TAUTOG

Tautoga onitis

Sometimes known as Blackfish, White Chin, Chub, Moll, Will George, Salt-water Chub, Oysterfish, Tautogue noir, and Tog

SUMMARY

Tautog is a slow growing, long-lived fish found from Nova Scotia, Canada to Georgia. It is highly dependent on finding suitable habitat that provides protection from predators and a good food supply. Most Tautog is caught in recreational fisheries, but some are commercially caught by various gears types, including bottom trawls which can cause substantial damage to the sea floor. Abundance of Tautog is low overall, and the U.S. population is considered overfished.

Criterion	**Points**
Life History	0.75
Abundance	1.00
Habitat Quality and Fishing Gear Impacts	1.25
Management	1.75
Bycatch	2.25
Final Score	**1.40**
Color	

Final Score	**Color**
2.40 - 4.00	
1.60 - 2.39	
0.00 - 1.59	

LIFE HISTORY

Core Points (only one selection allowed)

If a value for intrinsic rate of increase ('r') is known, assign the score below based on this value. If no r-value is available, assign the score below for the correct age at 50% maturity for females if specified, or for the correct value of growth rate ('k'). If no estimates of r, age at 50% maturity, or k are available, assign the score below based on maximum age.

1.00 Intrinsic rate of increase <0.05; OR age at 50% maturity >10 years; OR growth rate <0.15; OR maximum age >30 years.

Tautog is a long-lived species of fish, living for 30 years or more (Cooper 1966; Hostetter and Munroe 1993). They reach a maximum weight of 11.3 kg (IGFA 2001) and size of 91 cm (Robins and Ray 1986). Tautog grow slowly, with growth rates ranging from 0.09 to 0.15 (Cooper 1967; Hostetter and Munroe 1993). Growth is slower for female fish (Cooper 1967) and may vary between habitats, estuaries and years (Phelan et al. 2000). Larval Tautog have growth rates of 0.23-0.76 mm per day (Malchoff 1993; Dorf 1994; Gauthier et al. 2008) and young fish grow around 0.51 mm per day during the summer (Sogard et al. 1992; Dorf 1994). Tautog reach sexual maturity around 3 years of age (Chenoweth 1963; Olla and Samet 1977; Hostetter and Munroe 1993). There are regional differences in maturity, with Tautog from Rhode Island becoming sexually mature at smaller sizes (Cooper 1966) compared to Tautog from New York (Briggs 1977) and Chesapeake Bay (Hostetter and Munroe 1993). We have assigned a low score to account for Tautog's long lifespan and slow growth rates.

2.00 Intrinsic rate of increase = 0.05-0.15; OR age at 50% maturity = 5-10 years; OR a growth rate = 0.16–0.30; OR maximum age = 11-30 years.

3.00 Intrinsic rate of increase >0.16; OR age at 50% maturity = 1-5 years; OR growth rate >0.30; OR maximum age <11 years.

Points of Adjustment (multiple selections allowed)

-0.25 Species has special behaviors that make it especially vulnerable to fishing pressure (e.g., spawning aggregations; site fidelity; segregation by sex; migratory bottlenecks; unusual attraction to gear; etc.).

The majority of fishing occurs in the spring and fall when Tautog is grouped in spawning and pre-migratory schools, making them very susceptible to capture (ASMFC 2006). In addition, Tautog have high rates of site fidelity, meaning they tend to move only short distances from their home sites (Abel et al. 2005). Males have home sites around structured areas, where spawning typically takes place, (see more in the "Habitat" section below), which also makes them susceptible to overfishing, because they can be easily targeted and depleted.

-0.25 Species has a strategy for sexual development that makes it especially vulnerable to fishing pressure (e.g., age at 50% maturity >20 years; sequential hermaphrodites; extremely low fecundity).

-0.25 Species has a small or restricted range (e.g., endemism; numerous evolutionarily significant units; restricted to one coastline; e.g., American lobster; striped bass; endemic reef fishes).

Tautog is found from Nova Scotia, Canada to Georgia (Bigelow and Schroeder 1953; Parker 1994). When water temperatures drop below 10 ^{o}C, most adults form schools and migrate offshore to deeper waters (Cooper 1966: Briggs 1977). In the southern area of their range, Tautog can overwinter inshore and remain active year round (Auster 1989; Eklund and Targett 1991; Adams 1993; Hostetter and Munroe 1993). This has been shown through tag-recapture data in the Chesapeake Bay and Virginia waters (Arendt et al. 2001). Based on genetic analysis, there is one population of Tautog that ranges from Rhode Island to Virginia (Orbacz and Gaffney 2000) but more research on their population structure is still needed. Recent tagging studies in RI and MA suggest distinct local sub-populations in that region. We consider Tautog to have a small range and have therefore subtracted points.

-0.25 Species exhibits high natural population variability driven by broad-scale environmental change (e.g. El Nino; decadal oscillations).

+0.25 Species does not have special behaviors that increase ease or population consequences of capture OR has special behaviors that make it less vulnerable to fishing pressure (e.g., species is widely dispersed during spawning).

+0.25 Species has a strategy for sexual development that makes it especially resilient to fishing pressure (e.g., age at 50% maturity <1 year; extremely high fecundity).

Spawning occurs from Nova Scotia to North Carolina from mid-May to mid-August, with peaks occurring in June (Colton et al. 1979). For example, in New Jersey and the Mid Atlantic Bight, spawning occurs from April through September, with peaks occurring in June and July (Sogard et al. 1992). Spawning occurs as most adults migrate inshore to estuaries and other near shore marine waters, from overwintering locations (Chenoweth 1963; Cooper 1966; Stolgitis 1970; Olla et al. 1974; Briggs 1977). In the southern part of the Tautog's range, some adults will remain offshore year round and spawn (Olla and Samet 1977; Eklund and Targett 1990; Sogard et al. 1992; Adams 1993; Hostetter and Munroe 1993). Some research indicates adults return to the same locations, specifically in Rhode Island, to spawn over several years (Cooper 1966; Lynch 1991). The number of eggs produced is related to the size of the female, with larger females producing more eggs (Chenoweth 1963; LaPlante and Schultz 2007). For example, a fish weighing 0.2 kg can produce 5,000 eggs, while a female weighing 5 kg can produce up to 673,500 eggs (Chenoweth 1963). Other studies have estimated that large Tautog can produce 24-86 times as many eggs as small Tautog and that the average female spawns

10 to 16 million eggs in a season (LaPlante and Schultz 2007). We have awarded points because of their potentially high reproductive output.

+0.25 Species is distributed over a very wide range (e.g., throughout an entire hemisphere or ocean basin; e.g., swordfish; tuna; Patagonian toothfish).

+0.25 Species does not exhibit high natural population variability driven by broad-scale environmental change (e.g., El Nino; decadal oscillations).

0.75 Points for Life History

ABUNDANCE

Core Points (only one selection allowed)

Compared to natural or un-fished level, the species population is:

1.00 Low: Abundance or biomass is <75% of BMSY or similar proxy (e.g., spawning potential ratio).

The last population assessment for Tautog was completed in 2005, at which point it was found that Tautog were overfished and that fishing mortality rates were above the target rate for 17 out of 24 years for which data exist (ASMFC 2005). Populations of Tautog in the northern region (Massachusetts, Rhode Island, Connecticut, New York and New Jersey), have historically been overfished but it appears fishing mortality rates have declined since the implementation of management measures (ASMFC 2005). Conversely, in the southern region (Delaware, Maryland, Virginia and North Carolina), historical overfishing has not been detected and fishing mortality rates have not yet meet the overfishing definition, but may soon do so (ASMFC 2005). Specifically, the status of the population in Massachusetts is uncertain but populations of Tautog in Rhode Island appear to be improving (ASMFC 2005). The Long Island Sound (Connecticut) and New York populations appear to be increasing slowly and fishing mortality on Tautog has decreased in New Jersey but there is no strong evidence of population rebuilding (ASMFC 2005). The status of Tautog in Delaware is uncertain, but there is some evidence that management measures are working and the status of the population is not of "imminent concern" (ASMFC 2005). The status of the Maryland and Virginia populations are also uncertain (ASMFC 2005). We have assigned a low score to account for the high fishing mortality rates during most of the years for which data were available.

2.00 Medium: Abundance or biomass is 75-125% of BMSY or similar proxy; OR population is approaching or recovering from an overfished condition; OR adequate information on abundance or biomass is not available.

3.00 High: Abundance or biomass is >125% of BMSY or similar proxy.

Points of Adjustment (multiple selections allowed)

-0.25 The population is declining over a generational time scale (as indicated by biomass estimates or standardized CPUE).

-0.25 **Age, size or sex distribution is skewed relative to the natural condition (e.g., truncated size/age structure or anomalous sex distribution).**

The age composition of Tautog caught in Rhode Island waters appears to have changed over time (ASMFC 2005). For example, no fish older than 23 have been seen during fishing independent sampling after 1991 and by 2002, only a few fish older than 18 have been caught (ASMFC 2005). However, we have not subtracted points because information on this topic is lacking in other areas of their range.

-0.25 Species is listed as "overfished" OR species is listed as "depleted", "endangered", or "threatened" by recognized national or international bodies.

Tautog is currently considered “overfished” based on the 2005 assessment (ASMFC 2005).

-0.25 **Current levels of abundance are likely to jeopardize the availability of food for other species or cause substantial change in the structure of the associated food web.**

Juvenile Tautog feed on small invertebrates including mussels and crabs (Olla et al. 1975) and adults feed mostly on blue mussels and other shellfish and crustaceans (Olla et al. 1974; Arendt et al. 2001). When there are shortages of mussels in an area, Tautog may relocate (Steimle and Shaheen 1999). Striped bass have been observed preying on Tautog (Olla et al. 1974) and smooth dogfish, barn-door skate, red hake, sea raven and goosefish have also been reported as predators (Bigelow and Schroeder 1953). Tautog is considered an important component of reef ecosystems (ASMFC 1996) and healthy Tautog populations maintain the biodiversity and stability of these ecosystems through predation (Steimle and Shaheen 1999). The Atlantic States Marine Fisheries Commission suggested that keeping Tautog populations at sustainable levels will help prevent changes in the structure of reef fish (ASMFC 1996; Steimle and Shaheen 1999). There is no specific information on the effects of Tautog population size on the associated food web, so we have not subtracted any points.

+0.25 The population is increasing over a generational time scale (as indicated by biomass estimates or standardized CPUE).

Overall biomass estimates from fishery independent sampling surveys indicate abundance has been increasing since around 2000 (ASMFC 2006). Specifically, in Massachusetts abundances decreased in the late 1980's through 2004 but in 2005 levels returned to those from 1989 (ASMFC 2005). In Rhode Island, abundance declined from 1994-1998 but rebounded from 1999-2004 (ASMFC 2005). Connecticut estimates of abundance have been variable over time, with declines occurring in the late 1980's, increases in abundance occurring from 2001-2003, and then declining again slightly in 2004 (ASMFC 2005). In New York, abundances of Tautog decreased from 1994-1999, increased substantially from 2001-2003 and declined slightly in 2004 (ASMFC 2005). Abundances in New Jersey began to decline in 1990 and this decline continued through 1997, after which abundances have increased (ASMFC 2005).

+0.25 Age, size or sex distribution is functionally normal.

+0.25 Species is close to virgin biomass.

+0.25 Current levels of abundance provide adequate food for other predators or are not known to affect the structure of the associated food web.

1.00 Points for Abundance

HABITAT QUALITY AND FISHING GEAR IMPACTS

Core Points (only one selection allowed)

Select the option that most accurately describes the effect of the fishing method upon the habitat that it affects

1.00 The fishing method causes great damage to physical and biogenic habitats (e.g., cyanide; blasting; bottom trawling; dredging).

2.00 The fishing method does moderate damage to physical and biogenic habitats (e.g., bottom gillnets; traps and pots; bottom longlines).

Although primarily a recreational target, Tautog is also commercially fished, with the majority of landings occurring between Cape Cod and the Chesapeake Bay during the spring and fall (ASMFC 2010). Specifically in 2008, Massachusetts, Rhode Island, New York and New Jersey reported the most landings, with 43% being caught in

Massachusetts alone (ASMFC 2010). Hand lines (39%), trawls (26%) and pots and traps (26%) currently land most Tautog (http://www.st.nmfs.noaa.gov/st1/). Hand lines cause little damage to bottom habitats, pots and traps cause low to medium amount of damage, while trawls can cause a very high amount of damage to the sea floor (Morgan and Chuenpagdee 2003). We have assigned a middle score to account for the different impacts these gears have on bottom habitat.

3.00 The fishing method does little damage to physical or biogenic habitats (e.g., hand picking; hand raking; hook and line; pelagic long lines; mid-water trawl or gillnet; purse seines).

Points of Adjustment (multiple selections allowed)

-0.25 Habitat for this species is so compromised from non-fishery impacts that the ability of the habitat to support this species is substantially reduced (e.g., dams; pollution; coastal development).

It is likely that the population size of Tautog is highly dependent on the quantity and quality of food and shelter (ASMFC 1996). Tautog is most often found in shallow waters where they can better avoid predation and find food (Dorf and Powell 1997; Arendt 1999). Juveniles reside in habitats that provide protection from predators, such as rocks, and rock outcroppings, reefs, gravel, eelgrass beds and kelp (Olla et al. 1974; 1975; Dew 1976; Dorf and Powell 1997); Tautog appear to have a strong preference for habitat with vegetation (Sogard 1992). Juveniles will overwinter in shelters, such as crevices, along rock walls and under rocks after the water temperature drops to around 5 ºC and remain "debilitated", with little to no feeding occurring, until water temperatures increase in the spring (Olla et al. 1974;1975;1979). Adults reside in areas with more complex structures that also provide them with shelter and food sources (ASMFC 1996). In the waters north of Cape Cod, Tautog is typically found within 4 miles of shore and in waters less than 60 ft. deep around rocks and boulders, while south of Cape Cod they are found as far as 40 miles offshore and in waters up to 120 ft deep around shellfish beds, coastal jetties, pilings, shipwrecks and artificial reefs (ASMFC 1996). Adults tend to stay near their "home sites" but do move away to feed during the day, then returning at night and becoming dormant (Olla et al. 1974).

Dredging, shipwreck salvage, use of roller trawling gear over wrecks, low profile reefs and mussel beds have been identified as possible threats to Tautog habitat (ASMFC 1996). In addition, power plants, sewage discharge and other contaminants could negatively affect several life stages of Tautog (ASMFC 1996).

-0.25 Critical habitat areas (e.g., spawning areas) for this species are not protected by management using time/area closures, marine reserves, etc.

Critical habitat areas are not specifically protected by management measures.

-0.25 No efforts are being made to minimize damage from existing gear types OR new or modified gear is increasing habitat damage (e.g., fitting trawls with roller rigs or rockhopping gear; more robust gear for deep-sea fisheries).

There are no efforts being made to reduce the impact of otter trawls on bottom habitat in this fishery.

-0.25 If gear impacts are substantial, resilience of affected habitats is very slow (e.g., deep water corals; rocky bottoms).

+0.25 Habitat for this species remains robust and viable and is capable of supporting this species.

+0.25 Critical habitat areas (e.g., spawning areas) for this species are protected by management using time/area closures, marine reserves, etc.

+0.25 Gear innovations are being implemented over a majority of the fishing area to minimize damage from gear types OR no innovations necessary because gear effects are minimal.

+0.25 If gear impacts are substantial, resilience of affected habitats is fast (e.g., mud or sandy bottoms) OR gear effects are minimal.

1.25 Points for Habitat Quality and Fishing Gear Impacts

MANAGEMENT

Core Points (only one selection allowed)

Select the option that most accurately describes the current management of the fisheries of this species.

1.00 Regulations are ineffective (e.g., illegal fishing or overfishing is occurring) OR the fishery is unregulated (i.e., no control rules are in effect).

2.00 Management measures are in place over a major portion over the species' range but implementation has not met conservation goals OR management measures are in place but have not been in place long enough to determine if they are likely to achieve conservation and sustainability goals.

Tautog is managed by the Atlantic States Marine Fisheries Commission under the Fishery Management Plan (FMP) for Tautog (ASMFC 1996). The specific goals of this FMP

include: to keep and enhance populations through interstate management, to allow populations to be self-sustaining, maintain recent utilization patterns, protect critical habitat for all life stages, maintain healthy age structure and to conserve Tautog along the Atlantic coast while maintaining economic benefits to fishermen (ASMFC 1996). Management measures included in this plan are minimum size limits, fishing mortality limits (ASMFC 1996), requiring states to implement management measures allowing them to reach fishing mortality targets (ASMFC 1997), monitoring and data requirements (ASMFC 1999; 2002), and target and threshold reference points (ASMFC 2007). The Tautog Management Board is responsible for carrying out this plan and establishes and oversees the Plan Review Team, Technical Committee, and Stock Assessment Subcommittee, makes changes to the management program, approves state programs, and reviews state's compliance with the FMP (ASMFC 1996).

Massachusetts uses a size limit, possession limit, seasons, quota and gear restrictions as management tools, while Rhode Island and New Jersey have size limits, quotas and gear restrictions, Connecticut, New York, Delaware and Maryland have size limits, seasons and gear restrictions and Virginia only has a size limit (ASMFC 2010).

We have assigned a middle score because despite management measures, Tautog is considered overfished (ASMFC 2005).

3.00 Substantial management measures are in place over a large portion of the species range and have demonstrated success in achieving conservation and sustainability goals.

Points of Adjustment (multiple selections allowed)

-0.25 There is inadequate scientific monitoring of stock status, catch or fishing effort.

Management requires states to collect data for use in population assessments including commercial catch estimates, fishery independent estimates of abundance and 200 age and length samples per year (ASMFC 2010). The following have been identified by the Atlantic States Marine Fisheries Commission as research priorities: increased catch and discard length sampling, standardize state's long-term fishery independent monitoring, expand biological sampling, collect effort data, gear modifications for pots and traps, identification of regional and local genetic differences, define pre/spawning aggregation sites and wintering areas, define movement patterns, studies on preys dependence on Tautog abundance levels, define juveniles susceptibility to anthropogenic contamination, and define larval diets (ASMFC 2010).

Massachusetts provides annual fishery independent trawl surveys that are made south of Cape Cod during the spring (ASMFC 2006). Rhode Island conducts seasonal and monthly fishery independent trawling surveys in state waters (ASMFC 2006). In Connecticut, monthly trawl surveys are conducted in Long Island Sound and New York conducts seasonal trawl surveys in Peconic Bay (ASMFC 2006). New Jersey conducts

otter trawl surveys in January/February, April, June, August and October in coastal waters (ASMFC 2006).

Commercial data is available through the National Marine Fisheries Service dealer canvass system (ASMFC 2006). However, total Tautog landings are likely under reported because there are no federal requirements to do so (ASMFC 2006), so points were subtracted.

-0.25 Management does not explicitly address fishery effects on habitat, food webs, and ecosystems.

Management does not explicitly address fishery effects on habitat and food webs.

-0.25 This species is overfished and no recovery plan or an ineffective recovery plan is in place.

-0.25 Management has failed to reduce excess capacity in this fishery or implements subsidies that result in excess capacity in this fishery.

+0.25 There is adequate scientific monitoring, analysis and interpretation of stock status, catch and fishing effort.

+0.25 Management explicitly and effectively addresses fishery effects on habitat, food webs, and ecosystems.

+0.25 This species is overfished and there is a recovery plan (including benchmarks, timetables and methods to evaluate success) in place that is showing signs of success OR recovery plan is not needed.

Tautog is currently considered overfished (ASMFC 2005) but management has addressed this through addendum V to the fishery management plan (ASMFC 2007).

+0.25 Management has taken action to control excess capacity or reduce subsidies that result in excess capacity OR no measures are necessary because fishery is not overcapitalized.

1.75 Points for Management

BYCATCH

Core Points (only one selection allowed)

Select the option that most accurately describes the current level of bycatch and the consequences that result from fishing this species. The term, "bycatch" used in this document excludes incidental catch of a species for which an adequate management framework exists. The terms, "endangered, threatened, or protected," used in this document refer to species status that is determined by national legislation such as the U.S. Endangered Species Act, the U.S. Marine Mammal Protection Act (or another nation's equivalent), the IUCN Red List, or a credible scientific body such as the American Fisheries Society.

1.00 Bycatch in this fishery is high (>100% of targeted landings), OR regularly includes a "threatened, endangered or protected species."

2.00 Bycatch in this fishery is moderate (10-99% of targeted landings) AND does not regularly include "threatened, endangered or protected species" OR level of bycatch is unknown.

The mid-Atlantic and northeast bottom trawl fisheries and Atlantic mixed species trap/pot fishery are considered Category II fisheries under the Marine Mammal Act because they have been known to incidentally kill or injure bottlenose, common and white-sided dolphins, long and short-finned pilot whales, harbor porpoises and harp seals (FR 75 2010). A Category II fishery means there is occasional incidental mortality or serious injury of marine mammals. Bottom trawls typically have a low amount of fish and invertebrate bycatch associated with them (Morgan and Chuenpagdee 2003) but since the level of bycatch in the Tautog fishery is unknown, we have assigned a middle score.

3.00 Bycatch in this fishery is low (<10% of targeted landings) and does not regularly include "threatened, endangered or protected species."

Points of Adjustment (multiple selections allowed)

-0.25 Bycatch in this fishery is a contributing factor to the decline of "threatened, endangered, or protected species" and no effective measures are being taken to reduce it.

-0.25 Bycatch of targeted or non-targeted species (e.g., undersize individuals) in this fishery is high and no measures are being taken to reduce it.

-0.25 Bycatch of this species (e.g., undersize individuals) in other fisheries is high OR bycatch of this species in other fisheries inhibits its recovery, and no measures are being taken to reduce it.

-0.25 The continued removal of the bycatch species contributes to its decline.

+0.25 Measures taken over a major portion of the species range have been shown to reduce bycatch of "threatened, endangered, or protected species" or bycatch rates are no longer deemed to affect the abundance of the "protected" bycatch species OR no measures needed because fishery is highly selective (e.g., harpoon; spear).

+0.25 There is bycatch of targeted (e.g., undersize individuals) or non-targeted species in this fishery and measures (e.g., gear modifications) have been implemented that have been shown to reduce bycatch over a large portion of the species range OR no measures are needed because fishery is highly selective (e.g., harpoon; spear).

+0.25 Bycatch of this species in other fisheries is low OR bycatch of this species in other fisheries inhibits its recovery, but effective measures are being taken to reduce it over a large portion of the range.

Estimates of Tautog bycatch in the Mid-Atlantic Bight black sea bass trap fishery are very low (0.4% of catch) (Eklund and Targett 1990; 1991). Tautog have been reported as more commonly caught (23% of catch) in New York's lobster pot trap fishery (Graulich 1995) but made up only 1% of total lobster pot catch in all lobster fisheries combined (ASMFC 1996). Information on the amount of Tautog discarded in the commercial fishery is not available (ASMFC 2006).

+0.25 The continued removal of the bycatch species in the targeted fishery has had or will likely have little or no impact on populations of the bycatch species OR there are no significant bycatch concerns because the fishery is highly selective (e.g., harpoon; spear).

2.25 Points for Bycatch

REFERENCES

Able, K.W., Hales, L.S and Hagan, S.M. 2005. Movement and growth of juvenile (age 0 and 1+) tautog (*Tautoga onitis* [L]) and cunner (*Tautogolabrus adspersus* [Walbaum]) in a southern New Jersey estuary. Journal of Experimental Biology and Ecology 327:22-35.

Adams, A.J. 1993. Dynamics of fish assemblages associated with an offshore artificial reef in the southern Mid-Atlantic Bight. MS Thesis, College of William and Mary, Virginia.

Arendt, M.D. 1999. Seasonal residence, movement and activity of adult tautog (*Tautoga onitis*) in lower Chesapeake Bay. MS Thesis, College of William and Mary. 104 p.

Arendt, M.D., Lucy, J.A. and Munroe, T.A. 2001. Seasonal occurrence and site-utilization of adult tautog, *Tautoga onitis* (Labridae) at manmade and natural structures in lower Chesapeake Bay. Fisheries Bulletin 99:519-527.

Atlantic States Marine Fisheries Commission (ASMFC). 1996. Fishery Management Plan for Tautog. Atlantic States Marine Fisheries Commission, Washington, D.C. 69 p.

Atlantic States Marine Fisheries Commission (ASMFC). 1997. Fishery Management Plan for tautog, Addendum 1. Atlantic States Marine Fisheries Commission, Washington, D.C. 11 p.

Atlantic States Marine Fisheries Commission (ASMFC). 1999. Fishery Management Plan for tautog, Addendum 11. Atlantic States Marine Fisheries Commission, Washington, D.C. 7 p.

Atlantic States Marine Fisheries Commission (ASMFC). 2002. Fishery Management Plan for tautog, Addendum 111. Atlantic States Marine Fisheries Commission, Washington, D.C. 17 p.

Atlantic States Marine Fisheries Commission (ASMFC). 2005. Tautog stock assessment report for peer review. Stock assessment report No. 06-02 (supplement) of the Atlantic States Marine Fisheries Commission. Washington, D.C. 184 p.

Atlantic States Marine Fisheries Commission (ASMFC). 2006. Terms of reference & advisory report to the tautog stock assessment peer review. Stock Assessment Report No. 06-02 of the Atlantic States Marine Fisheries Commission. Washington, D.D. 23 p.

Atlantic States Marine Fisheries Commission (ASMFC). 2007. Fishery Management Plan for tautog, Addendum IV. Atlantic States Marine Fisheries Commission, Washington, D.C. 16 p.

Atlantic States Marine Fisheries Commission (ASMFC). 2007. Fishery Management Plan for tautog, Addendum V. Atlantic States Marine Fisheries Commission, Washington, D.C. 5 p.

Atlantic States Marine Fisheries Commission (ASMFC). 2010. 2008 review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for tautog (*Tautoga onitis*). Atlantic States Marine Fisheries Commission, Washington, DC. 20 p.

Auster, P.J. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North and Mid-Atlantic)-tautog and cunner. US Fish and Wildlife Service Biological Report 82 (11.105).

Bigelow, H.B. and Schroeder, W.C. 1953. Fishes of the Gulf of Maine. US Fish and Wildlife Service Fishery Bulletin 53:1-577.

Briggs, P.T. 1977. Status of tautog populations at artificial reefs in New York waters and effect of fishing. New York Fish and Game Journal 24:154-167.

Chenoweth, S. 1963. Spawning and fecundity of the tautog, *Tautoga onitis*. MS Thesis. University of Rhode Island, Kingston. 60 pp.

Colton, J.B., Smith, W.G., Kendall, A.W., Berrien, P.L. and Fahay, M.P. 1979. Principal spawning areas and times of marine fishes, Cape Sable to Cape Hatteras. US National Marine Fisheries Service Fishery Bulletin 76:911-915.

Cooper, R.A. 1966. Migration and population estimation of the tautog, Tautoga onitis (Linnaeus), from Rhode Island. Transactions of the American Fisheries Society 95:239-247.

Cooper, R.A. 1967. Age and growth of the tautog, Tautoga onitis (Linnaeus), from Rhode Island. Transactions of the American Fisheries Society 96:134-142.

Dorf, B.A. 1994. Habitat selection in juvenile tautog, *Tautoga onitis*, and juvenile cunner, *Tautogolabrus adspersus*. MS Thesis. The University of Rhode Island, Kingston.

Dorf, B.A. and Powell, J.C. 1997. Distribution, abundance and habitat characteristics of juvenile tautog (*Tautoga onitis*, Family Labridae) in Narragansett Bay, Rhode Island, 1988-1992. Estuaries 20:589-600.

Eklund, A.M. and Targett, T.E. 1990. Reproductive seasonality of fishes inhabiting hard bottom areas in the Middle Atlantic Bight. Copeia 1990:1180-1184.

Eklund, A.M. and Targett, T.E. 1991. Seasonality of fish catch rates and species composition from the hard bottom trap fishery in the Middle Atlantic Bight (US east coast). Fisheries Research 12:1-22.

Federal Register (FR). 2010. List of Fisheries for 2011. 50 CFR Part 229. 37 p.

Gauthier, D.A., Lincoln, J.A. and Turner, J.T. 2008. Distribution, abundance and growth of larval tautog, Tautoga onitis, in Buzzards Bay, Massachusetts, USA. Marine Ecology 29:76-88.

Graulich, K. 1995. American lobster (*Homarus americanus*) monitoring in New York waters, with emphasis on Long Island Sound, summary of 1994 sampling data. Annual report, Interjurisdictional Fisheries Act. Project #3-IJ-87. New York State Department of Environmental Conservation, East Setauket.

Hostetter, E.B. and Munroe, T.A. 1993. The importance of habitat to the early life history of estuarine dependent fishes. American Fisheries Society Symposium 14:147-158.

International Game Fish Association (IGFA). 2001. Database of IGFA angling records until 2001. IGFA, Fort Lauderdale, Fl.

LaPlante, L.H. and Schultz, E.T. 2007. Annual fecundity of tautog in Long Island Sound: size effects and long-term changes in a harvested population. Transactions of the American Fisheries Society 136:1520-1533.

Lynch, T.R. 1991. Marine finfish investigation, sport fish population survey in Rhode Island marine waters- tautog studies, January 1, 1990-December 31, 1990. Rhode Island Division of Fish and Wildlife Performance Report Project: F-54-R-1.

Malchoff, M.H. 1993. Age, growth and distribution of cunner (*Tautogolabrus adspersus*) and tautog (*Tautoga onitis*) larvae in the New York Bight: a single season analysis. MS Thesis. Bard College.

Morgan, L.E. and Chuenpagdee, R. 2003. Shifting gears: addressing the collateral impacts of fishing methods in US waters. Pew Science Series. Washington, D.C. Island Press.

Orbacz, E.A. and Gaffney, P.M. 2000. Genetic structure of tautog (*Tautoga onitis*) populations assayed by RFLP and DGGE analysis of mitochondrial and nuclear genes. Fishery Bulletin 98:336-344.

Olla, B.L., Beja, A.J. and Martin, A.D. 1974. Daily activity, movements, feeding and seasonal occurrences in the tautog, *Tautoga onitis*. US National Marine Fisheries Service Fishery Bulletin 72:27-35.

Olla, B.L., Beja, A.J. and Martin, A.D. 1975. Activity, movements and feeding behavior of the cunner, Tautogolabrus adspersus, and comparison of food habits with young tautog, *Tautoga onitis*, off Long Island, New York. US National Marine Fisheries Service Fishery Bulletin 73:895-900.

Olla, B.L. and Samet, C. 1977. Courtship and spawning behavior of the tautog, *Tautog onitis* (Pisces: Labridae), under laboratory conditions. Fishery Bulletin 75:585-599.

Olla, B.L., Beja, A.J. and Martin, A.D. 1979. Seasonal dispersal and habitat selection of cunner, Tautogolabrus adspersus, and young tautog, *Tautog onitis*, in Fire Island, Long Island, New York. US National Marine Fisheries Service Fisheries Bulletin 77:255-261.

Parker, R.O., Chester, A.J. and Nelson, R.S. 1994. A video transect method for estimating reef fish abundance, composition, and habitat utilization at Gray's Reef National Marine Sanctuary, Georgia. Fishery Bulletin 92:787-799.

Phelan, B.A., Goldbeg, R., Bejda, A.J., Pereira, J., Hagan, S., Clark, S., Studholme, A.L., Calabrese, A. and Able, K.W. 2000. Estuarine and habitat related differences in growth rates of young-of-the-year winter flounder (*Pseudopleuronectes americanus*) and tautog (*Tautoga onitis*) in three northeastern US estuaries. Journal of Experimental Marine Biology and Ecology 247:1-28.

Robins, C.R. and Ray, G.C. 1986. A field guide to Atlantic coast fishes of North America. Houghton Mifflin Company, Boston, USA.

Sogard, S.M. 1992. Variability in growth rates of juvenile fishes in different estuarine habitats. Marine Ecology Progress Series 85:35-53.

Sogard, S.M., Able, K.W. and Fahay, M.P. 1992. Early life history of the tautog *Tautoga onitis* in the Mid-Atlantic Bight. Fishery Bulletin 90:529-539.

Steimle, F.W. and Shaheen, P.A. 1999. Tautog, *Tautoga onitis*: life history and habitat requirements. Northeast Fisheries Science Center NOAA Technical Report NMFS-F/NEC.

Stolgitis, J.A. 1970. Some aspects of the biology of tautog, *Tautoga onitis* (Linnaeus), from the Weweantic River Estuary, Massachusetts, 1966. MS Thesis. University of Massachusetts, Amherst.