Northeast Fisheries Climate Change Overview: Social and Economic Factors

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The Northeast Region is often divided into New England (Maine to Connecticut) and the Mid-Atlantic (New York to Virginia) (see Fig. 1). In the Northeast, commercial landings in 2009 were 1.3 billion pounds, valued at $1.2 billion. Landings revenue in New England was dominated by American lobster (*Homarus americanus*; $298 million) and Atlantic sea scallop (*Placopecten magellanicus*; $210 million). These species represented 65% of total landings revenue, but only 20% of total landed pounds (NMFS 2010:50). Mid-Atlantic landings revenue came largely from sea scallop ($162 million) and blue crab (*Callinectes sapidus*; $85 million), comprising 57% of total landings revenue but only 15% of total landed pounds (NMFS, 2010:74). In terms of overall economic impacts, in 2009 the seafood industry in the Northeast Region was responsible for 232 thousand jobs, $25 billion in sales, $6 billion in income and $16 billion in value added from such activities as processing (NMFS, 2010:55,78).

Figure 1. Northeast Fishing Communities Profiled by the NMFS Northeast Fisheries

Science Center (Colburn *et al.*, 2010:1)

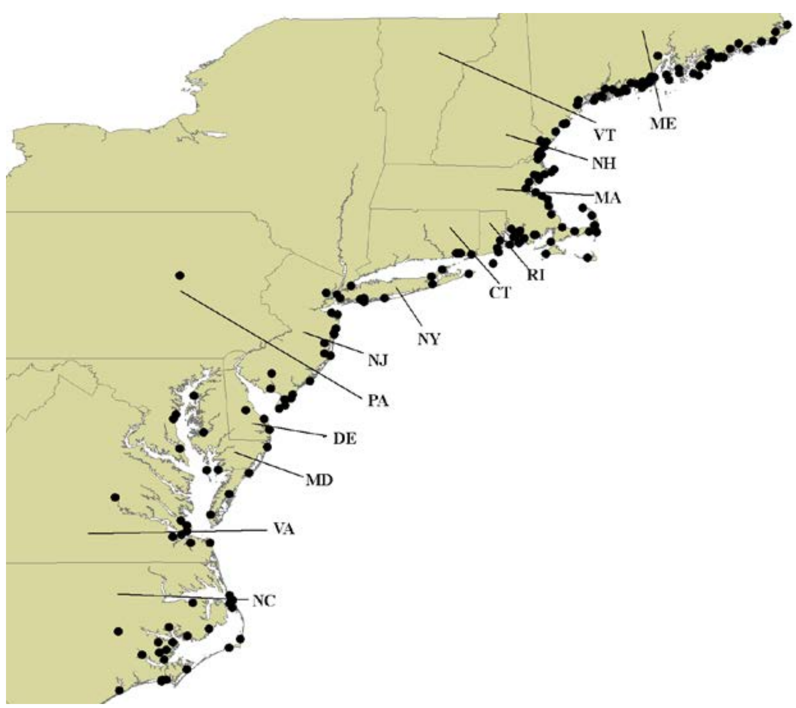

Figure 2. Blessing of the Fleet: Point Judith, Rhode Island
Photo credit: Lisa L. Colburn, Lisa L. Colburn, NEFSC/SSB

For commercial fishermen in the Northeast and elsewhere, however, fishing is more than a job or an income; it is a way of life. Studies show that fishermen value the independence and risk-taking afforded by fishing (Apostle *et al.*, 1985; Gatewood and McCay, 1990; Pollnac and Poggie, 1988; Smith and Clay, 2010), and may even subsidize fishing with income from another job (Veltre and Veltre, 1983:185-193) or by using kin as crew (often providing lesser incomes to individual crewmembers to allow the family enterprise to remain financially viable) (Doeringer *et al.,* 1986: 47). In the Northeast, groups that most commonly use kin as crew include the ethnic Sicilians of Gloucester, MA, the ethnic Portuguese of New Bedford and Provincetown, MA, and small, inshore vessels – especially from rural areas such as Downeast ME and areas of MD and VA. Household needs (e.g., debt) and cultural norms of equity can also influence both the degree to which fishermen maximize profits (Davis, 1991; Durrenberger, 1997) and the type of fishing (especially day vs. trip) that fishermen choose. Especially while their children are young, or if they desire stronger involvement in community groups and activities, they may choose small boat, inshore fishing over larger, trip vessels -- even if this means earning a more modest living (Maurstad, 2000). Festivals celebrating fishing, such as Blessings of the Fleet, are common throughout the Northeast and affairs for the entire community, not just fishermen and their families (see Figure 2 and NMFS (2009) for examples from the Northeast).

Recreational finfish anglers also value fishing for multiple reasons (Holland and Ditton 1992), including relaxation and following in the tradition of their parents. Sportfishing is a cultural subset that revolves around tournaments (see NMFS (2009) for examples in the Northeast). Recreational fishing can also mask subsistence fishing, potentially based on ethnicity, gender or location (Toth and Brown, 1997). In the Northeast, Steinback *et al.* (2009) found that 28% of presumed recreational anglers in fact fished for reasons other than recreation, including food or income, though fewer than 3% stated that they fished all or mostly for food or income. Overall, 54% of all interviewed anglers, whatever their motivations for fishing, ate at least some of their catch. Those who fished in part for food or income were also statistically more likely to collect non-finfish marine resources, such as shellfish, squid, seaweed or kelp (Steinback *et al.,* 2009:54).

Most social and economic impacts of climate change on fisheries flow from biological and ecological changes related to issues such as water temperature and acidity (Hannesson 2007, Felthoven *et al.* 2009, Cooley and Doney 2009). For Northeast Region fishermen, and the families, households, firms and communities that depend on them, the most relevant changes are those occurring to the ocean of the Northeast US shelf ecosystem (NEUS) and its denizens. Water temperatures are rising, surface seawater pH is decreasing (indicating increasing acidification), rainfall and riverflows are increasing, salinities are decreasing, and stratification is increasing (EAP 2012). All these changes impact marine life (Table 1).

Some Northeast species, such as Atlantic cod (*Gadus morhua*), will lose juvenile habitat (lowering biomass) and move out of the range of Northeast fishermen and into Canadian waters (Fogarty *et al*., 2008). Others, such as Atlantic croaker (*Micropogonias undulatus*), will see an increase in biomass as well as a range shift northward from the Mid-Atlantic into southern New England, thus providing New England fishermen with a larger stock to fish on but leaving Mid-Atlantic fishermen with less easy access (Hare *et al.*, 2010; Hare and Able, 2007)[1]. Yet others, such as lobster, will also see their ranges move northward, leaving the waters of NY and RI and increasing their presence in ME; but, warmer waters may also lead to increases in "lobster shell disease" (Frumhoff *et al.*, 2007:33), making the impact on fishermen more difficult to judge. Increased acidity affects shellfish most strongly. This would include scallops, lobsters, and blue crab -- three of the Northeast's most high-value species, so economic and social impacts are potentially very high (Cooley and Doney, 2009; McCay *et al.*, 2011). (See Table 1 for summary.)

Table 1. Known or Expected Direction of Social and Economic Impacts on Some Major Northeast Commercial and Recreational Species

Species	**Direction of Impact**
Atlantic cod (*Gadus morhua*)	Negative
Atlantic croaker (*Micropogonias undulatus*)	Positive
Atlantic lobster (*Homarus americanus*)	Ambiguous, but perhaps more negative
Atlantic sea scallop (*Placopecten magellanicus*)	Negative
blue crab (*Callinectes sapidus*)	Negative

But marine ecological changes are not the only climate change issues affecting fishermen and fishing-dependent industries. Many shellfish (including lobster) will suffer from sea level rise, as the coastal wetlands necessary to their juvenile stages are flooded (Frumhoff *et al.*, 2007:28). Sea level rise will also flood coastal infrastructure, especially docks and other fishing-related structures that are on the very edge of the current coastline. In the Northeast, many smaller ports have already lost infrastructure to gentrification (Gale, 1991; Colburn and Jepson, 2012), among other causes. With vital infrastructure such as boat repair facilities concentrated in fewer ports, loss in any of the remaining hubs could have

[1] We explored the cases of cod and croaker in more depth in an earlier section.

important negative impacts on the entire region's fishing fleet (NOAA, 1997a, 1997b; Robinson *et al*., 2003, 2005).

Many challenges remain for assessing the social and economic impacts of climate change on fisheries. For many Northeast species, we do not yet have studies to assess the impacts of climate change. In addition, the link between ocean conditions and fisheries is complex and poorly understood. Major uncertainties and gaps in understanding make it particularly difficult to quantify the effect of global climate changes on the stocks of commercially important fish species (Markowski *et al.*, 1999, EAP 2012). Since many fishermen in the Northeast fish multiple species at a time or in sequence over the year, until we have a clearer picture of all biological impacts it will be difficult to begin to more fully understand likely social and economic impacts.

Nor do fishermen live in a vacuum. Climate-related changes affecting local agriculture and terrestrial wildlife and all other aspects of their communities will impact fishermen and their families. Further, there are currently relatively few sociocultural or economic studies of climate change, and existing economic studies, e.g., Markowski *et al.*, (1999), do not measure all relevant non-market benefits such as ecosystem health, species loss, and human amenity impacts. So nothing definitive can be said about the net effect of climate change on the quality of life in the United States (Mendelsohn and Neuman, 1999). Grafton (2010), however, notes that although the specific effects of climate change on particular marine ecosystems and fish populations are difficult to predict, on a global and regional basis there is sufficient research to indicate that many, but not all, of these impacts will be negative.

Some tools for understanding social and economic impacts of climate change are emerging. Grafton (2010), for instance, has developed a risk and vulnerability assessment and management decision-making framework for adaptation. Some existing hazards research (e.g., Cutter *et al.*, 2008) is also relevant. Current research at the NMFS Northeast Fisheries Science Center (NEFSC) on social and economic indicators of human community vulnerability and resilience, fishery performance, and ecosystem function should help to flesh out some of these impacts in the Northeast over time. However, additional targeted research is also needed, especially case studies.

Yet understanding likely impacts is only the first step. Policies for adaptation are needed. Cinner *et al.* (2011), for instance, have developed a framework of policy actions to reduce different aspects of vulnerability at varying spatial and temporal scales. Kaje and Huppert (2007) used short-run climate forecasts to show that with predictable relationships between the environment and stock abundance, fishery managers should be able to forecast variation in stock survival and recruitment. Such forecasts could present an opportunity for increasing the economic value of fisheries and for achieving other management objectives. But, in an extensive review of the climate policy literature, Heller and Zavaleta (2009), found that in many recommendations the *how*, *by whom*, and *under what conditions they can be implemented* are not specified. Major gaps include the need for (1) more specific, operational examples of adaptation principles that are consistent with unavoidable uncertainty about the future; (2) a practical adaptation planning process to guide selection and integration of recommendations into existing policies and programs; and (3) greater integration of social science into the planning process (Heller and Zavaleta 2009). Current fisheries management regimes generally lack the flexibility necessary to arrive at workable adaptation strategies (OECD 2010, Ford *et al.* 2010), and the costs of developing these strategies will need to be accounted for. Some efforts at cost mitigation have begun in the Northeast (Moser *et al.* 2008). Ultimately, the sustainability of the Northeast fisheries in the face of climate variability and change will depend more on how society responds to climate impacts than on the magnitude of climate alterations *per se* (Merino *et al*. 2010).

Responses to climate change and effects on fisheries and communities

Fisheries in the U.S. are managed through a process that uses benchmarks based on the productivity of fish stocks. Predicting how management might change in response to climate change can be explored through scenarios that link climate change to changes in these benchmarks (Hare *et al.*, 2010). Such an approach has been used to show that the MSY of Atlantic croaker is likely to increase with predicted climate change along the mid-Atlantic coast (Hare *et al.*, 2010) while a similar exercise shows that Atlantic cod is likely to suffer a decrease in productivity and its associated benchmarks (Fogarty *et al.*, 2008). A major challenge will come from the uncertainty over the speed, magnitude, and location of effects brought on by climate change, which will make them difficult to distinguish them from “normal” climatic variation (Coulthard, 2009). And it should be recognized that not all stocks will be affected in the same manner, as some stocks will benefit while others will be adversely affected, making general rules relating climate change to desirable management changes problematic. Part of the challenge will also be to have management structures that can adapt to climate change, recognizing, for example, that fish distribution will change over time. In such cases, systems such as quotas and protected areas that tie management choices to particular areas may be ineffective if the distribution upon which protective measures were based change over time (OECD, 2010).

Finally, government responses that seek to mitigate climate change can also affect fisheries and fishing communities. Policies that restrict carbon emissions may increase fuel prices, for example, affecting the choice of where and how much to fish (McIlgorm, 2010).

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