24.0	-	13.9	-	-	62.2
New London, CT	0.8	-	5.9	-	7.8	-	-	-	2.6	3.3	-	-	20.4
New Haven, CT	1.6	-	4.5	-	1.8	-	-	-	52.5	37.3	-	-	97.7
Bridgeport, CT	2.4	-	-	-	-	-	11.6	-	56.0	15.6	-	-	85.6
Long Island, NY	-	-	-	-	-	-	-	-	32.0	56.5	-	-	88.6
Mid-Atlantic Ports of New York/New Jersey													
New York City, NY	7.0	3.5	1,843.2	-	18.1	19.8	16.6	343.3	1.3	162.1	2.6	-	2,417.5
Mid-Atlantic Delaware Bay													
Philadelphia, PA	6.2	0.9	165.4	2.0	19.3	13.8	36.7	45.4	-	96.7	6.6	-	392.8
Mid-Atlantic Chesapeake Bay													
Baltimore, MD	9.6	-	330.6	-	26.6	25.8	5.8	326.9	-	50.6	2.6	-	778.4
Hampton Roads, VA	18.3	2.6	1,686.8	-	26.7	33.6	11.6	137.6	-	38.2	2.6	-	1,958.1
Mid-Atlantic Morehead City and Beaufort, NC													
Morehead City, NC	2.8	0.8	5.7	-	3.9	18.6	-	-	-	9.1	-	-	40.9
Mid-Atlantic Wilmington, NC													
Wilmington, NC	10.8	1.8	66.3	-	41.0	13.9	-	19.7	-	58.9	1.3	-	213.8
Mid-Atlantic Georgetown, SC													
Georgetown, SC	4.8	-	-	-	2.3	4.6	-	-	-	-	-	-	11.8
Mid-Atlantic Charleston, SC													
Charleston, SC	3.1	-	1,165.4	-	28.7	61.2	5.8	90.4	-	59.8	-	0.7	1,415.0
Mid-Atlantic Savannah, GA													
Savannah, GA	6.4	3.6	936.7	-	43.7	68.0	40.7	61.6	-	51.9	1.3	0.7	1,214.8
Southeastern US													
Brunswick, GA	4.6	-	9.2	-	19.2	18.6	-	104.0	-	-	-	-	155.5
Fernandina, FL	-	-	14.4	-	17.7	23.2	2.0	2.8	-	-	-	-	60.1
Jacksonville, FL	3.9	-	95.0	2.0	10.8	26.3	-	116.0	-	53.2	1.3	-	308.5
Port Canaveral, FL	-	-	-	-	-	-	-	-	-	-	-	-	-
All Port Regions	**100.3**	**14.1**	**6,335.9**	**4.0**	**269.4**	**351.7**	**130.8**	**1,279.3**	**148.4**	**757.9**	**18.4**	**1.4**	**9,411.5**

a/ Includes recreational vessels.

b/ Includes fishing vessels, industrial vessels, research vessels, and school ships.

Source: Prepared by Nathan Associates Inc. based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

In 2003, there were 4,142 restricted-period arrivals at East Coast port areas from Baltimore through Port Canaveral of containerships and ro-ro cargo ships providing coastal liner service in international trade and cabotage routes. Assuming half of these calls were in the southbound direction, and that the typical vessel made calls at three US East Coast ports per service, there would be about 690 southbound vessels that would need to route outside of the seasonal speed-restricted areas. Based on an increase in routing of 108 nm[28] (200 km) and an average operating speed of 20 knots, the containership would have an increased sailing time of 5.4 hours. Using an approximate average hourly operating cost at sea of $2,000, the estimated economic impact for each southbound vessel would be $10,800. under 2003 conditions, the additional economic impact for containerships for coastwise shipping would be $7.5 million. Under 2004 conditions, it would be $7.6 million.

Under Alternative 6, the proposed speed restrictions in the mid-Atlantic region would be implemented within a 30-nm (56-km)-wide rectangle at Block Island Sound; a 20-nm (37-km) radius around each port area from the ports of New York and New Jersey south to the ports of Morehead City and Beaufort, North Carolina; and finally a continuous 20-nm (37-km) area from Wilmington, North Carolina, south to the northern boundary of the Southeast SMA. The additional distance incurred by southbound vessels would be 56 nm (104 km).[29] In 2003, there were 3,688 containership and ro-ro cargo ship restricted-period arrivals at US East Coast port areas from Baltimore thorough Port Canaveral. Assuming half of these calls were in the southbound direction, and that the typical vessel made calls at three East Coast ports per service, there would be about 615 southbound vessels that would need to route outside of the seasonal speed-restricted areas. Based on an increase in routing of 56 nm (104 km) and an average operating speed of 20 knots, each containership would have increased sailing time of 2.8 hours. Using an average hourly operating cost at sea of $2,000, the estimated economic impact for each southbound vessel would be $5,600. For 2003 and 2004, the additional economic impact on containerships for coastwise shipping under Alternative 6 would be $3.4 million annually.

In some comments on the DEIS, it was argued that restrictions are proposed during winter months, when speed and schedules are already adversely affected by weather; therefore, economic impacts would be greater. However, to the degree that vessels are operating at slower speeds during winter months, winter-time speed restrictions would actually result in lesser economic impacts.

[28] To avoid speed restrictions when traveling between ports, the vessels are assumed to sail outside of the 25 nm (46 km) SMA instead of the typical 8 nm (15 km) offshore. Based on a diagonal routing to the pilot buoy, the 25 nm (46 km) becomes an effective 37 nm (67 km). However, the diagonal access for a routing 8 nm (15 km) offshore is 10 nm (19 km). Thus, the difference of 27 nm (50 km) is the additional distance incurred resulting from having to sail further offshore per arrival and departure at the intermediate port calls.

[29] Vessels calling at port areas with circular buffers would have to travel 20 nm (37 km) for diagonal access to the port as compared to a normal distance of 10 nm (19 km) for diagonal access. The extra distance of 10 nm (19 km) applies to both arrival and departure for a total additional distance of 20 nm (37 km). Vessels calling at port areas with a continuous buffer from the shoreline are assumed to have an additional distance of 18 nm (34 km) each way, for a total of 36 nm (67 km) for an arrival and departure. As there is an average of three port calls and hence two intermediate port calls per service, the analysis assumes one intermediate call per string at a port area with a circular buffer in the northern portion of the MAUS (e.g., Hampton Roads) and one intermediate call per string at a southern MAUS port area with a continuous buffer (e.g., Savannah), for a total additional distance of 56 nm (104 km).

Direct Economic Impact on the Shipping Industry Relative to the Value of US East Coast Trade and Ocean Freight Costs

Section 3.4.2 presents data collected by the US Census Bureau on the volume and value of goods carried by vessels calling at US East Coast ports. It also presents information on vessel import charges that represent the aggregate cost of all freight, insurance, and other charges (excluding US import duties) incurred in bringing the merchandise from alongside the carrier at the port of exportation and placing it alongside the carrier at the first port of entry. In this section, the estimates of the direct economic impact on the shipping industry are compared to these indicators of the economic significance of US East Coast maritime activity.

Data Chart 4-34 shows, for each alternative, the significance of the estimated economic impact relative to the value of US East Coast trade in 2003 and 2004. This comparison is useful in determining whether increased shipping costs associated with the proposed operational measures would significantly affect the price and volume of traded goods via US East Coast ports. The direct economic impact on the shipping industry for each alternative is based on the base-case analyses presented in this chapter, including a speed restriction of 10 knots, unless otherwise stated. The value of trade merchandise is the same as reported in Chapter 3 for US East Coast imports and exports by Customs District and Port. In 2003, the total annual direct economic impact on the shipping industry of Alternative 5, the alternative with the greatest direct impact, would have been $155.8 million, while the value of US East Coast trade was $298.7 billion. This represents 0.052 percent of the value of traded merchandise in 2003 and 0.051 percent of the 2004 value. For other alternatives, the relative economic impact would be even smaller. In particular, for Alternative 6, it would be 0.022 percent (both in 2003 and 2004). These results indicate that implementation of the proposed operational measures would not have any measurable impact on the volume of merchandise traded through US East Coast ports.

To measure the significance of the proposed operational measures on the shipping industry, it is also instructive to compare the estimated direct economic impact with ocean freight costs associated with US East Coast trade. Ocean freight costs are considered as a proxy for shipping industry revenues. As indicated in Section 3.4.2, ocean freight charges averaged 5.3 percent of the value of imports. Given the composition of US trade, it is reasonable to assume that ocean freight charges would represent no less a percentage of the value of exports. Based on these factors, it is estimated that the direct economic impact on the shipping industry under Alternative 5 would represent less than one percent of the ocean freight costs for US East Coast trade in both 2003 and 2004. For other alternatives, the relative economic impact would be even smaller. For Alternative 6, in particular, the direct economic impact would represent about 0.4 percent of the ocean freight costs in both 2003 and 2004. These results indicate that the implementation of the proposed operational measures would have a minimal impact on the financial performance of the vessel operators calling at US East Coast ports.

Data Chart 4-34
Economic Impact as a Percentage Value of US East Coast Maritime Trade and Ocean Freight Costs, 2003 and 2004 ($ millions, unless otherwise specified)

Item	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
2003					
Direct economic impact	25.0	133.0	2.3	137.0	53.2
Additonal direct economic impact due to cumulative effect of mulit-port strings	-	11.3	-	11.3	8.7
Direct economic impact of re-routing of southbound coastwise shipping	-	7.5	-	7.5	3.4
Total direct economic impact on shipping industry	25.0	151.8	2.3	155.8	65.3
Trade Merchandise Value	298,741	298,741	298,741	298,741	298,741
Total direct economic impact as a percent of trade value (%)	0.008%	0.051%	0.001%	0.052%	0.022%
Ocean Freight Costs	15,833	15,833	15,833	15,833	15,833
Total direct economic impact as a percent of ocean freight cost (%)	0.158%	0.959%	0.015%	0.984%	0.412%
2004					
Direct economic impact	27.6	142.5	2.8	147.2	57.6
Additonal direct economic impact due to cumulative effect of mulit-port strings	-	11.9	-	11.9	9.4
Direct economic impact of re-routing of southbound coastwise shipping	-	7.6	-	7.6	3.4
Total direct economic impact on shipping industry	27.6	162.0	2.8	166.7	70.4
Trade Merchandise Value	325,051	325,051	325,051	325,051	325,051
Total direct economic impact as a percent of trade value (%)	0.008%	0.050%	0.001%	0.051%	0.022%
Ocean Freight Costs	17,228	17,228	17,228	17,228	17,228
Total direct economic impact as a percent of ocean freight cost (%)	0.160%	0.940%	0.016%	0.968%	0.409%

Source: Prepared by Nathan Associates from U.S Census Bureau Foreign Trade Statistics for 2003 and 2004 and analysis of U.S. Coast Guard data on vessel calls at U.S. ports as described in text.

4.4.3 Indirect Economic Impacts

Depending on the nature and significance of the direct economic impact, it is possible that implementation of the proposed operational measures could also have indirect economic impacts. Potential indirect economic impacts were identified by port authorities, shipping industry representatives, and community leaders during the public stakeholder meetings. These impacts included:

- Increased intermodal costs due to missed rail and truck connections.
- Diversion of traffic to other ports.
- Impact on local economies of decreased income from jobs lost to traffic diversions.

It is important to note that the timing and duration of the proposed speed restrictions would be well known and that vessel itineraries could be developed taking the delays into account. Therefore, except for the potential establishment of DMAs, unexpected disruptions to the manufacturing and transport logistics systems should not occur as a result of the proposed measures.

Many factors influence a shipping line’s decision to call at specific ports. These include the adequacy and suitability of port facilities and equipment; the ability of the terminal operator to quickly turn around the vessel; overall cargo demand; efficiency of intermodal transportation; port charges; and the port location relative to other ports and cargo markets. At the stakeholders meeting in Boston, there were particular concerns raised over the possibility of traffic diverting to other ports, such as Halifax, Nova Scotia.

In previous sections, the cost of increased vessel time from delays caused by the proposed speed restrictions were estimated. If cargo were to be diverted to other ports, it would be because the total additional costs associated with the new routes are less than the cost of delays to the current port. It would be double-counting to also include any additional overland transport costs to the estimated impact already presented.

The Maritime Administration (MARAD), an agency of the US Department of Transportation, has developed a Port Economic Impact Kit that allows users to assess the economic impact of port activity on a region's economy. The MARAD Port Economic Impact Kit uses an adaptation of input-output analysis that is a widely established tool for economic impact assessments. The model calculates the total economic impacts or multiplier effect of the deep-draft port industry and includes an indirect effect that reflects expenditures made by the supplying firms to meet the requirements of the deep-draft port industry as well as expenditures by firms stocking the supplying firms. The model also includes an induced effect that corresponds to the change in consumer spending that is generated by changes in labor income accruing to the workers in the deep-draft port industry as well as employment in the supplying businesses.

The MARAD Port Economic Impact Kit was applied in two recent studies on the economic implications of port calls in Boston.[30] These studies estimate that an average containership port call in Boston results in a positive economic impact for the region of approximately $900,000. This analysis used this estimate for the port area of Boston and other major ports to evaluate the impact of port calls diverted to Canadian ports.[31] For other port areas, such as Portland and Providence, that would generally have smaller vessels making port calls, this analysis used an estimate of $500,000 of total economic impact per port call.[32]

4.4.3.1 Alternative 1 – No Action Alternative

There would be no indirect economic impacts on local economies or vessel operations under the No Action Alternative

4.4.3.2 Alternative 2 – Mandatory Dynamic Management Areas

There would be no significant, indirect economic impacts on local economies or vessel operations associated with the use of DMAs in Alternative 2.

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[30] Hauke Kite-Powell, Economic Implications of Possible Reductions in Boston Port Calls due to Ship Strike Management Measures, a report produced for NOAA National Marines Fisheries Service and MASSPORT, March 2005; and Leigh Fisher Associates, Economic Impact Study of Massachusetts Port Authority and Port of Boston facilities, prepared for MASSPORT and the Greater Boston Chamber of Commerce, Draft Technical Report, June 30, 2005.

[31] For purposes of this section, other major port areas are New York/New Jersey, Philadelphia, Baltimore, Hampton Roads, Charleston, Savannah, Jacksonville, and Port Canaveral.

[32] The indirect economic impact is relative to the volume of cargo diverted, hence the size of containerships and ro-ro vessels calling at major ports and others was used as an indicator of the indirect economic impact per vessel.

4.4.3.3 Alternative 3 – Speed Restrictions in Designated Areas

There would be indirect adverse effects on certain port areas and vessel operations as a result of implementing Alternative 3. For Alternative 3, the net indirect economic impact is estimated at $141.1 million annually for 2003 conditions and $139.4 annually for 2004 condition (speed restriction of 10 knots).

As described in Section 2.2.3, under Alternative 3, there would be year-round speed restrictions established for a large area eastward of Massachusetts Bay, which would extend through the Great South Channel critical habitat area. This would affect vessel traffic in the Northeast region and port areas from Hampton Roads northward in the mid-Atlantic region. As shown in Data Chart 4-6, the average delay for a containership in Boston would be 149 minutes per arrival and another 149 minutes per departure. A permanent delay of nearly 5 hours per call year-round would be sufficient for shippers and vessel operators to look at alternative ports such as Halifax, Nova Scotia, that would not be affected by the proposed regulations.

A good portion of a port's traffic is often considered captive to that port. For cargoes that are destined for the port's immediate hinterland, it would not make economic sense to call at a distant port and then ship the cargo back to the original destination via expensive land transport. However, most ports also accommodate traffic that is not destined for the immediate hinterland but is through-traffic that may have economically-attractive routing alternatives. Port areas in the northeast and northern parts of the mid-Atlantic region serve as gateways to inland population centers and industrial areas such as western New York, western Pennsylvania, Ohio, Indiana, Illinois, and Michigan. These areas may be served via the Canadian ports of Halifax, Nova Scotia and Montreal, Quebec, without incurring the delays caused by ship strike reduction measures.[33] These Canadian ports currently compete with northeastern US ports for cargo destined for the mideastern US. Speed restrictions implemented in the US could shift the current competitive balance to the advantage of Canadian ports, which would not affected by speed restrictions.

It can be assumed that with a speed restriction of 10 knots, 25 percent of the containership and ro-ro cargo ship calls at Northeast ports would divert to Canadian ports.[34] This rate of diversion is considered a mid-point of a range of possible rates from a high of 35 percent to a low of 15 percent. This relatively high rate of potential diversion is due to the permanent, year-round speed restrictions proposed under Alternative 3 and considers the portion of cargo at Northeast ports that is destined for inland areas that could realistically be served via Canadian ports.

Port areas in the Block Island area can be assumed to lose no more than 15 percent of their vessel calls during restricted periods. More of the cargo at these smaller ports is for the local market and they are not considered gateway ports to areas further inland. The port areas of New York/New Jersey, Philadelphia, Baltimore, and Hampton Roads can be assumed to lose three percent of their containership and ro-ro cargo ship vessel calls during restricted periods. The diversion rate for these port areas is lower for several reasons. First, the speed restrictions are seasonal in the

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[33] Comments on the DEIS suggested that vessels may divert to other US ports in addition to those diverting to Canada. While this is possible, for the total economic impact analysis, only diversions to non-US ports are included. For diversions to ports within the US, the negative economic impact for one US port would be offset by gains in another US port.

[34] Other types of vessels are less likely to divert, as their cargoes are more likely destined for the port's immediate hinterland.

MAUS; second, due to the size of the local market, most vessels must call at the port area of New York/New Jersey; and third, due to the distance involved, Canadian ports are a less viable alternative for most of the cargo handled at MAUS ports.

The analysis also assumes that a 10-knot speed restriction under Alternative 3 would lead to the diversion of five percent of the containership and ro-ro cargo ship calls from the port area of Savannah during restricted periods. The speed restrictions would be in effect in Savannah for 212 days, as compared to 151 days for the nearby southeastern port areas of Brunswick, Fernandina, and Jacksonville. As Jacksonville is by far the largest and most important of these three alternative ports, this analysis assumes that 50 percent of the diverted Savannah calls would be handled at Jacksonville. Brunswick and Fernandina, which are smaller ports but closer to the Savannah hinterland, are each assumed to capture 25 percent of the diverted calls from Savannah.

On the other hand, the analysis assumes that 15 percent of the restricted-period cruise-vessel calls at Jacksonville would divert to the nearby port area of Port Canaveral. The assumption is based on a more than 2.4-hour savings per vessel call, as the effective distance of speed restrictions in Port Canaveral would be only 4.5 nm (8.3 km) compared to the 30.9 nm (57.2 km) at Jacksonville.

Data Chart 4-35 presents the assumed diversion rates under Alternative 3 (as well as the other alternatives) with restricted speeds of 10, 12, and 14 knots.

Data Chart 4-35
Percentage of Restricted Period Vessel Calls Assumed to be Diverted, by Alternative and Port Area

	Alternative 3			Alternative 4			Alternative 5			Alternative 6		
	Restricted speed in knots			Restricted speed in knots			Restricted speed in knots			Restricted speed in knots		
Port Area	10	12	14	10	12	14	10	12	14	10	12	14
Northeastern US	25.0%	20.0%	15.0%	-	-	-	27.0%	22.0%	17.0%	15.0%	10.0%	7.0%
Mid-Atlantic Block Island Sound	15.0%	10.0%	5.0%	-	-	-	16.0%	11.0%	6.0%	3.0%	2.0%	1.0%
Selected Mid-Atlantic Ports a/	3.0%	1.5%	0.5%	-	-	-	3.5%	1.7%	0.7%	1.5%	0.5%	0.1%
Savannah, GA	5.0%	3.0%	1.0%	-	-	-	-	-	-	-	-	-
Brunswick, GA	-	-	-	5.0%	3.0%	1.5%	-	-	-	3.0%	2.0%	1.0%
Fernandina, FL	-	-	-	5.0%	3.0%	1.5%	-	-	-	3.0%	2.0%	1.0%
Jacksonville, FL	15.0%	10.0%	5.0%	15.0%	10.0%	5.0%	40.0%	30.0%	20.0%	40.0%	30.0%	20.0%

a/ Includes port areas of New York/New Jersey, Philadelphia, Baltimore and Hampton Roads.

Source: Prepared by Nathan Assoicates as described in text.

For Alternative 3, the net indirect economic impact was estimated at $141.1 million annually under 2003 conditions (see Data Chart 4-36). The port areas of New York/New Jersey ($48.2 million), Savannah ($38.8 million), Boston ($24.8 million), and Hampton Roads ($29.6 million) would have the largest annual indirect economic impacts. Note that the port areas of Jacksonville, Brunswick, Fernandina, and Port Canaveral show a positive net economic impact (indicated by dollar amounts in parentheses) as they would gain vessel calls diverted from Savannah. The economic impact of Alternative 3 under 2004 conditions is $139.4 million annually (Data Chart 4-37).

The annual economic impact of port diversions under 2004 conditions would be $139.4 million with a 10-knot restriction; $79.6 million with a 12-knot restriction; and $37.3 million with a 14-knot restriction (Data Chart 4-37).

Data Chart 4-36
Indirect Economic Impact of Port Diversions by Alternative, Restricted Speed, and Port Area, 2003 ($000s)

	Alternative 2			Alternative 3			Alternative 4			Alternative 5			Alternative 6		
	Restricted speed in knots			Restricted speed in knots			Restricted speed in knots			Restricted speed in knots			Restricted speed in knots		
Port Area	10	12	14	10	12	14	10	12	14	10	12	14	10	12	14
Northeastern US - Gulf of Maine															
Eastport, ME	-	-	-	625	500	375	-	-	-	675	550	425	75	50	35
Searsport, ME	-	-	-	125	100	75	-	-	-	135	110	85	-	-	-
Portland, ME	-	-	-	8,375	6,700	5,025	-	-	-	9,045	7,370	5,695	825	550	385
Portsmouth, NH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Off Race Point															
Boston, MA	-	-	-	24,750	19,800	14,850	-	-	-	26,730	21,780	16,830	(700)	(150)	(10)
Salem, MA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Cape Cod Bay															
Cape Cod, MA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Block Island Sound															
New Bedford, MA	-	-	-	75	50	25	-	-	-	80	55	30	15	10	5
Providence, RI	-	-	-	3,375	2,250	1,125	-	-	-	3,600	2,475	1,350	4,750	2,850	1,900
New London, CT	-	-	-	150	100	50	-	-	-	160	110	60	30	20	10
New Haven, CT	-	-	-	75	50	25	-	-	-	80	55	30	15	10	5
Bridgeport, CT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Island, NY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Ports of New York/New Jersey															
New York City, NY	-	-	-	48,222	24,111	8,037	-	-	-	56,259	27,326	11,252	20,507	6,836	1,367
Mid-Atlantic Delaware Bay															
Philadelphia, PA	-	-	-	10,044	5,022	1,674	-	-	-	11,718	5,692	2,344	4,293	1,431	286
Mid-Atlantic Chesapeake Bay															
Baltimore, MD	-	-	-	16,686	8,343	2,781	-	-	-	19,467	9,455	3,893	7,155	2,385	477
Hampton Roads, VA	-	-	-	29,646	14,823	4,941	-	-	-	34,587	16,799	6,917	12,636	4,212	842
Mid-Atlantic Morehead City and Beaufort, NC															
Morehead City, NC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Wilmington, NC															
Wilmington, NC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Georgetown, SC															
Georgetown, SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Charleston, SC															
Charleston, SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Savannah, GA															
Savannah, GA	-	-	-	38,835	23,301	7,767	(4,150)	(2,490)	(1,245)	-	-	-	(2,490)	(1,660)	(830)
Southeastern US															
Brunswick, GA	-	-	-	(9,709)	(5,825)	(1,942)	3,075	1,845	923	-	-	-	1,845	1,230	615
Fernandina, FL	-	-	-	(9,709)	(5,825)	(1,942)	1,075	645	323	-	-	-	645	430	215
Jacksonville, FL	-	-	-	(19,418)	(11,651)	(3,884)	1,080	720	360	2,880	2,160	1,440	2,880	2,160	1,440
Port Canaveral, FL	-	-	-	(1,080)	(720)	(360)	(1,080)	(720)	(360)	(2,880)	(2,160)	(1,440)	(2,880)	(2,160)	(1,440)
All Port Areas	-	-	-	141,068	81,129	38,623	-	-	-	162,536	91,777	48,911	49,601	18,204	5,303

Source: Prepared by Nathan Associates based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports, 2003-2004 as described in text.

Data Chart 4-37
Indirect Economic Impact of Port Diversions by Alternative, Restricted Speed, and Port Area, 2004 ($000s)

Port Area	Alternative 2			Alternative 3			Alternative 4			Alternative 5			Alternative 6		
	Restricted speed in knots			Restricted speed in knots			Restricted speed in knots			Restricted speed in knots			Restricted speed in knots		
	10	12	14	10	12	14	10	12	14	10	12	14	10	12	14
Northeastern US - Gulf of Maine															
Eastport, ME	-	-	-	500	400	300	-	-	-	540	440	340	150	100	70
Searsport, ME	-	-	-	375	300	225	-	-	-	405	330	255	-	-	-
Portland, ME	-	-	-	5,125	4,100	3,075	-	-	-	5,535	4,510	3,485	825	550	385
Portsmouth, NH	-	-	-	125	100	75	-	-	-	135	110	85	-	-	-
Northeastern US - Off Race Point															
Boston, MA	-	-	-	24,750	19,800	14,850	-	-	-	26,730	21,780	16,830	(200)	150	190
Salem, MA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeastern US - Cape Cod Bay															
Cape Cod, MA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Block Island Sound															
New Bedford, MA	-	-	-	75	50	25	-	-	-	80	55	30	15	10	5
Providence, RI	-	-	-	3,150	2,100	1,050	-	-	-	3,360	2,310	1,260	4,250	2,550	1,700
New London, CT	-	-	-	375	250	125	-	-	-	400	275	150	60	40	20
New Haven, CT	-	-	-	225	150	75	-	-	-	240	165	90	45	30	15
Bridgeport, CT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Island, NY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Ports of New York/New Jersey															
New York City, NY	-	-	-	49,680	24,840	8,280	-	-	-	57,960	28,152	11,592	21,209	7,070	1,414
Mid-Atlantic Delaware Bay															
Philadelphia, PA	-	-	-	9,369	4,685	1,562	-	-	-	10,931	5,309	2,186	3,996	1,332	266
Mid-Atlantic Chesapeake Bay															
Baltimore, MD	-	-	-	16,605	8,303	2,768	-	-	-	19,373	9,410	3,875	6,980	2,327	465
Hampton Roads, VA	-	-	-	29,052	14,526	4,842	-	-	-	33,894	16,463	6,779	12,366	4,122	824
Mid-Atlantic Morehead City and Beaufort, NC															
Morehead City, NC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Wilmington, NC															
Wilmington, NC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Georgetown, SC															
Georgetown, SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Charleston, SC															
Charleston, SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mid-Atlantic Savannah, GA															
Savannah, GA	-	-	-	39,015	23,409	7,803	(3,775)	(2,265)	(1,133)	-	-	-	(2,265)	(1,510)	(755)
Southeastern US															
Brunswick, GA	-	-	-	(9,754)	(5,852)	(1,951)	3,000	1,800	900	-	-	-	1,800	1,200	600
Fernandina, FL	-	-	-	(9,754)	(5,852)	(1,951)	775	465	233	-	-	-	465	310	155
Jacksonville, FL	-	-	-	(13,703)	(7,835)	(1,967)	5,805	3,870	1,935	15,480	11,610	7,740	15,480	11,610	7,740
Port Canaveral, FL	-	-	-	(5,805)	(3,870)	(1,935)	(5,805)	(3,870)	(1,935)	(15,480)	(11,610)	(7,740)	(15,480)	(11,610)	(7,740)
All Port Areas	-	-	-	139,406	79,603	37,251	-	-	-	159,582	89,308	46,956	49,695	18,280	5,355

Source: Prepared by Nathan Associates based on analysis of U.S. Coast Guard data on vessel calls at U.S. ports, 2003-2004 as described in text.

4.4.3.4 Alternative 4 – Recommended Shipping Routes

While there may be minor, indirect adverse economic impacts on certain ports in the SEUS region, the overall economic impact of Alternative 4 would be negligible. Modest delays would be experienced at the port areas of Brunswick and Fernandina due to the increased distance associated with the use of recommended routes. Because of these delays, it can be assumed that 5 percent of the containership and ro-ro cargo ship calls at these two port areas would divert to the port area of Savannah, which would have no proposed operational measures. The reason for the relatively small rate of diversion is that much of the cargo handled at these ports is destined for the local market and not easily diverted to other ports. Under Alternative 4, cruise vessels can again be assumed to divert to Port Canaveral, where no operational measures are proposed under this alternative. From the perspective of the national economy, there are no net indirect economic impacts under Alternative 4. The diverted vessel calls at the southeastern port areas of Brunswick, Fernandina, and Jacksonville would be offset by the gains in vessels calling at the port areas of Savannah and Port Canaveral.

4.4.3.5 Alternative 5 – Combination of Alternatives

There would be indirect, long-term adverse effects on certain port areas and vessel operations under Alternative 5. The net indirect economic impact at 10 knots was estimated at $162.5 million annually (2003 conditions) and $159.6 million (2004 conditions).

Under this alternative, the rates of diversion for the affected port areas in the Northeast and mid-Atlantic regions would be similar to those under Alternative 3, except that the additional impact of DMAs and recommended routes can be assumed to slightly increase the rate of diversion. The port area of Savannah would not incur any diversions under Alternative 5 because the delays associated with the increased recommended routes for the southeast port areas would offset the speed restrictions into Savannah. The port area of Jacksonville would be affected twice as much under Alternative 5 relative to Port Canaveral. First, Jacksonville would be subject to the increased distance associated with the use of recommended routes, and second, the speed restrictions would be in effect for 30.9 nm (57.2 km) as compared to the 4.5 nm (8.3 km) at Port Canaveral. For these reasons, it can be assumed that as much as 40 percent of the restricted-period cruise vessel calls would divert from Jacksonville to Port Canaveral.

The 2003 estimated annual impact under Alternative 5 ($162.5 million) would be about 15 percent higher than that under Alternative 3 (see Data Chart 4-36). Rankings would be similar to those under Alternative 3 (Section 4.4.3.3) with the exception of Savannah. The 2004 annual net indirect impact would be $159.6 million (Data Chart 4-37).

The diversion rates for Alternative 5 would vary with the speed restriction (Data Chart 4-35), so there would be a lower economic impact at a speed restriction of 12 knots ($89.3 million annually) and a still lower one at 14 knots ($47.0 million annually) (2004 conditions, see Data Chart 4-37).

4.4.3.6 Alternative 6 – Proposed Action (Preferred Alternative)

There would be indirect adverse impacts on certain port areas and vessel operations under Alternative 6. For this alternative, the annual net indirect economic impact at a restricted speed of 10 knots would be $49.6 million for 2003 conditions and $49.7 million for 2004 conditions.

Under Alternative 6, the effective speed restrictions in the combined SMAs in the NEUS would be in effect during the month of April.[35] Shipping lines are not likely to alter their regular service pattern for delays that are incurred for one month per year. Thus, while Alternative 3 was assumed to cause a diversion rate of 25 percent, Alternative 6 is assumed to cause a lower diversion rate of 15 percent for containerships and ro-ro cargo ships during the restricted period.[36] For the port areas in Block Island Sound, the analysis assumed a diversion rate of only three percent for containerships and ro-ro cargo ships due to the limited duration of the large speed-restriction area. For the affected mid-Atlantic ports, a diversion of 1.5 percent of restricted-period containership and ro-ro cargo ship vessel calls was assumed.

An additional diversion was assumed to occur under Alternative 6 for the port area of Providence. This port area would have speed restrictions in effect for 181 days, as compared to 61 days for the port area of Boston. Therefore, it was assumed that 20 percent of the containership and ro-ro cargo ship restricted-period calls at Providence would divert to the nearby port area of Boston.

The southeastern ports of Brunswick and Fernandina were assumed to have three percent of their restricted-period arrivals of containerships and ro-ro cargo ships diverted to Savannah as the effect of the use of recommended routes creates additional delays relative to Savannah. Finally, 40 percent of the restricted-period cruise-vessel calls at Jacksonville were assumed to divert to Port Canaveral, as that port would not affected by speed restrictions or the use of recommended routes.

Under Alternative 6, the net indirect economic would be $49.6 million annually based on 2003 conditions. The largest impacts would occur in the port areas of New York/New Jersey ($20.5 million annually), Hampton Roads ($12.6 million annually), Baltimore ($7.2 million annually), Providence ($4.8 million annually), Philadelphia ($4.3 million annually), Jacksonville ($2.9 million annually), and Brunswick ($1.8 million annually). Three port areas would experience a net indirect economic impact gain: Port Canaveral ($2.9 million annually), Savannah ($2.5 million annually), and Boston ($0.7 million annually) (Data Chart 4-36).

Data Chart 4-37 shows the estimated annual indirect economic impacts under 2004 conditions. In general, they match closely those calculated for 2003. The slight decrease in the 2004 impact at certain port areas reflects the decline in containership and ro-ro vessel arrivals during the period when seasonal speed restrictions would be in effect. It is interesting to note the large increase in impact in Jacksonville, where cruise-vessel arrivals increased substantially.

With a speed restriction of 12 knots, the annual indirect economic impact of Alternative 6 (2004 conditions) would be $18.3 million; with a 14-knot restriction, it would be $5.4 million.

4.4.3.7 Summary of All Direct and Indirect Economic Impacts on the Shipping Industry and Port Areas

The annual direct, additional direct, and indirect economic impacts on the shipping industry are summarized in Table 4-2.

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[35] Speed restrictions would be in effect for other months in the NEUS but not in the large combined area encompassing Off Race Point and Great South Channel SMAs.

[36] For Alternative 6, speed restrictions would be in place for the months of March and April, so that the 15-percent diversion only applies to vessel calls during those months.

Table 4-2
Summary of All Impacts by Alternative at 10, 12, and 14 knots, 2003 and 2004 (millions of dollars per year)

Item	Alternative 2 Restriction speed (knots)			Alternative 3 Restriction speed (knots)			Alternative 4 Restriction speed (knots)			Alternative 5 Restriction speed (knots)			Alternative 6 Restriction speed (knots)		
	10	12	14	10	12	14	10	12	14	10	12	14	10	12	14
2003															
Direct economic impact															
Shipping industry vessels	25.0	16.1	9.8	133	83.6	49.5	2.3	2.3	2.3	137	86.7	51.8	53.2	33.4	20
Cumulative effect of multi-port strings	-	-	-	11.3	9.4	7.9	-	-	-	11.3	9.4	7.9	8.7	7.2	6.1
Re-routing of southbound coastwise shipping	-	-	-	7.5	7.5	7.5	-	-	-	7.5	7.5	7.5	3.4	3.4	3.4
Subtotal direct economic impact	25.0	16.1	9.8	151.8	100.5	64.9	2.3	2.3	2.3	155.8	103.6	67.2	65.3	44.0	29.5
Indirect economic impact of port diversions	-	-	-	141.6	81.5	38.8	-	-	-	162.5	91.8	48.9	49.6	18.2	5.3
Total economic impact	25.0	16.1	9.8	293.4	181.9	103.7	2.3	2.3	2.3	318.3	195.3	116.1	114.9	62.2	34.8
2004															
Direct economic impact															
Shipping industry vessels	27.6	17.7	10.8	142.5	89.2	52.5	2.8	2.8	2.8	147.2	92.8	55.2	57.6	36.1	21.5
Cumulative effect of multi-port strings	-	-	-	11.9	9.9	8.4	-	-	-	11.9	9.9	8.4	9.4	7.8	6.6
Re-routing of southbound coastwise shipping	-	-	-	7.6	7.6	7.6	-	-	-	7.6	7.6	7.6	3.4	3.4	3.4
Subtotal direct economic impact	27.6	17.7	10.8	162	106.7	68.5	2.8	2.8	2.8	166.7	110.3	71.2	70.4	47.3	31.5
Indirect economic impact of port diversions	-	-	-	139.4	79.6	37.3	-	-	-	159.6	89.3	47	49.7	18.3	5.4
Total economic impact	27.6	17.7	10.8	301.4	186.3	106	2.8	2.8	2.8	326.3	199.6	118	120.1	65.6	36.9

Source: Prepared by Nathan Associates as described in text.

4.4.4 Impacts on Commercial Fishing Vessels

Commercial fishing is a multimillion-dollar industry along the US East Coast. In 2003, commercial fish landings at US East Coast ports totaled $651 million; in 2004, it totaled $689 million (see Data Chart 3-5). The port of New Bedford, MA is the leading US port in terms of the value of commercial fish landings, with $206.5 million in 2004.

The proposed operational measures would apply only to vessels with a length of at least 65 ft (19.8 m). The USCG data exclude commercial fishing vessels less than 150 GRT; however, the analysis factored in fishing vessels over 65 ft (19.8 m) in length but weighing less than 150 GRT using information provided by NMFS' database of commercial fishing permits. In the southeast region, approximately 84 percent of the fishing vessels over 65 ft (19.8 m) weigh less than 150 tons; in the northeast region, nearly 67 percent of the fishing vessels over 65 ft (19.8 m) weigh less than 150 tons (Section 3.4.3).

The estimated annual economic impact of the proposed operational measures on commercial fishing vessels based on 2003 conditions and for speed restriction of 10 and 12 knots is presented in Data Chart 4-38 (only those alternatives that would have a noticeable impacts are included). The analysis assumed that the commercial fishing vessels would be affected for an effective distance of 25 nm (46 km) under Alternatives 3 and 5, and 20 nm (37 km) under Alternative 6 each way as they steam to and from fishing areas.

Many commercial fishing vessels steam at 10 knots or below and would not be affected by the proposed operational measures. The typical steaming speed for faster commercial fishing vessels generally does not exceed 12 knots and these vessels are not expected to be affected by speed restriction of 12 knots or more.

4.4.4.1 Alternative 1 – No Action Alternative

Under the No Action Alternative, there would be no impact on the commercial fishing industry. The ship strike reduction measures currently in place would remain unchanged, vessels would continue to go unregulated beyond the measures already in place, and the threat of ship strikes would remain unchanged. All vessels would still be required to adhere to the 500-yd (457-m) no-approach rule for right whales.

Data Chart 4-38
Estimated Economic Impact of Proposed Operational Measures on Commercial Fishing Vessels by Region, 2003

	Alternatives 3 and 5		Alternative 6	
Item	Northeast Region	Southeast Region	Northeast Region	Southeast Region
Commercial fishing permits for vessels over 65 ft LOA and under 150 GRT	572	290	572	290
Percent with steaming speed over 10 knots	40%	40%	40%	40%
Vessels potentially affected by speed restrictions	229	116	229	116
Typical steaming speed of affected vessels (knots)	12	12	12	12
Number of trips per year per vessel	20	20	20	20
Minutes of delay per trip with restricted speed of				
12 knots	-	-	-	-
10 knots	50.0	50.0	38.0	38.0
Operating cost per hour of steaming (dollars)	300	300	300	300
Estimated impact per year with restricted speed (dollars)				
12 knots	-	-	-	-
10 knots	1,144,000	580,000	869,440	440,800

Source: Prepared by Nathan Associates Inc.

4.4.4.2 Alternative 2 – Mandatory Dynamic Management Areas

As noted above, many fishing vessels operate at 10 knots or less and, therefore, only a limited number of vessels (those traveling at more than 10 knots) would have to slow down through a DMA under Alternative 2. A captain would have the discretion to route around the DMA instead of slowing down through it, in which case the vessel could incur additional costs in fuel due to the additional distance. However, it can be assumed that the captain would choose the lower-cost option, minimizing any effects. Thus, economic impacts on the commercial fishing industry under Alternative 2 are expected to be negligible. Unlike DAM restrictions under the ALWTRP, there are no fishing-gear regulations associated with DMAs under Alternative 2. However, if a DMA was implemented in an area covered by the ALWTRP regulations, then a dual-DAM/DMA might be designated to reduce the risk of both fishing-gear entanglement and ship strike. In this case, fishermen would have to adhere to the restrictions associated with both measures.

4.4.4.3 Alternative 3 – Speed Restrictions in Designated Areas

Only those commercial fishing vessels traveling at speeds higher than 10 knots would be adversely affected by the speed restrictions proposed under this alternative. These vessels would remain at sea for longer periods and thus burn more fuel (a delay in arriving at the dock or processing plant should not result in any additional costs, however). The estimated impact on commercial fishing vessels (2003 conditions) would be $1.1 million annually in the NEUS region and $0.6 million annually in the SEUS region. Combined, these impacts represent less than 0.3 percent of the total East Coast fishery landings in 2003.

4.4.4.4 Alternative 4 – Recommended Shipping Routes

Alternative 4 would have a negligible effect on fishing vessels operations. The recommended routes into the ports of Brunswick, Jacksonville, and Port Canaveral in the SEUS are not expected to affect commercial fishing vessel either because these vessels are destined for fishing grounds or the locations of fixed gear such as lobster pots and do not regularly utilize shipping lanes. Shipping lanes are developed for use by vessels calling at large, commercial-shipping, whereas fishing vessels generally dock at smaller ports.

Fishing vessels in the Cape Cod Canal could be affected if they utilize the recommended routes. Vessels concentrating fishing effort within Cape Cod Bay and outside of the lanes would not be affected. Affected vessels would remain at sea for a longer time, possibly burning more fuel, potentially resulting in higher costs. For the same reasons as mentioned under Alternative 2 (Section 4.4.4.2), any impacts are expected to be negligible.

4.4.4.5 Alternative 5 – Combination of Alternatives

Adverse impact on commercial fishing vessels under Alternative 5 would be the same as under Alternative 3: $1.1 million annually in the NEUS region and $0.6 million annually in the SEUS region (2003 conditions) because the relevant restrictions under this alternative are those proposed under Alternative 3. Other restrictions proposed under Alternative 5 are those proposed under Alternatives 2 and 4, and, as noted above, these restrictions would have no noticeable effects on fishing vessels.

4.4.4.6 Alternative 6 – Proposed Action (Preferred Alternative)

Under Alternative 6 (10-knot speed restriction), the expected adverse economic impact on commercial fishing vessels was estimated at $0.9 million annually for the NEUS region and $0.4 million annually for the SEUS region (2003 conditions). The combined annual impact of $1.3 million represents less than 0.2 percent of the East Coast commercial fishery landings total for 2003 and 2004, and 2005.

Only fishing vessels 65 ft (19.8 m) long or more would be affected, and among those, only those vessels traveling at speeds more than 10 knots, which represent only 40 percent of the total. When compared to the total annual revenue generated in 2004 by these affected vessels only, the estimated annual impact amounts to 0.5 percent of this revenue.

There would be no impact on fishing vessels if a speed limit of 12 knots or more is implemented.

4.4.5 Impacts on Passenger Vessels

The following sections describe the economic impacts of the proposed operational measures on specific types of other vessels.

4.4.5.1 Cruise Industry

The proposed measures would affect the vast majority of cruise ships, since they are longer than 65 ft (19.8 m). Effects on the cruise industry are covered in Sections 4.4.1 and 4.4.3, as cruise vessels are included in the USCG Vessel Arrival Database.

4.4.5.2 Ferry Boat Industry

The vast majority of passenger vessels operating along the US East Coast sail within the COLREGS lines and would not be affected by the proposed operational measures. However, in the southern New England area, a well-developed passenger-ferry sector operates beyond the COLREGS line and would be subject to the proposed measures. A list of major southern New England passenger-ferry operators, routes served, and service characteristics are presented in Data Chart 4-39; a complete inventory of ferry vessel operations is included in Appendix E.

Passenger-ferry operations in southern New England generally fall into two categories: fast ferry service, with vessel speeds ranging from 24 to 39 knots; and regular ferry service, with vessel speeds from 12 to 16 knots. As shown in Data Chart 4-39, there are nine operators providing fast ferry service on eight routes with 11 vessels. Key destinations include Provincetown, Block Island, Nantucket, and Martha's Vineyard, while major origin points include Boston, New London, Hyannis, Harwich, Point Judith, and Quonset Point. Regular ferry service is provided by eight operators on 11 routes with 16 vessels. These ferries serve many of the same origins and destinations as the fast ferry service. Additional origin points include Plymouth, Falmouth, and Woods Hole.

Data Chart 4-39
Southern New England Ferry Operators, 2005

Operator	Route	Vessel Speed (knots)	Distance (nm)	Summer Schedule	Average Adult Fare ($)
Fast Ferries					
Bay State Cruises	Boston-Provincetown	30	50	6 trips daily	32
Boston Harbor Cruises	Boston-Provincetown	39	50	4 trips daily	30
Cross Sound Ferry Service	New London-Block Island	35	30	10 trips daily	15
Cross Sound Ferry Service	New London-Orient Point LI	30	16	12 trips daily	15
Freedom Cruise Line	Harwich-Nantucket	24	30	6 trips daily	26
Hy-Line Cruises	Hyannis- Nantucket	30	27	10 trips daily	31
Hy-Line Cruises	Hyannis-Martha's Vineyard	24	20	8 trips daily	14
Island High Speed Ferry	Point Judith-Block Island	33	11	12 trips daily	15
New England Fast Ferry	New Bedford- Martha's Vineyard	30	30	10 trips daily	25
Steamship Authority	Hyannis- Nantucket	30	27	10 trips daily	28
Vineyard Fast Ferry	Quonset Point-Martha's Vineyard	33	50	4 trips daily	30
Regular Ferries					
Bay State Cruises	Boston-Provincetown	16	50	2 trips Sat and Sun	15
Capt. John Boats	Plymouth-Provincetown	14	25	2 trips daily	18
Cross Sound Ferry Service	New London-Orient Point LI	13	16	30 trips daily	10
Hy-Line Cruises	Hyannis- Nantucket	15	27	6 trips daily	16
Hy-Line Cruises	Hyannis-Martha's Vineyard	12	20	6 trips daily	16
Hy-Line Cruises	Nantucket-Martha's Vineyrd	16	20	6 trips daily	16
Interstate Navigation Company	Point Judith-Block Island	12	11	8 trips daily	10
Interstate Navigation Company	Newport-Block Island	12	22	2 trips daily	12
Patriot Party Boats	Falmouth- Martha's Vineyard	15	5	8 trips daily	7
Pied Piper	Falmouth-Edgartown	12	9	6 trips daily	15
Steamship Authority	Woods Hole-Martha's Vineyard	12	7	32 trips daily	6
Steamship Authority	Hyannis- Nantucket	12	27	12 trips daily	14

Source: Prepared by Nathan Associates from data on operator websites and selected interviews.

Alternative 1– No Action Alternative

There would be no impact on passenger ferry service under Alternative 1.

Alternative 2 – Mandatory Dynamic Management Areas

Under Alternative 2, there would potentially be direct, long-term, adverse effects on passenger-ferry service. This alternative calls for establishing a DMA over a 39.6-nm (73-km) square based on the trigger conditions described in Section 2.1.4. Interviews with passenger-ferry operators identified their particular concern in the case of a DMA implemented during the peak summer season. For a fast ferry operator, a DMA directly along their route would result in the suspension of service for the entire period that the DMA is in effect. There are three reasons for this. First, the demand for fast ferries (which normally operate at 24 to 39 knots) would virtually disappear if the ferries were restricted to a speed of 10 knots. Second, any remaining demand would not be sufficient to cover vessel operating costs. Third, many of the handling and comfort characteristics of fast ferries would suffer at these reduced speeds.

Assuming 100 percent compliance with voluntary DMAs, the estimated net economic loss from the implementation of a single DMA for the eleven identified fast ferry operators would be $2.2 million annually (see Data Chart 4-40a).[37] This estimate is based on a daily operating cost of a fast ferry vessel of $13,320 (excluding fuel costs). Some operators have stated that the loss of income and profits from a single 15-day DMA during peak season would cause them to go out of business. However, it can be assumed that many of the fast ferry operators, who also operate regular ferries, would be able to remain in business, as they would generate some incremental profits from passengers who would have otherwise used the fast ferry service.[38]

Operators of regular ferry services would also be affected by DMAs. For these operators, it is estimated that a speed restriction of 10 knots would cause an average delay of 30 minutes for each ferry trip.[39] The 118 daily trips of regular ferry services would incur additional costs of $5.9 million annually as a result of a single DMA. With a restricted speed of 12 knots, the average delay would be 20 minutes and the impact $3.9 million annually. With a restricted speed of 14 knots, the average delay would be six minutes and the estimated impact $2.0 million annually.

Alternative 3 – Speed Restrictions in Designated Areas[40]

There would be direct, long-term, adverse effects on passenger ferry service as a result of implementing Alternative 3. Under this alternative, speed restrictions would be in place year-round in Cape Cod Bay and for the months of October to April in Block Island Sound. It can be assumed that the two fast ferry operations from Boston to Provincetown would cease and be replaced by regular ferry service. Overall ferry demand would likely diminish as passengers curtail day trips or seek alternative modes of transport. Fast ferry operators would either sell their vessels or deploy them in other routes. While a loss for the distressed sale of the vessels may be

[37] This same estimate applies to alternate restricted speeds of 10, 12 and 14 knots, as it is assumed that the fast ferry service would be temporarily suspended under any of those speeds.
[38] It is very difficult to estimate the portion of passenger demand that would be lost to cancellations during a DMA. Relevant factors include the purpose of the trip; the availability of alternative ferry origins that may not be affected by the DMA; availability of other economically viable transport modes; and competing entertainment options.
[39] This analysis assumes that on average, only half of a DMA area would affect the ferry vessel's route, hence the effective distance of the DMA would be approximately 20 nm (37 km).
[40] The analysis in this section for Alternative 3 also applies to Alternative 5.

incurred, this would not represent a recurring annual economic impact and is not included in this assessment.

Data Chart 4-40a
Estimated Economic Impact of Proposed Operational Measures on Southern New England Ferry Operators, 2005 ($)

Type of vessel and alternative	Restricted speed in knots 10	12	14
Fast Ferries			
Alternative 2	2,178,000	2,178,000	2,178,000
Alternative 3	7,128,000	7,128,000	7,128,000
Alternative 6	2,577,600	2,577,600	2,577,600
Regular Ferries			
Alternative 2	5,900,000	3,933,333	1,966,667
Alternative 3	5,900,000	3,933,333	1,180,000
Alternative 6	6,031,250	3,989,583	1,985,417
Total			
Alternative 2	8,078,000	6,111,333	4,144,667
Alternative 3	13,028,000	11,061,333	8,308,000
Alternative 6	8,608,850	6,567,183	4,563,017

Source: Prepared by Nathan Associates from data on operator websites and selected interviews.

The proposed speed restrictions for Block Island Sound would be in effect outside the peak summer season. In this area, it can be assumed that the nine fast ferry operators would lose an average of 30 business days per year.[41] The economic impact of suspending operations for these 30 days for these nine operators was estimated to be $7.1 million annually.

Regular ferries would incur average delays of approximately 30 minutes per trip with a speed restriction of 10 knots. Since the restrictions would be during the off-peak season, it is expected that these delays would be absorbed in the more open ferry schedule without losing any round-trip daily service. The estimated incremental cost of the delays would be $5.9 million annually. With a 12-knot restriction, it would be $3.9 million; with a 14-knot restriction, $1.2 million.

Alternative 4 – Recommended Shipping Routes

There would be no economic impact on passenger ferry services under Alternative 4. Ferry vessels use routes distinct from the shipping lanes and would not be affected.

Alternative 5 – Combination of Alternatives

Impacts under this alternative would be the same as under Alternative 3 because the relevant restrictions under this alternative are those also proposed under Alternative 3.

Alternative 6 – Proposed Action (Preferred Alternative)

Under Alternative 6, speed restrictions in Cape Cod Bay would be implemented from January 1 through May 15 only and the fast ferry service from Boston to Provincetown would remain in operation. Speed restrictions in Block Island Sound would be in force from November 1 through

[41] While regular ferry service is year-round, the high-speed Block Island ferry only operates from mid-April through mid-October. Thus the 30 days of lost business consists of 15 days from October 1- 15 and 15 days from April 16 - 30.

April 30. However, the speed-restricted area would not extend to the shoreline and, therefore, would not affect fast ferry operations.[42] DMAs would also be implemented under Alternative 6; their economic impact may be estimated in the same manner as it was for Alternative 2. The estimated economic impact for fast ferry service under Alternative 6 would be similar to that under Alternative 2 with an increment from the speed restrictions proposed on the Boston-Provincetown route from January 1 through May 15. The annual impact is estimated to be $2.6 million. This is a conservative estimate, as it assumes 100 percent compliance. However, DMAs under Alternative 6 would be voluntary. Lower levels of compliance would result in a proportionately lower impact.

For regular ferries, the economic impact would also be similar to that of Alternative 2 with an increment for speed restrictions proposed on the Boston-Provincetown route from January 1 through May 15. The estimated impact would be is $6.0 million annually at 10-knot ($4.0 million annually at 12 knots and $2.0 million annually at 14 knots).

From information provided by industry members, the annual revenue for passenger ferries that would be affected by the proposed measures has been estimated based on an average of $40,000 per vessel per day during a peak season of 120 days. On this basis, the annual impact on affected high-speed ferry operators would amount to 4.9 percent of the annual revenue generated by the affected vessels; the impact on affected regular-speed ferry operators would amount to 7.9 percent of the annual revenue of the affected vessels. Again, these numbers assume 100 percent compliance with voluntary DMAs. Should ferry operators choose not to comply with DMA speed restrictions, however, then annual economic impacts would be $400,000 for high-speed ferries, or less than one percent of annual revenues; and $132,000 for regular-speed ferries, or about 0.2 percent of annual revenues.

Finally, it should be noted that the large majority of passenger ferries operate within the COLREG lines, and therefore, would not be affected at all by the proposed measures. Out of 172 ferry routes on the East Coast in 2000, only 10 crossed segments of the Atlantic Ocean. Therefore, the expected impacts of the proposed measures in relation to the annual revenues of the entire East Coast passenger ferry industry would be minimal.

4.4.5.3 Impacts on Ferry Passengers

The proposed operational measures would have a direct economic impact on ferry passengers whose travel time would be increased because of speed restrictions. As recognized by the US Department of Transportation (USDOT), time saved from travel may be devoted to other activities, such as remunerative work or recreation. USDOT guidelines recommend that hourly values of travel-time be used in all economic analyses of transportation regulatory actions. Specific values are recommended for local travel and intercity travel and whether the travel is for business or personal purposes.

The USDOT guidelines recommend using the median household income divided by 2,000 hours as the basis for valuation of intercity business travel time, and 70 percent of that value for intercity personal travel time. Based on 2000 Census data, these hourly values amount to $21.20 for intercity business travel and $14.80 for intercity personal travel. Based on Census Bureau

[42] The rectangular area proposed has its northern limits running approximately in a line from Montauk to the southwestern coast of Block Island.

data for 2005, the hourly value of intercity business travel time is $23.16 and intercity personal travel time is $16.21. The more recent values have been used in this analysis.

The estimated economic impact of proposed operational measures on Southern New England ferry passengers is presented in Data Chart 4-40b. The estimates shown are based on the same assumptions as those underlying the estimates of impact on ferry operators, described above. However, for those alternatives that would cause fast ferries to cease operations, it was assumed that the fast ferry passengers would divert to regular ferries. In this case, the delay in travel time for former fast ferry passengers would consist of two components (1) the extra time required by the slower average speed of regular ferries versus fast ferries for the portion of the trip not affected by speed restrictions and (2) the extra time required by the proposed speed restrictions where they would apply. As an illustration, a fast ferry trip that previously took 1 hour to travel 30 nm (56 km) at 30 knots would, with implementation of speed restrictions, take 2.6 hours: 2 hours to traverse the average effective distance of a DMA of 20 nm (37 km) at 10 knots plus 0.6 hours to transit the remaining 10 nm (19 km) at an average speed of 15 knots instead of 30.

Data Chart 4-40b
Estimated Economic Impact of Proposed Operational Measures on Southern New England Ferry Passengers, 2005 ($)

Type of vessel	Restricted speed in knots		
and alternative	10	12	14
Fast Ferries			
Alternative 2	3,221,251	2,516,603	2,013,282
Alternative 3	6,862,666	5,453,368	4,446,727
Alternative 6	3,571,387	2,790,146	2,232,117
Regular Ferries			
Alternative 2	1,291,127	859,890	258,225
Alternative 3	5,164,506	3,439,561	1,032,901
Alternative 6	1,619,379	1,078,506	323,876
Total			
Alternative 2	4,512,378	3,376,493	2,271,507
Alternative 3	12,027,172	8,892,929	5,479,628
Alternative 6	5,190,766	3,868,653	2,555,993

Source: Prepared by Nathan Associates as decribed in text.

Alternative 1– No Action Alternative

There would be no impact on ferry passengers under Alternative 1.

Alternative 2 – Mandatory Dynamic Management Areas

Under Alternative 2, the estimated economic impact on fast ferry passengers of a speed restriction at 10 knots would be $3.2 million annually. This is based on an assumed average of 90 passengers per trip incurring a delay of 1.6 hours for 92 fast ferry trips per day over 15 days and an hourly value of passenger time of $16.21. With a speed restriction of 12 knots, the estimated delay would be 1.25 hours and the estimated economic impact $2.5 million annually. With a speed restriction of 14 knots, the estimated delay would be 1 hour and the estimated economic impact $2.0 million annually.

For regular ferries, the estimated annual economic impact with a 10-knot restriction would be $1.3 million (based on a delay of 30 minutes for 90 passengers on 118 daily trips over 15 days). At 12 knots, the estimated delay would be 20 minutes and the annual impact $0.9 million; at 14 knots, the estimated delay would be 6 minutes and the estimated annual impact $0.3 million.

Alternative 3 – Speed Restrictions in Designated Areas

Under Alternative 3, it can be assumed that the nine fast ferry operators in the Block Island Sound area would suspend operations for 30 days per year and their passengers would divert to regular ferries. The two fast ferry operations from Boston to Provincetown would cease and be replaced by regular ferry service. For the purposes of the passenger impact analysis, 120 days per year of peak operation for the Boston-Provincetown services were assumed. The resulting impact on fast ferry passengers would be $6.9 million annually at 10 knots, $5.5 million annually at 12 knots, and $4.4 million annually at 14 knots.

For regular ferries, the impact would be similar to that of Alternative 2, except that regular ferry operations can be assumed to be affected for 60 days a year. The resulting annual economic impact would be $5.2 million at 10 knots, $3.4 million at 12 knots, and $1.0 million at 14 knots.

Alternative 4 – Recommended Shipping Routes

There would be no economic impact on ferry passengers under Alternative 4.

Alternative 5 – Combination of Alternatives

Impacts under this alternative would be the same as under Alternative 3 as the relevant factors are those that are also part of that alternative.

Alternative 6 – Proposed Action (Preferred Alternative)

Under Alternative 6, the impact would be the same as under Alternative 2 for fast ferry passengers affected by the DMAs. However, there would be an additional impact of 15 days during early May for the two fast ferries operating from Boston to Provincetown that together account for 10 trips daily. The total estimated annual economic impact on fast ferry passengers would be $3.6million at 10 knots, $2.8 million at 12 knots, and $2.2 million at 14 knots.

For regular ferries, the economic impact again would be the same as that of Alternative 2 with an increment for speed restrictions during 30 daily trips on the Boston-Provincetown route over 15 days. The total annual impact would be $1.6 million at 10 knots, $1.1 million at 12 knots, and $0.3 million at 14 knots.

The above estimates assume 100 percent compliance with DMAs. However, under Alternative 6, DMAs would be voluntary, and ferry operators may choose not to comply with them. In that case, impacts would be less than estimated.

4.4.6 Impacts on Whale-Watching Vessels

Like the passenger ferry industry, the whale-watching industry can be categorized into operations that deploy fast vessels traveling at speeds of 25 to 38 knots and operations that deploy slower, regular vessels traveling at speeds of 16 to 20 knots. Data Chart 4-41 presents information for the major whale-watching operators in Massachusetts Bay. There are four operators of fast vessels; two are based in Boston, one in Barnstable, and one in Provincetown (two vessels). There are five operators of regular-speed vessels; they are based in Newburyport, Boston, Gloucester, Plymouth (six vessels), and Provincetown (four vessels). A survey of whale-watching operators in New England indicated that the majority of whale-watching vessels are 65 ft (19.8 m) and longer, and, therefore, would be affected by the proposed operational measures.

4.4.6.1 Alternative 1 – No Action Alternative

The No Action Alternative would have an indirect effect on the whale-watching industry. Whale-watching vessels derive profit from transporting customers to whale habitats with the intention of sighting one or more whales. In order to please and retain customers, they prefer that whales are sighted at least once on every trip. The larger the whale population – including right whales – the higher the probability that one or more animals will be sighted on any given trip. No new operational measures are proposed in Alternative 1, and the current measures have proved ineffective at reducing the amount of ship strikes to whales. Therefore, under this alternative, the right whale population would continue to decline, which would reduce the probability that right whales would be sighted regularly. However, most whale-watching trips do not target right whales only and the adverse effect is expected to be negligible.

Data Chart 4-41
Massachusetts Bay Whale Watching Operators, 2005

Operator	Location	Vessel Speed	Vessels
High-Speed Vessels			
Boston Harbor Cruises	Boston, MA	37	1
Hyannis Whale Watcher Cruises	Barnstable, MA	38	1
New England Aquarium	Boston, MA	25	1
Portuguese Princess Excursions	Provincetown, MA	25	2
Regular Speed Vessel			
Massachusetts Bay Lines	Boston, MA	18	1
Capt. John Boats	Plymouth, MA	17	6
Newburyport Whale Watch	Newburtyport, MA	20	1
Yankee Whale Watching	Gloucester, MA	20	1
Dolphin Fleet of Provincetown	Provincetown, MA	16	4

Source: Prepared by Nathan Associates from data on operator websites and selected interviews.

4.4.6.2 Alternative 2 – Mandatory Dynamic Management Areas

Implementing Alternative 2 would have direct adverse effects on whale-watching vessels that are 65 ft (19.8 m) or more in length and operate in the vicinity of designated DMAs. It can be assumed that high-speed vessels would suspend operations when DMAs are in effect along their route: communications with persons in the whale-watching industry indicated that it would not be economically viable to operate a high-speed vessel at less than half its normal operating speed. The estimated economic impact from the suspension of five high-speed vessels for a single 15-day DMA would be $0.4 million annually.[43] For regular-speed vessels, the analysis assumed 100 percent compliance with the DMAs. [44] Under this assumption, the estimated economic impact of a 10-knot restriction would be $0.9 million annually for the 13 regular-speed vessels, which would incur a 54-minute delay each way for two trips per day. At 12 knots, the estimated economic impact would be $0.5 million annually; at 14 knots, it would be $0.3 million.

The estimated economic impact of Alternative 2 are high for the industry as a whole, but actual impacts may in fact be less for several reasons. Individual vessels would have the option of altering their destination based on the occurrence of a DMA and operators of high-speed vessels, assumed in the analysis to be suspending their operations in case of DMA, indicated that they likely would choose to travel to alternate sighting grounds or target another whale species. The analysis also assumed that regular-speed whale-watching vessels over 65 ft (19.8 m) would need to reduce their speed when transiting through a DMA. However, if whales were located in a DMA, it is likely that a nearby whale-watching vessel would already be traveling at a slow speed to allow its passengers to look and take pictures. If a DMA were designated in an area the vessel would have to traverse to reach a particular destination, the captain could route around the area or seek other potential whale-watching spots that day in order to avoid delays. All these factors are likely to minimize actual impacts.

Conversely, because the number of effective DMA-days in the northeast (excluding Cape Cod Bay) was estimated to be 68 per year (in Cap Cod Bay, it was estimated to be 105 days per year) (see Table 4-1) and the impact analysis above is based on a single DMA, actual impacts could be higher than estimated if multiple DMAs are designated in the same year. However, each DMA would likely not affect every whale-watching operators every time, minimizing the potential for substantially higher impacts than estimated.

4.4.6.3 Alternative 3 – Speed Restrictions in Designated Areas[45]

Alternative 3 would have direct adverse effects on whale-watching vessels 65 ft (19.8 m) and longer along the US East Coast. Under this alternative, the proposed year-round speed restrictions in the Northeast region and Cape Cod Bay would render high-speed whale-watching vessels unprofitable, with the consequence that they might be sold or diverted into other service. As this would not be a recurring cost, potential loss associated with the sale of the vessel is not included in this economic assessment. It also can be assumed that regular-speed whale-watching vessels would be put into service to replace the high-speed vessels. However, demand for whale-watching from locations such as Boston would likely diminish because the additional time required to reach whale feeding areas is likely to discourage passengers. It is possible that some of the demand would divert to other whale-watching operations located closer to the feeding areas.

Regular-speed whale-watching vessels would be subject to the year-round speed restrictions extending 25 nm (46 km) from the coastline and in Cape Cod Bay. It is estimated that, with a 10-knot restriction, the 13 regular-speed vessels operating in that area would incur a 54-minute delay each way for two round-trips daily during a 90-day summer whale-watching period. On

[43] Calculated based on a $13,320 daily operating costs excluding fuel times 15 days for 5 vessels.
[44] This analysis assumes that on average, only half of a DMA would affect the whale-watching vessel's route, hence the effective distance of the DMA would be approximately 20 nm (37 km).
[45] This analysis also applies to Alternative 5.

this basis, the annual economic impact of the alternative was estimated to be $5.6 million (it would be $3.1 million at 12 knots and $1.9 million at 14 knots) (see Data Chart 4-42).

Speed restrictions proposed in the mid-Atlantic from October 1 to April 30 would extend out 25 nm (46 km), which would include the majority of the right whale migratory corridor. In the Southeast, speed restrictions from November 15 through April 15 in the MSRS WHALESSOUTH reporting area and critical habitat would also affect the majority of whale-watching trips if the vessel is 65 ft (19.8 m) or longer and if the designated speed limit is lower than the average vessel operating speed. Due to the seasonal nature of the speed restrictions in the MAUS and SEUS and the small number of whale watching operators in these regions, it is expected that any economic impact on the whale-watching industry could be avoided or would be negligible.

Data Chart 4-42
Estimated Economic Impact of Proposed Operational Measures on Massachusetts Bay Whale Watching Operators, 2005 ($)

Type of vessel and alternative	Restricted speed in knots 10	12	14
High-Speed Vessels			
Alternative 2	399,600	399,600	399,600
Alternative 3	-	-	-
Alternative 6	399,600	399,600	399,600
Regular Speed Vessel			
Alternative 2	936,000	520,000	312,000
Alternative 3	5,616,000	3,120,000	1,872,000
Alternative 6	936,000	520,000	312,000
Total			
Alternative 2	1,335,600	919,600	711,600
Alternative 3	5,616,000	3,120,000	1,872,000
Alternative 6	1,335,600	919,600	711,600

Source: Prepared by Nathan Associates from data on operator websites and selected interviews.

4.4.6.4 Alternative 4 – Recommended Shipping Routes

Alternative 4 would not affect whale-watching operations. The recommended shipping lanes into the Cape Cod Bay, Brunswick, Fernandina, and Jacksonville port areas are primarily for use by commercial shipping vessels, not smaller passenger vessels such as whale-watching vessels, which typically are based in smaller harbors.

4.4.6.5 Alternative 5 – Combination of Alternatives

Alternative 5 would have the same direct, long-term, adverse effects on whale-watching vessels 65 ft (19.8 m) and longer as Alternative 3 (see Section 4.4.6.3) because the relevant measures would be the same.

4.4.6.6 Alternative 6 – Proposed Action (Preferred Alternative)

Alternative 6 would have direct adverse impacts on whale-watching vessels 65 ft (19.8 m) and longer. Under this alternative, speed restrictions for Cape Cod Bay would be in place from

January 1 through May 15. Therefore, the peak summer whale-watching season would not be affected. Similarly, speed restrictions for an extended Off Race Point are proposed for March through April only. Thus, the economic impact of Alternative 6 can be considered the same as those of Alternative 2, as they would result primarily from the implementation of DMAs. Total impacts would be $1.3 million annually at 10 knots, $0.9 million annually at 12 knots, and $0.7 million annually at 14 knots (see Data Chart 4-42). These estimates assume 100 percent compliance. Since DMAs would be voluntary, lower levels of compliance would result in proportionately lower impacts.

With the exception of the New England Aquarium, all the potentially affected whale-watching operators are small economic entities. Considering these small operators only, the annual impacts would amount to an estimated 4.2 percent of the total annual revenue generated by the affected high-speed vessels and 3.8 percent of the revenue generated by affected regular-speed vessels. (using information from the industry, annual revenue was estimated based on an average revenue of $16,000 a day per vessel for a peak season of 120 days).

However, only a small minority of the total number of whale watching operations (approximately 13 percent) and of vessels (approximately 7 percent) would be affected. Also, all above estimates conservatively assume full compliance with DMAs. Should vessel operators choose not to observe the voluntary speed restrictions, as they would be free to do, there would be no impacts at all.

Because the number of whale-watching operators in the MAUS and SEUS regions is minimal, the impact of the proposed operational measures on the whale-watching industry in these areas is expected to be negligible.

4.4.7 Impacts on Charter Vessel Operations

During stakeholder meetings, representatives of the charter fishing industry raised concerns about the negative effects speed restrictions may have on their industry. In some areas, charter vessels travel up to 50 nm (92.6 km) offshore to reach prime fishing areas. At vessel speeds of up to 17 knots, they can reach their destination in less than three hours. A speed restriction of 10 knots over 20 nm (37 km), as would happen under Alternative 6, would add about 100 minutes to the roundtrip and could severely affect client demand and reduce the competitiveness of the larger headboats (more than 65 ft [19.8 m]), particularly for the half-day (6-hour trips) and full-day (11- to 12-hour trips) charters. It is likely that vessels less than 65 ft (19.8 m) long would increase their share of this market, partially offsetting the overall impact. For extended full-day charters (18- to 24-hour trips), headboats longer than 65 ft (19.8 m) would incur additional costs associated with the 100-minute increase in roundtrip travel time.

4.4.7.1 Alternative 1 – No Action Alternative

The No Action Alternative would have no effect on charter vessels or the charter industry.

4.4.7.2 Alternative 2 – Mandatory Dynamic Management Areas

Under Alternative 2, DMAs would potentially affect larger charter vessels (65 ft [19.8 m] and longer) only. However, these vessels could either route around the DMA or reduce their speed through it. It can be assumed they would choose the option that would be the most time- and cost-efficient, thus minimizing, though not eliminating, any resulting time penalty. Overall, impacts are expected to be negligible.

4.4.7.3 Alternative 3 – Speed Restrictions in Designated Areas

Under Alternative 3, a speed restriction of 10 knots over 25 nm (46 km) would have minor, direct, long-term, adverse economic impacts on charter vessels, amounting to an estimated $1.0 million annually. The annual impact would be $598,000 with a 12-knot speed restriction and $299,000 with a 14-knot restriction. As already noted, only headboats 65 ft (19.8 m) longer would be affected.

4.4.7.4 Alternative 4 – Recommended Shipping Routes

There would be no impacts on charter vessels under Alternative 4.

4.4.7.5 Alternative 5 – Combination of Alternatives

The impacts under Alternative 5 – $1.0 million annually at 10 knots, $598,000 at 12 knots, and $299,000 at 14 knots – would be the same as under Alternative 3.

4.4.7.6 Alternative 6 – Proposed Action (Preferred Alternative)

Under Alternative 6, it is estimated that the economic impact of a speed restriction of 10 knots for these vessels over 20 nm (37 km) would be approximately $796,000 annually.[46] At a 12-knot speed restriction, the estimated annual impact would be $480,000; at 14 knots, it would be $240,000.

Based on an estimated annual revenue for a charter fishing headboat of $504,000 (assuming 90 charters with 80 passengers paying $70 each), the annual impact for a 10-knot speed restriction would represent 3.9 percent of the annual revenue generated by the potentially affected boats. However, the proportional impact would be much less when compared to the total revenue generated by the charter fishing industry since most of the industry's fleet consists of boats less than 65 ft (19.8 m) long, which would not be affected by the proposed measures.

4.4.8 Indirect Economic Impact of Other Market Segments on the Local Economy

Industry representatives and other parties expressed concern that implementation of the proposed operational measures on passenger ferries, whale-watching vessels and charter fishing vessels would also have an indirect economic impact on local communities. For example, operators of fast ferries between Boston and Provincetown stated that suspension of their services due to the implementation of a DMA during peak season would seriously affect tourism-related businesses in Provincetown. However, members of the passenger ferry industry have also expressed concerns about their ability to compete with car travel, suggesting that it is likely that in the absence of convenient ferry service, passengers would select a different mode of transportation to travel to Provincetown. If that is the case, any indirect economic impacts on the local economy

[46] This calculation assumes 40 headboat vessels with 30 roundtrips during the off-season months for fishing – November through April – and an hourly steaming operating cost of $400. The calculations do not include any offsetting impact of revenue gains by operators of smaller charter fishing vessels.

can be expected to be limited. These indirect impacts may increase slightly if the high price of gas makes car travel less desirable; however, high energy prices would also affect the cost of travelling by ferry.

Similarly, whale-watching operators and tourism officials in the Greater Boston area expressed concerns that visitors would cut their trip short or cancel their visit to the region entirely because of potential impacts from implementation of a DMA. However, unlike the passenger ferry operators that have to operate on a fixed route, whale-watching operators under most circumstances could alter their route to avoid the DMA and select routes and destinations where whales other than right whales could be observed. In addition, operators of vessels under 65 ft (19.8 m) in length would likely be available to serve customers desiring to observe right whales within the DMA area (these vessels would still be required to comply with the 500-yd (457-m) no-approach regulation). In this case, the implementation of a DMA might actually generate additional business for whale-watching operators. Overall, tourists would have sufficient attractive alternatives and are not expected to cut short or cancel their visit to the region due to the proposed operational measures.

The proposed operational measures for the mid-Atlantic region would be effective from November through April and would not fall within the peak months for charter fishing. In addition, it is expected that customers lost to the larger headboats would be served by charter fishing operators with smaller vessels. For these reasons, any indirect economic impacts on the local communities are expected to be minimal.

4.4.9 Summary of the Direct and Indirect Economic Impacts on all Maritime Sectors

This section summarizes the annual economic impacts of the alternatives considered in this FEIS based on 2004 conditions with a 10-knot speed restriction (impacts for 12 and 14 knots also are briefly stated). Data Chart 4-43 presents the annual direct and indirect economic impacts by alternative and speed restriction for both 2003 and 2004 conditions.

- **Alternative 5** would have the largest estimated annual economic impact, at an estimated $359.7 million, including $200.1 million in direct impacts and $159.6 million in indirect impacts. Speed restrictions year-round would have substantial repercussions through the northeast region port areas and the northern mid-Atlantic port areas. The combination of DMAs, recommended routes and speed restrictions also would contribute substantially to the impacts. The brunt of the impacts would be borne by the commercial shipping industry, with a combined direct economic impact of $166.7 million annually. This represents 83 percent of the total direct economic impact. The total annual economic impact with a speed restriction of 12 knots would be $223.3 million; with a speed restriction of 14 knots, it would be $134.1 million.
- **Alternative 3** would have the second-largest annual economic impact, estimated at $334.8 million annually. The direct economic impact would be $195.4 million and the indirect economic impact $139.4 million. The total annual economic impact with a speed restriction of 12 knots would be $210 million; with a speed restriction of 14 knots, it would be $121.7 million.

- **Alternative 6** (**Proposed Action**) would have the third-largest total annual economic impact, with an estimated $137.3 million per-year, for five years, including $87.6 million in direct impact and $49.7 million in indirect impact. The total annual economic impact with a speed restriction of 12 knots would be $77.4 million; with a speed restriction of 14 knots, it would be $45 million. Impacts would cease five years after the measures' date of effectiveness.
- **Alternative 2** ranks fourth in terms of total economic impact, with an estimated $41.5 million annually. This alternative would not have indirect impact. The total annual economic impact with a speed restriction of 12 knots would be $28.1 million; with a speed restriction of 14 knots, it would be $17.9 million.
- **Alternative 4** would have the lowest total economic impact, with an estimated $2.8 million annually for 10, 12, and 14 knots. This alternative would consist only of the use of recommended routes; negative secondary impacts on some port areas would be offset by gains to others.

Table 4-3 summarizes the potential impacts of Alternative 6 (the proposed action) on industries other than the shipping industry measured as a percentage of the annual revenue generated by the affected activities in 2004. The numbers are the same as those calculated to assess impacts to small economic entities in the economic impact report because, with one exception, these industries consist entirely of such entities. The exception is the whale watching industry, because one operator, the New England Aquarium, is not a small entity, and, therefore, is not taken into account in the table. The Aquarium accounts for one affected vessel out of 18. It should also be noted that the estimates shown in Table 4-3 are quite conservative because (1) they only take into account revenues generated by the affected vessels whereas these vessels represent only a minority of the vessels operated by each industry and (2) they assume full compliance with voluntary DMAs, whereas it is likely that at least some operators would choose not to observe the recommended speed restriction.

Table 4-3
Estimated Economic Impacts of Alternative 6 on Industries Other Than the Shipping Industry

Industry	Estimated Annual Economic Impact ($ Million)	Economic Impact as a % of Annual Revenues[1]
Commercial Fishing	1.3	0.5%
Passenger Ferries		
High-speed Vessels	2.6	4.9%
Regular-speed Vessels	6	7.9%
Whale Watching		
High-speed Vessels	0.3	4.2%
Regular-speed Vessels	0.9	3.8%
Charter Vessels	0.796	3.9%

1. Based on estimated 2004 revenues from the affected operations only. Impacts as a percentage of the total annual revenue of each industry would be smaller.

Data Chart 4-43
Total Direct and Secondary Economic Impact by Alternative and Restriction Speed, 2003 and 2004 ($000s)

	Alternative 2			Alternative 3			Alternative 4			Alternative 5			Alternative 6		
	Restriction speed in knots			Restriction speed in knots			Restriction speed in knots			Restriction speed in knots			Restriction speed in knots		
Item	10	12	14	10	12	14	10	12	14	10	12	14	10	12	14
2003															
Direct economic impact															
Shipping industry vessels	25,026.5	16,119.0	9,829.8	133,009.9	83,641.1	49,461.4	2,333.4	2,333.4	2,333.4	137,000.4	86,678.1	51,755.2	53,158.3	33,423.8	20,007.9
Cumulative effect of multi-port strings	-	-	-	11,265.1	9,350.0	7,885.6	-	-	-	11,265.1	9,350.0	7,885.6	8,718.7	7,236.5	6,103.1
Re-routing of southbound coastwise shipping	-	-	-	7,500.0	7,500.0	7,500.0	-	-	-	7,500.0	7,500.0	7,500.0	3,400.0	3,400.0	3,400.0
Commercial fishing vessels	-	-	-	1,724.0	-	-	-	-	-	1,724.0	-	-	1,310.2	-	-
Charter fishing vessels	-	-	-	1,000.0	597.6	298.8	-	-	-	1,000.0	597.6	298.8	796.0	480.0	240.0
Passenger ferries	8,078.0	6,111.3	4,144.7	13,028.0	11,061.3	8,308.0	-	-	-	13,028.0	11,061.3	8,308.0	8,608.9	6,567.2	4,563.0
Pasengers' time on passenger ferries	4,512.4	3,376.5	2,271.5	12,027.2	8,892.9	5,479.6				12,027.2	8,892.9	5,479.6	5,190.8	3,868.7	2,556.0
Whale watching vessels	1,335.6	919.6	711.6	5,616.0	3,120.0	1,872.0	-	-	-	5,616.0	3,120.0	1,872.0	1,335.6	919.6	711.6
Subtotal direct economic impact	38,952.5	26,526.4	16,957.6	185,170.2	124,162.9	80,805.4	2,333.4	2,333.4	2,333.4	189,160.7	127,199.9	83,099.1	82,518.5	55,895.8	37,581.6
Indirect economic impact of port diversions	-	-	-	141,608.0	81,489.0	38,803.0	-	-	-	162,536.0	91,777.2	48,911.2	49,600.5	18,203.5	5,302.7
Total economic impact	38,952.5	26,526.4	16,957.6	326,778.2	205,651.9	119,608.4	2,333.4	2,333.4	2,333.4	351,696.7	218,977.1	132,010.3	132,119.0	74,099.3	42,884.3
2004															
Direct economic impact															
Shipping industry vessels	27,578.8	17,700.7	10,781.8	142,476.8	89,229.6	52,530.3	2,790.6	2,790.6	2,790.6	147,171.3	92,772.0	55,237.8	57,569.2	36,050.4	21,544.6
Cumulative effect of multi-port strings	-	-	-	11,932.6	9,904.1	8,352.8	-	-	-	11,932.6	9,904.1	8,352.8	9,411.5	7,811.5	6,588.1
Re-routing of southbound coastwise shipping	-	-	-	7,600.0	7,600.0	7,600.0	-	-	-	7,600.0	7,600.0	7,600.0	3,400.0	3,400.0	3,400.0
Commercial fishing vessels	-	-	-	1,724.0	-	-	-	-	-	1,724.0	-	-	1,310.2	-	-
Charter fishing vessels	-	-	-	1,000.0	597.6	298.8	-	-	-	1,000.0	597.6	298.8	796.0	480.0	240.0
Passenger ferries	8,078.0	6,111.3	4,144.7	13,028.0	11,061.3	8,308.0	-	-	-	13,028.0	11,061.3	8,308.0	8,608.9	6,567.2	4,563.0
Pasengers' time on passenger ferries	4,512.4	3,376.5	2,271.5	12,027.2	8,892.9	5,479.6	-	-	-	12,027.2	8,892.9	5,479.6	5,190.8	3,868.7	2,556.0
Whale watching vessels	1,335.6	919.6	711.6	5,616.0	3,120.0	1,872.0	-	-	-	5,616.0	3,120.0	1,872.0	1,335.6	919.6	711.6
Subtotal direct economic impact	41,504.8	28,108.1	17,909.6	195,404.6	130,405.4	84,441.6	2,790.6	2,790.6	2,790.6	200,099.1	133,947.9	87,149.0	87,622.2	59,097.4	39,603.2
Indirect economic impact of port diversions	-	-	-	139,406.0	79,603.0	37,251.0	-	-	-	159,582.0	89,308.4	46,956.4	49,695.0	18,280.0	5,355.0
Total economic impact	41,504.8	28,108.1	17,909.6	334,810.6	210,008.4	121,692.6	2,790.6	2,790.6	2,790.6	359,681.1	223,256.3	134,105.4	137,317.2	77,377.4	44,958.2

Source: Prepared by Nathan Associates as described in text.

4.4.10 Impacts on Environmental Justice

The proposed operational measures evaluated in this FEIS were developed based on the range of the right whale and vessel traffic patterns; they do not specifically target any one port community. Depending on the alternative, the 26 port areas considered here would experience negligible to minor adverse economic impacts (only economic impacts have any potential to raise economic justice issues). Within each port area, these impacts would not be localized and limited to or focused on specific minority or poor neighborhoods. Rather, they would be distributed throughout the entire region and local economy. The activities and businesses likely to be directly or indirectly affected by the proposed action are varied and are not disproportionately identified with a given ethnic or economic minority. Therefore, within each port area, the economic impacts of the proposed action would not likely disproportionately affect minority or low-income populations.

However, as shown in Section 3.4.8.2, 10 of the 26 port areas considered in this EIS have a higher percentage of minority or low-income residents than the United States as a whole and, as such, qualify as environmental justice communities, warranting closer scrutiny. Of these 10 areas, six – New York City, Hampton Roads, Georgetown, Charleston, Baltimore, and Savannah – have a minority population greater than the United States or representing more than 50 percent of the area's total population and four – Eastport, Morehead City, Wilmington, and Brunswick[47] – have a higher percentage of residents living below the poverty line than the United States as a whole. If any of these ten areas experienced proportionately greater impacts than the other 16 areas, the proposed action could raise issues of environmental justice.

Because of the wide differences in size and economic activities between the areas, comparison of economic impacts among the 26 affected port areas is not easily made. To allow for such a comparison, an index must be defined. For the purposes of this analysis, this index is the ratio of the estimated direct economic impacts on the shipping industry (in dollars) to the total value (in dollars) of the merchandise shipped to and from a given port area in 2004 as shown in Data Chart 3-3b. While this index does not incorporate all economic impacts, the direct impacts on the shipping industry represent a sufficient component of those impacts to provide a reliable ranking of, and allow for a meaningful comparison among, potential economic impacts to the 26 port areas under each of the six alternatives considered.

4.4.10.1 Alternative 1 – No Action Alternative

Under this alternative, existing mitigation measures would continue, and none of the operational measures would be implemented. Therefore, there would be no change to existing socioeconomic conditions and no potential for environmental justice issues.

4.4.10.2 Alternative 2 – Mandatory Dynamic Management Areas

Table 4-4 shows how each port area would be affected under Alternative 2 using the previously defined index. The areas are ranked based on the intensity of impacts as measured by the index (in descending order) with the ten areas that are environmental justice communities shown in boldface.

[47] The cities of Georgetown, Charleston, and Savannah occur in both categories, and are not counted twice.

Table 4-4
Relative Intensity of Economic Impacts by Port Area – Alternative 2

Port Area	Economic Impact Index[1]	Port Area	Economic Impact Index[1]
Cape Cod, MA	7.325	**Brunswick, GA**	0.012
Port Canaveral, FL	0.866	Boston, MA	0.012
Searsport, ME	0.131	New Haven, CT	0.011
Fernandina, FL	0.127	*All Areas*	*0.008*
Salem, MA	0.105	**Wilmington, NC**	**0.008**
Eastport, ME	**0.075**	**Morehead City, NC**	**0.006**
Bridgeport, CT	0.068	**Hampton Roads, VA**	**0.004**
Portland, ME	0.051	Providence, RI	0.004
New London, CT	0.029	**Charleston, SC**	**0.003**
Savannah, GA	**0.028**	**New York, NY[2]**	0.003
Jacksonville, FL	0.025	Philadelphia, PA	**0.003**
Portsmouth, NH	0.019	**Baltimore, MD**	**0.003**
Georgetown, SC	**0.015**	Long Island, NY[2]	N/A[2]
New Bedford, MA	0.013		

Notes:

1. Direct impacts on the shipping industry as a percentage of total 2004 merchandise value for each port. Impacts calculated for the 10-knot speed restriction were used.

2. For the purposes of this analysis, New York and Long Island are factored together.

As can be seen, only four of the ten environmental justice areas have an impact index superior to that of the areas together. Even in those cases, while the impacts would be relatively high compared to those on the areas as a whole, they would remain very small in absolute terms – for instance, annual direct impacts on the shipping industry at Eastport would amount to $87,300. They would also remain small in relative terms – impacts on Eastport, the most heavily affected of all ten environmental justice areas, would still represent seven-hundredths of one percent of the value of all merchandise traded at the port in 2004. Additionally, as already noted, within each area, impacts would not specifically affect any particular ethnic or economic group since the shipping and other industries likely to be affected are not disproportionately identified with such groups and the cost of the proposed action would be spread across private companies, the port city and surrounding jurisdictions, and the consumer. Therefore, Alternative 2 would not raise substantial issues of environmental justice.

4.4.10.3 Alternative 3 – Speed Restrictions in Designated Areas

Table 4-5 shows how each port area would be affected under Alternative 3 using the same method as previously defined.

Alternative 3 has a higher economic impact than Alternative 2. There is one additional environmental justice area affected, and four out of ten environmental justice areas would experience relatively heavier impacts than all the areas taken together. However, as under Alternative 2, these impacts would remain small compared to the overall activity of each port area and they would not target specific minority or low-income groups. On this basis, Alternative 3 would not raise substantial issues of environmental justice.

Table 4-5
Relative Intensity of Economic Impacts by Port Area – Alternative 3

Port Area	Economic Impact Index[1]	Port Area	Economic Impact Index[1]
Cape Cod, MA	101.375	**Hampton Roads, VA**	**0.067**
Bridgeport, CT	1.098	**Wilmington, NC**	**0.062**
Searsport, ME	0.668	Boston, MA	0.061
Salem, MA	0.555	Philadelphia, PA	**0.044**
Eastport, ME	**0.384**	*All Areas*	*0.044*
New London, CT	0.377	**Morehead City, NC**	0.044
Portland, ME	0.258	**Savannah, GA**	**0.042**
New Haven, CT	0.221	**Baltimore, MD**	**0.039**
New Bedford, MA	0.206	**New York, NY[2]**	**0.037**
Fernandina, FL	0.182	Jacksonville, FL	0.032
Port Canaveral, FL	0.151	**Charleston, SC**	**0.022**
Georgetown, SC	**0.133**	**Brunswick, GA**	**0.015**
Portsmouth, NH	0.096	Long Island, NY[2]	N/A[2]
Providence, RI	0.071		

Notes:

1. Direct impacts on the shipping industry as a percentage of total 2004 merchandise value for each port. Impacts calculated for the 10-knot speed restriction were used.

2. For the purposes of this analysis, New York and Long Island are factored together.

Table 4-6
Relative Intensity of Economic Impacts by Port Area – Alternative 4

Port Area	Economic Impact Index[1]	Port Area	Economic Impact Index[1]
Fernandina, FL	0.091	Providence, RI	0
Jacksonville, FL	0.017	**Wilmington, NC**	**0**
Brunswick, GA	**0.004**	**Eastport, ME**	**0**
All Areas	*0.001*	Cape Cod, MA	0
Boston, MA	0	**Savannah, GA**	**0**
Salem, MA	0	Philadelphia, PA	0
Portland, ME	0	**Baltimore, MD**	**0**
New Haven, CT	0	**Morehead City, NC**	**0**
New Bedford, MA	0	**New York, NY[2]**	**0**
Port Canaveral, FL	0	**Charleston, SC**	**0**
Searsport, ME	0	Bridgeport, CT	0
Georgetown, SC	**0**	New London, CT	0
Portsmouth, NH	0	Long Island, NY[2]	N/A[2]
Hampton Roads, VA	**0**		

Notes:

1. Direct impacts on the shipping industry as a percentage of total 2004 merchandise value for each port. Impacts calculated for the 10-knot speed restriction were used.

2. For the purposes of this analysis, New York and Long Island are factored together.

4.4.10.4 Alternative 4 – Recommended Shipping Routes

Table 4-6 shows how each port area would be affected under Alternative 4 using the index previously defined. The areas are ranked based on the intensity of impacts as measured by the index, with the ten areas that are environmental justice communities shown in boldface. Under this alternative, Brunswick is the only environmental justice community that would incur economic impacts. However, these impacts would be very minor – $253,000 per year, or four-thousandths of one percent of the port's total 2004 merchandise value and, as previously noted, would not target any specific ethnic or low-income community. Therefore, Alternative 4 would not raise substantial issues of environmental justice.

4.4.10.5 Alternative 5 – Combination of Alternatives

Table 4-7 shows how each port area would be affected under Alternative 5 using the same method as previously defined.

Under Alternative 5, four out of ten environmental justice areas would experience relatively heavier impacts than all the areas taken together. However, these impacts would remain small compared to the overall activity of each port area (though less so than under Alternatives 2, 3, or 4), and they would not target specific minority or low-income groups. On this basis, Alternative 5 would not raise substantial issues of environmental justice.

Table 4-7
Relative Intensity of Economic Impacts by Port Area – Alternative 5

Port Area	Economic Impact Index[1]	Port Area	Economic Impact Index[1]
Cape Cod, MA	102.425	**Hampton Roads, VA**	**0.067**
Bridgeport, CT	1.098	Boston, MA	0.064
Searsport, ME	0.697	**Wilmington, NC**	**0.062**
Salem, MA	0.579	Jacksonville, Fl	0.051
Eastport, ME	**0.400**	*All Areas*	*0.045*
New London, CT	0.377	Philadelphia, PA	0.044
Port Canaveral, FL	0.324	**Morehead City, NC**	**0.044**
Portland, ME	0.270	**Savannah, GA**	**0.042**
Fernandina, FL	0.270	**Baltimore, MD**	**0.039**
New Haven, CT	0.221	**New York, NY[2]**	**0.037**
New Bedford, MA	0.206	**Charleston, SC**	**0.022**
Georgetown, SC	**0.133**	**Brunswick, GA**	**0.020**
Portsmouth, NH	0.100	Long Island, NY[2]	N/A[2]
Providence, RI	0.071		

Notes:

1. Direct impacts on the shipping industry as a percentage of total 2004 merchandise value for each port. Impacts calculated for the 10-knot speed restriction were used.

2. For the purposes of this analysis, New York and Long Island are factored together.

4.4.10.6 Alternative 6 – Proposed Action (Preferred Alternative)

Table 4-8 shows how each port area would be affected under Alternative 6.

Under Alternative 6, seven of the ten environmental justice areas would experience impacts heavier than the impacts on the 26 areas taken together. However, in all cases, these impacts would be very small, and would only be incurred during the five-year period the measures would be in effect; for example, impacts in Eastport, the most affected of the ten environmental justice areas, would represent one tenth of one percent of the port's 2004 total merchandise value. Additionally, as already noted, within each area, impacts would not specifically affect any particular ethnic or economic group since the shipping and other industries likely to be affected are not disproportionately identified with such groups and the cost of the proposed action would be spread across private companies, the port city and surrounding jurisdictions, and the consumer. Therefore, Alternative 6 would not raise substantial issues of environmental justice.

Table 4-8
Relative Intensity of Economic Impacts by Port Area – Alternative 6

Port Area	Economic Impact Index[1]	Port Area	Economic Impact Index[1]
Cape Cod, MA	20.050	**Wilmington, NC**	**0.029**
Bridgeport, CT	0.424	Portsmouth, NH	0.025
Fernandina, FL	0.266	**Hampton Roads, VA**	**0.023**
Port Canaveral, FL	0.173	**Savannah, GA**	**0.020**
New London, CT	0.155	**Morehead City, NC**	**0.020**
New Bedford, MA	0.132	**Brunswick, GA**	**0.020**
Searsport, ME	0.105	*All Areas*	*0.018*
New Haven, CT	0.104	Boston, MA	0.016
Eastport, ME	**0.103**	Philadelphia, PA	0.016
Salem, MA	0.069	**Baltimore, MD**	**0.013**
Portland, ME	0.065	**New York, NY[2]**	**0.012**
Georgetown, SC	**0.061**	**Charleston, SC**	**0.011**
Jacksonville, FL	0.049	Long Island, NY[2]	N/A[2]
Providence, RI	0.029		

Notes:

1. Direct impacts on the shipping industry as a percentage of total 2004 merchandise value for each port. Impacts calculated for the 10-knot speed restriction were used.

2. For the purposes of this analysis, New York and Long Island are factored together.

4.5 Impacts on Cultural Resources

As described in Section 3.5, no cultural resources have been identified on the ocean surface in areas that would be affected by the proposed action and alternatives. Therefore, there would be no impacts to cultural resources. The proposed actions are limited to speed restrictions, spatial closures, and re-routing of ships to recommended routes. Furthermore, the USCG conducted the PARS to analyze any existing "navigational hazards" in the recommended routes. Any cultural resource located on the ocean surface would have been considered a hazard to navigation, hence the lanes were not designated in an area with potential hazards.

Consultation with the Advisory Council on Historic Preservation, a NOAA Marine Archeologist, and NOAA General Counsels, resulted in a consensus that the proposed operational measures in the alternatives have no potential to affect any cultural resources or historic properties.[48]

4.6 Regulatory Impacts

The proposed action and alternatives would comply with EO 12898 (Section 1.6.1). A Regulatory Impact Review/Regulatory Impact Analysis is provided in Chapter 5, in compliance with EO 12866 (Section 1.6.2). The Final Regulatory Flexibility Analysis will be included in the Final Rule, in accordance with the Regulatory Flexibility Act (RFA). A discussion of impacts resulting from the implementation of the operational measures on minorities and low-income environmental justice communities is included in Section 4.4.10. The ESA, MMPA, and other relevant legislation are discussed in the following sections.

4.6.1 Endangered Species Act

4.6.1.1 No Action Alternative

The No Action Alternative would not be consistent with the objectives of the ESA. The ESA prohibits the "taking" of any listed species (see Section 1.7.1). Under the No Action Alternative, the "taking" of right whales as a result of ship strikes would continue, and the population would not recover. The *Recovery Plan for the North Atlantic Right Whale*, which is required by the ESA, identifies downlisting the species from endangered to threatened as an intermediate goal. The ultimate goal is to promote the recovery of North Atlantic right whales to a level sufficient to warrant their removal from the list of endangered and threatened wildlife and plants. Under Alternative 1, ship strikes would continue and the right whale population would not be expected to increase, therefore neither goal would be reached. The western population of the North Atlantic right whale would continue to face extinction under this alternative.

4.6.1.2 Action Alternatives

Implementing any of the action Alternatives 2 through 6, each of which contain one or more operational measure(s) aimed at reducing right whale mortalities by ship strikes, would reduce the number of "takes" under the ESA, and increase the probability that the population will recover. Under these alternatives, NMFS would be consistent with the objectives of the ESA to protect North Atlantic right whales, and the species would have a significantly increased chance of recovery and survival. Alternatives 5 and 6, which combine operational measures, would result in a higher probability of population recovery and have the potential to meet the intermediate goal of the Recovery Plan to downlist right whales to threatened in a more timely matter than the alternatives that propose only one operational measure.

[48] Consensus gained through personal communication (via e-mail) with Bruce Terrell, Marine Archeologist, NOAA/National Marine Sanctuary Program, Mary Elliot Rolle, NOAA/General Counsel for Ocean Services, Ole Varmer, NOAA/General Counsel International Law, and Dr. Tom McCulloch, Archeologist, ACHP.

4.6.2 Marine Mammal Protection Act

4.6.2.1 No Action Alternative

The No Action Alternative would be inconsistent with the objectives of the MMPA. The MMPA also prohibits the "taking" of marine mammals without authorization (see Section 1.7.2).[49] The existing measures contained in this alternative have not effectively reduced ship strikes that "take" marine mammals. Under the No Action Alternative, the endangered North Atlantic right whale, which is also a depleted marine mammal species under the act, would not be protected from the threat of ship strikes. The western population of the North Atlantic right whale would continue to face extinction.

4.6.2.2 Action Alternatives

Implementing any of the action Alternatives 2 through 6, which each contain one or more operational measures aimed at reducing right whale mortalities by ship strikes, would reduce the number of "takes" under the MMPA, and increase the probability that the population will recover. These alternatives are consistent with the objectives of the MMPA to protect North Atlantic right whales, and the species would have a significantly increased chance of recovery and survival. Alternatives 5 and 6, which combine operational measures, would result in a higher probability of population recovery and have the potential to bring the right whale population to levels reaching Optimum Sustainable Population (see Section 3.2.1).

4.6.3 Ports and Waterways Safety Act

4.6.3.1 No Action Alternative

Under the No Action Alternative, vessel traffic would continue to route through critical habitat and migratory corridors without any regard to the presence of whales. There would be no known additional action taken by the USCG under the Ports and Waterways Safety Act of 1972, beyond actions they are currently taking for the preservation of right whales and other marine species.

4.6.3.2 Action Alternatives

The USCG made recommendations on NOAA's proposed shipping routes through the PARS study. Recommended shipping routes are included in Alternatives 4, 5, and 6. Through conducting the PARS, the USCG has fulfilled its mandate to protect the marine environment under the Ports and Waterways Safety Act of 1972. These recommended routes will protect the right whale and other marine species while ensuring navigational safety. The Vessel Traffic Service (VTS) system may also be expanded into additional port areas in order to disseminate information concerning the NMFS rulemaking.

[49] The definition of 'taking' varies slightly from the MMPA to the ESA.

4.6.4 Regulatory Flexibility Act

4.6.4.1 No Action Alternative

Under the No Action Alternative, NMFS would not propose any regulatory measures and there would be no subsequent effects that could have a significant economic impact on small entities. Therefore, analysis under the Regulatory Flexibility Act would be unnecessary.

4.6.4.2 Action Alternatives

Inclusion of speed restrictions in the final rule require NMFS to prepare a final regulatory flexibility analysis (FRFA). The FRFA utilizes the US Small Business Administration's (SBA) small business-size standards, which correspond to the North American Industry Classification System Codes (NAICS). The SBA defines a small business in the deep-sea freight transportation sector as a firm with 500 or fewer employees. The SBA defines a small business in the commercial fishing sector as a firm with gross revenues up to $4.0 million. All directly regulated sectors are assessed in the FRFA. Based on these standards and industry data on firm size, the number of small entities in the affected industries are identified and the impacts are quantified. The FRFA will be included in the Final Rule.

4.6.5 Coastal Zone Management Act

4.6.5.1 No Action Alternative

Implementing the No Action Alternative would not adversely affect any land or water uses in the states' coastal zone. None of the existing mitigation measures that would continue under Alternative 1 have an effect on state coastal waters, therefore there would be no impacts with respect to the Coastal Zone Management Act (CZMA).

4.6.5.2 Action Alternatives

The operational measures in the alternatives would not affect land uses within state waters (out to 3 nm [6 km]), but the measures may affect water uses and resources, as defined in Section 304 (10) and (18) of the CZMA. The SEUS management area extends out to approximately 30 nm (56 km) offshore. The MAUS SMAs are proposed 20-25 nm (37-46 km) offshore into state waters in some cases, although only speed restrictions are proposed. In the NEUS, the GSC management area is offshore, and there are not any permanent measures proposed in the Gulf of Maine. The Off Race Point management area runs adjacent to the eastern land side of Cape Cod, although only speed restrictions are proposed in this area, which would not affect coastal or inland waters. The Cape Cod Bay management area does include state waters, and may affect coastal uses, but the proposed measures for this area – speed restrictions and recommended shipping routes – would not have a physical effect on coastal waters.

While several of the operational measures contained in the alternatives may be implemented within state waters (3 nm [5.6 km]), the actual associated action – speed restrictions – would have neutral or positive effects on a state's coastal zone. Reducing the speed of ships into certain ports and other management areas would affect vessel traffic, although it would not interfere with public access or right of passage in state waters. The majority of the applicable state policies include a policy to conserve endangered and threatened wildlife, which is the main objective of the proposed measures, thus resulting in a positive impact on the policies of the state coastal zone management programs.

Given this situation, and following an evaluation of applicable state-enforceable policies, NMFS determined that the implementation of the alternatives would be consistent to the maximum extent practicable with the enforceable policies of the coastal zone management programs of the states included within the geographic scope of the rulemaking. These states are Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. The 'Consistency Determination' letters were submitted to the states, along with the proposed rule and a copy of the DEIS, for review and concurrence by the responsible state agencies under Section 307 of the CZMA. NMFS received concurrence from nine of the 15 states, and after the 60-day review period, NMFS assumed concurrence from the remaining states, as stated in the letter. A copy of the consistency determination letter and the state responses is provided in Appendix F.

4.6.6 National Marine Sanctuaries Act

4.6.6.1 No Action Alternatives

Implementing the No Action Alternative would not affect any resources in Stellwagen Bank National Marine Sanctuary (SBNMS) or Gray's Reef National Marine Sanctuary (GRNMS), and therefore there would be no impact on the resources protected by the National Marine Sanctuaries Act (NMSA).

4.6.6.2 Action Alternatives

The majority of SBNMS overlaps with the Off Race Point and Cape Cod Bay SMAs, and therefore implementation of the rule should be consistent with the NMSA's mandate to prohibit the destruction, loss of, or injury to any sanctuary resource (16 U.S.C. § 1443). While the operational measures in the action alternatives would affect sanctuary resources, including right whales and other endangered baleen whales, the impacts are expected to be beneficial. As mentioned in Section 4.2, species such as fin and humpback whales, which are also threatened by ship strikes, would be afforded protection by the seasonal speed restrictions. While the SMAs may not provide protection for the entire season in which these species are present or sufficient coverage to protect their entire habitat, partial protection is still a postive impact relative to the status quo, by which there are no mandatory speed restrictions anywhere within SBNMS. Therefore, implementation of any of the action alternatives would not result in the destruction, loss of, or injury to any sanctuary resource relative to status quo (No Action Alternative).

Gray's Reef, which is located 17.5 nm (32 km) off Sapelo Island, Georgia, between Savannah and Brunswick, overlaps with the Southeast SMA. For similar reasons to those mentioned above for SBNMS, implementation of any of the action alternatives would not adversely affect GRNMS.

4.6.7 Effects Analysis on Other Resources

4.6.7.1 Possible Conflicts Between the Proposed Action and the Objectives of Federal, Regional, State and Local Land Use Plans, Policies, and Controls for the Area Concerned

Local land use plans are not applicable, as the proposed action and alternatives occur in state and Federal waters. There are several Federal agencies with jurisdiction in the EEZ. The USCG is coordinating on the vessel operational measures, specifically the PARS, to identify recommended routes. Throughout this process, the USCG has not notified NMFS of any conflict between the proposed action and other USCG policies. As all sovereign vessels are exempt from the operational measures, there are no foreseeable conflicts with the policies of other Federal agencies, or their vessels or operations. NMFS has had numerous meetings with the Navy and has accepted written comments from Navy personnel on the ANPR, NOI to prepare a DEIS, proposed rule, and DEIS. The National Ocean Service's National Marine Sanctuary Program (NMSP) has two sanctuaries within the scope of the rulemaking: Stellwagen Bank and Gray's Reef. A coordination letter was sent to these sanctuaries along with a copy of the DEIS to ensure consistency with their policies. NMFS received a comment letter from the NMSP on October 5, 2006, and addressed their comments in the FEIS (see Appendix C).

The state coastal zone management programs were provided with consistency determination letters under the CZMA. A copy of this letter, along with the state responses, is provided in Appendix F. All nine states that responded to the consistency determination concurred with NMFS' determination (Section 4.6.5.2). Massachusetts was the only state to raise concerns. In response to their concerns, NMFS granted an exemption to state enforcement vessels (see Section 1.4).

States that have environmental clearinghouses were sent a coordination letter along with the DEIS to ensure consistency with other environmental protection divisions within the agency. Georgia, South Carolina, North Carolina, Maryland, Rhode Island, and Florida responded to this coordination letter, and included any comments provided by applicable state agencies. The only states that provided comments were Maryland and Florida, and these comments were also formally submitted to NMFS during the comment period on the DEIS. Their comments are addressed in the FEIS (Appendix C).

4.6.7.2 Public Health and Safety

NMFS would identify exemptions from the operational measures in the final rule. These exemptions would be granted if a situation persists where public safety is at risk (e.g., where oceanographic, hydrographic, or meteorological conditions restrict the maneuverability of the vessel). Exemptions are also granted for Federal and state law-enforcement vessels involved in enforcement or human safety activities. Therefore, the proposed action and alternatives would have a negligible effect on public safety. If anything, the reduced vessel emissions at sea attributable to reduced speeds would have a positive impact on public health, although local and regional weather patterns would determine the transport and dispersion of any marine emissions, so that it is difficult to predict the location of these positive effects on air quality and public health. Additionally, maritime safety would be increased slightly because reduced vessel speeds in the affected areas would tend to decrease the risk of collisions between vessels or with natural or man-made obstacles, e.g. rocks, shoals, buoys. Hong Kong provides an example in which vessel speed was reduced for safety. In June 2007, the Government of the Hong Kong Special Administrative Region implemented vessel speed restrictions of five knots, applying to all vessels, in numerous ports and port entrances throughout most of Hong Kong and neighboring waters to enhance navigational and human safety (Hong Kong Special Administrative Region, 2007).

With respect to routing measures, the PARS considered safety and navigational hazards in evaluating the recommended routes; routes were not established in locations that posed a threat to mariner safety. Regarding speed restrictions, some commenters have argued that they will increase navigational and human safety, although a number of industry and Federal sources indicate that the speeds being considered would not a priori endanger vessels or mariners. However, the final rule would include exceptions for navigational safety in inclement weather conditions.

4.6.7.3 Energy Requirements and Conservation Potential

Estimated world fleet fuel consumption, calculated for all main and auxiliary engines in the internationally-registered oceangoing fleet (including military vessels), is approximately 289 million metric tons annually (Corbett and Koehler, 2003). Table 4-9 provides a profile of the world fleet, main engine power and the percentage of energy demand by vessel type. The cargo fleet accounts for the large majority of fuel consumption (66 percent), while the noncargo fleet uses 20 percent and the military accounts for the remaining 14 percent. This review includes estimates for the world fleet, as such data is readily available and is used as a standard measure for this research. As similar data is unavailable for the US East Coast, these estimates are provided for general background information on vessel energy requirements.

Many factors determine fuel consumption by marine vessels, including:

- **Engine Type, Age, and Condition.** Newer engines tend to use less fuel than older ones. Fuel consumption of marine diesel engines has decreased rapidly over the past 30 years, and modern engines can use more than 25 percent less fuel than an older engine (Georgakaki *et al.,* 2005). Fuel consumption also varies according to the vessel type and engine loads. "Average fuel consumption is a composite of the fuel-usage rates at various engine loads. In general, cargo ships have more fuel-efficient, larger engines than nontransport ships (fishing and factory vessels, research and supply ships, tugboats). Typical fleet[50] average fuel consumption rates were 206 g/kWh for transport ships and 221 g/kWh for nontransport ships…" (Corbett and Koehler, 2003).
- **Climatic and Sea Conditions.** Traveling into the wind or in rough seas will increase fuel requirements.

[50] Fleet refers to the world's merchant fleet, using ship registry data from Lloyd's Maritime Information System, 2002.

Table 4-9
Profile of World Fleet, Number of Main Engines, and Main Engine Power[a]

Ship Type	Number of Ships	Percent of Fleet	Number of Main Engines	Percent of Main Engines	Installed Power (MW)	Percent of Total Power	Percent of Energy Demand
Cargo Fleet							
Container vessels	2662	2%	2755	2%	43,764	10%	13%
General cargo vessels	23,739	22%	31,331	21%	72,314	16%	22%
Tankers	9098	8%	10,258	7%	48,386	11%	15%
Bulk/combined carriers	8353	8%	8781	6%	51,251	11%	16%
Noncargo Fleet							
Passenger	8370	8%	15,646	10%	19,523	4%	6%
Fishing vessels	23,371	22%	24,009	16%	18,474	4%	6%
Tugboats	9348	9%	16,000	11%	19,116	4%	5%
Other (research, supply)	3719	3%	7500	5%	10,265	2%	3%
Registered fleet total	88,660	82%	116,280	77%	280,093	62%	86%
Military vessels	19,646	18%	34,663	23%	172,478	38%	14%
World fleet total	108,306	100%	150,913	100%	452,571	100%	100%

Note:
[a]The world fleet represents internationally-registered vessels greater than 100 gross tons; the cargo fleet represents vessels whose main purpose is transporting cargo for trade. Percent of energy demand mainly adjusts for reduced activity (in loads and hours) by military vessels under typical operations.
Source: Corbett and Koehler, 2003.

- **Hull Type and Condition.** Long, thin vessels consume less fuel per given speed than broad vessels. A smooth hull will also meet less resistance than a rough one. The cruise line Costa Crociere estimates it can achieve fuel savings of about three percent by applying a silicone-base coating to its cruise ships (Cruise Industry News, 2006).
- **Speed.** For any given vessel, speed is probably the single most important factor influencing fuel consumption. Doubling the speed of a vessel increases fuel consumption three times and, conversely, decreasing the speed of a vessel by one half decreases the fuel consumption by one third. The Food and Agricultural Organization of the United Nations has estimated that a six-percent reduction in speed (from 9 to 8.5 knots) can result in a fuel savings of approximately 11 percent for fishing vessels (Wilson, 1999).

While there are many variables determining fuel consumption, the information above indicates that speed is the most important factor. It also is the only variable the operational measures would affect. Therefore, in general, the speed restrictions proposed along the East Coast would slightly reduce vessel energy consumption. This reduction would vary according to the type of vessel, the load, and engine type and size. Routing measures such as recommended routes, and the option of routing around a DMA instead of slowing down, would likely increase fuel consumption with the increase in distance traveled. However, the recommended routes do not significantly diverge from current vessel traffic patterns, and DMAs are temporary and occur in a finite area, which can also be transited at reduced speeds to avoid extra distance. Weighing the benefits of fuel consumption resulting from large-scale speed restrictions with the disadvantages of the routing measures in three states is likely to result in slight net benefits. Although fuel savings could be significant for specific vessels in certain areas at given times, the cumulative reduction in fuel use for all vessels is very difficult to estimate and is likely to be small.

4.6.7.4 Natural or Depletable Resource Requirements and Conservation Potential

Decreased fuel consumption resulting from speed reductions would have a very minor, direct, long-term, positive impact on depletable US and world petroleum resources. Although the fuel savings could be significant for individual marine vessels operating in the area, savings are unlikely to be significant compared to global or US petroleum demand and supply.

4.6.7.5 Urban Quality, Historic and Cultural Resources, and the Design of the Built Environment

The proposed action involves measures at sea and includes no urban areas or areas with a built environment. Cultural resources are discussed in Sections 3.5 and 4.5.

4.6.7.6 Relationships Between Local Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

The proposed action would not impact the short-term use of man's environment. To the contrary, it would lessen the impact of the maritime industry on ocean resources by reducing the number and severity of right whale ship strikes. In the long-term, economic impacts on the industry would not be significant and productivity would not be substantially affected. While the shipping industry's initial adaptation to the new regulations would have a cost, after the first year the regulations are implemented, the proposed measures would become standard operating procedures and result in incrementally less costs to the industry over time.

4.6.7.7 Irreversible and Irretrievable Commitments of Resources which would be Involved in the Proposed Action should it be Implemented

The proposed action would result in an irretrievable commitment of resources in terms of the man-hours the industry would initially have to commit in adapting to the operational measures and integrating the speed restrictions and recommended routes into their voyage-planning on a seasonal basis. As the regulations would not change after the initial implementation, the human resources utilized to plan for the new regulations would only be necessary during the first year of implementation.

The proposed action would also require an irretrievable commitment of man-hours from the government in monitoring and enforcement of the operational measures. However, NOAA intends to use existing technology (to the extent practicable) to monitor compliance, which could potentially be used to supplement existing enforcement capabilities, so the amount of additional man-hours required for this particular action would be minimal.

4.6.7.8 Unavoidable Adverse Environmental Effects of the Proposed Action

The only unavoidable adverse effects of the proposed action on the natural environment are the potential minor, adverse effects on water quality in the SEUS, resulting from concentrating vessels in recommended routes. This is based on the premise that water pollution regulations are less stringent seaward of 12-24 nm (22-44 km), and the shipping lanes extend to approximately 30 nm (56 km) offshore. Although it is possible that there would be an increase in the concentration of pollution in these waters, it is unlikely that mariners would specifically discharge wastewater and other pollutants in the offshore sections of the shipping lanes instead of elsewhere during their voyage. Any effects would be short-term, as use of the routes is expected to be greater when right whales occur in these waters – from November 15 through April 15.

The proposed action also results in unavoidable adverse effects on the human environment in the form of compliance costs. The level of the economic impact varies depending on the limit for the speed restrictions. A speed restriction of 10 knots has the highest economic impact, followed by 12, and then by 14 knots. The economic effects are unavoidable, but necessary to the implementation of the operational measures. NMFS will make efforts to inform the affected industries of the operational measures, and allow sufficient time for the industry to adapt to the new regulations and integrate the measures into their voyage-planning in order to minimize the economic impacts as much as possible through planning.

4.7 Cumulative Effects

NEPA requires the inclusion of a cumulative effects analysis in EIS. CEQ's regulations for implementing NEPA define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" regardless of what agency (local, state, Federal or non-Federal) or person undertakes other actions (40 CFR § 1508.7). CEQ's guidelines for evaluating cumulative effects emphasize the growing evidence that "the most devastating environmental effects may result not from the direct effect of a particular action, but from the combination of individually minor effects of multiple actions over time" (CEQ, 1997). The purpose of the cumulative effects analysis is to ensure that a decision on the proposed action is not made in isolation without considering other past, present, and future influences on the affected resources.

This section analyzes the cumulative effects of implementing the alternatives on the biological, economic, and social-resource components of the affected environment. The baseline against which the cumulative effects are measured is the affected environment as described in Chapter 3, "Affected Environment." The geographic scope is defined by the areas described in Chapters 1 and 2. Cumulative effects will be addressed with respect to the physical, biological, and human environment.

4.7.1 Cumulative Effects on the Physical Environment

4.7.1.1 Air Quality

Climate Change

Air emissions from shipboard combustion engines are largely composed of the following gases that contribute to the greenhouse effect: carbon dioxide, methane, and nitrous oxide. Each greenhouse gas differs in its capacity to absorb and retain heat in the atmosphere. Methane, for example, traps over 21 times more heat per molecule than carbon dioxide, and nitrous oxide absorbs 270 times more heat per molecule than carbon dioxide. The greenhouse effect is the rise in temperature that Earth is experiencing because increasing amounts of these three gases are trapping energy from the sun in the atmosphere. Without these gases, heat would escape into space and the Earth's average temperature would be about 60 degrees Fahrenheit colder (EPA, 2005b).

Human-induced climate change, caused by increasing greenhouse concentrations, has the potential to introduce additional pressures on right whales. Key changes that may accompany global warming include increased precipitation, increased ocean temperature, decreased sea ice coverage, and changes in ocean salinity. Climate change effects of this nature have the potential to influence many aspects of an ecosystem, including habitat, food webs, and species interactions (NMFS, 2005a).

A number of studies review and discuss the likely impacts of global climate change on cetaceans, marine mammals, and marine environments in general. Evaluations of the direct effects of climate change on whales are generally confined to cetaceans in the Arctic and Antarctic regions, where the impacts of climate change are expected to be the strongest. It is possible, however, that the indirect effects of climate change on prey availability and cetacean habitat will be more widespread, and could affect North Atlantic right whales. For example, climate change could exacerbate existing stresses on fish stocks that are already overfished and indirectly affect prey availability (e.g., prey common to fish and whales) for large whale species. Increasing [ocean] temperatures could alter ocean upwelling patterns, fostering increased blooms of dinoflagellates that produce biotoxins. Increased precipitation is also associated with higher temperatures, which could result in more pollutant runoff to coastal waters, and elevating cetacean exposure to chemical contaminants (NMFS, 2005a).

Habitat shifts are another possible implication of climate change. Walther *et al*. (2002) examined recent shifts of marine communities in response to rising water temperatures, concluding that most cetaceans will experience poleward shifts in prey distributions.[51] Distributional habitat shifts may also occur at the local level, but these are highly dependent on complex local attributes as well as ocean current and weather patterns. Such factors also influence the occurrence, distribution, and relative abundance of right whale prey. Baleen whales are highly mobile species, migrating annually from food-rich areas at high latitudes to breeding areas at low latitudes. It is postulated that baleen whales use currents, salinity, and temperature cues to locate regions of high prey abundance and thus may be less affected by climatic habitat shifts than by a general reduction in prey availability.[52] Nevertheless, any general depression of high-latitude prey production and/or poleward shift of feeding grounds could place additional stress on migrating whales. For some whale species, these small changes may have little material effect, but for species already vulnerable because of existing anthropogenic and natural threats, such as the North Atlantic right whale, these changes could be significant obstacles to species survival (NMFS, 2005a).

EPA (2005b) reports that actions are taking place "at every level to reduce, to avoid, and to better understand the risks associated with climate change." Cities and states across the country have prepared greenhouse gas inventories and are actively pursuing programs and policies to reduce greenhouse gas emissions. Nationally, the US Global Change Research Program is

[51] For example, a doubling of greenhouse gases from pre-industrial times could reduce sea ice in the Southern Hemisphere by more than 40 percent. This could produce adverse effects on the abundance of krill, the primary source of food for whales in this area.

[52] Evidence suggests a strong relationship between right whale distribution and threshold densities of calanoid copepods (Finzi *et al*., 1999). For example, right whales do not appear to utilize Cape Cod Bay as a foraging ground unless the densities of copepods are above certain minima (Kenney *et al*., 2001).

coordinating the world's most extensive research effort on climate change. EPA and other Federal agencies are actively engaging the private sector, states, and local governments in partnerships to address global warming, while at the same time, strengthening their economies. For more information, consult the US Climate Action Report (US Department of State, May 2002). Globally, countries around the world have expressed a firm commitment to strengthening international responses to the risks of climate change. The US is working under the auspices of the United Nations Framework Convention on Climate Change to increase international action (EPA, 2005b).

Routing Measures

As mentioned in Section 1.4, the establishment of an Area to be Avoided (ATBA) and changes to the Boston Traffic Separation Scheme (TSS) have/will occur independently of the proposed rulemaking, thus, the measures were removed from all alternatives in the FEIS, and are analyzed in several sections of the cumulative effects analysis.

The modifications to the northern leg of the TSS were implemented in July 2007, and the changes to the southern leg of the TSS and the establishment of an ATBA would occur 2009 if approved by the IMO. These routing measures would not affect air quality; if/when established, these measures would merely redistribute emissions.

Further, the USCG generally does not conduct NEPA analysis on these routing measures. Figure 2-1 of the USCG Commandant Instruction (COMDTINST) M16475.1D lists actions that are categorically excluded from analysis under NEPA, including promulgation of "Regulations in aid of navigation, such as those concerning rules of the road, International Regulations for the Prevention of Collisions at Sea (COLREGS), bridge-to-bridge communications, vessel traffic services, and marking of navigation systems" (Section 34 (i)). As Rule 10 of COLREGS stipulates the navigational rules for vessels operating in TSSs, it is the basis used for categorically excluding amendments to TSSs from NEPA analysis (67 FR 53740; 65 FR 53911).

As the majority of the analysis on these routing measures had already been completed for the DEIS, the respective cumulative impact sections provide a description of the impacts on the physical (Section 4.7.1) and biological environments (Section 4.7.2.5), and a quantitative economic impact (Section 4.7.3.4) for each measure. Therefore, readers interested in the cumulative economic impact can add the impact of one or both of these measures to the economic impact of the preferred alternative.

4.7.1.2 Ocean Noise Levels

Whales, dolphins, and other marine mammals rely, to a large extent, on their hearing to locate food, find mates, and keep groups together. Large whales communicate primarily using low-frequency sounds (typically below 1,000 Hz) that are capable of propagating long distances through water (Richardson, 1995). The growing amount of noise within this low-frequency range from ships and other sources represents an additional potential threat to large whales. Noise may disrupt and inhibit feeding and communication that facilitates reproduction; disturb or otherwise disrupt use of calving grounds, feeding grounds, or migratory routes; or, in the worst case, cause direct auditory damage and death (NMFS, 2005a). Noise sources include ship and boat propeller and engine noise; drilling, blasting, and dredging; acoustic deterrent devices used by fish farms and fishing vessels; airguns used in seismic exploration; and the use of low- and mid-frequency sonar in military operations. In recent years, low- and mid- frequency sonar have garnered attention from both the scientific community and the general public. Quantifying the impact of acoustic emissions, however, has been difficult, and its effect on marine mammals is not well understood (NMFS, 2005a).

There is a need for additional data on the impact of chronic noise exposure on cetacean health. Potential impacts from undersea noise vary from no effect to possible disturbance to temporary hearing loss or long-term behavioral changes that may reduce whale survival and reproduction. One response of particular concern is the potential for the displacement of cetacean populations from certain locations because of high levels of anthropogenic noise (NMFS, 2005a).

As described in Section 3.3.4, the main sources of anthropogenic ocean noise in the Atlantic Ocean are shipping; offshore drilling and mineral exploration activities; and military exercises. The direct and indirect impacts of the proposed action on shipping noise are described in Section 4.3.

Offshore Drilling and Mineral Exploration Noise

The Minerals Management Service is the lead Federal agency charged with managing offshore oil exploration and leasing. From 1976 to 1983, ten oil and gas lease sales were held in the Atlantic outer continental shelf area. On the blocks leased during that period, 47 exploratory wells were drilled, but hydrocarbons were discovered in only five of the wells drilled. The last of these natural gas and oil leases was relinquished in 2000, and currently there are no leases for oil and gas in existence off the Atlantic coast. However, exploration for sand and gravel deposits is presently occurring on the outer continental shelf of several Atlantic states (MMS, 2005).

Noise from Seismic Exploration for Scientific Research

Federal agencies, such as the National Science Foundation (NSF), provide funding to academic institutions and research facilities to conduct seismic research in the ocean. Seismic research focuses on the geology and geophysics of the seafloor, including earthquake and submarine volcano processes, and undersea landslides. The equipment used for the seismic programs includes multibeam bathymetric sonars, bottom-profiling sonars, acoustic current profilers, and airguns. Airguns emit strong pulses of compressed air that result in sound pulses ~ 0.1 second in duration near the source, to ~ 1.0 second at a distance. Airguns are often used in arrays and towed 98 to 164 ft (30 to 50 m) behind the ship. Seismic surveys introduce low-frequency sound (peak energy typically < 250 Hz) into the ocean. These devices are used to obtain information on the seafloor, the composition of sediments, locations of mineral deposits below the substrate, and ocean currents and circulation patterns.

Noise from airguns and other seismic sources can have potentially adverse effects on marine mammals, sea turtles, fish, and other marine resources. The effects range from no response, to habituation, behavioral changes, masking or hearing impairment, and other physical effects. To minimize or avoid adverse effects of seismic operations on marine resources, monitoring and mitigation methods are incorporated into the research programs. NSF and NMFS are currently conducting a programmatic EIS/OEIS on the environmental impacts of seismic operations conducted from NSF's primary seismic ship, the R/V Marcus G. Langseth. The programmatic EIS/OEIS will address the planned program as a whole, rather than assessing individual cruises separately.

Shipping and Vessel Noise

Shipping has been a constant source of anthropogenic noise in the ocean since the inception of motorized waterborne commerce and transportation, and will continue to increase with the steady increase in commercial shipping. From 1985 to 1999, world seaborne trade increased 50 percent to approximately five billion tons, and is estimated to account for 90 percent of world trade (Westwood *et al*., 2002). A modern-day supertanker cruising at 17 knots produces sounds of 190 decibels (dB) or more with peak energy below 500 Hz. Midsized ships such as tugboats and ferries are quieter, producing source levels around 150 to 170 dB in the same frequency range (NRC, 2003; Jasny *et al*., 2005).

The ATBA in the Great South Channel critical habitat would not affect levels of ocean noise; it would merely temporarily redistribute vessel noise away from this location. The shift and narrowing of the Boston TSS would also redistribute noise slightly north of the existing TSS, removing a concentration of vessel traffic and noise from aggregations of baleen whales sighted in and near the existing TSS.

Noise from Military Activities

Although direct, unequivocal evidence has not been obtained, there are increasing indications that military activities have the potential to disturb, injure, or kill marine mammals. In 1996 six right whale deaths were recorded in waters adjacent to the Southeast critical habitat area (one death resulted from a ship strike). The Navy maintains a base adjacent to this area and uses offshore waters for gunnery exercises. Because several of the carcasses were found near a Navy gunnery range, it was suspected that some deaths were related to underwater explosions, but no conclusive link was established (NMFS, 2005a). The Navy currently has mitigation measures in place to prevent similar events from reoccurring (Appendix A).

Undersea Warfare Training Range

The Navy is proposing to build a 500 nm^2 (1,713 km^2) undersea-warfare training range, approximately 57 nm (105 km) off the East Coast of the US. The impacts of this project are described in the initial *Draft Overseas Environmental Impact Statement/Environmental Impact Statement for the Undersea Warfare Training Range* (DoN, 2005a). The EIS assesses alternative sites for the range off the coast of northeastern Florida and northeastern Virginia. The area selected for the range would be fitted with undersea cables and sensor nodes (underwater acoustic transducer[53] devices), which would be used for antisubmarine warfare training. The transducer nodes would receive and transmit acoustic signals from ships operating within the site. Training events would involve submarines, ships, and aircraft. The training exercises would utilize both passive and active mid-frequency (1 to 10 kHz) sonar (maximum source levels ~ 235 dB). Since the initial DEIS has been published, the Navy has published a notice of intent to prepare a revised EIS (72 FR 54105; September 21, 2007).

In the DEIS, the Navy considers the potential noise effects of the undersea warfare training range on marine mammals, including the right whale. The preferred location for the training range off southeastern North Carolina would be located more than 47 nm (87 km) offshore. As 63.8 percent of North Atlantic right whales sightings are within 10 nm (18.5 km) of the coast, with 94.1 percent reported within 30 nm (56 km) of the coast (Kraus *et al*., 1993 *in* DoN, 2005a; Knowlton *et al*., 2002), the DEIS concludes that there would be no significant impacts on right

[53] A transducer is an instrument that converts one form of energy to another.

whales if the preferred alternative were selected. However, this finding was questioned by scientists, government agencies and non-governmental organizations through comments on the DEIS. NMFS specifically suggested the need for "further analysis of right whale sightings in this area…to evaluate the potential impacts of the preferred alternative" in their comment letter to the Navy, dated January 30, 2006. Until these analyses are conducted, the cumulative effects of this action on right whales are unknown.

If the Navy were to pick the alternative northeastern Florida site, which overlaps with right whale critical habitat for calving from December through April, the DEIS projects that some disturbance of right whales would occur from active acoustic sources when in use. The DEIS concludes that while momentary disturbance from active acoustics is likely, right whales would not "exhibit long-term displacement in the area of the proposed range, nor would the overall migratory pattern be significantly affected." If this alternative were to be selected, the Navy would initiate ESA Section 7 consultation with NMFS to develop mitigation measures (DoN, 2005a).

In summary, the cumulative effects of the three primary sources of anthropogenic noise discussed in this section, in addition to other natural and anthropogenic threats to right whales, might result in long-term adverse impacts on the health of the right whale population. Cumulative impacts are difficult to analyze without greater understanding of the effects of noise on right whale hearing and behavior.

The need for NMFS to take action on noise pollution and acoustic impacts was first identified in 1987, when it was determined that the intense sounds from an acoustic source could potentially harass marine mammals and was therefore subject to the take provisions of the MMPA. In 1995, the agency formed the NMFS Acoustics Program. Today, the program is:

- Working with panels of acoustics experts to develop new or updated Noise Exposure Criteria for marine mammals, fish and sea turtles.
- Funding research to address critical data needed to improve and expand Noise Exposure Criteria.
- Developing acoustic-exposure policy guidelines for NOAA.
- Leading efforts to develop a global passive-acoustic noise-monitoring network in key marine environments.
- Continuing to work cooperatively with the shipping industry to address the emerging issue of shipping noise and marine mammals, which was the subject of the May 2004 international symposium and an upcoming symposium in May 2007 on vessel- quieting technology.
- Providing technical analysis for NOAA's Incidental Take Authorizations involving human sound sources.

Information on the NMFS Acoustics Program may be found at:
http://www.nmfs.noaa.gov/pr/acoustics/

4.7.1.3 Water Quality

As described in Section 3.3.2, "Water Quality," research suggests that pollution in the marine environment adversely affects marine mammals. While not directly killing cetaceans, pollutants are believed to cause sub-lethal direct effects that may alter cetacean physiology, including reproduction, immune defense, endocrine system functions, and possibly neural systems that control social and migratory behavior. Indirectly, water pollutants can affect the numbers and diversity of cetacean prey species and lead to bioaccumulation in whales from eating contaminated prey. Whales are particularly vulnerable to chemical pollutants because they are long-lived, have extensive fat stores (where chemicals accumulate), and toothed whales are often at the top of the food chain. Although little direct evidence of the link between chemical pollution and cetaceans is available, evidence of the adverse effects of pollution on terrestrial species and non-cetacean marine mammals is sufficient to warrant concern about similar impacts on cetacean species.

As the human population along the East Coast continues to expand, the amount of sewage and industrial waste that reaches ocean waters, particularly in the shallow coastal waters favored by right whales, could also continue to grow. Any increase in pollutants in coastal waters could magnify negative effects on right whales, impairing their health and impeding recovery of their population.

Working to control water pollution are an array of laws, as follows:

- **Clean Water Act** – Controls pollution in the nation's waterways by controlling point and nonpoint discharges.
- **Coastal Zone Management Act** – Encourages environmentally sound development in coastal areas.
- **Marine Protection, Research, and Sanctuaries Act of 1972** – Regulates ocean disposal of materials.
- **Oil Pollution Act of 1990** – Ensures that parties responsible for spills or releases of oil or other hazardous substances are liable for damages and cleanup.
- **MARPOL Conventions** – International conventions that control pollution of the marine environment by ships.

Agencies responsible for administering these laws are continuously seeking better enforcement tools and funding to reduce sources of pollution, such as by upgrading and building new sewage treatment plants. Continuing enforcement will serve to contain existing and future water pollution, but to the extent that ocean waters continue to be polluted, pollutants will have negative effects on cetaceans (NMFS, 2005a). The following paragraph discusses a specific US action with respect to water quality.

NMFS' broader set of operational measures to reduce ship strikes to right whales have the potential for cumulative impacts on water quality. Shifting the Boston TSS would have a negligible effect on water quality outside the territorial sea. The 12-degree northern rotation in the Boston TSS adds 3.75 nm (6.9 km) to the trip for vessels traveling to or from points south in the TSS (see Figure 4-11, The Previous and Existing Traffic Separation Scheme in the Approach to Boston) (Wiley, 2005, *unpublished data*). Prior to July 1, 2007, the northern segment of the current TSS was completely within the contiguous zone and was located almost entirely within the territorial sea, where there are strict regulations on ocean dumping. The shift resulted in a slight increase in the section of the TSS that lies outside the territorial sea in the contiguous zone. While there are fewer restrictions with respect to vessel discharges outside of 12 nm (22 km) in the contiguous zone than within 12 nm (22 km) only a small section of the TSS is affected. The shift and narrowing of the TSS are not expected to change the number of vessels that use these lanes and would add only minutes to the trip. Furthermore, this shift routes vessels away from an area where whales are sighted frequently, so that any potential increase in pollution would be removed from areas with high densities of whales.

4.7.2 Cumulative Effects on the Biological Environment

4.7.2.1 Commercial Whaling

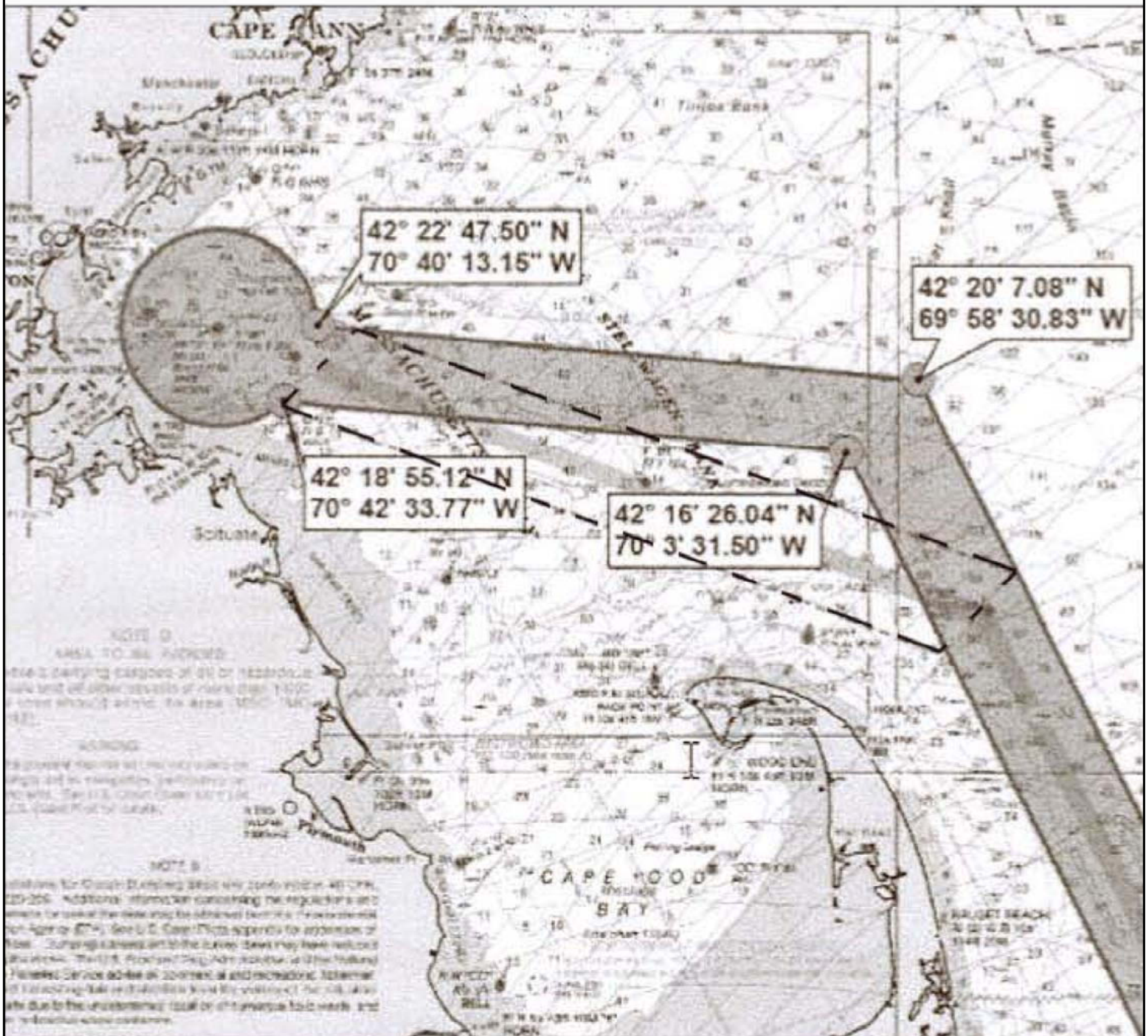
Commercial whaling may have started as early as 800 A.D. in Scandinavia, and is known to have been practiced by the Basques off the coast of France and Spain as early as the 12th century. Early whaling, utilizing hand-held harpoons, targeted slow-swimming species like right whales and bowhead whales. With the development of steam-driven vessels and, in 1868, the invention of the explosive harpoon gun, the age of modern whaling began. These innovations in whaling technology allowed whalers to target faster-swimming species, such as blue, fin, and sei whales (NMFS, 2005a).

The International Whaling Commission (IWC) was established in 1946 to regulate whaling and thus ensure the sustainability of the whaling industry (Cooke, 1995; Holt, 1999). The IWC originally negotiated harvest quotas with member nations based on estimates of whale populations. These quotas were set too high, however, and the system eventually proved incapable of preventing overexploitation (Gambell, 1999). By the early 1980s, the organization had shifted its focus from whaling regulation to whale conservation. The result was the 1982 approval of a temporary, voluntary ban on commercial whaling, which came into effect in 1986 and remains in effect to this day. As a result of this ban, most IWC members have ceased whaling entirely; only Denmark, Iceland, and Norway continue any form of whaling in the North Atlantic, and the number of whales taken by these nations has been greatly reduced (NMFS, 2005a).

North Atlantic right whales were the first target of commercial whaling and, consequently, the first large whale species to be hunted to near extinction by such efforts. Whalers targeted this species for several reasons, including the presence of right whales in near coastal waters, the relatively slow speed at which they swim, their tendency to float when dead, and the high yield of commercially valuable products (e.g., oil and baleen) they provided. These factors also contributed to the whale's common name, which is said to have originated from the English whalers who designated this species of whale as the "right" – that is, correct – whale to hunt. More than 800 years of uncontrolled and intense commercial whaling is the primary reason that the population of right whales has declined to its present-day critical level (NMFS, 2005a).

The commercial harvest of right whales in substantial numbers began in the 1500s with Basque whalers in the Strait of Belle Isle region off Newfoundland (Aguilar, 1986). As the stocks in these waters became depleted, hunting efforts shifted to the Labrador and New England coasts. In total, between the 11th and 17th centuries, an estimated 25,000 to 40,000 North Atlantic right whales are believed to have been taken. This early period of intense whaling may have resulted in a significant reduction in the stock of right whales by the time colonists in the Plymouth area began hunting them in the 1600s. Nonetheless, a modest but persistent whaling effort along the coast of what is now the eastern United States continued. One record from January 1700, for example, reports 29 right whales killed in Cape Cod Bay in a single day (Reeves and Mitchell, 1987; NMFS, 2005a).

The Previous and Existing Traffic Separation Scheme in the Approach to Boston*



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*Note: The previous TSS is depicted with dashed lines and the existing TSS is shaded. Coordinates identify endpoints for the existing TSS (effective 1 July 2007).

Figure 4-11

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The League of Nations adopted a resolution banning all harvesting of right whales in 1935. At that time, it was thought that fewer than 100 right whales survived in the western Atlantic (NMFS, 2001a *in* NMFS, 2005a).

4.7.2.2 The Atlantic Large Whale Take Reduction Plan (ALWTRP)

Fishing gear entanglement is a primary cause of anthropogenic mortality to large whales, including right whales, as discussed in Section 1.1. Whales and other marine species may become entangled in fishing gear such as nets, traps, and pots that are left in the water from hours to days. They may become so entangled that they are unable to swim to the surface to breathe; entanglements may result in long-term effects, such as starvation in cases where lines are wrapped around the mouth, or in a whale becoming debilitated as it drags the gear for days or weeks. Studying entanglements from 1997 to 2001, Waring *et al.* (2003) found that the species suffering serious injury most frequently, in descending order, were humpback, right, minke, and fin whales. Fatal entanglements most frequently involved, in descending order, minke, humpback, right, and fin whales. The annual right whale mortality rate resulting from entanglements was 1.2 in 2003. As this number exceeds the PBR levels for right whales (see Section 1.1.1), NMFS took action to reduce mortality from entanglements.

The Atlantic Large Whale Take Reduction Team (ALWTRT) is one of several take-reduction teams (TRTs) established by NMFS in 1996 to help develop plans to reduce the number of whales entangled by fishing gear along the Atlantic coast. The ALWTRT is composed of fishermen, scientists, conservationists, and state and Federal officials. TRTs were established as advisory teams under the MMPA.

The MMPA requires Take Reduction Plans (TRPs) for strategic marine mammals stocks that interact with Category I or II fisheries (see Section 1.1.2.2). The right whale is considered a strategic stock because its human-caused mortality exceeds the PBR level and it is listed as endangered under the ESA. Therefore, the ALWTRT helped NMFS develop the ALWTRP that was published in November 1997 as an interim final rule. A final rule was published in February 1999. The plan addresses right, humpback, fin, and minke whales. The plan described in the final rule was intended to be an evolving plan that would change as whale researchers learn more about the status of whale stocks and gain a clearer understanding of how and where entanglements occur. NMFS retained the ALWTRT as a feature of the plan, to help the agency monitor progress and advise on needed improvements. NMFS proposed broad-based gear modifications to the ALWTRP in June 2005 and the final rule was published in October 2007 (see Section 1.7.2) to further reduce entanglements.

The ALWTRP and proposed amendments would have a beneficial cumulative effect on the right whale population. Reducing both of the primary causes of human-induced mortality – entanglement and ship strikes – will have significant beneficial effects on the population. Ship strike and entanglement reduction measures should have a measurable impact on the population status by reducing the mortality rate and allowing the population to recover and eventually reach sustainable population levels.

4.7.2.3 Whale Watching

The popularity of whale watching is growing, and with it the number of vessels that seek out whales for viewing, and consequently there are concerns about their short-term and long-term effects on whale behavior and populations (IFAW *et al.,* 1995). It is estimated that the industry attracts more than nine million participants a year in 87 countries, generating revenue of one billion US dollars (Hoyt, 2001). Whale watching tends to concentrate on whale aggregations and aggregation areas, such as those used for feeding. When large numbers of vessels descend on one area and "when some approach too closely, move too quickly, operate too noisily, or pursue animals, performance of life processes in wild cetaceans may be interrupted" (Lien, 2001). A number of studies have shown that whale watching has short-term impacts on whales by, for example, startling them and temporarily driving them away from feeding patches or distracting them from socializing, but studies of long-term effects are lacking (Amaral and Carlson, 2005).

Amaral and Carlson (2005) reviewed the literature – 204 articles – on whale-watching impacts worldwide. They note that whale watching may enhance environmental tourism, regional economics, environmental education and research but that it is critical to avoid negative impacts on whales being watched, which can include acoustic disturbance, increased energy expenditure, exclusion from habitats, and vessel strikes. The authors reviewed the impact of whale watching on many types of whale behavior, such as time feeding, time diving, tail slaps, group cohesion, respiration, time spent traveling, etc. Whale responses were elicited most often by the speed and direction of the whale-watching boats. None of the studies specifically looked at impacts on Northern right whales, with one exception, and that was Watkins (1986).

Watkins (1986) studied the impact of whale watching in Cape Cod Bay on four species of baleen whales, including Northern right, minke, humpback and fin whales. Watkins reviewed cruise and experiment logs both prior to and after 1976, they year of the advent of whale-watching in the area, to document any changes in whale behavior. He found that minke whales changed from frequent positive interest in vessels to generally uninterested reactions; finback whales changed from mostly negative to uninterested reactions; humpback whales dramatically changed from mixed responses that were often negative to often strongly positive reactions; but right whales continued their behavior with little change. He noted that the whales studied seemed to react primarily to underwater sound, but also to light reflectivity and tactile sensations. Watkins theorized that the type of activities in which right whales engage influences their sensitivity to and tendency to avoid noise disturbance and vessel activity (Watkins, 1986).

Most studies of the impact of whale watching on whales focus on short-term disruptions to their behavior. Studies of long-term impacts are needed to determine whether whale-watching activities could create long-term negative changes to whale behavior and biology, such as by driving them from productive feeding grounds or by causing them to exert energy needed for migration and reproduction to avoid whale-watching vessels (IFAW *et al*., 1995). Such studies would allow more-complete assessment, making the cumulative effects clearer. Meanwhile, many regions and countries have developed whale-watching guidelines to reduce pressure on whales and avoid negative effects. A compilation of such guidelines can be found in Carlson (2003).

4.7.2.4 Habitat Destruction

Several human activities that may adversely affect right whale habitat have already been discussed, including fishing; anthropogenic noise; contaminants; oil and gas exploration and development; and other energy-related development. There are few data regarding the possible indirect adverse effects of these types of human activities on right whales. However, it is possible that certain activities that degrade right whale habitat may be slowing population recovery. Studies are needed to determine if various activities are affecting right whales and right whale productivity (NMFS, 2005b). This section describes several of these topics and also introduces coastal development as a possible cause of habitat destruction.

A continued threat to the coastal habitat of the right whale in the western North Atlantic is the undersea exploration and development of mineral deposits, as well as the dredging of major shipping channels. Section 4.7.1.2 describes offshore drilling and exploration specifically with respect to noise, and this section describes the general effects. Although oil exploration has occurred in the past, NMFS is not aware of any current plans to explore or develop oil resources in this region. If these activities occur, there may be consequent adverse effects to the right whale population by vessel movements, noise, spills, or effluents. These activities may possibly result in disturbance of the whales or their prey, and/or disruption of the habitat, and should be subject to ESA Section 7 consultations (NMFS, 2005b).

Right whales also occur in areas where dredging and its associated disposal operations occur on a regular basis, such as along the southeastern US coast. The USACE has responsibility/oversight for many of these dredging and disposal operations and has consulted with NMFS under Section 7 of the ESA on these activities (Appendix A). As a result, engaging in dredging operations and related activities requires protective measures, such as posting lookouts on dredge vessels and adherence to recommended precautionary guidelines for operations to reduce the risk of collision (NMFS, 2005b).

Coastal development of waterfront property, marinas, and other recreational facilities is a threat to right whale habitat. This type of development introduces vessel traffic and other human activities that may adversely affect right whales. One example is the development of a gated subdivision and marinas at Cumberland Harbor in Georgia. The marinas would hold up to 800 boats, and while these would be small, recreational vessels, a vessel of this size class has been recently implicated in a right whale ship strike. In this case, boaters will receive outreach materials on right whales and endangered species and Federal regulations will be enforced to mitigate the impacts of these marinas (Bynum, 2005). Other examples include Liberty Harbor in Brunswick, Georgia, and Lane Fernandina Marina in Fernandina Beach, Florida. Both of these expansion projects include conservation measures to reduce ship strikes.

It is unknown to what extent these activities may disturb or otherwise affect right whales. It appears that whale behavior and the type of activity in which they are engaged influence right whale sensitivity to, and tendency to avoid, noise disturbance and vessel activity (Watkins 1986; NMFS, 1991 *in* NMFS, 2005b), but more studies are needed.

In the *Recovery Plan for the North Atlantic Right Whale* (NMFS, 2005b), NMFS identified the need to conduct studies to determine the direct and indirect effects of activities and impacts associated with coastal development on the distribution, behavior, and productivity of right whales. The activities studied should include, but not be limited to, sewage outfall; dredging activities (and associated plumes); dredge spoils; dumping; habitat alteration; noise; oil and gas exploration and development; and aquaculture activities, including effects on prey species as well as on right whales directly. As the impacts are identified, NMFS will take steps to minimize identified adverse effects from coastal development (NMFS, 2005b).

Cape Wind Project

Cape Wind Associates has proposed an offshore wind-energy project that consists of the installation and operation of 130 Wind Turbine Generators (WTGs) on Horseshoe Shoal in

Nantucket Sound. The wind-generated energy produced by the WTGs would be transmitted via a submarine transmission cable system to the electric service platform, which would transform and transmit the electric power to the shore via alternating current submarine cable circuits (USACE, 2004). The USACE published a DEIS on this project in November 2004, a marine biological assessment in May 2004 which assessed the impacts of the project on threatened and endangered marine species, and a final environmental impact review in February 2007. The facility is expected to be operational in 2010.

The Cape Wind project has the potential to disturb right whales and their habitat. The project will introduce vessel traffic during the construction of the project and then regularly thereafter for operation and maintenance. Increased vessel traffic may disrupt right whale behavior, increase the probability of vessel strikes, and may result in acoustic harassment, although minimal data exist on the effects of vessel noise on right whales. However, there have been very few whale sightings in Nantucket Sound, and the bathymetric and oceanographic features that are conducive to dense aggregations of prey are not as prevalent in Nantucket Sound as they are in other feeding grounds, such as Stellwagen Bank, Jeffreys Ledge, Browns and Bacaro Banks, and in the Great South Channel (Kenney and Winn, 1986 *in* USACE, 2004). Only seven records exist of right whales occurring in Nantucket Sound since the early 1900s; whales are more common offshore to the east of Nantucket Island than in the Sound (USACE, 2004). Given the rare occurrence of right whales in Nantucket Sound, the probability of cumulative, adverse effects to right whales is low.

4.7.2.5 NMFS' Other Measures to Reduce Ship Strikes to Right Whales

Nonregulatory Measures

Four additional nonregulatory measures being undertaken by NMFS will also have a long-term, positive cumulative impact on right whale recovery through various means to reduce the threat of ship strikes. These measures include the following elements:

1. Continue ongoing conservation and research activities to reduce the threat of ship strikes.
2. Develop and implement additional mariner education and outreach programs.
3. Conduct Section 7 consultations, as appropriate, with Federal agencies that operate or authorize the use of vessels in waters inhabited by right whales.
4. Develop a right whale conservation agreement with the Government of Canada.

Continuing ongoing research and conservation activities, described in Section 1.2.1, in addition to the vessel operational measures, will increase the level of right whale protective measures. The grant program will continue to fund studies of new technologies, right whale biology and habitat parameters, and identification of new and expanded ship strike mitigation measures. The MSRS will continue to provide data on vessel traffic information. The northeastern and southeastern right whale recovery plan implementation teams will continue to educate mariners about the threat of ship strikes, and as elements of the program are implemented the teams may help disseminate information to mariners. Current enhanced outreach and education efforts, including updating and disseminating navigational charts, brochures, placards and other publications to educate mariners about the vulnerability of right whales to ship strikes, will further the program objectives.

Mariner awareness is a key component to reducing the threat of ship strikes. While feedback from current efforts indicates that the maritime community is increasingly aware of the problem, NMFS is developing and implementing a comprehensive education and outreach program for mariners and the general boating public which highlights the severity of the ship strike problem and provides steps that can be taken the reduce the threat. NMFS has compiled a comprehensive list of tasks to raise mariner awareness that targets all segments of the recreational and commercial shipping industries, other agencies, and the general public. Tasks include developing curricula for maritime training academies; providing training modules for captain re-licensing; providing advice on voyage planning for domestic and foreign-flagged vessels; and ensuring all east coast pilots have material to distribute. Key groups, such as the implementation teams and others, are assisting in reviewing, prioritizing, and performing the tasks.

Conducting ESA Section 7 consultations (see Section 1.7.3) would establish separate agency-specific ship strike reduction measures to cover vessels owned or operated by, or under contract to, Federal agencies that would be exempt from the speed restrictions. These vessels are exempted because the national security, navigational, and human safety missions of some agencies may be compromised by mandatory vessel-speed restrictions. NMFS will use Section 7 consultations to assess vessel activities authorized, funded or carried out by Federal agencies. NMFS will review actions, including those subject to the conditions of existing Biological Opinions (e.g., see Appendix A), that involve vessel operations of relevant Federal agencies (i.e., the USACE, EPA, MARAD, MMS, NOAA Corps, USCG, and US Navy) and determine whether to recommend initiation or re-initiation of Section 7 consultation to ensure those activities are not jeopardizing the continued existence of right whales or destroying or adversely modifying their critical habitat.

Development of a right whale conservation agreement with the government of Canada would be aimed at extending protection measures into Canadian right whale habitat, thereby strengthening the overall effectiveness of NMFS' right whale conservation measures. As North Atlantic right whales are transnational in distribution, NOAA intends, with the appropriate Federal agency or agencies, to initiate negotiation of a bilateral conservation agreement with Canada to ensure that, to the extent possible, protection measures are consistent across the border and as rigorous as possible. Although the specific language of such an agreement has not been identified, NOAA has already communicated the need for an agreement and cooperative efforts to Canadian officials.

United States Proposed Measures to the International Maritime Organization

The US prepared and submitted a proposal to the IMO in April 2006 to reconfigure the TSS that services Boston, Massachusetts. The proposed realignment was developed jointly by NMFS and NOS' National Marine Sanctuaries Program, and analyzed by the USCG regarding navigational safety. The proposal submitted by the USCG on behalf of the US included a 12-degree shift in the northern leg and narrowing the two traffic lanes by approximately 0.5 mi (0.8 km) each (Figure 4-11). The separation zone between the two lanes would remain unchanged at its current 1.0-mi (1.6-km) width. The realignment is expected to provide a significant reduction in ship strikes to right whales and other baleen whale species occurring in the area, with minimal impact to mariners using the TSS. The TSS is expected to reduce the risk of ship strikes to right whales by 58 percent, and by 81 percent to other baleen whales occurring in the area. The IMO's subcommittee on Safety and Navigation reviewed the proposal in July 2006 and the Maritime

Safety Committee endorsed the proposal in December 2006. The changes in the TSS were implemented in July 2007. The shifted segment is defined by the following coordinates:

Location	Latitude (N)	Longitude (W)
NW Corner	42° 22' 47.50"	070° 40' 13.15"
NE Corner	42° 20' 7.08"	069° 58' 30.83"
SW Corner	42° 18' 55.12"	070° 42' 33.77"
SE Corner	42° 16' 26.04"	070° 03' 31.50"

The United States submitted two additional vessel routing proposals to the IMO in April 2008. One proposal is to narrow each lane of the southern leg of the Boston TSS from 2.0 mi (3.2 km) to 1.5 mi (2.4 km), leaving the western boundary of the TSS and the width of the mile separation zone unchanged. The second proposal is to establish a 7,450-km^2 (4,269-mi^2) ATBA in the Great South Channel critical habitat exclusive of the Boston TSS. Vessels over 300 GRT would voluntarily avoid this area from April through July. Similar to the concept of shipping lanes, this measure would reduce the co-occurrence of right whales and ships, thus significantly reducing the possibility of ship strikes. Vessels less than 300 GRT, but 65 ft (19.8 m) and longer transiting the area would be required to abide by the speed restrictions of the Great South Channel SMA. The ATBA would be bound by the following coordinates:

Latitude (N)	Longitude (W)
41° 44.4'	069° 33.6'
42° 10.0'	068° 31.0'
41° 38.0'	068° 13.0'
41° 1.2'	069° 4.2'

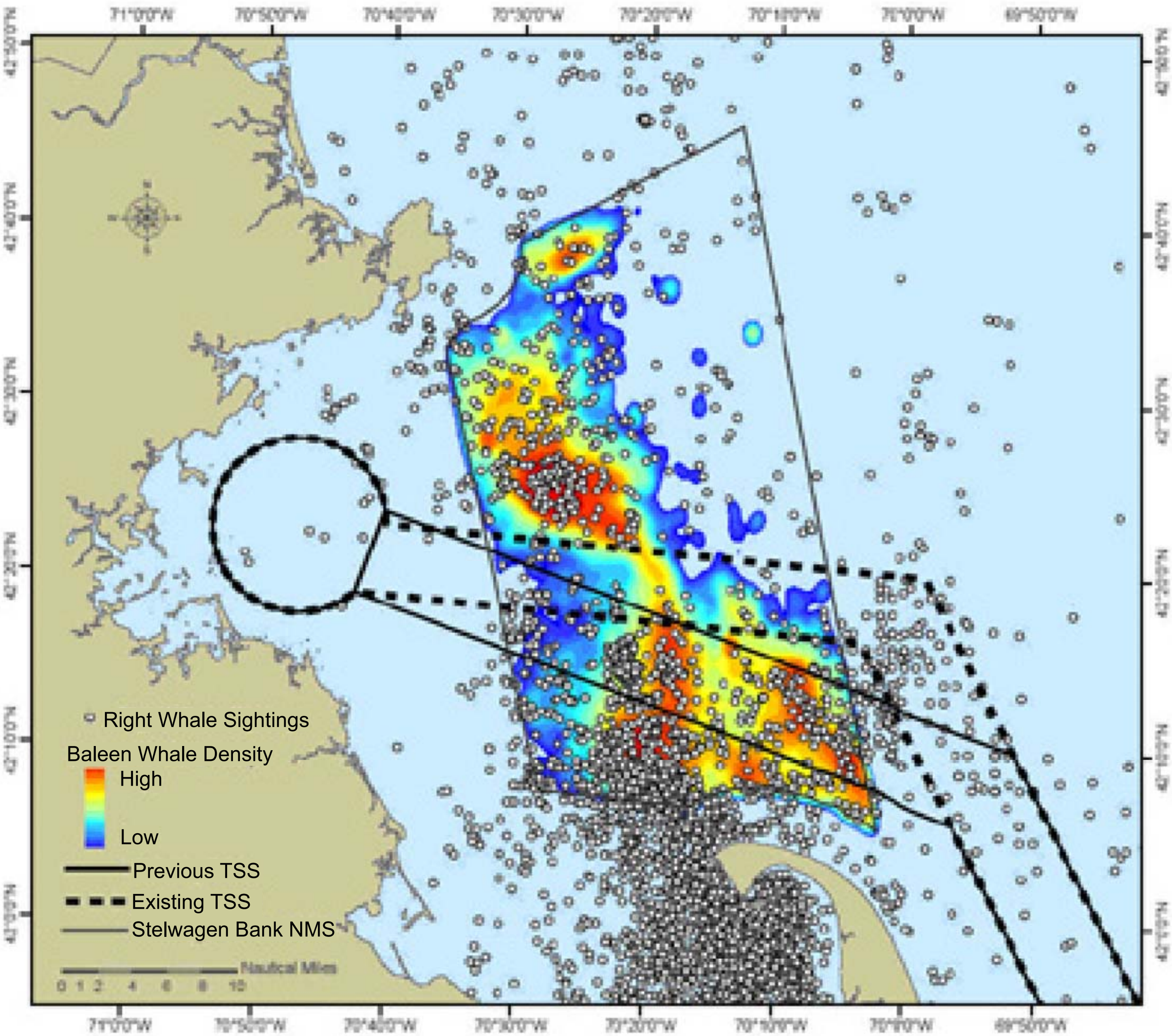
The highest density of traffic within the ATBA follows a route originating from the southwest corner to the northeast corner. (Traffic densities within the TSS are higher, although the TSS is not included in the ATBA.)

Impacts on Right Whales

Some of the modifications to the TSS have already been implemented and additional changes to the TSS would occur in the reasonably foreseeable future; these actions would have a positive impact on right whales. The shift in the Boston TSS places the TSS north of an area of known high whale density (see Figure 4-12, Distribution of Right Whales Relative to the Previous and Existing Boston TSS). Biologists estimate that changes to the TSS would result in a significant reduction in the risk of ship strikes of right whales (United States, 2006). Narrowing the lanes in the southern leg of the Boston TSS from 2 nm (3.7 km) to 1.5 nm (2.8 km) would translate to a reduction in the relative risk of ship strike by 11 percent (Merrick and Cole, 2007). Therefore, changes in the TSS would have a direct positive impact on the right whale population in the NEUS.

The ATBA in the Great South Channel would route vessels of 300 GRT and greater around an important feeding ground from April 1 to July 31 (see Figure 4-13, Right Whale Sightings and Ship Traffic Density in Great South Channel from April through July, 1999 to 2005). Vessels under 300 GRT but 65 ft (19.8 m) or more in length would have to reduce speed through the Great South Channel SMA as a result of speed restrictions contained in the rulemaking. Cumulatively, the majority of vessels would either be traveling at reduced speeds through the

Distribution of Right Whales Relative to the Previous and Existing Boston TSS



*Note: Baleen Whale Density is also depicted.

Figure 4-12

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Right Whale Sightings and Ship Traffic Density in the Great South Channel
April - July, 1999 - 2005

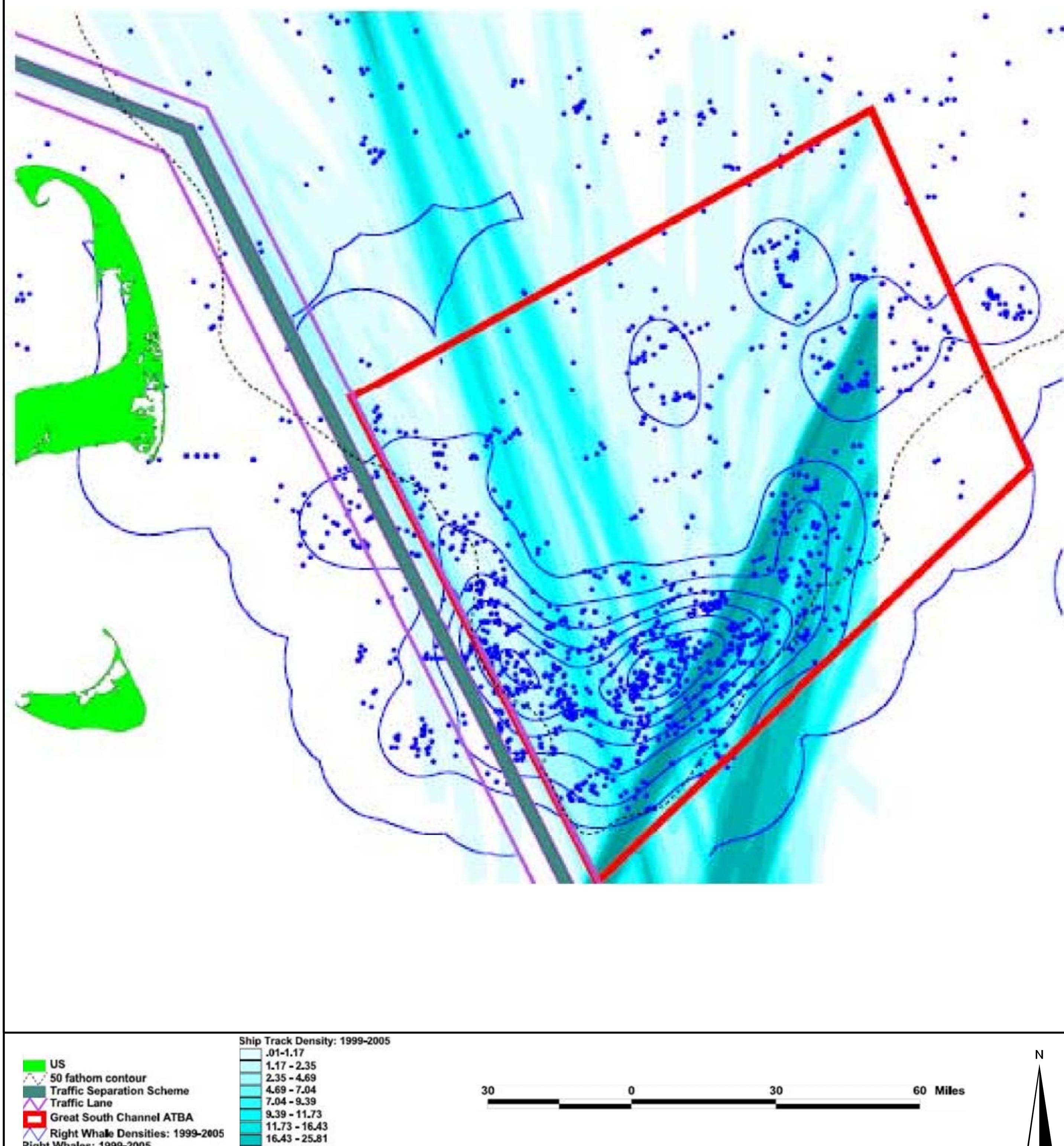

Figure 4-13

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Great South Channel or transiting around the critical habitat area, thus reducing the occurrence and/or severity of a ship strike. Using vessel traffic data from the MSRS and right whale sightings data, Merrick and Cole (2007) developed a model to identify areas of highest relative risk for right whale-vessel interactions for specific polygons within the MSRS, specifically the ATBA. Based on these data, the model predicted that creation of an ATBA could reduce interactions between right whales and vessels by 63 percent. Relative risk of ship strikes with fin and humpback whales would also be reduced.

Impacts on Other Marine Species

The shift in the Boston TSS (Figure 4-12) would have positive impacts on humpback, fin, and sei whales, which, on the basis of thousands of observations of these species in the current TSS from whale-watching platforms from the years 1979 to 2002, are known to occur in this area. The change in the TSS shifted the shipping lane north of an area that has a high density of whale sightings. The shift is expected to result in an 81 percent[54] reduction of ships encountering other large whales. Mahaffey (2006) modeled ship strike risk in the Northeast, and determined that fin and humpback whales have a high risk factor within the Boston TSS from April through June and July through September. Therefore, these species would receive seasonal protection through the speed restrictions associated with the Off Race Point and Great South Channel SMAs, as the TSS overlaps with these areas.

The ecological basis for the change in the TSS is the difference in whale densities in and around the TSS, which is attributable to the composition of the substrate in this area. The substrate under the current TSS consists primarily of sand, over which the preferred forage species of these whales occurs. The seafloor under the TSS consists primarily of gravel and, to a lesser extent, sand, therefore reducing prey densities in the proposed TSS and thereby the occurrence of whales feeding in this area (United States, 2006; Merrick, 2005b). In addition, the narrowing of the lanes would serve to reduce the overlap between large whales and ships.

The impacts of the ATBA and the TSS on the physical environment are provided in Section 4.7.1. The economic impacts of the ATBA and TSS are provided in Section 4.7.3.4.

4.7.2.6 Other Navy Training Exercises

There are various training exercises conducted by the Navy in the Atlantic Ocean aside from the sonar-related activities discussed in Section 4.7.1.2. Some of these programs occur offshore, away from right whale habitat, while other activities overlap with right whale habitat. This section provides information on a few representative programs that may occur in right whale habitat, but is not an exhaustive account of all Navy training exercises. In addition to these activities, the Navy has a suite of regularly-occurring activities within the Boston Complex in the Gulf of Maine (see Section 3.4.7). The Navy has initiated informal consultation on these activities under Section 7 of the ESA, and has implemented interim measures for ongoing activities in coordination with NMFS to minimize the impacts on protected species. These activities are coordinated by the Brunswick Naval Base, and are not discussed in detail in this section, as the Brunswick Naval Base is on the Base Realignment and Closure list for closure, and when this occurs, these exercises will be relocated.

[54] This number also includes minke whale sightings.

Sinking Exercises (SINKEX)

The Navy proposes to conduct Sinking Exercises (SINKEXs), off the coasts of Virginia, North Carolina, and South Carolina. During a SINKEX, a vessel is used as a target or test platform against which the Navy fires live and inert ordnance in order to sink the vessel. The primary purpose of this program is to train Fleet personnel in the use of live weapons against a representative target. In accordance with the Navy's permit under the Marine Protection, Research, and Sanctuaries Act, the SINKEX must be conducted at a distance of greater than 50 nm (92.6 km) from shore and in waters deeper than 6,000 ft (1,830 m). The SINKEX program follows the contours of the shore (as reflected by the boundary of the EEZ), and is generally greater than 200 nm (370 km) offshore (DoN, 2005b).

Very few right whale sightings occur beyond the continental shelf. The Navy's Biological Assessment reviewed the seasonal occurrence of right whales in the proposed site and found the following: a possible occurrence in the spring and fall; unknown in the winter; absent in the summer. The Navy selected the proposed SINKEX location based on several factors, including areas with a low likelihood of encountering an endangered species. However, transiting from port to the SINKEX location crosses the right whale migratory corridor, which increases the potential for vessel collisions. To this end, the Navy adopted mitigation measures to reduce the potential for collisions; Appendix A describes these measures in detail. In addition to these mitigation measures, the Navy developed a monitoring plan to minimize the probability of affecting any protected species or shipping vessels in the vicinity of an exercise (DoN, 2005b). This action would take place in the reasonably foreseeable future, although given the information above, the SINKEX program should not have significant effects on right whales.

Previous informal Section 7 consultations under the ESA with the NMFS' Northeast Regional Office (NERO) and Southeast Regional Office (SERO) have determined that the SINKEX program was not likely to adversely affect listed species. The Navy has completed Section 7 consultation for this SINKEX program in the western Atlantic Ocean. NMFS concluded that the proposed action is not likely to jeopardize the continued existence of threatened or endangered species in the action area. The proposed location for SINKEXs does not contain designated critical habitat and therefore SINKEXs are not likely to adversely modify critical habitat.

Virtual At-Sea Training/Integrated Maritime Portable Acoustic Scoring & Simulator (VAST/IMPASS) System

The Virtual At-Sea Training/Integrated Maritime Portable Acoustic Scoring & Simulator (VAST/IMPASS) System for firing exercises is a portable gunnery-scoring system to be used within and seaward of already established Navy Operating Areas (OPAREAs) off the East Coast and Gulf of Mexico. The proposed action will take place in waters farther than 12 nm (22.2 km) from shore. The Virginia Capes Operating Area (VACAPES OPAREA) is located in the coastal and offshore waters of the Atlantic, adjacent to Delaware, Maryland, Virginia, and North Carolina. The western boundary of the VACAPES OPAREA is located approximately 3 nm (5.6 km) off the coastline in the territorial waters of the US, and the remainder of the OPAREA to the east is located in the US EEZ (DoN, 2001a in DoN, 2004). The Cherry Point (CHPT) OPAREA is located in the nearshore and offshore waters of North Carolina. The western boundary of the OPAREA is located approximately 3 nm (5.6 km) off the coast at the boundary between North Carolina State waters and US territorial waters. The Jacksonville and Charleston (JAX/CHASN) OPAREA is located in the South Atlantic Bight, off the coasts of North Carolina, South

Carolina, Georgia, and northeastern Florida. The majority of the western boundary of the JAX/CHASN OPAREA is located approximately 3 nm (5.6 km) off the Southeast coast, except for the area off southern Georgia and northern Florida, where the boundary lies from 3 to 7 nm (5.6 to 13 km) from shore (DoN, 2004).

From fall through spring, North Atlantic right whales are expected to occur in continental shelf waters throughout the East Coast OPAREAs (DoN, 2001a; 2002a; 2002b *in* DoN, 2004). Estimated densities of right whales are highest in winter (0.9 to 1.7 whales/1,000 km^2 [386 mi^2]) in the three East Coast OPAREAs. Right whale occurrences are concentrated in nearshore waters of JAX/CHASN OPAREA during the fall and winter (DoN, 2002b). During the summer, right whales occur further north, on their feeding grounds (density of 0 whales/1,000 km^2 [386 mi^2]); however, there are sightings in the JAX/CHASN OPAREA during summer (DoN, 2004). Right whale sightings in very deep offshore waters of the western North Atlantic are infrequent. There is limited evidence, however, suggesting that there may be a regular offshore component of their distributional and migratory cycle (DoN, 2004).

Potential impacts to right whales and other endangered species resulting from the proposed use of the VAST/IMPASS system include collisions with Navy vessels, acoustic and explosive impacts from detonation of explosive ordnance, and acoustic impacts of gun blasts. Based on analysis in the BA, the Navy determined that the proposed action would either have no effects (muzzle blast noise from air to water and noise from sonic boom of the shell) on endangered species or negligible effects (gun noise transmitted through ship hull and physical injury from the exploding shell and debris). Based on the mitigation measures listed below, collisions with right whales are not expected (DoN, 2004).

The Navy developed a marine mammal and sea turtle mitigation plan to minimize the risk of impacts to these animals. The mitigation plan includes the following measures:

1. Pre-exercise monitoring of the target area using high-power binoculars prior to the event, during deployment of the sonobuoy array, and during return to the firing position.
2. Ships would not fire on the target if any marine mammals or sea turtles are detected within or approaching the impact area. Operations would be suspended until the impact area is clear of marine mammals or sea turtles.
3. Post-exercise monitoring of the entire impact range for the presence of marine mammals and sea turtles would take place using high-power binoculars and the naked eye during the retrieval of the sonobuoy array following each firing exercise.
4. The visibility must be such that the fall of the shot is visible from the firing ship during the exercise.
5. The VAST/IMPASS system would be used only during daylight hours and only in Beaufort Sea State 3 or less. Calm sea states and good lighting conditions contribute to high visibility conditions, making it easier to spot any marine mammal or sea turtle in the area.
6. If marine mammals or sea turtles are detected in the vicinity of the Navy vessel, personnel would increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of Navy assets and protected species. Actions may include changing speed and/or direction and are dictated by environmental and other conditions. No firing will occur if marine mammals are detected within 66 yards (60 m) of the vessel.

7. The exercise will not be conducted in an area of biological significance and the exercise will not be conducted if sargassum is detected in the impact area (DoN, 2004).

The Navy determined that the proposed action may affect but is not likely to adversely affect right whales. The proposed action is not likely to result in the destruction or adverse modification of North Atlantic right whale critical habitat, as the action will be conducted in a manner consistent with the restrictions in the existing BO issued by NMFS in May 1997 (Appendix A). The Navy is planning to undergo Section 7 consultations for the VAST/IMPASS System. As the consultation is not completed, it has yet to be determined whether NMFS concurs with the Navy's findings in this BA.

4.7.2.7 Liquefied Natural Gas (LNG) Terminals and Deepwater Ports

The LNG industry has been steadily growing, and to accommodate this growth new marine-based LNG facilities are being proposed internationally. These facilities convert the state of LNG from a liquid to a gas and transport the natural gas to customers through a network of pipelines. Section 4.7.3.1 summarizes the four existing LNG facilities, four approved by the Federal Energy Regulatory Commission (FERC) (two of which are expansions of existing facilities), four proposed to FERC, one proposed to MARAD/USCG, and one approved by MARAD/USCG on the East Coast (as of June 2008).

This section describes the five approved projects mentioned above – the four inshore terminals, and the approved offshore deepwater port. While all the proposed facilities would increase vessel traffic on the East Coast, only two of these proposals are for offshore deepwater ports that would be located in right whale habitat. Four proposals are inshore and would affect vessel traffic if approved, although as these projects are in various stages of the application and environmental processes, vessel traffic information is not available for all of the proposals. Although there are five active proposals, it is possible that only a few of these proposals will be licensed by the Federal Government. Out of the 40 LNG proposals in North America, industry analysts predict that only 12 will ever be built (FERC, 2006a).

Approved Inshore LNG Terminals

Four inshore proposals have been approved by FERC since publication of the DEIS, and will likely be constructed or expanded in the reasonably forseeable future. These projects are described below, based on findings from the FEISs issued by FERC, and BOs issued by NMFS. The four inshore terminals proposed to FERC but not yet approved are not described in this section. These include terminals proposed in Pleasant Point, Robbinston, and Calais, Maine and Baltimore, Maryland. The one offshore proposal, Safe Harbor Energy, offshore of New York is also not described this this section.

Crown Landing LNG - Logan Township, New Jersey

FERC has approved Crown Landing LNG's proposal for a new LNG facility in the Delaware River, New Jersey. Based on a navigation-simulation study conducted by Moffatt & Nichol International on behalf of Crown Landing, the LNG facility would generate an additional 150 LNG ships per year. FERC determined that the project is not likely to adversely affect the North Atlantic right whale, and initiated Section 7 consultation with NMFS. NMFS completed the Crown Landing BO on May 23, 2006 and concurred with FERC's determination for whales. The applicants agreed to adhere to the seasonal speed restrictions in the ship strike reduction proposed rule as an interim measure until final regulations are issued (FERC, 2006c).

Dominion LNG - Cove Point, Maryland

FERC approved a proposal by Dominion Cove Point LNG to expand the existing LNG import terminal in Calvert County, Maryland. The expansion would increase LNG tanker visits from 90 to 120 ships per year, to approximately 200 per year. The FEIS states that right whale occurrences in the Chesapeake Bay are rare, although these vessels must transit right whale habitat in the Atlantic in order to call on the Cove Point Terminal, and there is potential for ship strikes by an LNG Vessel. To mitigate the potential for ship strikes, FERC notes that when implemented, LNG vessels would be required to abide by NMFS ship strike regulations. In the interim, the agency recommends that Dominion should incorporate the following voluntary NMFS guidelines into its Terminal Use Agreement with LNG ship operators (FERC, 2006c). In all coastal and offshore waters along the East Coast of the U.S. and Canada:

- If a right whale sighting is reported within 20 nautical miles of a ship's position, post a lookout familiar with spotting whales.
- If a right whale is sighted from the ship, or reported along the intended track of a large vessel, mariners should exercise caution and proceed at a slow, safe speed when within a few miles of the sighting location, bearing in mind that reduced speed may minimize the risk of ship strikes.
- Do not assume right whales will move out of your way. Right whales, generally slow moving, seldom travel faster than 5-6 knots. Consistent with safe navigation, maneuver around observed right whales or recently reported sighting locations. It is illegal to approach closer than 500 yards of any right whale (see 50 CFR 222.32, Chapter 2).
- Any whale accidentally struck, any dead whale carcass spotted, and any whale observed entangled in fishing gear should be reported immediately to the U.S. or Canadian Coast Guard noting the precise location and time of the accident or sighting.

In addition to the guidelines above, Cove Point implemented their own ship strike mitigation plan, which includes 10-knot speed advisories from November through April within 30 nm (56 km) of the Chesapeake Bay entrance. Based on these mitigation measures, FERC determined that the project is not likely to adversely affect North Atlantic right whales. The informal Section 7 consultation with NMFS concluded that the LNG terminal is not likely to adversely affect right whales.

Weaver's Cove LNG - Fall River, Massachusetts

FERC has approved a proposal by Weaver's Cove Energy to construct an LNG terminal in Taunton River, Massachusetts. Due to recent changes in plans, Weaver's Cove Energy proposed a change in the number of anticipated ship deliveries from 50 to 70, to 120 a year, by vessels small enough to fit through the opening of the Brightman Street Bridge (FERC, 2006b). The FEIS issued by FERC addressed the potential for ship strikes resulting from the increase in vessel traffic transiting Narragansett Bay, and the agency recommended that Weaver's Cove Energy should coordinate with NMFS to determine appropriate speed-restriction measures to minimize impacts on right whales. If the vessels adhere with the measures in the NMFS-proposed rulemaking, then FERC concludes that the project is not likely to adversely affect North Atlantic right whales (FERC, 2006c). Due to the changes in the original plans, Section 7 consultation with NMFS will be re-initiated.

EL Paso - Southern LNG - Elba Island, Georgia

This LNG terminal on Elba Island, Georgia is already an existing terminal (see Section 4.7.3.1 for a description of current operations at this terminal); however El Paso - Southern LNG submitted a proposal to FERC to expand this terminal. Southern LNG has agreed to notify LNG terminals via an automated identification system (AIS) to slow to 10 knots or less when consistent with safe navigation. The AIS is currently operational and sends an AIS message to all incoming vessels. Current AIS data is being archived until a live feed to NOAA's Southeast Regional Office AIS network is achieved. Informal Section 7 consultation has been completed on this terminal and NOAA has concluded that the project would not likely to adversely affect Right Whales.

Offshore LNG Deepwater Ports

The two offshore facilities addressed in detail in this section that would have potential impacts on right whales are the Neptune and Northeast Gateway Deepwater Ports. Neptune has been approved and construction started in July 2008, and Northeast Gateway is fully operational. This section addresses the cumulative impacts of constructing/operating these facilities and the increase in vessel traffic generated by the proposed LNG terminals on right whales in the reasonably foreseeable future.

Neptune LNG

The Neptune LNG terminal is being built approximately 22 mi (35 km) northeast of Boston, Massachusetts, in a water depth of approximately 260 ft (79 m). One unloading buoy system at the deepwater port would moor up to two shuttle regasification vessels (SRVs). There would be an initial increase in vessel traffic in Massachusetts Bay during the construction of the terminal and installation of a 10.9-mi (17.5-km) pipeline that would connect to the existing Algonquin HubLine™ natural gas pipeline (Neptune LNG, LLC, 2005). The Deepwater Port license application includes estimates of the vessel traffic from operations (including construction); support vessels are estimated to take 61 round trips per year, SRVs would take approximately 50 round trips per year, and pilot vessels would also take 50 round trips per year, accompanying the SRVs (Neptune LNG, LLC, 2005). Therefore, this facility would increase vessel traffic by approximately 161 round trips (322 one-way trips) per year.

The USCG and MARAD published a notice of availability for the FEIS on November 2, 2006 (71 FR 64606), and the record of decision (ROD) has been approved with conditions. In their scoping comments on the NOI to prepare an EIS for the Neptune LNG Deepwater Port, NOAA specifically requested that the EIS consider the potential impacts of the construction and operation of the terminal on endangered species, including right whales. While the FEIS does consider the potential impacts of this vessel traffic and construction on right whales, the findings of the BO supercede the conclusions in the FEIS.

In addition to the FEIS, these agencies consulted with NMFS under Section 7 of the ESA. The BO resulting from this consultation determined that the action may adversely affect but is not likely to jeopardize right whales or adversely modify or destroy critical habitat. During this process, the applicant and the agencies agreed to the following mitigation measures (which are not specific terms and conditions of the BO): seasonal speed restrictions of 10 knots or less, in accordance with the proposed rule to reduce ship strikes to right whales; year round speed restrictions in the Off Race Point SMA; and installation of passive acoustic detection buoys (to determine the presence of calling whales) in the portion of the Boston TSS that passes through SBNMS. Right whale detections through the buoys or reports from the Sighting Advisory System will be monitored prior to entering the area, and appropriate action will be taken in response to active sightings. Also, Neptune vessels will enter the Boston TSS as soon as practicable and remain in the TSS until the Boston Harbor Precautionary Area (see Figure 4-11).

Northeast Gateway

The Northeast Gateway LNG terminal is located offshore in Massachusetts Bay, approximately 13 mi (21 km) south-southeast of the city of Gloucester, Massachusetts, in Federal waters approximately 270 to 290 ft (82 to 88 m) in depth. The natural gas is delivered to shore by a new 16.4-mi (26.4-km) pipeline from the deepwater port to the existing Algonquin HubLine™ pipeline (Northeast Gateway Energy Bridge, LLC, 2005). As with the Neptune project, the construction and operation of this terminal will increase vessel traffic over current levels. The Deepwater Port license application states that there would be an estimated 55 to 62 Energy Bridge™ regasification vessels (EBRV) arrivals per year. In addition, support vessels would take one trip per week, or 52 trips per year. Therefore, this facility would increase vessel traffic by 162 to 176 round trips (324 to 352 one-way trips) per year (Northeast Gateway Energy Bridge, LLC, 2005).

The USGC and MARAD published a notice of availability for the FEIS on October 26, 2006 (71 FR 62657), and the ROD has been approved with conditions. In addition to commenting on the NOI, NOAA also provided comments to assist the USCG with their completeness determination and recommended the collection of additional data for further analyses that will be necessary to evaluate the impacts on NOAA's trust resources. These comments include NOAA's concern that the Northeast Gateway project would negatively impact conservation within SBNMS, specifically with respect to NOAA's plans to reconfigure the Boston TSS to reduce the risks of collisions between ships and endangered whales. NOAA issued an Incidental Harrassment Authorization (IHA) on May 14, 2007 (72 FR 27077), which contained various monitoring and mitigation measures to prevent ship strikes to right whales.

Northeast Gateway did include some mitigation measures in its application. The applicant expressly states that "EBRV speed while transiting outer Massachusetts Bay will be less than the sea speed of the vessel because the vessel will be slowing down in preparation for docking at the Northeast Port. In addition, Northeast Gateway will observe seasonal speed restrictions while transiting through or in the TSS adjacent to the Great South Channel and Off Race Point to minimize potential ship strikes on whales" (Northeast Gateway Energy Bridge, LLC, 2005). NOAA's comment letter reiterated that while speed may reduce the number of strikes, speed reduction alone will not reduce the risk of ship strike to zero, and the additional vessel traffic is expected to increase the risk of ship strike mortalities in SBNMS.

Another topic addressed with respect to right whales is the planned construction period of late summer to early spring, which overlaps with the high-use period of right whales in the area, primarily from January through April. The actual construction period has since been changed to May through November to avoid this seasonal aggregation. Construction commenced in May 2007 and was completed in November 2007. Also, noise during construction and the potential for entanglement by fishing gear displaced by LNG sites pose additional threats to right whales. These topics have been analyzed in the EIS and Section 7 consultations.

The BO for Northeast Gateway also came to a finding that the project may adversely affect, but is not likely to jeopardize right whales or adversely modify or destroy critical habitat. Through the Section 7 consultation process, the applicant and agencies voluntarily committed to the following mitigation measures: a seasonal 10-knot speed restriction in the Off Race Point and Great South Channel SMAs; a year-round 12-knot speed restriction in the Boston TSS; and these vessels will enter the TSS as soon as practicable, and remain in the TSS until they need to divert to transit north to the deepwater port.

There is also one proposed offshore proposal for a pipeline from the Bahamas to Port Everglades in Fort Lauderdale, Florida. If approved, the Suez Calypso LNG project would not significantly affect right whales because they generally do not occur this far south in Florida.

4.7.2.8 Port Expansion Projects

Proposed Marine Container Terminal at the Charleston Naval Complex

The South Carolina State Ports Authority (SCSPA) is proposing to develop a marine container terminal at the south end of the Charleston Naval Complex, on the Cooper River in Charleston Harbor, South Carolina. The proposed terminal is designed to handle primarily containerized cargo. The marine container terminal development covers 288.1 acres (ac) (116.6 hectares [ha]) and will support cargo-marshalling areas, cargo-processing areas, cargo-handling facilities, and related terminal operating facilities. Construction on the new terminal is expected to be completed in 2013, although it is not expected to reach full capacity until 2025 (USACE, 2006e).

The USACE released a FEIS on this project on December 12, 2006. The FEIS estimates that the new terminal will result in an increase of 650 vessel calls per year at full capacity (USACE, 2006e). This represents a 12 percent increase in arrivals from the estimate of 5,000 vessel transits per year, as reported from the Charleston Branch Pilots Association.

The USACE initiated Section 7 consultation on this project with NOAA's SERO and the SCSPA agreed to fund aerial surveys for right whales approximately 30 nm (56 km) north and south of the port of Charleston approach and out to 25 nm (46 km) for five years. This is an interim measure until the proposed right whale ship strike reduction measures are implemented, at which time the funding for the aerial surveys will be discontinued. The port of Charleston also participates in education and outreach activities to raise awareness among mariners. These harm-avoidance measures will reduce the potential for ship strikes, and thus NOAA concluded that the project's shipping-related effects on right whales are discountable or insignificant.

Proposed Marine Container Terminal at the Port of Jacksonville

The Jacksonville Port Authority proposes to construct a two-berth marine container terminal on the western side of Dames Point along the St. Johns River in Florida. The new container terminal is scheduled for completion in December 2008 or early 2009 with operations expected to begin late 2008 or early 2009. The new terminal is expected to increase vessel traffic by approximately nine percent at full capacity. This is a nine-percent increase over the current estimate of 4,350 annual vessel transits of the Jacksonville Harbor.

As the permitting agency, the USACE initiated Section 7 consultation under the ESA on the effects of this project on threatened and endangered species under NMFS' jurisdiction. NMFS concluded that the increase in vessel traffic will not affect right whale critical habitat and that the effects on right whales are discountable or insignificant. The latter finding is based on current harm-avoidance measures employed by the port of Jacksonville and NMFS. The port authority provides educational materials to their client shipping companies and vessel captains, and will ensure that these parties are aware of current and future protection measures, such as the MSRS and the ship strike reduction rulemaking. In addition, the applicant volunteered to supplement hydrographic surveys for the areas off the coasts of Florida and Georgia where NOAA is implementing recommended shipping lanes to route vessels away from high densities of right whales.

Maersk Marine Container Terminal, Portsmouth, VA (APM Terminals VA, Inc.)

APM Terminals has built a privately-owned marine container terminal along the Elizabeth River in the City of Portsmouth, Virginia. The terminal includes 4,000 ft (1,219 m) of berthing facilities along the Elizabeth River, and a 291-acre container terminal (on 576 acres of land) marine container facility adjacent to the berthing facilities, and road and rail infrastructure to access the terminal. Waterborne access to the facility is provided via Craney Island Reach, which currently provides deepwater access for vessel traffic utilizing numerous existing terminal facilities located on the Elizabeth River (USACE, 2003). Construction was completed by 2007.

The purpose of this project is to accommodate vessels with a larger carrying capacity. The current types of vessels calling at the existing APM terminal are known as Panamax vessels and larger, Post-Panamax vessels, which are expected to be replaced by Suezmax vessels. It is expected that Suezmax vessels will be introduced in the next three years and will utilize the proposed facility. These vessels will increase container carrying capacity by replacing smaller Panamax vessels without affecting the current number of vessel movements in Hampton Roads. Therefore, this facility is not expected to increase the number of vessels transiting the Elizabeth River in Hampton Roads (USACE, 2003). The environmental assessment prepared for this project does not address impacts on right whales.

Craney Island Dredged Material Management Area, Hampton Roads

The Virginia Port Authority (VPA) is proposing an eastward expansion of the Craney Island Dredged Material Management Area and subsequent development of a marine containerized cargo terminal complex on the new cell. The Norfolk District of the USACE has prepared a FEIS on the impacts of this project.

The first phase of this project would result in an additional 470 vessel calls to the Port of Hampton Roads in 2018. In 2050, when the terminal reaches build-out, shipping traffic in the Hampton Roads Harbor System is expected to increase by nine to 15 vessel calls per week, for a total of 770 vessel calls per year. The USACE concluded that the increases in vessel traffic related to the proposed eastward expansion and container terminal project are not likely to affect listed marine mammals (USACE, 2006b). Although the USACE provided NMFS with this conclusion in a letter dated January 5, 2006, since the terminal is not actually scheduled to be built until 2016, NMFS found that there was insufficient information to draw a conclusion about whales, and too much uncertainty in predicting the actual volume of shipping traffic, the vessel routes, and the status of whales. NMFS requested that the USACE reinitiate consultation when more project details were available.

Navigation Channel Deepening in the Port of Savannah

The Georgia Ports Authority (GPA) is proposing to deepen the Savannah River navigation channel from 42 ft (12.8 m) mean low water to a maximum depth of 48 ft (14.6 m). In order to receive a permit for construction, the USACE must complete a Tier II EIS, a final mitigation plan and an incremental analysis of the channel depths from 42 to 48 ft (12.8 to 14.6 m). The Tier I EIS did not include estimates of increased vessel traffic as a result of the harbor-deepening project and the USACE published a Final Tier II EIS in March 2008. The Biological Assessment prepared by GPA follows the mitigation measures outlined in the 1995 Biological Opinion for navigation channels in the Southeast and concludes that the project is not likely to affect right whales (GPA, 2006).

Proposed Construction of a Disposal Site for Dredged Material in Baltimore Harbor

The USACE constructed a disposal site for dredged material in the middle branch of the Patapsco River, at Masonville, Baltimore City. The new site began to supplement the current dredged-material disposal containment facilities at Hart-Miller Island and Cox Creek in 2007. The USACE prepared a DEIS that indicated barge traffic would temporarily increase during construction and dredged-material placement operations, although it does not provide an estimate of the expected increase in vessel traffic entering the Delaware Bay after construction is completed (USACE, 2006a).

Summary

While these accounts of port expansion projects are not exhaustive, they do represent the majority of large projects in East Coast ports that will affect the amount of vessel traffic transiting through right whale habitat.

These projects demonstrate the importance of ship strike reduction measures to mitigate an increase in vessel traffic from the increase in capacity of existing ports, and also the predicted increase due to the popularity of waterborne commerce. The timing of these port-expansion projects is in the reasonably foreseeable future, and they will reach full capacity at different times, spreading out the impacts. Nevertheless, an increase in the number of transiting vessels will increase the risk of ship strikes to right whales. While the individual consultations conducted on a portion of these projects came to findings of ‘not likely to adversely affect right whales’, the cumulative impacts of all the port-expansion projects on the East Coast have not been quantitatively analyzed. However, given that the additional vessels calling at these new facilities in the near future would be required to abide by speed restrictions in the rulemaking, there should not be significant, negative effects from these projects. In the future, when these ports reach full capacity, NMFS may reconsider the operational measures against the new baseline, and make appropriate adjustments for the increase in vessel traffic.

4.7.3 Cumulative Effects on the Human Environment

4.7.3.1 Liquefied Natural Gas Vessels

When LNG vessels approach offshore platforms and ports, they impose restrictions on other vessels. Pursuant to the regulations of the Deepwater Port Act, the USCG is authorized to establish a safety zone around deepwater ports. Therefore, there is a 1,640-ft (500-m) safety zone around LNG terminals in which unauthorized vessels are prohibited from anchoring or transiting at any time (33 CFR 147). There is also a 2.2-mi (3.5-km)-radius precautionary area from the center of the terminal to alert prudent vessel operators of the possible presence of maneuvering LNG carriers in the safety zone around the port.

There are several existing and proposed LNG terminals along the US East Coast. In the Northeast, there are three proposed inshore LNG sites, one existing offshore LNG site and one approved and currently under construction, one inshore site approved by FERC, and one existing. Northeast Gateway LNG is fully operational, and is located approximately 10 mi (16 km) offshore of Gloucester, Massachusetts. The Suez-Neptune LNG terminal is being built approximately 22 mi (35 km) northeast of Boston. In northern Maine, an inshore Quoddy Bay terminal at Pleasant Point, a Downeast terminal in Robbinston, and a BP terminal in Calais have been proposed to FERC. Weaver's Cove in the Taunton River, near Fall River, Massachusetts has been approved. The existing LNG site is in Everett, Massachusetts.

In the mid-Atlantic, there is only one existing terminal – in Cove Point, which is located in Calvert County, MD. In April 2005, Dominion CP LNG submitted an application to expand the terminal, and FERC has since approved this expansion. Several new terminals have been proposed to FERC, including a proposal for Long Island Sound, NY, by Broadwater Energy, and Sparrows Point in Baltimore, by AES Corp. The Crown Landing LNG facility in the Delaware River, NJ, has been approved by FERC.

In the Southeast, there is one existing terminal – on Elba Island, in Chatham County, Georgia, 5 mi (8 km) downstream from Savannah, Georgia. El Paso and Southern LNG submitted a proposal to FERC to expand this terminal. The area around this LNG terminal in the Savannah River is designated a Regulated Navigation Area by the USCG (33 CFR 165.756). This prohibits all vessels 1,600 GRT or greater, except those that are moored, from approaching within 2 nm (3.7 km) of a LNG tankship that is underway within the RNA without the permission of the Captain of the Port. This closes the port down to other vessels for an hour or more during the arrival and departure of a tankship (W. Penberty, personal communication, November 15, 2005). However, it does take an LNG vessel up to 24 hours to unload, so it is unlikely that other commercial shipping vessels would be affected by delays from both the arrival and departure of LNG tankships. There is also one proposed offshore proposal for a pipeline from the Bahamas to Port Everglades in Fort Lauderdale, Florida. If approved, this project would not significantly affect right whales because they generally do not occur this far south in Florida.

There is potential for cumulative effects on the shipping industry in the form of additional delays into ports if vessels are delayed by speed restrictions or other operational measures included in the alternatives, and by LNG restrictions associated with the aforementioned safety zones. The additive effects of these delays could result in an increase in the economic cost to the commercial shipping industry and/or the port. However, these existing and proposed deepwater ports would be located outside of shipping fairways and navigation channels. If the proposed LNG terminal is an inshore terminal, it would increase vessel traffic around the site and/or port. Given that the proposed sites are not yet approved, there is no way to analyze the potential impacts of the occurrence of ship strikes. This may be possible in the future if the sites are approved, and if specific vessel routes and arrival data become available.

4.7.3.2 United States Coast Guard Restrictions

The Coast Guard has a lead role in providing homeland security in US harbors and ports and along the coastlines. Commercial, tanker, passenger, and merchant vessels have all been subject to increased security measures enforced by the USCG. As part of its missions for both national security and law enforcement, the Coast Guard may board vessels at any time. The agency is authorized to board vessels subject to the jurisdiction of the US, upon the high seas, and upon waters over which the US has jurisdiction. In these waters, the agency is authorized to make inquires, examinations, inspections, searches, seizures, and arrests (14 U.S.C. § 89) (USCG, 2005).

Potential cumulative effects could result from a vessel that is operating under speed restrictions or other operational measures in the alternatives and is boarded by the USCG. The vessel would have to reduce its speed further or come to a complete stop while the Coast Guard officers board and inspect the vessel, crew, cargo, and documentation. This would result in additional delays in arriving at a port.

4.7.3.3 Vessels Restricted to Daylight Only and Tidal Windows

Certain vessels are restricted to entering ports during daylight hours only, and other deep-draft vessels may also be restricted by tidal windows in parts of the East Coast that have changes in water depth due to tides. LNG vessels are subject to tidal restrictions coming into Boston, and nighttime transit restrictions in Boston Harbor. There are similar nighttime transit restrictions approaching the Cove Point LNG site in Maryland, and vessels are required to arrive at the Cape Henry Pilot Station at the mouth of Chesapeake Bay at least eight hours prior to dusk or to wait until the following day.

The port of Savannah is in the process of a harbor-deepening project that will be completed around 2013, and until then vessels need to plan for appropriate tidal windows to call at the port. LNG vessels are affecting the schedule of port traffic into Savannah as well. Port traffic is restricted one hour before LNG vessels enter the harbor and up to two hours after. Southern LNG reactivated in 2001, and LNG vessel calls have increased from one in 2001 to 41 in 2004. This increase is expected to continue to the point where there could be over 100 annual vessel calls as early as 2008, resulting in additional delays (W. Penberthy, personal communication, November 15, 2005).

LNG vessels may have additional delays if DMAs are implemented in or around the approaches to these ports, but the actual number of DMAs that could be triggered each year is minimal, the restrictions are temporary, and the vessels may chose to route around the precautionary area to save time instead of slowing down through the area. If LNG vessels are transiting in areas with SMAs or shipping lanes with speed restrictions, the times and areas would be known well ahead of time to allow the company to plan ahead or avoid these delays.

4.7.3.4 Other Federal Actions Resulting in an Economic Impact to the Industries Affected by the Proposed Action and Alternatives

There are several other current and reasonably foreseeable actions by Federal agencies that may have economic impacts on similar groups of stakeholders that are affected by the vessel operational measures to reduce ship strikes to right whales. If these actions are taken in the future, there would be a cumulative economic burden on specific industries.

Cape Wind Project

The Cape Wind project (described in Section 4.7.2.4) may have minimal temporary adverse effects on marine navigation in the immediate vicinity of construction operations. Temporary restrictions during construction would be implemented to protect public safety. Once operational, the large spaces – minimum 0.34-nm [0.63-km] by 0.54-nm [1.0-km] spacing – would allow vessels not restricted by depth to navigate between the WTGs. Once installed, the submarine cables would not affect navigation, as the cables would be buried at a minimum depth of 6 ft (1.8 m) below the seabed. Although there may be temporary adverse effects during construction, it is not expected that the operation of the Wind Park and the installation of the inner-array and submarine cable systems would substantially adversely impact general commercial/recreational vessel navigation or ferry operations in this area of Nantucket Sound in the long term (USACE, 2004).

Economic Effects of ALWTRP on the Fishing Industry

As discussed in Section 4.7.2.2, the proposed modifications to the ALWTRP regulations would have a positive effect on the recovery of the right whale. However, these proposed modifications would also have an economic impact on the fishing industry in the northeastern and mid-Atlantic US.

The following is an excerpt from the FEIS for amending the ALWTRP (NMFS, 2007a).

> [Table 4-10] presents the results of the economic impact analysis for Alternatives 1 through 6 Final (Preferred). As the [table] indicates, the incremental costs the alternatives would impose on the commercial fishing industry range from zero in the case of Alternative 1, the no action alternative, to approximately $19.2 million per year under Alternatives 2, 3*, 4, and 6 Draft*. The preferred alternative would impose incremental costs of approximately $13.4 million per year. In the case of Alternatives 2, 3*, 4, 6 Draft*, and 6 Final (Preferred), the impact of the new standards on lobster trap/pot vessels accounts for between 92 and 93 percent of estimated compliance costs; impacts on gillnet vessels account for between 4 and 5 percent of the total, and impacts on other trap/pot vessels account for the remaining 2 to 3 percent. The analysis suggests that Alternative 5 would impose incremental compliance costs of approximately $1.3 million annually. In this case, the impact of the new standards on lobster trap/pot vessels accounts for approximately 79 percent of estimated compliance costs; impacts on gillnet vessels account for 14 percent of the total, and impacts on other trap/pot vessels account for the remaining 7 percent.

Table 4-10
Estimated Increase in Annualized ALWTRP Compliance Costs: All Affected Fisheries (2007 dollars)

Regulatory Alternative	Lobster Trap/Pot	Other Trap/Pot	Gillnet	Total
Alternative 1 (No Action)	$0	$0	$0	N.A.
Alternative 2	$17,939,000	$448,900	$844,500	$19,232,400
Alternative 3*	$17,894,600	$453,500	$835,100	$19,183,200
Alternative 4	$17,939,000	$448,900	$842,900	$19,230,800
Alternative 5	$1,001,700	$91,300	$178,500	$1,271,400
Alternative 6 Draft*	$17,906,300	$453,800	$835,600	$19,195,600
Alternative 6 Final (Preferred)	$12,288,000	$393,000	$717,300	$13,398,300
Key: * = Specified as a Preferred Alternative in the DEIS. Note: Totals may not sum due to rounding.				

The cumulative effects analysis chapter of the ALWTRP FEIS also includes a detailed description of the major fisheries affected by the regulatory alternatives, including current and past regulations. Please refer to Section 9.4.3 of the ALWTRP FEIS for additional cumulative effects on the fishing industry.

Southeast Gillnet Rule under the ALWTRP

NMFS issued a temporary emergency rule and a proposed rule in the *Federal Register* on November 15, 2006 (71 FR 66469), and a final rule was published June 25, 2007 (72 FR 34632). The final rule prohibits gillnet fishing or gillnet possession during annual restricted periods (November 15 – April 15) associated with the right whale calving season in the Southeast US Restricted Area and in waters within 35 nm (65 km) of the South Carolina coast. Exemptions to the fishing prohibitions are for strikenet fishing for sharks and gillnet fishing for Spanish mackerel south of 29º00' N latitude. An exemption to the prohibition on the possession of gillnet gear is provided for transiting through the area if gear is stowed in accordance with this rule. This action is required to meet the goals of the MMPA and ESA, and is necessary to protect North Atlantic right whales from serious injury or mortality from entanglement in gillnet gear in their calving area in Atlantic Ocean waters off the Southeast US. NMFS is taking this action based on its determination that a right whale mortality, documented on January 22, 2006, was the result of an entanglement by gillnet gear within the Southeast US Restricted Area. This action is consistent with the ALTWRP regulations at 50 CFR 229.32(g) and is necessary to protect North Atlantic right whales from further serious injury or mortality in the Southeast US Restricted Area from entanglement in gillnet gear.

Under the ESA temporary emergency rule, NMFS prohibited gillnet fishing or gillnet possession in Atlantic Ocean waters west of 80º00' W longitude between 29º00' N. latitude (just south of New Smyrna Beach, Florida) and 32º00' N latitude (the approximate state boundary between Georgia and South Carolina) and within 35 nm (65 km) of the South Carolina coast. The emergency rule was in effect from November 15, 2006, through April 15, 2007, and the final rule was effective for the following calving season. Environmental assessments (EAs) on the rules are available at *www.nero.noaa.gov/whaletrp*. These EAs analyze the biological and socioeconomic impacts of the rulemaking.

The impacts of the Southeast gillnet and ALWTRP proposed rules have the potential for cumulative effects on the fishing industry when combined with the impacts from the ship-strike reduction rule. These vessel operational measures would have minimal impacts on the fishing industry at a 12-knot speed restriction, but there are minor adverse economic impacts at a 10-knot speed restriction. See Section 4.4.4 for a detailed description of economic impacts on the fishing industry. Only vessels 65 ft (19.8 m) and greater are subject to the speed restrictions, therefore only a small subset – i.e., vessels 65 ft (19.8 m) and longer with an average operating speed greater than 10 knots – would be affected by the ship strike rule and potentially the ALWTRP rule. This is in contrast to fishing vessels less than 65 ft (19.8 m), which would only be affected by the ALWTRP regulations. If a 10-knot speed restriction is imposed, then there would be minor direct, cumulative, adverse economic impacts on this subset of the fishing industry.

Marine Diesel Engine Emission Standards

The EPA published a Final Rule in the *Federal Register* on February 28, 2003 (40 CFR 9745) to adopt emission standards for new marine diesel engines installed on vessels flagged or registered in the US with displacement at or greater than 30 liters per cylinder, also known as Category 3 marine diesel engines. The current Tier I standards implemented in these regulations will apply until the EPA adopts a second Tier of standards in a future rulemaking, which should be completed by April 27, 2007. The Tier II standards will consider the state of technology that may permit deeper emission reductions and the status of international action for more stringent standards. Similar emission standards for marine engines with per-cylinder displacement of less than 30 liters – also known as Category 1 and 2 marine diesel engines – were published in an ANPR in the *Federal Register* on June 29, 2004. EPA published the proposed rule for these standards on April 3, 2007. The final rule was published on May 6, 2008 (73 FR 25098). These standards are expected to result in significant reductions of NO_x and PM, and are expected to benefit public health. Refer to Section 3.3.3 for a description of the effects of these emissions on air quality. However, these standards also have compliance costs for the industry as there are requirements for engine design, maintenance, and repair. Six categories of potentially affected industries were identified in the final rule. One of these categories – Water Transportation, freight and passenger – is also affected by the operational measures.

Anti-Fouling System Regulations

The IMO adopted the International Convention on the Control of Harmful Anti-fouling Systems on Ships in October 2001; and was entered into force in September, 2008. Anti-fouling paints are used to coat the bottoms of ships to prevent marine organisms, including algae and mollusks (barnacles), from attaching to the hull, which slows down the ship and increases fuel consumption. The paint kills these organisms, but also leaches into the water, harming other marine organisms and affecting the environment. One type of anti-fouling paint contains the organotin tributylin (TBT) that has been proven extremely harmful to the environment. The IMO adopted a resolution in 1990 to recommend that governments adopt measures to eliminate the use of anti-fouling paint containing TBT. This convention goes a step further, prohibiting the use of any harmful organotins in anti-fouling paints used on ships and establishing, by January 2008, a mechanism to prevent the potential use of other harmful substances in anti-fouling systems. Although there are no Federal regulations implementing this convention, the EPA issued notices of availability for water-quality and aquatic-life criteria for TBT, to provide recommendations to States on their water quality standards or regulations. Therefore, TBT is regulated at the state level. Regulations on the use of anti-fouling paint would result in minimal economic impacts on the affected maritime industries as the old, harmful paints will be phased out, and new vessels and those requiring a new coat of anti-fouling paint would be required to apply paint that complies with their state laws and regulations.

Ballast Water Regulations

The IMO adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments in February 2004; it has not yet entered into force. The USCG is drafting regulations to develop ballast-water discharge standards, which would require vessels to have systems with which to treat ballast water before discharge. This action has potential economic impacts on the shipping industry, although data will not be available until the regulatory analysis on the ballast-water discharge standards is complete.

International Routing Measures

The 12-degree northern rotation of the Boston TSS increases its length by 3.75 nm (6.9 km). This analysis assumes that 60 percent of vessel arrivals in Boston would be affected by this change.[55] Had this revision to the Boston TSS been in place in 2003, the direct economic impact on the shipping industry would have been approximately $205,000, with the port area of Boston accounting for 98 percent of the impact; the remaining economic impact is $3,000 for the port area of Salem. In 2004, the estimated direct economic impact would have been $210,000. Tables that present the economic impact by port area and vessel type are included in Appendix F of the Economic Impact Report.

The second component of the amendment would narrow each lane of the TSS from 2.0 mi (3.2 km) to 1.5 mi (2.4 km) in width, with the separation zone between the two lanes remaining unchanged at its current 1.0-mi (1.6-km) width. This component would not impact vessel operations in terms of travel distance or time and hence does not result in any additional economic impact.

With the designation of the Great South Channel critical habitat area as an ATBA, vessels would be expected to voluntarily avoid the area from April 1 to July 31. Vessels under 300 GRT but 65 ft (19.8 m) or more in length would be subject to uniform speed restrictions within the ATBA, in compliance with the speed restrictions in the rule. The ATBA for the Great South Channel critical habitat is not expected to have an additional economic impact, as the timing of the ATBA coincides with the seasonal management area for the Great South Channel under the proposed rule. Accordingly, due to the speed restrictions, vessels heading to ports in the NEUS would have already chosen to avoid this area and are assumed to route either to the west and use the TSS, and vessels heading to Europe would route to the southeast and east of the Great South Channel critical habitat.

4.7.3.5 Summary of the Cumulative Impacts with Respect to Right Whale Population Recovery

Despite the cumulative impacts of the natural and anthropogenic actions previously mentioned, the operational measures to reduce the occurrence and severity of ship strikes are expected to have a positive effect on the right whale population. Ship strikes are the leading anthropogenic cause of mortality of right whales, followed by fishing gear entanglement. When the ship strike measures are coupled with the fisheries regulations of the ALWTRP and other conservation measures, the mortality rate should decrease. As mentioned in Section 4.1, the efficiency of these measures is based on current levels of shipping. Should shipping significantly increase – as expected in the future – then the measures would be reconsidered to account for the higher risk of ship strikes resulting from a larger global fleet of vessels.

4.8 Comparison of the Impacts of the Alternatives

This section provides a comparison of the impacts for each alternative by the resource area. Please note that when referring to the impacts of Alternative 6, they would only apply during the five-year period of effectiveness. A summary of this comparison is also provided in table format in Table 4-11.

[55] The determination of 60 percent is based on the following assumptions: 45 percent of vessels arrive from the north and depart to the south (one trip through the TSS); 30 percent arrive from the south and depart to the south (two trips through the TSS); 15 percent arrive from the north and depart to the south (one trip through the TSS); and 10 percent arrive from the north and depart to the north (no trips through the TSS). This results in a total factor of 120 percent, which is cut in half to apply to vessel arrivals only.

Alternative 1, the No Action alternative, would have negative impacts on the right whale population and other marine species, as ship strikes would continue to occur at current levels or even increase in the future as waterborne commerce increases, as it has been shown that the status quo is not providing sufficient protection. Alternatives 2, 3, and 4 each propose one main type of operational measure aimed at reducing ship strikes – DMAs, speed restrictions in designated areas, and recommended shipping routes, respectively. These alternatives would offer more protection to right whales than Alternative 1, and less than Alternatives 5 and 6, which propose a combination of operational measures. Alternative 2 would not specifically benefit other marine species, whereas Alternatives 3 and 4 would provide minor benefits.

Alternative 6 would provide a higher level of protection to right whales and other marine species for the duration of the measures. This alternative includes multiple ship strike reduction measures, including DMAs, speed restrictions in the NEUS, MAUS, and SEUS SMAs, and, recommended routes only that would also feature speed restrictions due to their location within the SMAs. Alternative 5 would provide the highest level of protection to right whales and other marine species, as it combines the measures from Alternatives 1 through 4 and accounts for all available ship strike reduction measures, expanded areas with speed restrictions, and year-round speed restrictions in the NEUS, as opposed to the seasonal restrictions proposed in Alternative 6.

Alternative 1 would have no effects on the physical environment. None of the alternatives affect bathymetry and substrate, as all alternatives would only affect the ocean surface. Alternative 4 would not affect water quality in the NEUS. Alternatives 2, 3 (in all areas), and 5 (in the NEUS) would have negligible impacts on water quality, whereas Alternatives 4 and 6 would have minor adverse effects on water quality in the SEUS. This is a result of concentrating vessel traffic in shipping lanes outside of 12 to 24 nm (22 to 46 km), where water quality regulations are less stringent. Alternative 5 would have negligible to minor adverse effects on water quality; negligible for speed restrictions (including speed restrictions proposed within DMAs) and minor for the same reason mentioned above for the shipping lanes in the SEUS. Alternative 4 would have no overall effect on air quality. Alternatives 2, 5, and 6 would have only minor, positive impacts on air quality due to reduced emissions. Alternative 3 would have a direct, positive effect on air quality. Alternatives 2, 4, 5, and 6 would potentially have minor positive impacts on the levels of ocean noise, and Alternative 3 potentially would have slightly more of a positive effect on ocean noise levels, due to larger-scale speed restrictions that would reduce vessel noise.

Refer to Section 4.4 for a thorough discussion of the direct and indirect impacts for all affected sectors. All numbers in this paragraph and the following ones are annual estimates based on 2004 conditions. Alternative 1 would not affect the maritime industry. Alternative 4 would have the smallest economic impact on the maritime industry, with $2.8 million for all three speed restrictions analyzed. Alternative 2 follows, with $41.5 million (10 knots), $28.1 million (12 knots), and $17.9 million 914 knots). Alternative 6 falls in the middle, at $137.3 million (10 knots), $77.4 million (12 knots), and $45 million (14 knots). Alternative 3 would have the second-highest impact, at $334.8 million (10 knots), $210 million (12 knots), and $121.7 million (14 knots). Alternative 5 would have the highest economic impact, at $359.7 million (10 knots), $223.3 million (12 knots), and $134.1 million (14 knots) (see Data Chart 4-43).

With respect to the shipping industry, Alternative 4 would have the smallest impact at $2.8 million for all three speed restrictions. Alternative 2 follows, with $27.6 million (10 knots), $17.7 million (12 knots), and $10.8 million (14 knots). Alternative 6 would have impacts amounting to $120.1 million (10 knots), $65.6 million (12 knots), and $36.9 million (14 knots).

Alternative 3 would have the fourth-greatest impact, with $301.4 million (10 knots), $186.3 million (12 knots), and $106 million (14 knots). Alternative 5 would have the greatest economic impact, with $326.3 million (10 knots), $199.6 million (12 knots), and $118 million (14 knots) (see Table 4-2).

At a speed restriction of 12 or 14 knots, there would not be any adverse economic impacts on commercial fishing vessels for any of the alternatives. At a speed restriction of 10 knots, Alternatives 3, 5, and 6 would have minor, adverse economic effects on this industry: Alternatives 3 and 5 would cost the industry $1.7 million, and Alternative 6 would cost $1.3 million (see Data Chart 4-43).

Alternative 4 would not affect ferry vessels. Alternative 2 would have the smallest economic impact on ferries, at $8.1 million (10 knots), $6.1 million (12 knots), and $4.1 million (14 knots). Alternative 6 follows, with $8.6 million (10 knots), $6.6 million (12 knots), and $4.6 million (14 knots). Alternatives 3 and 5 would have the highest economic impact, at $13 million (10 knots), $11.1 million (12 knots), and $8.3 million (14 knots).

Similarly, Alternative 4 would have no impact on ferry passengers. Alternative 3 and 5 would have the largest adverse impact, amounting to $12 million with a 10-knot speed restriction, $8.9 million with a 12-knot restriction, and $5.5 million with a 14-knot restriction. Alternative 6 would have the second largest effect, with a estimated $5.2 million at 10 knots, $3.9 million at 12 knots, and $2.5 million at 14 knots. Alternative 2 would have effects that would be slightly less than those of Alternative 6: $4.5 million at 10 knots; $3.4 million at 12 knots; and $2.3 million at 14 knots.

Alternative 4 would not affect whale-watching vessels. Alternatives 2 and 6 would have the smallest economic impact on whale-watching vessels – $1.3 million at 10 knots, $0.9 million at 12 knots, and $0.7 million at 14 knots. Alternatives 3 and 5 would have a higher economic impact, at $5.6 million at 10 knots, $3.1 million at 12 knots, and $1.9 million at 14 knots.

Alternatives 2 and 4 would not affect charter vessels. Alternatives 3 and 5 would have the smallest economic impact on charter vessels – $1.0 million at 10 knots, $598,000 at a 12 knots, and $299,000 at 14 knots. Alternative 6 would have an economic impact of $796,000 at 10 knots, $480,000 at 12 knots, and $240,000 at 14 knots.

None of the alternatives would have disproportionate effects on environmental justice communities. None of the alternatives would have an effect on cultural resources.

4.9 Mitigation Measures

Mitigation measures are not addressed separately in this FEIS as the objective of the proposed action and alternatives is to have a long-term, positive effect on the environment by reducing the likelihood of death and serious injury to right whales resulting from ship strikes, thereby contributing positively to the recovery of the population. In essence, the operational measures contained in the proposed action and alternatives are mitigation measures in themselves. The preferred alternative balances the biological benefit to right whales and the economic impact that results from the measures. Ship strike reduction measures are essential to the recovery of the species. NMFS will evaluate the effectiveness of the ship strike reduction measures through monitoring and enforcement, which will be addressed in the final rule. If right whale ship strikes continue, NMFS will modify these measures as appropriate. The FRFA will identify potential mitigation measures for small businesses and alternative actions are mentioned throughout the economic impact section, so vessel operators are aware of the least-cost option(s) and other actions they can take to avoid economic hardship.

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Summary Matrix of Impacts

Alternative 1: No Action	Alternative 2: Mandatory Dynamic Management Areas	Alternative 3: Speed Restrictions in Designated Areas	Alternative 4: Recommended Shipping Routes	Alternative 5: Combination of Alternatives 1-4	
be significant, direct, egative effects on the right ation and recovery status. would continue and n increase with the e in shipping in the future.	There would be minor, direct, long-term, positive effects on the right whale population as a result of implementing DMAs.	**10 Knots** There would be major, direct, long-term, positive effects on right whale recovery with a speed limit of 10 knots. **12 knots** There would be direct, long-term, positive effects on right whale recovery with a speed limit of 12 knots. **14 Knots** There would only be minor, direct, long-term, positive effects on right whale recovery because a speed limit of 14 knots would not provide sufficient protection against ship strikes.	**NEUS** There would be direct, long-term, positive effects on right whale recovery due to the proposed shipping lanes in the NEUS. **MAUS** There would be direct, long-term, adverse effects on right whale recovery in the MAUS because there are no proposed shipping lanes in this region. **SEUS** There would be direct, long-term, positive effects on right whale recovery due to the proposed shipping lanes in the SEUS.	There would be significant, direct, long-term, positive effects on right whale population recovery in all three regions by combining Alternatives 1-4, as the additive effects of current conservation measures, DMAs, speed restrictions and shipping lanes would significantly reduce the probability of ship strike. Generally, the level of positive effects increases as the speed limit decreases, i.e., major benefits at 10 knots to minor benefits at 14 knots.	The effe reco resu mea Ger incr dec kno
e Mammals be indirect, long-term, cts on other marine om implementing the No ative. impacts on sea turtles sult from the proposed ould not occur under the ernative. alternatives are expected birds or protected and marine fish, and y are not mentioned in	**Other Marine Mammals** There would be no significant effects on other marine mammals from the use of DMAs because they are based on right whale sightings. **Sea Turtles** There would be no significant effects on sea turtles from a DMA implementation because it is based on right whale sightings.	**Other Marine Mammals** There would be minor, indirect, long-term beneficial effects on other marine mammals from speed restrictions if they occur in the designated areas. **Sea Turtles** There would potentially be minor, indirect, long-term, beneficial effects on sea turtles from speed restrictions if they occur in the designated areas.	**Other Marine Mammals** There would be no significant effects on other marine mammals from the recommended shipping routes. **Sea Turtles** There would be no significant effects on sea turtles from the recommended shipping routes.	**Other Marine Mammals** There would be major, indirect, long-term, positive effects on other marine mammals from implementing broad spatial and temporal speed restrictions and recommended shipping routes. Only marine mammals that occur in the restricted areas and routes would benefit from these operational measures. **Sea Turtles** There would potentially be an indirect, long-term, positive effect on sea turtles from implementing broad spatial and temporal speed restrictions and recommended shipping routes. Only sea turtles that occur in the restricted areas and routes would benefit from these operational measures.	**Oth** The effe resu mea Onl the ben mea **Sea** The pos resu mea turt are the
and Substrate be no effects on and substrate from the No ative. **ty** be no effects on ocean from the No Action be no effects on air he No Action Alternative. **e** be no effects on ocean he No Action Alternative.	**Bathymetry and Substrate** There would be no effects on bathymetry and substrate from implementing DMAs. **Water Quality** There would be negligible effects on ocean water quality from implementing DMAs. **Air Quality** There would be minor, direct, short-term, positive impacts on air quality at sea from implementing DMAs if vessels transit through DMAs at a reduced speed.	**Bathymetry and Substrate** There would be no effects on bathymetry and substrate from implementing speed restrictions in designated areas. **Water Quality** There would be a negligible amount of effects on ocean water quality from implementing speed restrictions. **Air Quality** There would be a direct, short-term, positive impact on air quality in the designated areas where vessels transit through at reduced speeds.	**Bathymetry and Substrate** There would be no effects on bathymetry and substrate from implementing recommended shipping routes. **Water Quality** There would be no impacts on water quality in the NEUS, and potentially minor, adverse impacts in the SEUS region due to the concentration of vessel traffic in the shipping lanes. **Air Quality** There would be no significant, long-term impacts on air quality as a result	**Bathymetry and Substrate** There would be no effects on bathymetry and substrate as a result of combining the measures in Alternatives 1-4. **Water Quality** There would be negligible to minor adverse effects on water quality as a result of combining DMAs, speed restrictions and recommended shipping routes. See Alternative 4. **Air Quality** By combining the positive effects on air quality from Alternatives 2 and 3	**Bat** The bat of i mea **Wa** The wat pot the con ship **Air** The

Summary Matrix of Impacts

Alternative 1: No Action	Alternative 2: Mandatory Dynamic Management Areas	Alternative 3: Speed Restrictions in Designated Areas	Alternative 4: Recommended Shipping Routes	Alternative 5: Combination of Alternatives 1-4	
	There would potentially be minor, direct, short-term, positive effects on ocean noise levels from implementing DMAs. Noise would be temporarily reduced if the vessel reduces speed through the DMA.	There would potentially be direct, short- and long-term, positive impacts on the levels of ocean noise by reducing noise levels in the immediate areas where restrictions are proposed. There would be long-term impacts in the NEUS, where speed restrictions are proposed year-round, and short-term elsewhere.	concentrated in these lanes, there would be no change in the overall amount of emissions. **Ocean Noise** There would potentially be minimal, direct, short-term, adverse effects on ambient noise levels in the ocean as a result of routing vessels into recommended shipping routes.	5 would have minor, direct, long-term, positive effects on air quality. **Ocean Noise** Combining the positive effects on ocean noise from Alternatives 2 and 3 and the adverse effects of Alternative 4 would potentially have minimal, direct, long-term, slightly positive effects on ocean noise.	criti **Oc** The dire as a ship low
no impacts on port areas perations from the No ative.	There would be adverse economic impacts because slowing down through a DMA or routing around a DMA would result in additional time spent at sea, which translates to higher costs. Impacts (all estimates based on 2004 conditions): **10 knots** Annual direct impact: $27.6 million. **12 knots** Annual direct impact: $17.7 million. **14 knots** Annual direct impact: $10.8 million. No additional direct impacts or indirect impacts.	There would be adverse economic impacts on port areas and vessel operations because speed restrictions would affect vessel arrival times, which affect vessel costs. Impacts (all estimates based on 2004 conditions): **10 knots** Annual direct impact: $142.5 million. Additional annual direct impact: $19.5 million. Annual Indirect impact: $139.4 million. Total annual impacts: $301.4 million. **12 knots** Annual direct impact: $89.2 million. Additional annual direct impact: $17.5 million. Annual indirect impacts: $79.6 million. Total annual impacts: $186.3 million. **14 knots** Annual direct impact: $52.5. Additional annual direct impact: $16 million. Annual indirect impact: $37.3 million. Total annual impacts: $106 million.	Adverse economic impacts would occur if vessels deviate from their original routes to travel in the recommended shipping routes, which would add extra mileage to voyages. Impacts (all estimates based on 2004 conditions): **10 knots** Annual direct impact: $2.8 million. **12 knots** Annual direct impact: $2.8 million. **14 knots** Annual direct impact: $2.8 million. No additional direct impacts or indirect impacts.	There would be adverse economic impacts for the same reasons as stated under Alternatives 1 through 4. Impacts (all estimates based on 2004 conditions): **10 knots** Annual direct impact: $147.2 million. Additional annual direct impact: $19.5 million. Annual indirect impacts: $159.6. Total annual impacts: $326.3 million. **12 knots** Annual direct impact: $92.8 million. Additional annual direct impact: $17.5 million. Annual indirect impact: $89.3 million. Total annual impacts: $199.6 million. **14 knots** Annual direct impact: $55.2 million. Additional annual direct impact: $16 million. Annual indirect impact: $47.0 million. Total annual impacts: $118 million.	The imp thro dev rec resu whi Imp con **10** Anr Add mill Anr Tot **12** Anr Add mill Anr Tot **14** Anr Add mill Anr Tot
be no impacts on ishing vessels under the ernative.	There would be negligible impacts at a 10-, 12-, or 14-knot speed restriction.	There would be no adverse impacts at 12- and 14-knot speed restriction. With a 10-knot restriction, there would be an adverse estimated at $1.7 million annually.	There would be negligible impacts at a 10-, 12-, or 14-knot speed restriction.	There would be no adverse impacts at 12- and 14-knot speed restriction. With a 10-knot restriction, there would be an adverse estimated at $1.7 million annually.	The a sp Wit be a mill
be no impacts on ferry r the No Action	There would be a direct adverse impact: 10 knots: $8.1 million annually. 12 knots: $6.1 million annually. 14 knots: $4.1 million annually. (Estimates based on 2004 conditions)	There would be a direct adverse impact: 10 knots: $13 million annually. 12 knots: $11.1 million annually. 14 knots: $8.3 million annually. (Estimates based on 2004 conditions)	There would be no impacts.	There would be a direct adverse impact: 10 knots: $13 million annually. 12 knots: $11.1 million annually. 14 knots: $8.3 millions annually. (Estimates based on 2004 conditions)	The imp 10 12 14 (Es

Summary Matrix of Impacts

Alternative 1: No Action	Alternative 2: Mandatory Dynamic Management Areas	Alternative 3: Speed Restrictions in Designated Areas	Alternative 4: Recommended Shipping Routes	Alternative 5: Combination of Alternatives 1-4	
be no impacts on ferry	There would be adverse impacts in southern New England: 10 knots: $4.5 million annually. 12 knots: $3.4 million annually. 14 knots: $2.3 million annually.	There would be adverse impacts in southern New England: 10 knots: $12 million annually. 12 knots: $8.9 million annually. 14 knots: $5.5 million annually.	There would be no impacts on ferry passengers.	There would be adverse impacts in southern New England: 10 knots: $12 million annually. 12 knots: $8.9 million annually. 14 knots: $5.5 million annually.	The sou 10 12 14
be no impacts on whale- ssel operations under the ternative.	There would be direct adverse impacts: 10 knots: $1.3 million annually. 12 knots: $0.9 million annually. 14 knots: $0.7 million annually. (Estimates based on 2004 conditions)	There would be direct adverse impacts: 10 knots: $5.6 million annually. 12 knots: $3.1 million annually. 14 knots: $1.9 million annually. (Estimates based on 2004 conditions)	There would be no effects on whale-watching vessel operations.	There would be direct adverse impacts: 10 knots: $5.6 million annually. 12 knots: $3.1 million annually. 14 knots: $1.9 million annually.	The imp 10 12 14
be no impacts on charter tions under the No Action	There would be no impacts on charter vessel operations.	There would be direct adverse economic impacts: 10 knots: $1.0 million annually. 12 knots: $598,000 annually. 14 knots: $299,000 annually. (Estimates based on 2004 conditions)	There would be no impacts on charter vessel operations.	There would be direct adverse economic impacts: 10 knots: $1.0 million annually. 12 knots: $598,000 annually. 14 knots: $299,000 annually. (Estimates based on 2004 conditions)	The eco 10 12 14 (Es
be no impacts on al justice communities.	No low-income or minority populations would be disproportionately affected. Alternative 2 does not raise environmental justice concerns under EO 12898.	No low-income or minority populations would be disproportionately affected. Alternative 3 does not raise environmental justice concerns under EO 12898.	No low-income or minority populations would be disproportionately affected. Alternative 4 does not raise environmental justice concerns under EO 12898.	No low-income or minority populations would be disproportionately affected. Alternative 5 does not raise environmental justice concerns under EO 12898.	Un min disp 6 d con
be no impacts on cultural	There would be no impacts on cultural resources.	There would be no impacts on cultural resources.	There would be no impacts on cultural resources.	There would be no impacts on cultural resources.	The reso