

# WHITE HAKE



## UNDERUTILIZED STATUS

White hake qualified as an underutilized species in the 2019 evaluation but did not meet all criteria in the 2021 evaluation. This was because in the 2021 evaluation period:

- More than 50% of the white hake annual catch limit was used in 3 out of the 5 years throughout 2015-2019
- Stock status change:
  - below target population level
  - overfished



2019 Evaluation



2021 Evaluation



2023 Evaluation

## IN A CHANGING CLIMATE



Climate Exposure



Vulnerability to Distribution Shift

### Most Sensitive Biological Attributes

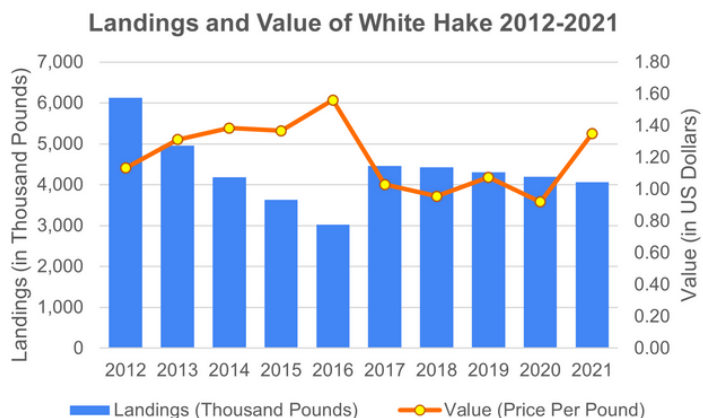
- Population Growth Rate
- Spawning Cycle
- Stock Status

### Observed Changes in Behavior

- Poleward Movements
- Shifted Into Deeper Water
- Decreased Abundance in Warming Water

## LANDINGS & VALUE

From 2012 - 2021, white hake landings ranged from a high of 6,129,000 pounds in 2012 to a low of 3,029,000 pounds in 2016. The highest average ex-vessel price for white hake was \$1.56/lb in 2016 while the lowest average ex-vessel price for white hake was \$0.92/lb in 2020. Landings and value data were collected from the [Fisheries One Stop Shop \(FOSS\)](#) database prepared by NOAA.



## EXPANDING MARKETS

Expanding market opportunities for white hake is not recommended at this time since the most recent stock assessment suggests that white hake are overfished and below target population level. Market opportunity recommendations for white hake could be reviewed again after the 2023 evaluation and after a new stock assessment is released.

# WHITE HAKE



## OVERVIEW

White hake (*Urophycis tenuis*) are found from the Gulf of St. Lawrence to the Middle Atlantic Bight in different environments including canyons, muddy basins, and estuaries.<sup>1</sup> Although they are managed as a single stock under the Northeast Multispecies FMP, scientists discuss them as two; the northern stock and the Georges Bank – Mid Atlantic Bight stock. The northern stock spawns in the late summer in the southern Gulf of St. Lawrence and on the Scotian Shelf, while the Georges Bank - Middle Atlantic Bight stock's spawning cycle and location are not well understood.<sup>1,2</sup>

White hake reach sexual maturity at different sizes in each stock. Males and females of the Gulf of St. Lawrence stock are mature when they reach 40 cm and 43 cm, respectively, while the Georges Bank- Middle Atlantic Bight stock's median age at sexual maturity is 1.5 years when males are 35 cm and females are 32 cm. Females grow larger and live longer than males. Demersal juveniles are found in eelgrass beds. Inshore demersal juveniles prefer depths 5-75m in the spring and 5 -50m in the fall, while offshore juveniles can be found in deeper waters ranging from 50-225m in the spring and 5 -175m in the fall.<sup>3,4,5</sup>

White hake make inshore movement during warmer months. They are most abundant inshore during spring and autumn when waters reach 5- 14°C.<sup>1,2,6</sup> Growth of adults is relatively slow, and spawning occurs in a relatively narrow time span (early spring) in deep water.<sup>1</sup> White hake are cannibalistic; adults also feed on fish and crustaceans while juveniles feed on polychaetes and crustaceans.<sup>7,8</sup> Juvenile white hake are an important prey species for coastal seabirds in Maine including Atlantic puffins and Arctic terns.<sup>2,9,10</sup>

## OBSERVED & PROJECTED SHIFTS

During a general warming over the North Atlantic from 1968 - 2007, white hake made significant poleward movements, significantly expanded the area that they occupy, and moved into significantly deeper waters.<sup>11</sup> Longer summer duration may negatively affect early life stages of white hake - fall stock biomass declined at a 4-year lag with increasing summer temperature duration.<sup>12</sup> A decrease in white hake abundance in Narragansett Bay was correlated with warming ocean temperatures.<sup>13</sup> Suitable thermal area is not expected to drastically change for white hake in either spring or fall by late century.<sup>14</sup> When white hake were assessed for their climate resilience using metrics of sensitivity, directionality, and future habitat availability, they showed relatively lower confidence in long-term market potential relative to 6 other species.

# WHITE HAKE



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# ACADIAN REDFISH



## UNDERUTILIZED STATUS

Acadian redfish qualified as an underutilized species in the 2019 evaluation and 2021 evaluation because they met all five criteria:

- Less than 50% of the annual catch limit was used in 3 out of the 5 years during each evaluation period (2012-2017 and 2015-2019)
- Stock status:
  - remains above target population level
  - not overfished
  - no overfishing
  - species can be landed



2019 Evaluation



2021 Evaluation



2023 Evaluation

## IN A CHANGING CLIMATE



Climate Exposure



Vulnerability to Distribution Shift

### Most Sensitive Biological Attributes

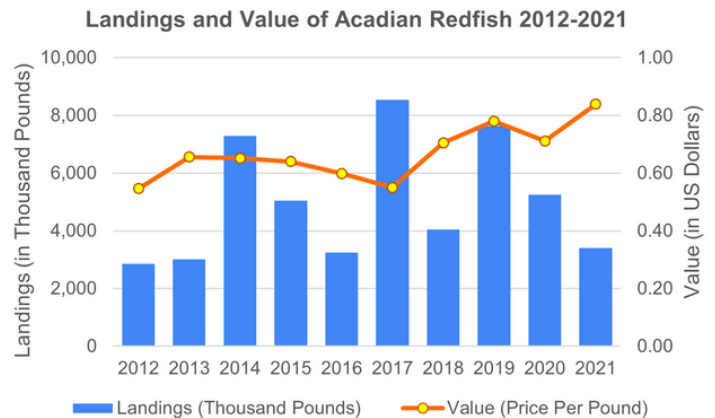
- Population Growth Rate
- Spawning Cycle
- Adult Mobility

### Observed Changes in Behavior

- Decline in Area Occupied

## LANDINGS & VALUE

From 2012 - 2021, Acadian redfish landings ranged from a high of 12,943,000 pounds in 2020 to a low of 7,885,000 pounds in 2013. The highest average ex-vessel price for Acadian redfish was \$0.67/lb in 2012 while the lowest average ex-vessel price for Acadian Redfish was \$0.51/lb in 2018. Landings and value data were collected from the [Fisheries One Stop Shop \(FOSS\)](#) database prepared by NOAA.



## EXPANDING MARKETS

New markets may be attracted to the vibrant red skin on Acadian redfish, the portion-ready sized fillets, and the affordable price point. Expanding markets for Acadian redfish would need to happen soon since they have a high vulnerability to distribution shift.

# ACADIAN REDFISH



## OVERVIEW

The Acadian redfish (*Sebastes fasciatus*) is one of three rockfish species in the *Sebastes* genus found within the Gulf of Maine. Acadian redfish prefer cool deep waters from Newfoundland's Grand Banks to the Gulf of Maine. These fish are well known for ovoviparous reproduction, low fecundity, slow growth, and their long-life span.<sup>1,2</sup> The most recent estimates suggest a median age at maturity of 5.5 - 6.6 years.<sup>3,4</sup> Mating occurs in late fall and early winter and larvae emerge from late spring to August after a 45-60 day incubation period.<sup>5</sup> Acadian redfish are primarily caught using otter trawls by vessels from Maine and Massachusetts.<sup>3,6</sup> Low fecundity and a slow growth rate have made Acadian Redfish vulnerable to overfishing in the past. Redfish have been exploited in New England since the 1930's.

The redfish fishery grew as freezing methods and transportation improved throughout the early and mid-1900's and peaked in 1952 at 130,000 metric tons before declines in the 1950s. Regulations such as season and area closures, permit limits, gear restrictions, and minimum body size requirements were established in the 1990s. The population was considered rebuilt in 2012.<sup>7</sup>

A recent age structure and growth study suggests that population characteristics such as age, length-at-age, and age of maturity has not shifted in Gulf of Maine populations despite increased ocean temperatures and periods of overfishing.<sup>4</sup> However, more information is needed to fully understand how this species will respond to increased temperatures and their adaptive capacity.

## OBSERVED & PROJECTED SHIFTS

Acadian redfish are sensitive to temperature changes and will likely be negatively affected by climate change.<sup>8</sup> From 1968-2007, Acadian redfish reduced the area they occupy by approximately 2,400 square miles ( $159.8 \text{ km}^2 \text{ yr}^{-1}$ ).<sup>9</sup> Their fall stock biomass appeared to be influenced by the duration of summer-like temperatures.<sup>10</sup> By the end of the century under RCP 8.5, Acadian redfish are projected to experience a large northward centroid shift (over 800 km) and lose almost half of their historic suitable thermal habitat.<sup>11</sup> Acadian redfish are projected to lose a greater percentage of thermal area in the fall (-35%) than in the spring.<sup>12</sup> When Acadian redfish were assessed for their climate resilience using metrics of sensitivity, directionality, and future habitat availability, they showed relatively lower confidence in long-term market potential relative to 6 other species.

# ACADIAN REDFISH



## REFERENCES

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# ATLANTIC POLLOCK



## UNDERUTILIZED STATUS

Atlantic pollock qualified as an underutilized species in the 2019 evaluation and 2021 evaluation because they met all five criteria:

- Less than 50% of the annual catch limit was used in 3 out of the 5 years during each evaluation period (2012-2017 and 2015-2019)
- **Stock status:**
  - remains above target population level
  - not overfished
  - no overfishing
  - species can be landed



2019 Evaluation



2021 Evaluation



2023 Evaluation

## IN A CHANGING CLIMATE



Climate Exposure



Vulnerability to Distribution Shift

### Most Sensitive Biological Attributes

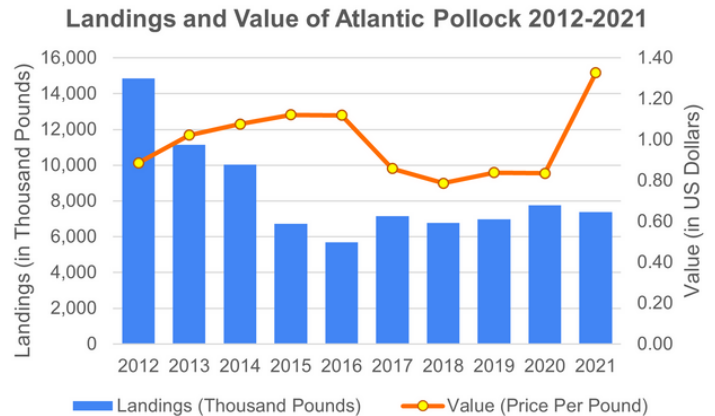
- Population Growth Rate
- Early Life Requirements

### Observed Changes in Behavior

- Decline in Area Occupied
- Shifted Into Deeper Water

## LANDINGS & VALUE

From 2012 - 2021, Atlantic pollock landings ranged from a high of 14,846,000 pounds in 2012 to a low of 5,692,000 pounds in 2016. The highest average ex-vessel price for Atlantic pollock was \$1.32/lb in 2021 while the lowest average ex-vessel price for Atlantic pollock was \$0.79/lb in 2018. Landings and value data were collected from the [Fisheries One Stop Shop \(FOSS\)](#) database prepared by NOAA.



## EXPANDING MARKETS



New markets may be attracted to Atlantic pollock's white fleshed fillets, versatility, and affordable price point. Expanding markets for Atlantic pollock would need to happen soon since they have a high vulnerability to distribution shift and are shifting into deeper water.

# ATLANTIC POLLOCK



## OVERVIEW

Atlantic pollock (*Pollachius virens*) are part of the Gadidae family and are found throughout the water column in the Northwestern Atlantic Ocean along the western Scotian Shelf, the Gulf of Maine, Great South Channel, and Georges Bank. They are common bycatch in the Acadian redfish fishery.<sup>1,2</sup>

Atlantic pollock reach maturity between 3 and 6 years old and will spawn multiple times per season. Preferred spawning habitat is hard, rocky, and cobble bottoms in cold water. Spawning occurs within a narrow range of temperatures between 4.5 - 8°C.<sup>3</sup> Timing of spawning differs by location, occurring in November through February in the Gulf of Maine and Georges Bank, and during September through April on the Scotian Shelf.<sup>3</sup> Pelagic eggs are found in waters 50-250 m deep and at temperatures ranging from 2-17°C.<sup>4</sup> Juveniles are found in inshore rocky subtidal and intertidal habitats and make several inshore-offshore movements that correlate with temperature changes, with preferred temperatures of 4-12°C and depths between 25-75m.<sup>5,6,7</sup> Adult pollock are distributed throughout the nearshore areas of the Gulf as well as offshore regions in the Gulf of Maine, Great South Channel, and along the northern edges of Georges Bank. Adults are associated with temperatures between 1-12°C while most were found in waters between 6-7°C from spring to fall. Research suggests that pollock segregate according to size with larger individuals inhabiting deeper waters.<sup>8</sup>

Atlantic pollock in the Scotian Shelf, Georges Bank, and the Gulf of Maine are assessed as a single unit since there are no significant genetic differences among these fish.<sup>9</sup>

## OBSERVED & PROJECTED SHIFTS

Atlantic pollock are expected to be challenged by climate change, particularly through changes in their distribution, population growth rate, and early life requirements.<sup>10</sup> Atlantic pollock reduced the area they historically occupied by 281.1 km<sup>2</sup> yr<sup>-1</sup> between 1968-2007 and have moved into deeper waters (1.36m yr<sup>-1</sup>).<sup>11</sup> Thermal habitat projections for Atlantic pollock were not included in recent studies.<sup>12,13</sup> When Atlantic pollock were assessed for their climate resilience using metrics of sensitivity, directionality, and future habitat availability, they showed relatively lower confidence in long-term market potential relative to 6 other species.



# ATLANTIC POLLOCK



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# BUTTERFISH

## UNDERUTILIZED STATUS

Butterfish qualified as an underutilized species in the 2019 evaluation but they did not meet all criteria in the 2021 evaluation. Butterfish did not qualify as underutilized in the 2023 evaluation because:

- Stock status change:
  - below target population level



2019 Evaluation



2021 Evaluation



2023 Evaluation

## IN A CHANGING CLIMATE



Climate Exposure



Vulnerability to Distribution Shift

### Most Sensitive Biological Attributes

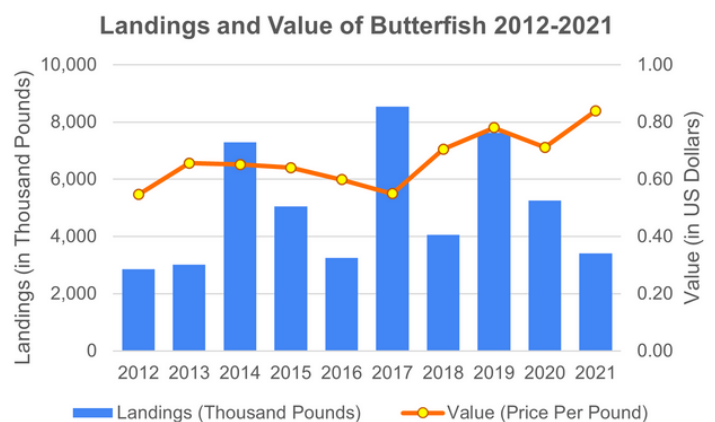
- Early Life History Requirements
- Spawning Cycle

### Observed Changes in Behavior

- Increased Abundance in Warming Water

## LANDINGS & VALUE

From 2012 - 2021, butterfish landings ranged from a high of 8,535,000 pounds in 2017 to a low of 2,858,000 pounds in 2012. The highest average ex-vessel price for butterfish was \$0.84/lb in 2018 while the lowest average ex-vessel price for butterfish was \$0.55/lb in 2012 and 2017. Landings and value data were collected from the [Fisheries One Stop Shop \(FOSS\)](#) database prepared by NOAA.



## EXPANDING MARKETS



Photo credit: Fishwatch.gov

New markets may be attracted to butterfish's delicate white fleshed fillets, affordable price point, and the fact they do not have scales. Consumers who are unfamiliar with buying / eating whole fish may need additional outreach since the small fish are almost always sold whole. Supplying new markets with butterfish that would otherwise be discarded, rather than encouraging additional fishing pressure on butterfish, may be preferable since they are below target population.

# BUTTERFISH



## OVERVIEW

Butterfish (*Peprilus triacanthus*) are small, short-lived (~3 years), rapidly growing fish ranging from Newfoundland to Florida but are primarily found between Cape Hatteras and the Gulf of Maine. Butterfish feed on planktonic prey, live near the water's surface, make seasonal migrations, and are considered eurythermal (4.4-22°C)<sup>1,2</sup> and euryhaline (5-32ppt).<sup>3</sup> Butterfish have ecological importance as a forage fish serving as a valuable prey species for many small and large commercial fish.<sup>2,4,5</sup> Butterfish mature during their second summer and spawn during June-July. Eggs and larvae are common in high salinity zones in Southern New England's estuaries, the Mid Atlantic Bight, and in Chesapeake Bay's mixing zone.

Butterfish north of Cape Hatteras make seasonal migrations in response to changing temperatures. As temperatures warm each spring, they move inshore and northwards from their wintering grounds on the edge of the Mid Atlantic Bight. Butterfish reach the Gulf of Maine in June and are most abundant in northern waters in September.<sup>6</sup> Butterfish begin moving southward from the Gulf of Maine in October. By January, butterfish move offshore to depths of 200m in the Northwestern Atlantic and 350m in the South Atlantic Bight.<sup>7</sup> Butterfish appear to distribute across different habitats by age-class in the spring, with age 2 and 3 fish found farther northeast and in deeper waters than age 1 butterfish.<sup>8</sup> Butterfish have also expanded their spatial distribution in association with increased surface temperatures.<sup>8</sup>

## OBSERVED & PROJECTED SHIFTS

Butterfish are expected to benefit from warming climate conditions.<sup>9</sup> Butterfish increased in Narragansett Bay between 1959-2005 when it warmed 1.6°C.<sup>10</sup> Butterfish were projected to gain a significant amount of suitable thermal area in both the spring (306%) and fall (24%) seasons.<sup>11</sup> They are expected to shift northward throughout the rest of the century and gain a significant percentage of suitable thermal habitat.<sup>12</sup> When butterfish were assessed for their climate resilience using metrics of sensitivity, directionality, and future habitat availability, they showed relatively neutral confidence in long-term market potential relative to 6 other species.

# BUTTERFISH



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# HADDOCK

## UNDERUTILIZED STATUS

Haddock from Georges Bank and Georges Bank East stock qualified as an underutilized species in the 2019 evaluation and 2021 evaluation because:

- Less than 50% of the annual catch limit was used in 3 out of the 5 years during each evaluation period (2012-2017 and 2015-2019)
- **Stock status:**
  - remains above target population level
  - not overfished
  - no overfishing
  - species can be landed



2019 Evaluation



2021 Evaluation



2023 Evaluation

## IN A CHANGING CLIMATE



Climate  
Exposure



Vulnerability to  
Distribution Shift

### Most Sensitive Biological Attributes

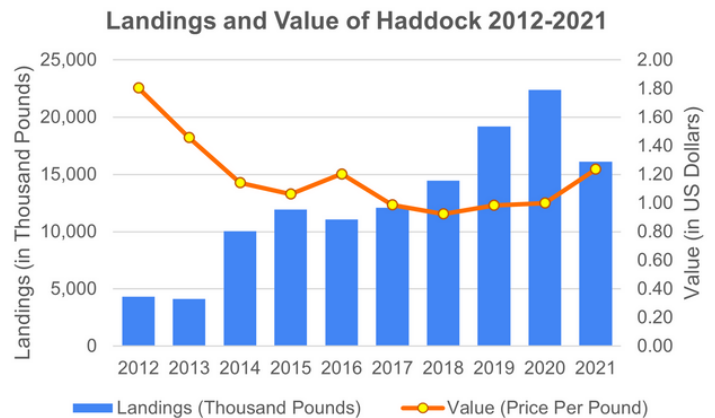
- Early Life Requirements
- Spawning Cycle
- Sensitivity to Temperature

### Observed Changes in Behavior

- Stock has produced several strong year classes despite warming conditions

## LANDINGS & VALUE

From 2012 - 2021, haddock landings have been increasing from a low of 4,123,000 pounds in 2013 to a high of 22,377,000 pounds in 2020. The highest average ex-vessel price for haddock was \$1.81/lb in 2012 while the lowest average ex-vessel price for haddock was \$0.92/lb in 2018. Landings and value data were collected from the *Fisheries One Stop Shop (FOSS)* database prepared by NOAA.



## EXPANDING MARKETS

Haddock is a familiar fish to many consumers. A climate-smart approach to expanding markets for haddock could be to utilize more of the annual catch limit rather than importing haddock fillets and encouraging markets to use locally caught haddock because of its low carbon footprint.



# HADDOCK



## OVERVIEW

Haddock (*Melanogrammus aeglefinus*) are fast-growing, productive, and long-living fish that are part of the Gadidae family. They range from 0.2m – 1m in size and are found from Newfoundland to New Jersey with abundant populations in Georges Bank and Gulf of Maine. They prefer bottom temperatures above 1.6 °C and below 11.1 °C at depths ranging from 45-135m. Adults in western Gulf of Maine conduct seasonal coastal movements. Juvenile haddock are an important prey item for other groundfish and other predators.<sup>1</sup>

Haddock's age-at-maturity appears to have shifted earlier since the 1960s, with females now maturing at age 2 instead of 3.<sup>2,3</sup> Haddock are broadcast spawners and productivity increases with body size. Spawning primarily occurs in Georges Bank from January to June,<sup>4</sup> with peak spawning between February and early April, with larval survival and growth enhanced by earlier hatching timing<sup>5</sup> and at preferred temperatures of 7-9°C.<sup>6</sup>

Haddock in the Northwestern Atlantic are divided into three stocks - the Gulf of Maine stock, the Georges Bank stock, and Georges Bank East stock. The Gulf of Maine stock is jointly managed by NOAA Fisheries and the New England Fishery Management Council. Both entities collaborate with Canada to manage the Georges Bank stocks.

Haddock are harvested with otter trawls, gillnets, as well as hook and line. A recent stock assessment states that since 2010, Georges Bank haddock produced several exceptionally strong year classes with record high spawning stock biomass and several large recruitment events. The population biomass is high and the population is experiencing low mortality.<sup>7</sup>

## OBSERVED & PROJECTED SHIFTS

While haddock are not considered as sensitive to climate change as many other species, they are expected to be negatively affected by climate change. The<sup>8</sup> timing and duration of seasons appear to impact the northern haddock population. Earlier springs may negatively impact haddock recruitment and are related to the center of northern haddock biomass shifting further north. Meanwhile, longer summers may positively affect fall stock biomass with a 2-year lag. By late<sup>9</sup> century, thermal area for haddock is projected to decline in the spring (-19%) and fall (-46%).<sup>10</sup> When haddock were assessed for their climate resilience using metrics of sensitivity, directionality, and future habitat availability, they showed relatively neutral confidence in long-term market potential relative to 6 other species.

# HADDOCK



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# SCUP



## UNDERUTILIZED STATUS

Scup during their winter II season qualified as an underutilized species in the 2019 evaluation and 2021 evaluation because:

- Less than 50% of the annual catch limit was used in 3 out of the 5 years during each evaluation period (2012-2017 and 2015-2019)
- **Stock status:**
  - remains above target population level
  - not overfished
  - no overfishing
  - species can be landed



2019 Evaluation



2021 Evaluation



2023 Evaluation

## IN A CHANGING CLIMATE



Climate Exposure



Vulnerability to Distribution Shift

### Most Sensitive Biological Attributes

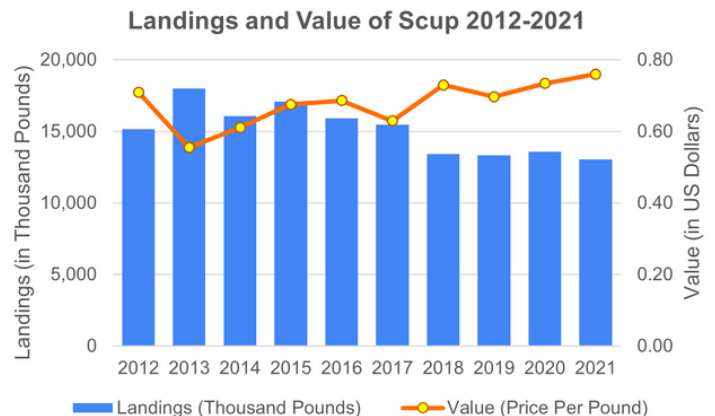
- Population Growth Rate
- Spawning Cycle
- Early Life Requirements

### Observed Changes in Behavior

- Increased Abundance in Warming Water

## LANDINGS & VALUE

From 2012 - 2021, scup landings ranged from a high of 18,003,000 pounds in 2013 to a low of 13,031,300 pounds in 2021. The highest average ex-vessel price for scup was \$0.73/lb in 2018 and 2021 while the lowest average ex-vessel price for scup was \$0.55/lb in 2013. Landings and value data were collected from the *Fisheries One Stop Shop (FOSS)* database prepared by NOAA.



## EXPANDING MARKETS

New markets may be attracted to scup's delicate white fleshed fillets, versatility, and affordable price point. Consumers who are unfamiliar with buying / eating whole fish may need additional outreach since scup are generally sold whole and contain many small bones. Markets may be more willing to offer scup if processors can consistently provide high-quality filleted product.



# SCUP



## OVERVIEW

Scup (*Stenotomus chrysops*) are a long-living, slow growing, schooling species that are concentrated between Massachusetts and South Carolina but have been observed as far north as the Bay of Fundy.<sup>1</sup> Scup are found in estuaries and coastal waters during summer but migrate southward to the outer continental shelf at depths about 200m in the winter.<sup>2</sup> The Middle Atlantic Bight population mixes with the “southern porgy” (*S. aculeatus*) in the Middle/South Atlantic Bight area. They are managed by the Mid-Atlantic Council.

While scup have been documented to live to 20 years and reach sizes longer than 45cm,<sup>3</sup> most of the Middle Atlantic population is less than 7 years old and less than 33cm.<sup>4</sup> The average size of scup has been in decline since the 1930s.<sup>5</sup>

Scup mature at age 2 at 15.5 cm. but most are mature by age 3 and at 21cm.<sup>6</sup> Spawning occurs from May through August along the inner continental shelf off southern New England.<sup>2</sup> Eggs hatch in 2-3 days depending on temperature,<sup>7</sup> larvae are planktivorous, while juveniles and adults feed on benthic vertebrates in estuarine and coastal areas during summer and early fall. Scup move southward to warmer waters during winter months from New Jersey to South Carolina.<sup>2</sup>

Scup are commonly caught as bycatch during the spring/summer longfin inshore squid fishery in Southern New England and Nantucket Sound.<sup>8</sup>

## OBSERVED & PROJECTED SHIFTS

Scup are expected to benefit from warming climate conditions. From 1972-2008 their along-shelf center of biomass had a significant positive relationship with temperature, their suitable thermal habitat shifted northward, and larger scup were found further north than smaller scup during spring.<sup>9</sup> Scup also became more abundant in Narragansett Bay between 1959-2005 when it warmed 1.6°C.<sup>10</sup> Scup are projected to gain thermal area in both spring (128%) and fall (48%).<sup>11</sup> Their suitable thermal habitat is expected to continue expanding northward throughout the rest of the century.<sup>12</sup> When scup were assessed for their climate resilience using metrics of sensitivity, directionality, and future habitat availability, they showed the highest confidence in long-term market potential relative to 6 other species.

# SCUP



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# SILVER HAKE



## UNDERUTILIZED STATUS

Both northern and southern silver hake met all criteria in the 2021 evaluation as an underutilized species, while only the northern stock qualified in the 2019 evaluation. Southern silver hake did not qualify as underutilized in the 2019 evaluation because:

- Stock status:
  - below target population level



## IN A CHANGING CLIMATE



Climate Exposure



Vulnerability to Distribution Shift

### Most Sensitive Biological Attributes

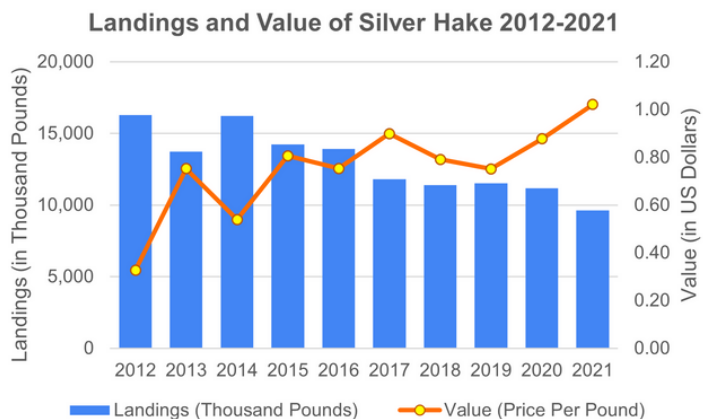
- Stock Status
- Early Life History Requirements

### Observed Changes in Behavior

- Poleward Movements
- Southern Stock has Reduced the Area It Occupies

## LANDINGS & VALUE

From 2012 - 2021, silver hake landings ranged from a high of 16,292,000 pounds in 2012 to a low of 9,624,000 pounds in 2021. The highest average ex-vessel price for silver hake was \$1.02/lb in 2021 while the lowest average ex-vessel price for silver hake was \$0.63/lb in 2012. Landings and value data were collected from the Fisheries One Stop Shop (FOSS) database prepared by NOAA.



## EXPANDING MARKETS

New markets may be attracted to silver hake's white fleshed fillets, versatility, and affordable price point. In the marketplace, silver hake are often referred to as "whiting". Large whiting are commonly referred to as "King whiting" which are likely sold filleted, while smaller whiting are sold whole.



Photo credit: Fishwatch.gov

# SILVER HAKE



## OVERVIEW

Silver hake (*Merluccius bilinearis*) are fast growing, dense schooling, and fast-swimming semi-pelagic fish that are part of the Gadidae family. They are found over a wide range of temperatures and depths from Cape Fear, North Carolina to the Gulf of St. Lawrence and the Grand Banks of Newfoundland but are most abundant from New Jersey to Nova Scotia. Because of morphometric differences and differences in fishing pressure, silver hake are managed as two separate stocks - a northern stock and a southern stock. The northern stock ranges from the Gulf of Maine to northern Georges Bank and the southern stock extends from southern Georges Bank to Cape Hatteras. The two stocks intermingle during the summer months on Georges Bank.<sup>1</sup> They are managed by the New England Council under the Small Mesh Multispecies FMP.

Silver hake are piscivorous<sup>2,3,4</sup> and important prey to elasmobranchs and other groundfish.<sup>5</sup> Silver hake reach sexual maturity early around 2-3 years old. Spawning can begin as early as January in the Middle Atlantic Bight, but most spawning activity occurs in shallow waters in spring and summer May-June in the southern stock and July - August in the northern stock.<sup>6</sup> Notable spring and summer spawning areas include coastal Gulf of Maine, southern and southeastern Georges Bank, and southern New England.<sup>1</sup> Females can participate in up to 3 spawning events within one season.<sup>7</sup>

Silver hake migrate into deeper waters during autumn and into shallow waters during spring and summer to spawn, and make diurnal vertical migrations in search of prey.<sup>4,8</sup>

## OBSERVED & PROJECTED SHIFTS

Both silver hake stocks made significant poleward shifts.<sup>9</sup> Northern silver hake significantly expanded the areas they occupy while southern silver hake significantly constricted the areas they occupy and have moved into shallower waters.<sup>9</sup> Earlier spring warming may negatively affect early life stages of silver hake - there was a negative correlation between 1-year lag spring stock biomass of silver hake and spring phenology. Northern silver hake distributions appear slightly more northward in years with extreme rates of early warming.<sup>10</sup> Silver hake shifted out of Narragansett Bay over time as water temperatures increased 1.6°C.<sup>11</sup> Towards the end of the century, silver hake are expected to gain thermal habitat area in the spring but lose suitable habitat area in the fall.<sup>12</sup> When silver hake were assessed for their climate resilience using metrics of sensitivity, directionality, and future habitat availability, they showed relatively neutral confidence in long-term market potential relative to 6 other species.

# SILVER HAKE



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