Species Status Assessment

Class: Osteichthyes
Family: Anguillidae
Scientific Name: *Anguilla rostrata*
Common Name: American eel

Species synopsis:

The American eel, *Anguilla rostrata* lives in nearshore areas of lakes and streams with various bottom types, including rocks. The American eel has a very large range in the Atlantic Ocean and estuaries and rivers of the Atlantic and Gulf coasts of the United States and southeastern Canada, as well as much of the Mississippi River basin and the West Indies and Caribbean regions. Individuals travel to ocean spawning areas near the end of its life. The American eel is considered a single stock since all mature eels from the entire range migrate the Sargasso Sea to spawn. They only spawn once during their lifetime, making it especially difficult to protect this species.

The American eel is native to 17 of 18 watersheds in New York and is still found in 15. Its New York range has been extended into the Erie and upper Genesee watersheds, while the Erie is the only one where it is entirely non-native. It continues to be found in many of the areas previously known in the Long Island, Delaware, and Lower Hudson watersheds but has declined to near absence in all the others. Extensive information on New York's inland population is reported by Dittman et al. (2010a).

A 2010 petition seeking protection of the American eel under the Endangered Species Act resulted in a 90-day finding in 2011, and an extensive status review is now being conducted to determine whether federal protection is warranted (USFWS 2011).

I. Status

a. Current and Legal Protected Status

i. Federal _____Not Listed_____ **Candidate:** __Yes__

ii. New York _____SGCN_____

b. Natural Heritage Program Rank

i. Global ____G4_____

ii. New York ____S3_____ **Tracked by NYNHP?** __No__

Other Rank:

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Threatened (2012)

Status Discussion:
The 2012 Atlantic States Marine Fisheries Commission assessment found American eel to be depleted in U.S. waters. The stock is considered to be at or near historically low levels (USFWS 2007, ASMFC 2012). Endangered species listing was not found to be warranted in 2007, but American eel is now listed as a candidate after a 2010 petition to the U.S. Fish and Wildlife Service.

II. Abundance and Distribution Trends

a. North America

i. Abundance

__X__ declining ____increasing ____stable _____ unknown

ii. Distribution:

____ declining ____increasing __X__stable _____ unknown

Time frame considered: _Severe abundance decline in the past ten years (NatureServe 2012)

b. Regional

i. Abundance

__X__ declining ____increasing ____stable ____unknown

ii. Distribution:

____ declining ____increasing __X__stable ____unknown

Regional Unit Considered: __Severe abundance decline in region 5 - Northeast__
Time Frame Considered: _____

c. Adjacent States and Provinces

CONNECTICUT Not Present _____ No data _____

i. Abundance

__X__ declining ____increasing ____stable ____unknown

ii. Distribution:

____ declining ____increasing __X__stable ____unknown

Time frame considered: _____
Listing Status: _____Not Listed_____ SGCN? __Yes__

MASSACHUSETTS Not Present _____ No data _____

i. Abundance

__X__ declining ____increasing ____ stable ____unknown

ii. Distribution:

____ declining ____increasing __X__ stable ____unknown

Time frame considered: __Moderate abundance decline since the 1980s____
Listing Status: _____Not Listed_____ SGCN? ___Yes___

NEW JERSEY **Not Present _____** **No data _____**

i. **Abundance**

__X__ declining ____increasing __X?__ stable ____unknown

ii. **Distribution:**

____ declining ____increasing __X__ stable ____unknown

Time frame considered: _____
Listing Status: ____Not Listed____ SGCN? __No____

ONTARIO **Not Present _____** **No data _____**

i. **Abundance**

__X__ declining ____increasing ____stable ____unknown

ii. **Distribution:**

____ declining ____increasing __X__stable ____unknown

Time frame considered: ___Early 1990s - present_____
Listing Status: _____Endangered_____

PENNSYLVANIA **Not Present _____** **No data _____**

i. **Abundance**

__X__ declining ____increasing __X?__ stable ____ unknown

ii. **Distribution:**

____ declining ____increasing __X__ stable ____ unknown

Time frame considered: _____
Listing Status: ____Not Listed____ SGCN? __Yes__

QUEBEC **Not Present _____** **No data _____**

i. **Abundance**

__X__ declining ____increasing ____stable ____unknown

ii. **Distribution:**

____ declining ____increasing __X__stable ____unknown

Time frame considered: _Moderate abundance decline since 1980s_____
Listing Status: _____Vulnerable_____

VERMONT **Not Present _____** **No data _____**

i. **Abundance**

__X__ declining ____increasing ____stable ____unknown

ii. **Distribution:**

____ declining ____increasing __X__stable ____unknown

Time frame considered: __Moderate abundance decline since 1980s _____
Listing Status: _____Special Concern_____ SGCN? _Yes__

d. NEW YORK **No data _____**

i. **Abundance**

__X__ declining ____increasing ____stable ____unknown

ii. **Distribution:**

__X__ declining ____increasing ____stable ____unknown

*Severe decline in abundance

Monitoring in New York.

There have been monitoring programs carried out by the NYSDEC Rare Fish Unit from 1998 through 2012. The NYSDEC, Bureau of Marine Resources carries out an annual young-of-the-year survey on Long Island which is used in ASMFC stock assessments. Citizen scientists also conduct a similar survey on the Hudson River. Additionally, some of the other surveys conducted by the NYSDEC have reported occurrences of American eels. Monitoring by USGS in the St. Lawrence drainage was reported by Dittman *et al.* (2010b).

Trends Discussion:

Rangewide, the short term trend for this species is unknown and the long-term trend is thought to have shown up to 50% a decline (NatureServe 2012). According to the 2012 ASMFC benchmark stock assessment, the population of American eels is depleted and is at or near historic low levels (ASMFC 2012).

Once highly abundant in Great Lakes and Atlantic watersheds, eel numbers have declined drastically (ASMFC 2000, Haro et al. 2000). Historically, they contributed up to 25 to 50% of the fish biomass in stream and lake habitats. They are still found in 15 of the 18 watersheds (all but Allegheny, Erie and the Genesee above Rochester), as well as the marine district of New York, but their range has dramatically declined in all of these watersheds in the last 25 years. There were significant populations in the Susquehanna, Chemung and Newark Bay areas, and they have declined to the point that there are none or almost no recent reports.

Comparison catches from three periods (1930s, 1970s, and 2000s) with comprehensive surveys are not good indicators of decline because much of the reduction occurred earlier. The highest frequency occurrences for all three periods (1930s, 1970s and 2000s) were from Long Island, lower Hudson and Delaware watersheds, averaging 10-55% for the three periods combined. Watersheds where there are only remnants of earlier numbers include the Susquehanna, Raquette, Oswego, Black, Champlain, upper Hudson, Mohawk, St. Lawrence (including tributaries to the east), and Ontario. Statewide, the number of records for this species has been declining for decades, but there were over 2,800 reports prior to 1986. The number of records in the watersheds within the native range of the St. Lawrence drainage, Mohawk, Upper Hudson, Susquehanna and Chemung were 532 before 1977 and 234 after 1977.

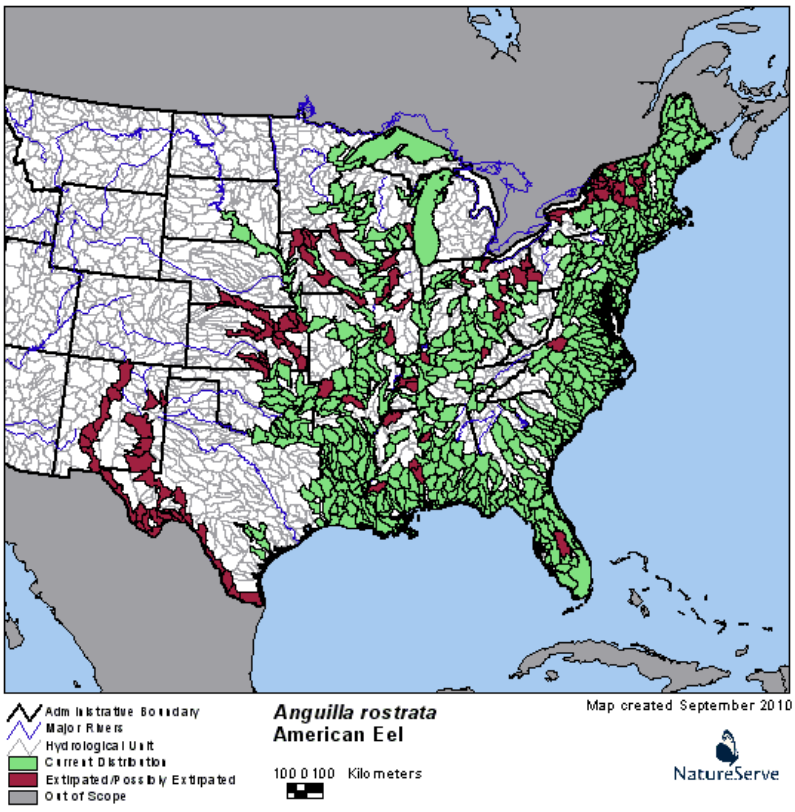

Figure 1. U.S. distribution of American eel by watershed (NatureServe 2012).

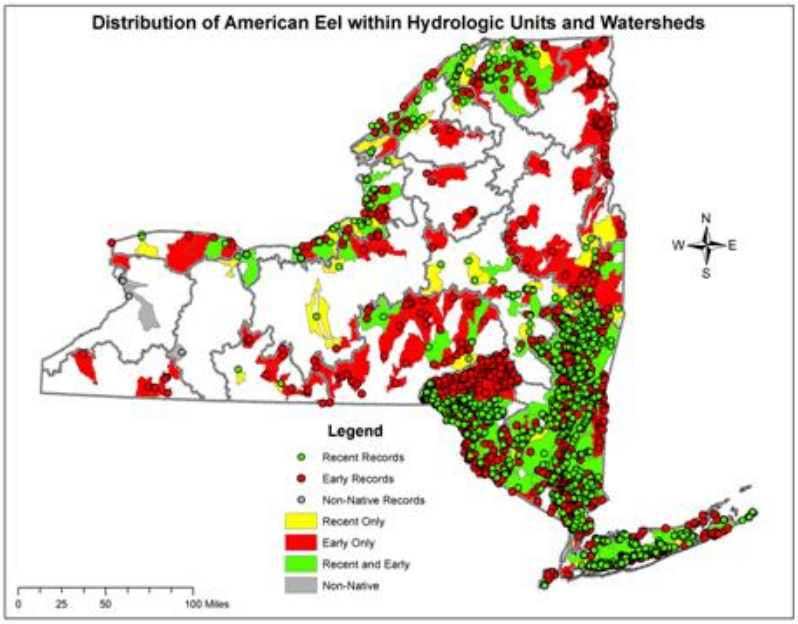

Figure 2. American eel distribution in New York, depicting fish sampled from before and after 1977, as shown with corresponding HUC units (after 1977) where they were found.

Watershed name	Total # HUC10	Early only	Recent only	both	Watershed status
Allegheny	4	4	0		Loss
Black	5	3	1	1	
Chemung	11	7	2	2	Loss
Delaware	28	8	1	19	
Genesee (mouth)	1			1	
L Champlain	17	15	1	1	
Long Island	22	3	2	17	
Lower Hudson	54	7	2	45	
Mohawk	26	4	8	14	
Newark Bay	3	2	0	1	
Ontario	26	6	6	14	
Oswegatchie	7	2	1	4	
Oswego	8	3	2	3	
Raquette	3	1	1	1	
St. Law&SLC	20	4	3	6	
Susquehanna	18	13	1	18	Loss
Upper Hudson	17	10	2	5	
sum					
Erie	1	1	0		
Genesee (abv Roch.)	1	1			

Table 1. Records of rare fish species in hydrological units (HUC-10) are shown according to their watersheds in early and recent time periods (before and after 1977) to consider loss and gains. Further explanations of details are found in Carlson (2012). Watersheds where they are non-native are marked in grey.

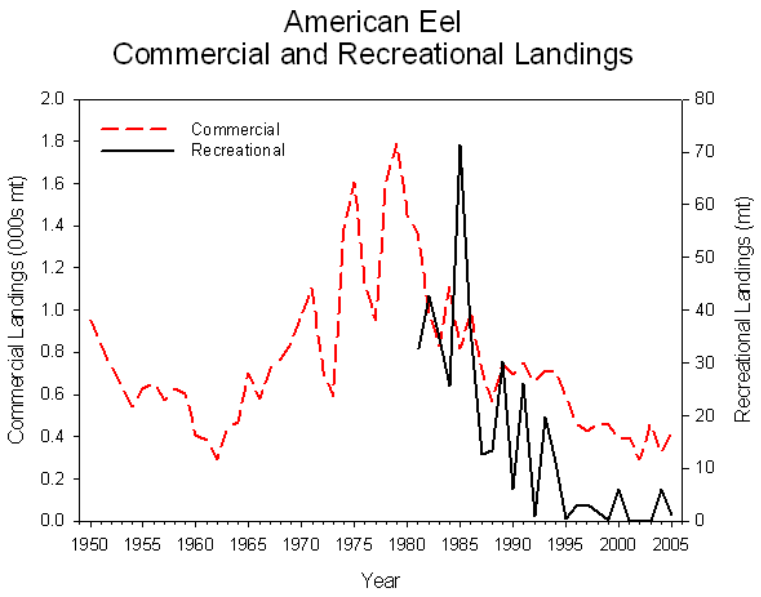

Figure 3. Commercial and recreational American eel landings in U. S. Atlantic waters (Shepherd 2006).

III. New York Rarity, if known:

Historic	# of Animals	# of Locations	% of State
prior to 1977	_____	**523***	**17/18 watersheds**
prior to 1980	_____	_____	_____
prior to 1990	_____	_____	_____

*Within the native range of the St. Lawrence drainage, Mohawk, Upper Hudson, Susquehanna and Chemung.

Details of historic occurrence:

Historically, American eel has been found in the marine district and all inland watersheds of New York State with the exception of the Genesee watershed above Rochester and the Erie watershed. In the Erie, its passage above Niagara Falls is by canal (Scott and Crossman 1998).

Current	# of Animals	# of Locations	% of State
	_____	**234***	**15/18 watersheds**

*Within the native range of the St. Lawrence drainage, Mohawk, Upper Hudson, Susquehanna and Chemung.

Details of current occurrence:

The highest frequencies of occurrence for American eel are in the Long Island, lower Hudson and Delaware watersheds. Watersheds where there are only remnants of earlier numbers include Susquehanna, Raquette, Chemung, Newark Bay, Oswego, Black, Champlain, upper Hudson, Mohawk, St. Lawrence (including tributaries to the east) and Ontario.

New York's Contribution to Species North American Range:

% of NA Range in New York	**Classification of New York Range**
____ 100 (endemic)	**__X__ Core**
____ 76-99	**____ Peripheral**
____ 51-75	**____ Disjunct**
____ 26-50	**Distance to core population:**
__X__ 1-25	**_____**

IV. Primary Habitat or Community Type:

1. Large/Great River, Low-Moderate Gradient, Assume Moderately Buffered, Warm

2. Medium River, Low-Moderate Gradient, Assume Moderately Buffered, Warm

3. Small River, Low-Moderate Gradient, Assume Moderately Buffered, Neutral, Warm

4. Marine, Deep Subtidal

5. Canal

6. Estuarine, Brackish Shallow Subtidal

Habitat or Community Type Trend in New York:

____ Declining____Stable ____ Increasing __X__ Unknown

Time frame of decline/increase: _____

Habitat Specialist? _____ Yes __X___ No

Indicator Species? __X__ Yes _____ No

Habitat Discussion:

American eels occupy the broadest diversity of habitats of any fish species (Helfman et al. 1987), using fresh water, marine and brackish habitats. All freshwater systems are used including large rivers and their small tributaries as well as reservoirs, canals, farm ponds and subterranean springs (USFWS 2011).

Spawning occurs in the Sargasso Sea, in the western Atlantic Ocean east of the Bahamas and south of Bermuda. Spawning has never been directly observed, and suitable conditions for it remain speculative. Larvae drift and swim in prevailing currents (Antilles Current, Florida Current, and Gulf Stream) that take them to areas near continental coasts or continental slope waters.

Some elvers travel upstream to spend the majority of their life growing as yellow eels in rivers, streams, ponds, and the shallow, more productive areas of lakes; other eels remain in estuaries for their entire development prior to migration to the ocean. Based on otolith microchemistry, Secor et al. (2002) found three modes of habitat use by yellow-phase eels in the Hudson River: freshwater (only freshwater use since elver stage), brackish water (no evidence of freshwater use), and "mixed" modes (use of freshwater for 2-19 years, followed by migration to environments with brackish salinities.

Soft, undisturbed bottom sediments may be important to migrating elvers for shelter. Postlarval eels tend to be bottom dwellers and hide in burrows, tubes, snags, plant masses, other types of shelter, or in the substrate. They are inactive in bottom mud during winter in the north. Mature adults migrate back downstream to return to the Sargasso Sea, and die after spawning. In the ocean, American eels have been taken at depths greater than 6,000 meters (NatureServe 2012).

V. New York Species Demographics and Life History

_____ Breeder in New York

_____ Summer Resident

_____ Winter Resident

_____ Anadromous

__X__ Non-breeder in New York

__X__ Summer Resident

__X__ Winter Resident

__X__ Catadromous

_____ Migratory only

_____Unknown

Species Demographics and Life History Discussion:

The American eel is a catadromous species, which spends the majority of a 20 to 30 year life span in freshwater habitats. As adults, they migrate to the Sargasso Sea to spawn before dying. The larvae migrate back into freshwater systems, completing the cycle (Tesch 1977, EPRI 1999).

Spawning occurs in winter and early spring (McCleave et al. 1987). Larvae are transported by currents to areas near the continental margin of North America and then metamorphose into unpigmented "glass eels" during the pelagic stage (8-12 months after hatching), and actively move toward land. Glass eels develop external pigmentation as they enter coastal areas and are then referred to "elvers." Young eels begin moving upstream in river systems before pigmentation is complete, generally in spring in the northeastern United States. Some yellow eels move far into stream headwaters whereas others remain in estuaries. In general, eels in fresh water are all or almost all females. Eels develop into the "yellow eel" stage, which resemble the adult stage, usually by age 2. Body size and age of maturity are greater in the north than in the south, and yellow eels in freshwater of the Hudson River have been found up to 25 years old (Helfman et al. 1987, Secor et al. 2002). After the lengthy "yellow eel" stage, eels may undergo a physical and physiological transformation into a distinct, sexually mature "silver eel" stage, and move downstream into the ocean to spawn; adults presumably die after spawning (NatureServe 2012).

Threats:

American eels require unimpeded access from rivers, lakes and estuaries to the ocean to complete its catadromous life cycle; interference with migration caused by dams is a well-documented threat.

Eels have been virtually eliminated from the Susquehanna and Chemung drainages by dam blockage for several decades. Dams serve as barriers to migration and are a major threat to juvenile eels during upstream migration and to adults during downstream migration. Hydroturbines associated with dams cause mortality to out-migrating adults.

Overfishing has been identified as a possible threat to eels. Areas of New York that allow commercial harvest of eels include the Delaware and Long Island watersheds. All life stages are harvested commercially in New York's Marine District. Commercial bait harvest, as well as recreational harvest occurs in the Hudson River.

Additional factors possibly contributing to the decline along the Atlantic Coast of Canada and the United States include habitat loss and alteration, oceanic conditions, parasitism, predation, and pollution (NatureServe 2012). An exotic nematode parasite, *Anguillicola crassus*, has been found in the Hudson River estuary (Barse and Secor 1999) where it has been detected at a 60% prevalence rate (Morrison and Secor 2003).

There are no data to suggest unusual sensitivity by American eel to agricultural contaminants such as pesticides and herbicides (ASMFC 2000) but high levels of contaminants have been reported (Hodson et al. 1994).

Are there regulatory mechanisms that protect the species or its habitat in New York?

_____ No ____ Unknown

__X__ Yes

New York has several regulations in place for the harvest of American eels. In all waters except the Hudson River the recreational size limit is six inches, with a daily limit of 50 eels allowed. From the Hudson River from Battery to Troy and all tributaries upstream to the first barrier, American eels that are greater than 14 inches may not be possessed. Additionally, eels that are six to 14 inches may be possessed in any number for use as bait. No eels may be possessed for use as food. For all waters, American eels may be harvested all year (NYSDEC 2013).

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Improve knowledge of eel utilization through better reporting of harvest, increasing knowledge of eel population dynamics and life history (ASMFC 2000).

Identify, categorize, and prioritize important and historic American eel habitat (ASMFC 2000).

Establish and maintain stream buffers to promote improved water quality (ASMFC 2000).

Mitigate to the extent possible the effects of various hazards to the upstream and downstream migration of American eel. Such mitigation should include, but not be limited to support of fish passage research, requirements for the construction of fish (eel) passage facilities upon construction of dams, power generating facilities and relicensing of same, and outright removal of identified hazards to eel passage to provide migratory passage and access to historic eel freshwater habitat (ASMFC 2000).

Investigate changes in turbine design to improve downstream fish passage and continue efforts to direct eel away from turbine passage to other higher survival passage opportunities through the use of devices that effectively deflect American eels from water intakes at hydroelectric dams. Investigations should also include feasibility of dam shut-downs during off-peak/night time hours to encourage passive escapement of migrating adult eels (ASMFC 2000).

Additional recommendations are provided by Dittman et al. (2010a).

VI. References

Atlantic States Marine Fisheries Commission (ASMFC). 2000. Interstate fishery management plan for American Eel. ASMFC Fishery Management Report No. 36, Washington, D.C.

Atlantic States Marine Fisheries Commission (ASMFC). 2012. Stock Assessment Report No. 12-01 of the Atlantic States Marine Fisheries Commission: American Eel Benchmark Stock Assessment. 342 pp.

Barse, A. M. and D. H. Secor. 1999. An exotic nematode parasite of American Eel. Fisheries 24(2):6-10.

Carlson, D.M. 2001. Species accounts for the rare fishes of New York. N. Y. S. Dept. Env. Cons. Albany, NY.

Carlson, D.M. 2012 (draft). Species accounts of inland fishes of NYS considered as imperiled, 2012. NYDEC Watertown, NY

COSEWIC 2006. COSEWIC assessment and status report on the American eel *Anguilla rostrata* in Canada. Comm. on status of Endang. Wildl. in Can., Ottawa 71pp.

Dittman, D.E., L.S. Machut, and J.H. Johnson. 2010a. Overview: American Eel History, Status, and Management Options. Final Report for C005548, Comprehensive Study of the American Eel. State Wildlife Grant. NYSDEC, Bureau of Wildlife, Albany, NY. 36 pp.

Dittman, D.E., L.S. Machut, and J.H. Johnson. 2010b. Lake Ontario / St. Lawrence River Drainage: American Eel History, Status, and Management Options. Final Report for C005548, Comprehensive Study of the American Eel. State Wildlife Grant NYSDEC, Bureau of Wildlife, Albany, NY. 122 pp.

EPRI (Electric Power Research Institute). 1999. American eel (*Anguilla rostrata*) scoping study: a literature and data review of life history, stock status, population dynamics, and hydroelectric impacts. EPRI,TR-111873, Palo Alto CA

Goode, G.B. 1884. The fisheries and fishery industries of the United States. Section I: Natural history of useful aquatic animals. United States Commission of Fish and Fisheries: 631-656.

Haro, A., W. Richkas, K, Whalen, A. Hoar, W.-D. Busch, S. Lary, T. Brush, and D. Dixon. 2000. Population decline of the American eel: implications for research and management. Fisheries 25(9):7-16.

Helfman, G. S., D. E. Facey, L. S. Hales, Jr., and E. L. Bozeman, Jr. 1987. Reproductive ecology of the American eel. American Fisheries Society Symposium 1:42-56.

Hodson, P.V., M. Castonguay, C.M. Couillard, C. Desjardins, E. Pellitier, and R. McLeod. 1994. Spatial and temporal variations in chemical contamination of American eel, (Anguilla rostrata) captured in the estuary of the St. Lawrence River. Can. J. Fish. Aquat. Sci. 51: 464-478.

MacGregor, R., J. Casselman, L. Greig, W.A. Allen, L. McDermott and T. Haxton 2010. Draft recovery strategy for the American eel (*Anguilla rostrata*) in Ontario. Ont. Rec. Strat. Ser. OMNR Petersborough 78pp.

McCleave, J. D., R.C. Kleckner, and M. Castonguay. 1987. Reproductive sympatry of American and European eel and implications for migration and taxonomy. American Fisheries Society Symposium 1:268-297.

Morrison, W. E. and D. H. Secor. 2003. Demographic attributes of yellow-phase American eels (*Anguilla rostrata*) in the Hudson River estuary. Canadian Journal of Fisheries and Aquatic Sciences 60(12):1487-1501.

NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: May 10, 2012).

New York State Department of Environmental Conservation (NYSDEC). 2013. Statewide Angling Regulations. http://www.dec.ny.gov/outdoor/31421.html. Accessed 38 June 2013.

Peterson, R.H. (ed). 1997. Proceedings of the Eel Workshop on the American Eel in Eastern Canada: Stock Status and Management Strategies. Can. Tech. Report Fish. Aqua. Sci. 2196. 1-174.

Secor, D. H., J. E. Baker, W. E. Morrison, and J. C. Steinbacher. 2002. Ecology and contamination of the Hudson River American eel. Report submitted to Hudson River Foundation, 40 West 20th Street, Ninth Floor, New York, NY 10011. University of Maryland Center for Environmental Science Tech. Series No. TS-367-02-CBL.

Scott, W.B and E.J. Crossman 1998. Freshwater fishes of Canada. Galt House Publ. Oakville, Ont. 966 pp.

Tesch, F.W. 1977. The eel: biology and management of Anguillid eels. Chapman and Hall. London. Pp. 434.

United States Fish and Wildlife Service (USFWS). 2011. 90-Day Finding on a Petition to list the American eel as Threatened. Federal Register 76(189):60431-60444.

Date last revised: January 29, 2014