

Monkfish – *Lophius americanus*

Overall Vulnerability Rank = Low ■

Biological Sensitivity = Low ■

Climate Exposure = High ■

Data Quality = 79% of scores  $\geq 2$

| <i>Lophius americanus</i>              |                                    | Expert Scores           | Data Quality | Expert Scores Plots (Portion by Category) |  |
|--|------------------------------------|-------------------------|--------------|---|--|
| Sensitivity attributes                 | Stock Status                       | 2.0                     | 2.6          |   |  |
|  | Other Stressors                    | 1.5                     | 2.0          |   |  |
|  | Population Growth Rate             | 3.0                     | 2.0          |   |  |
|  | Spawning Cycle                     | 2.4                     | 2.8          |   |  |
|  | Complexity in Reproduction         | 1.7                     | 1.6          |   |  |
|  | Early Life History Requirements    | 1.9                     | 1.2          |   |  |
|  | Sensitivity to Ocean Acidification | 1.1                     | 1.4          |   |  |
|  | Prey Specialization                | 1.3                     | 3.0          |   |  |
|  | Habitat Specialization             | 1.5                     | 2.8          |   |  |
|  | Sensitivity to Temperature         | 2.0                     | 2.8          |   |  |
|  | Adult Mobility                     | 2.3                     | 2.6          |   |  |
|  | Dispersal & Early Life History     | 2.0                     | 2.4          |   |  |
|  | <b>Sensitivity Score</b>           |                         | <b>Low</b>   |   |  |
|  | Exposure variables                 | Sea Surface Temperature | 3.9          | 3.0                                       |  |
| Variability in Sea Surface Temperature |                                    | 1.0                     | 3.0          |   |  |
| Salinity                               |                                    | 1.5                     | 3.0          |   |  |
| Variability Salinity                   |                                    | 1.2                     | 3.0          |   |  |
| Air Temperature                        |                                    | 1.0                     | 3.0          |   |  |
| Variability Air Temperature            |                                    | 1.0                     | 3.0          |   |  |
| Precipitation                          |                                    | 1.0                     | 3.0          |   |  |
| Variability in Precipitation           |                                    | 1.0                     | 3.0          |   |  |
| Ocean Acidification                    |                                    | 4.0                     | 2.0          |   |  |
| Variability in Ocean Acidification     |                                    | 1.0                     | 2.2          |   |  |
| Currents                               |                                    | 2.1                     | 1.0          |   |  |
| Sea Level Rise                         |                                    | 1.1                     | 1.5          |   |  |
| <b>Exposure Score</b>                  |                                    | <b>High</b>             |              |   |  |
| <b>Overall Vulnerability Rank</b>      |                                    | <b>Low</b>              |              |   |  |

## **Monkfish (Goosefish) (*Lophius americanus*)**

Overall Climate Vulnerability Rank: **Low** (76% certainty from bootstrap analysis).

Climate Exposure: **High**. Two exposure factors contributed to this score: Ocean Surface Temperature (3.9) and Ocean Acidification (4.0). All life stages of Monkfish (Goosefish) use marine habitats.

Biological Sensitivity: **Low**. Only one sensitivity attributes scored above 2.5: Population Growth Rate (3.0). Monkfish (Goosefish) are relatively slow growing and late maturing (Steimle et al., 1999).

Distributional Vulnerability Rank: **High** (72% certainty from bootstrap analysis). Monkfish (Goosefish) are habitat generalists that make seasonal movements and have dispersive early life history stages.

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Monkfish (Goosefish) on the Northeast U.S. Shelf is estimated to be neutral, but with a moderate degree of uncertainty (66-90% certainty in expert scores). Monkfish (Goosefish) is a temperate water fish and the effect of warming on habitat availability in the Northeast U.S. is unclear. There is not much information regarding productivity, thereby creating uncertainty as to the directional effect of climate.

Data Quality: 79% of the data quality scores were 2 or greater indicate that data quality is moderate.

Climate Effects on Abundance and Distribution: Relatively little is known regarding climate effects on Monkfish (Goosefish). The abundance of a congener, *Lophius piscatorius*, has increased in Iceland in recent years, likely as a result of warming temperatures (Solmundsson et al., 2010). They may suggest that productivity of Monkfish (Goosefish), which are at the southern extent of their range in the Northeast U.S. Shelf, will decrease as warming continues. Monkfish (Goosefish) have shifted northwards (Nye et al., 2009) and their distribution is related to temperature (Murawski, 1993).

Life History Synopsis: Monkfish (Goosefish), or Monkfish, is a benthic, marine, anglerfish species that occurs from southern and eastern Grand Banks and northern Gulf of St. Lawrence to eastern Florida, but is only common north of Cape Hatteras, North Carolina (Steimle et al., 1999). Males mature after about 4 years, but females mature after about 5 years and live longer than males (Steimle et al., 1999; NEFSC, 2010). Spawning occurs in spring through autumn starting in the south, and eggs are released in long, floating, mucus veils (Steimle et al., 1999). Egg veils, and individual eggs, are buoyant on the surface and incubation lasts 1 week to 4.5 months depending on temperature (Steimle et al., 1999). Newly hatched larvae remain in the veil for 2-3 days after hatching, and are pelagic after emerging (Steimle et al., 1999). Larvae are zooplanktivores, consuming copepods, crustacean larvae, and chaetognaths (Steimle et al., 1999). After several weeks to a few months in the plankton, young juveniles slowly transition into benthic juveniles that resemble the adult (Steimle et al., 1999). Small juveniles consume fish (Sand Lance), crustaceans, and squid, but the consumption of invertebrates decreases with growth (Steimle et al., 1999). Swordfish, Spiny Dogfish, Thorny Skate, Smooth Dogfish, Atlantic Cod, Sandbar Shark, and Dusky Shark consume Monkfish (Goosefish) juveniles, and cannibalism by larger individuals may be a substantial source of mortality (Steimle et al., 1999). Juveniles and adults tolerate a wide range of temperatures and salinities, but avoid low salinity and temperature extremes (Caruso, 2002). In the Gulf of Maine, Monkfish (Goosefish) migrate offshore in winter – spring to avoid cold temperatures and find food, then return to coastal waters in summer – autumn (Steimle et al., 1999). In the mid-Atlantic region, Monkfish (Goosefish) move offshore in summer – autumn to avoid warm temperatures and find food (Steimle et al., 1999). Adult Monkfish (Goosefish) are found over hard sand, pebbly-gravel, mixed

sand and shell, mud, and clay substrate and rest for long periods in depressions on the bottom or partially covered in sediment (Steimle et al., 1999). The first dorsal spine is adapted to act as a lure to coax small fish to within range (Caruso, 2002). The large wide mouth opens quickly creating suction, and prey fishes are swallowed whole (Caruso, 2002). Adults are opportunistic ambush predators of invertebrates and fish (primarily squid, clupeids, hakes, American Plaice, Little Skate, Monkfish (Goosefish), and Sand Lances), but also eat sea birds and diving ducks (Steimle et al., 1999; Caruso, 2002). Monkfish (Goosefish) can consume large quantities of prey including animals almost as large as they are, but then refuse food for several days (Caruso, 2002). Large Monkfish (Goosefish) have few predators (Steimle et al., 1999). The New England and Mid-Atlantic Fishery Management Councils jointly manage Monkfish (Goosefish) through the Monkfish (Goosefish) Fishery Management Plan (NEFSC, 2010). The Monkfish (Goosefish) fishery is divided into two regions: north of Georges Bank and south of Georges Bank (NEFSC, 2010). Neither stock is overfished nor experiencing overfishing, but the northern stock was identified as most vulnerable (NEFSC, 2010).

#### Literature Cited:

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