U.S. Fish and Wildlife Service
American Eel *(Anguilla rostrata*)
12-month Petition Finding Form; Docket Number FWS-HQ-ES-2015-0143

ACTION: Notice of 12-month petition finding.

SUMMARY: We, the U.S. Fish and Wildlife Service (USFWS or Service), announce our 12-month finding on a petition to list the American eel (*Anguilla rostrata*) as a threatened or endangered species under the Endangered Species Act of 1973, as amended (Act). After a review of the best available scientific and commercial information, we find that listing the American eel is not warranted at this time. The best available scientific and commercial information indicates that the American eel remains widely distributed throughout its native range and remains relatively abundant, as demonstrated by fishery landings, fishway counts of juvenile eels, and genetic estimates of spawner abundance. While sources of individual mortality still exist, there are no stressors (natural or human induced negative pressures affecting individuals or subpopulations of a species), individually or cumulatively, that rise to the level of threats (natural or human induced pressure affecting a species as a whole) to the American eel's panmictic population. Although listing is not warranted at this time, we ask the public to continue to submit to us any new information that becomes available concerning the status of, or threats, to the American eel.

SUPPLEMENTARY INFORMATION:

Background

Section 4(b)(3)(B) of the Act (16 U.S.C. 1531 *et seq.*), requires that, for any petition to revise the Federal Lists of Endangered and Threatened Wildlife and Plants that contains substantial scientific or commercial information that listing the species may be warranted, we make a finding within 12 months of the date of receipt of the petition. In this finding, we will determine that the petitioned action is (1) not warranted, (2) warranted, or (3) warranted, but the immediate proposal of a regulation implementing the petitioned action is precluded by other pending proposals to determine whether species are endangered or threatened, and expeditious progress is being made to add or remove qualified species from the Federal Lists of Endangered and Threatened Wildlife and Plants. We must publish these 12-month findings in the Federal Register.

Previous Federal Actions

For a complete petition history for the American eel prior to September 2011, see the Previous Federal Action section of our September 27, 2011, 90-day substantial petition finding (76 FR 25084). Publication of the 90-day finding (September 27, 2011; 76 FR 25084) opened a period to solicit new information that was not previously available or was not considered at the time of our previous 2007 status review and not warranted 12-month finding (February 2, 2007; 72 FR 4967), and initiated a new status review.

On December 23, 2011, the petitioner (Center for Environmental Science Accuracy and Reliability (CESAR), formerly known as the Council for Endangered Species Act Reliability) filed a Notice of Intent to sue the Service for failure to publish a finding within 12 months of receiving the April 30, 2010, petition. On August 7, 2012, CESAR filed a complaint with the U.S. District Court for the District of Columbia for the Service's failure to meet the petition's statutory timeline. On April 24, 2013, the Service entered into a court approved settlement agreement with CESAR stipulating that the Service would complete a status review of American eel and deliver a 12-month finding to the Federal Register on or before September 30, 2015 (Stipulated Settlement Agreement, *Center for Envt'l Science Accuracy and Reliability v. Salazar, et al.* (D.D.C., Case No. 1:12-cv-01311-EGS), Doc. 18, filed April 24, 2013.).

To ensure the status review was based on the best scientific and commercial information available, the Service, in November 2013 through January 2014, requested any new or updated American eel information since the 2007 status review. The requests were sent to state and Federal agencies, Native American tribes, nongovernmental agencies, and other interested parties. In addition to any new or updated information, the requests specifically sought information related to panmixia, glass eel recruitment, climate change, oceanographic conditions, and eel abundance at fishways. See the lists of references reviewed and cited for a list of agencies, organizations, and parties from which we received information; these reference lists are available at *http://www.regulations.gov* at *http://www.fws.gov/northeast/newsroom/eels.html*.

Species Information

A complete review of the best available scientific and commercial information is contained in the 2015 supporting document entitled, *American Eel Biological Species Report* (Report). The Report provides a summary of the current (post 2007) literature and information regarding the American eel's distribution, habitat requirements, life history and stressors. The Report is available as a Supplemental Document at *http://www.fws.gov/northeast/newsroom/eels.html*. Information from the Report is summarized below; refer to the Report for more detailed discussions of each of the following subject areas. Additional information that was not included in the Report, or became available after the Report's completion, is cited accordingly.

Taxonomy and Genetics

The taxonomy and genetics of the American eel are reviewed in the Report (2015, pp. 3–6). Contemporary phylogenetic studies of the genus *Anguilla* using genetic markers recognize 16 living *Anguilla* species. Most of these species are tropical eels that are found in the Indo-Pacific. Two temperate species of eel occur in the North Atlantic: American eel and European eel (*Anguilla anguilla*). These two species evolved more than 2 million years ago, when the ancestral Atlantic eel species gave rise to American and European eel. American and European eel are the two most closely related species of *Anguilla*. They have similar genotypes, have nearly identical life history characteristics, overlap in their breeding areas in the Sargasso Sea, and can produce hybrids that are generally found only among eels in Icelandic waters. Information on European eel is included in this status review where it informs the biology of American eel or the assessment of stressors common to both species. The best available information indicates that American eel are a single panmictic population that lacks distinct population structure, breeds in the Sargasso Sea, and shares a single common gene pool. The Service considers the single rangewide population of American eel a valid listable entity.

Life History

The life history information in this section is summarized from the Report (2015, pp. 7–26). American eel are a catadromous fish species. Catadromous fishes spawn in the ocean but feed and grow in freshwater. American eel catadromy is now viewed as facultative since eels commonly use brackish estuaries or near shore marine habitats, in addition to the freshwater habitats that are normally associated with catadromous species. After mature eels spawn in the Sargasso Sea, the eggs hatch into "leptocephali," a larval stage that last for about 1 year. Leptocephali are transported by ocean currents from the Sargasso Sea to the Atlantic coast of North America, the Caribbean, Gulf of Mexico, Central America and northern portions of South America. Leptocephali metamorphose into "glass eels" while at sea and then actively swim across the continental shelf to coastal waters. Glass eels transform into small pigmented juvenile eels, commonly called "elvers," after taking up residence in marine, estuarine, or freshwater rearing habitats in coastal waters. As they grow, the larger juvenile eels are known as "yellow eels." American eels begin sexual differentiation at a length of about 20 to 25 centimeters (cm) (7.9 to 9.8 inches (in)), well in advance of maturation as a "silver eel." Upon nearing sexual maturity, silver eels begin migration toward the Sargasso Sea, completing sexual maturation en route.

Prior to sexual differentiation, American eels are intersexual, meaning they have no morphologically differentiated sex chromosomes and can develop into either sex. Male and female yellow eels can be distinguished histologically when they reach a length of about 200 to 350 millimeters (mm) (about 8 to 14 in). Males mature at a younger age and smaller size than females. Males are more common in the southern part of the range, in estuaries where they generally grow faster, and in habitats with high densities of eels. Females are more common in the northern portion of the range and in habitats where eel density is low, such as the headwaters of river basins. According to Davey and Jellyman (2005, p. 37), "Male fitness is maximized by maturing at the smallest size that allows a successful spawning migration (a time-minimizing strategy) whereas females adopt a more flexible size-maximizing strategy that trades off pre-reproductive mortality against fecundity—gender is determined principally by environmental factors."

Researchers can estimate how much time an eel spends in freshwater versus saltwater habitats by using the ratio of minerals deposited on the species' otolith (ear bone). The ratio of strontium to calcium along transects from the core to periphery of otoliths shows that, within a river basin, some eels enter freshwaters as glass eels and remain there, some remain in coastal or estuarine waters, some move between the habitats after some years, and some move between habitats annually or irregularly. Use of this range of habitats demonstrates the plasticity and adaptability of the American eel.

American eel are semelparous, meaning they spawn only once and then die at sea. American eel reproduction occurs in a biological desert (i.e., the Sargasso Sea) where there is a low risk of predation, but limited opportunity for growth. Juvenile growth occurs in continental waters where there is abundant food and juvenile eels may grow rapidly, but accessing these habitats entails the biological costs of two long migrations. American eel larvae must migrate thousands of miles from ocean breeding habitats to juvenile habitats. Larval migration is initially accomplished largely by passive drift with ocean currents, but likely requires active swimming to cross continental shelf waters. Mature silver eels reverse this migration and must swim against, under, or around, the same ocean currents that carry eel larva to continental waters. The adult spawning migration requires large amounts of stored fat to provide the energy needed for prolonged swimming.

Historical Range

The historical range of the American eel likely includes all accessible river systems and coastal areas having access to, and from, the western North Atlantic Ocean and the wider Caribbean Sea (figure 1) (Report 2015, pp. 1–2, 33–52). American eel have been documented in watersheds and coastal areas spanning 44 degrees (°) of latitude from 54.3° in Hamilton Inlet, Labrador to 10.3° in Trinidad and Venezuela (Benchetrit and McCleave 2014, Scott and Crossman 1998, pp. 624–625; Tesch 2003, pp. 92–97). Historically, American eel were widely distributed in Central America, Colombia, Venezuela, Caribbean Islands with permanent streams, the gulf coast of the United States, most of the Mississippi River basin, the east coast of the United States, the maritime provinces of Canada, and Lake Ontario waters. A few eels have been collected in Greenland since 1841. In general, the historical distribution and density of eels decreased with distance inland due to the species’ density dependence and natural blockages such as Niagara Falls.

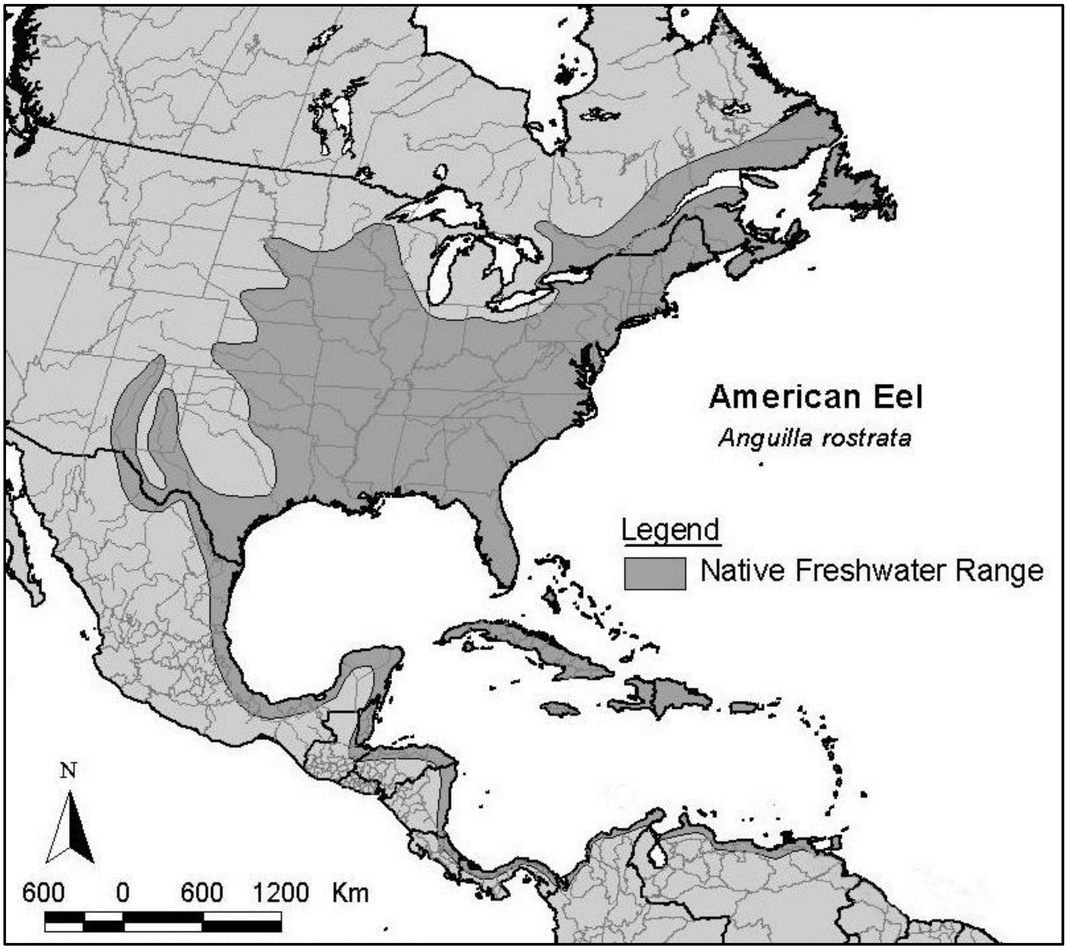

Figure 1. Native freshwater range of American eel (updated from NatureServe, 2006).

Current Distribution

In addition to the American eel's natural historical range, the species was also introduced in some areas through canals, locks, and fishways. For example, construction of the Chicago Sanitary and Ship Canal, and the Welland Canal, which bypassed Niagara Falls, allowed American eel to expand their range to all of the Great Lakes upstream of Lake Ontario. The current distribution of American eel in the United States is limited by impassable dams. Although American eels are still present in most of their historical range, including estuaries, coastal marine habitats, and most rivers, they have been eliminated from certain watersheds, particularly in headwater areas upstream of impassable dams. American eels are rare in, or have been eliminated from, the province of Ontario, and some headwater streams throughout the Appalachian mountains. Figure 2 shows the current distribution of American eel in the continental United States based upon contemporary fish survey data (e.g., electrofishing, trapping, and netting) provided by state regional fish biologists, recent eel fishway construction, NatureServe (2013) data, current records of eel stocking, and published eel distribution records. Currently, American eel are found in much of the Mississippi River watershed and all of the States eastward (Report 2015, pp. 33–52). The species is found throughout Central America and the wider Caribbean, including Colombia, northern Venezuela, and the Caribbean

Islands with permanent streams.

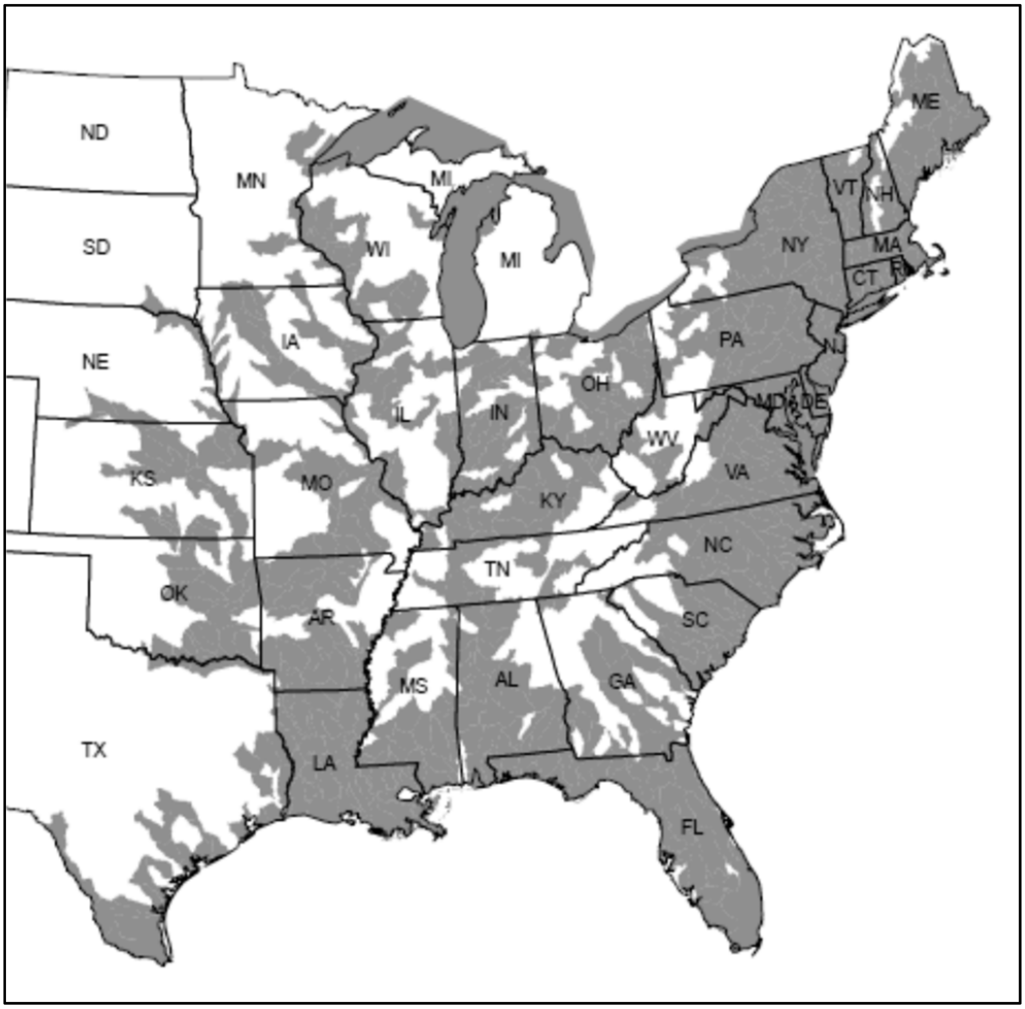

Figure 2. Current American eel distribution in the continental United States based on presence or absence in hydrological unit code (HUC) 8 watersheds.

Habitat

American eel habitat requirements are described in the Report (2015, pp. 27–32). American eel are ubiquitous in many continental aquatic habitats including marine habitats, estuaries, lakes, ponds, small streams, and large rivers to the headwaters. They may be locally abundant to the extent that they sometimes constitute a large proportion of the total fish biomass in many watersheds. In freshwater, preferred habitat is found in lakes and rivers to depths of at least 10 meters (m) (33 feet (ft)). American eel occupy a broad array of habitats, possibly more habitats than any fish in the world. American eel use a variety of marine and freshwater habitats at different life stages. Eel larvae rely upon ocean currents to return to continental waters, while mature silver eels use riverine, estuarine, and marine habitats during their migrations to the spawning grounds in the Sargasso Sea. Juvenile eels in marine habitats primarily use shallow, protected waters in estuaries and near-shore habitats. Juvenile eels are mostly benthic and will use substrates that include rock, sand, mud, large wood, and submerged vegetation for protection and cover, particularly during daylight. Freshwater overwintering habitat is not well documented, but yellow eels have been observed to overwinter in mud bottoms in both freshwater and estuary habitats.

Population Estimates

As previously described in the 2007 12-month finding (72 FR 4947) and confirmed in the Report (2015, p. 33) and summarized below, no rangewide estimate of American eel abundance exists. We have reviewed the best available information—including fisheries landings, juvenile abundance indices, and distribution—to determine the current status of the species over broad geographic areas extending from Canada to the wider Caribbean (Report 2015, pp. 33–52). However, specific information on demographic structure is lacking and difficult to determine because the American eel is a single panmictic population with individuals randomly spread over the entire range, with growth rates and sex ratios that are affected by local environmental conditions. Because of this unique life history, site-specific information on eels must be evaluated in context of the significance to the entire population. Determining population trends is challenging because the relevant available data are limited to a few locations that may or may not be representative of the species' range and little information exists about key factors such as mortality and recruitment that could be used to develop an assessment model. Furthermore, the ability to make inferences about species' viability based on available trend information is hampered without an overall estimate of eel abundance. The following sections summarize our analysis and understanding of the species' status.

The distribution and abundance of American eel is described in the Report (2015, pp. 33–52) based upon commercial harvests, young-of-the-year (YOY) surveys that have been conducted for stock assessment purposes, and various fisheries surveys conducted by state and Federal agencies. Harvests in commercial fisheries have been used as indicators of fish abundance, although market conditions, fishing regulations, switching among commercial fishing opportunities, changing effort and other factors have significant effects on eel landings that are independent of eel abundance (Report 2015, pp. 34, 52). Nonetheless, eel landings data are available from 1950, at which time the U.S. harvest was about 900 tons (Report 2015, p. 34). Landings declined through the early 1960s to a low of 332 tons in 1962 and then increased, reaching a peak in the late 1970s to mid-1980s when annual U.S. landings were about 1,500 tons. United States landings have been relatively stable since 1998 at about 470 tons, with about two-thirds of this harvest landed in the Chesapeake Bay states of Maryland and Virginia. The Atlantic States Marine Fisheries Commission (ASMFC) (2014a, entire) updated the American eel stock assessment with 3 years of YOY survey data and found that trend analyses at 19 of 20 long-term YOY survey locations were not significant (i.e., no trends up or down) despite the fact that 5 of the sites had their highest YOY catches on record.

Along with the updated harvest and YOY survey data, we also received American eel capture records from state fish and game agencies, Federal agencies, and museums.

These data were suitable to determine the presence or absence of American eels. Distribution information from the 2007 status review was updated, and the current distribution of American eel at a HUC 8 watershed level is depicted in figure 2. In addition to the above information, researchers used genetic methods to estimate the annual abundance of spawning eel in the Sargasso Sea. The researchers suggested that the number of breeding American eel in any given year may be about 50 to 100 million with estimates between 4.7 and 109 million spawners annually from 1997 to 2006 (Report 2015, p. 5). Although these genetic data and some YOY indices appear to show an increase in eel abundance in recent years, trend analyses do not show a significant change since the 2007 Status Review. Therefore, based on the best available information, we consider the trend in eel abundance since 2007 to be stable.

Harvest and landings data are of limited value for characterizing long-term abundance trends or exploring factors influencing those trends (Haro *et al.* 2000, p. 14). Few data sets have been collected with systematic, repeatable methods that produce standardized results over long periods of time. Even when landings data are accurate, market conditions and economic opportunities for commercial fishers have significant effects on eel landings that are independent of eel population abundance. Data on landings and fishing effort are known to be incomplete or nonexistent in many areas within the American eel's range, and there is the possibility that catches are underreported. For example, the extensive harvest of young, yellow-phase eels for use as crab bait in the Chesapeake Bay region and as live bait for recreational fisheries for species such as striped bass (*Morone saxatilis*) in the Mid-Atlantic region to New England is an additional source of landings that may be underreported (Electric Power Research Institute (EPRI) 1999). A further complication is that fisheries for American eel target many life stages, from glass eels and elvers to the sexually mature silver-phase stage, yet the size and age composition of reported landings is, for the most part, undocumented. In addition, effort data are often lacking, so harvests cannot be standardized as catch-per-unit effort. This variability contributes significant uncertainty in efforts to determine the number of eels harvested and which individual year classes are represented in the harvest data. Although the data discussed above are of limited value for long-term trend analysis, they are still the best available data and can be helpful in evaluating shorter term trends such as from the 2007 status review to now. Therefore, based on the best available information, we consider the trend in eel abundance to be stable.

Summary of Information Pertaining to the Five Factors

Section 4 of the Act (16 U.S.C. 1533) and implementing regulations (50 CFR 424) set forth procedures for adding species to, removing species from, or reclassifying species on the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, a species may be determined to be endangered or threatened based on any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence.

In making this finding, information pertaining to the American eel in relation to the five factors provided in section 4(a)(1) of the Act is discussed below. In considering what factors might constitute threats we must look beyond the mere exposure of the species to the factor to determine whether the species responds to the factor in a way that causes actual effects to the species. If there is exposure to a factor, but no response, or only a positive response, that factor is not a threat. If there is exposure and the species responds negatively, the factor may be a threat and we then attempt to determine how significant a threat it is. If the threat is significant, it may drive or contribute to the risk of extinction of the species such that the species warrants listing as endangered or threatened as those terms are defined by the Act. This does not necessarily require empirical proof of a threat. The combination of exposure and some corroborating evidence of how the species is likely affected could suffice. The mere identification of factors that could affect a species negatively is not sufficient to compel a finding that listing is appropriate; we require evidence that these factors are operative threats that act on the species to the point that the species meets the definition of an endangered or threatened species under the Act.

In making our 12-month finding on the petition, we consider and evaluate the best available scientific and commercial information. This evaluation includes information from all sources, including state, Federal, tribal, academic, and private entities and the public. However, because we have a robust history with the American eel and completed a thorough status review for the species in 2007, we are incorporating, by reference, the 2007 12-month finding (72 FR 4947) and using its information as a baseline for this 2015 status review and 12-month petition finding. Any substantive changes about the data used in the 2007 12-month finding or conclusions drawn from that data, upon review of the best available scientific and commercial information since 2007, are described in the Species Report or below, as appropriate.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

The 2010 petition asserted that American eel habitat has been reduced, which has had cascading adverse effects. The 2007 12-month finding (72 FR 4947) concluded that Factor A was not a threat to the American eel. We have reviewed new information available since the 2007 finding to determine whether Factor A is a threat to the species.

American eel are plastic in their life history and habitat requirements, and their catadromy is a conditional strategy in response to environment, food availability, and competition (Report 2015, pp. 7–26). Although juvenile growth habitat is typically considered to be freshwater, a portion of the glass eels that reach continental waters will take up residence and complete their life cycle without ever entering freshwater, or may enter freshwater only intermittently. Facultative catadromy may be density dependent, and available marine and estuarine habitat may compensate for the loss of freshwater habitat blocked by dams—that is, at low eel density, young eels may settle in estuaries and marine habitats. Although some estuary habitat has been lost in the past, and we do not know the full extent of these losses, estuarine habitat is sufficient to support the species and we do not find it to be a limiting factor for American eel.

The 2007 12-month finding (72 FR 4947) found that American eel remain widely distributed throughout watersheds in their historical range despite the construction of dams that were built for hydroelectricity, water supply, flood control, navigation, and recreation. Natural and artificial barriers in rivers may impede upstream eel movement, but upstream migration is entirely halted only in the cases of the largest dams and waterfalls, such that some eels may still be able to colonize upper reaches. This information is reviewed in the Report (2015, pp. 65–72). Large dams, many of which were built as long as a century ago, are likely to be complete barriers to upstream eel movement and have made some upstream habitat unavailable to eels. Small eels can climb over or around many smaller dams that lack fish passage by climbing wetted surfaces. A study of 335 dams that were not equipped with fish passage found eels above half of the dams that were less than 6.2 ft (1.9 m) high, but only 5 percent of the dams that exceeded 13.5 ft (4 m) (Cooney and Kwak 2013, p. 182). Many dams have been retrofitted with upstream eel fishways and now pass thousands of eels annually—an eel fishway that was required at Roanoke Rapids, Virginia, pursuant to Federal Energy Regulatory Commission (FERC) relicensing began operating in 2010 and passed 1.9 million eels between 2010 and 2013, including 820,000 eels in 2013. Many eel fishways have been required through the FERC licensing process, and resource agencies routinely request this conservation measure. Juvenile eels also move upstream using fishways that were built for anadromous species, although eel passage efficiency is likely to be low due to the high water velocity that is typical of these fishways. Dams with locks are known to pass eels. Eels are found upstream of a series of 29 locks on the upper Mississippi River (Report 2015, p. 49), and in some years more than 1 million eels have passed through the lock at Beauharnois Dam on the St. Lawrence River (Report 2015, p. 67). Despite past historical barriers to their migration, eels continue to be present in much of the historical range (figure 2).

Conservation Efforts to Reduce Habitat Destruction, Modification, or Curtailment of Its Range

Many eel passage barriers at federally-licensed hydropower dams are being addressed through the FERC relicensing process. Some passage barriers are being addressed through dam removal, and many projects have installed upstream eel fishways at the request of Federal and state resource agencies, or as a result of Service fishway prescriptions—for example, eel fishways have been installed at multiple hydroelectric projects in the following watersheds: St. Lawrence River (Quebec, Canada), Penobscot River (Maine), Kennebec River (Maine), Presumpscot River (Maine), Raquette River (New York), Oswego River (New York), Connecticut River (Connecticut and Massachusetts), Shetucket River (Connecticut), Shenandoah River (West Virginia), and Roanoke River (North Carolina). Dam removal provides the most effective upstream and downstream passage. Bernhardt *et al*. (2005, p. 637) documented $7.5 billion that was spent on U.S. stream restoration projects between 1990 and 2003 and noted that many of these projects have improved American eel passage. While those levels of stream restoration occurred prior to our 2007 status review, additional information indicates 295 dams were removed in the United States between 2008 and 2012, many of which were within the range of American eel (American Rivers 2013, entire).

Summary of Factor A

American eel have been extirpated from some portions of the historical range, mostly as a result of large hydroelectric and water storage dams built since the early twentieth century. Although dams have extirpated eels from some large rivers and certain headwaters, the species remains widely distributed over the majority of its historical range. American eel are currently present in 36 states, eastern Canada, Latin America, Caribbean islands with permanent streams, Colombia, and Venezuela. The extensive range of American eel provides multiple freshwater and estuarine areas that support the species' life stages and thus buffer the species as a whole from stressors affecting individuals or smaller populations in any one area.

Currently, ocean habitats and the full range of continental habitats (estuaries, lakes, and rivers) remain available and occupied by the American eel. A portion of the American eel population completes its life cycle without ever entering freshwater. Although some estuary habitat has been lost, and we do not know the full extent of these losses, estuarine habitat does not appear to be a limiting factor for American eel. Access to some freshwater habitat is affected by large dams constructed for hydroelectricity, water supply, flood control, navigation, and recreation purposes—these dams are passable to some degree if they are equipped with fishways or locks, but otherwise result in a complete loss of eel habitat. We consider habitat loss from barriers to be a historical effect, and any population-level effects likely have been realized. Our review of the best available scientific and commercial information indicates there is no evidence to suggest that any new federally-licensed hydroelectric dams proposed within the species' range or will be proposed in the future will likely cause significant effects to the American eel. We conclude that although some dams appear to form a complete barrier to upstream migration, American eels are able to negotiate many barriers to varying degrees. Many passage barriers can be, and some are being, addressed by installing eel fishways.

The status of the American eel and the effects of freshwater habitat loss must be examined in light of the American eel's habitation in freshwater, estuarine, and marine habitats. Highly fecund females continue to be present in extensive areas of freshwater (lacustrine and riverine), estuarine, and marine habitats; males also continue to be present in these habitats. Recruitment of glass eels continues to occur in these habitats with no evidence of continuing reduction in glass eel recruitment. For these reasons, we conclude that the available freshwater, estuarine, and marine habitats are sufficient to sustain the American eel population, and that the destruction, modification, or curtailment of the species' habitat or range is not a current threat, nor likely to become a threat in the future.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Harvests of American eel are described in the Report (2015, pp. 79–85) and summarized below. The 2007 12-month finding (72 FR 4947) concluded that Factor B was not a threat to the American eel. New information since 2007 indicates that American eel harvest occurs throughout the species' freshwater and estuarine range. Most harvest of American eel occurs in commercial fisheries located along the Atlantic coasts of the United States and Canada, where eels are harvested as glass, yellow, and silver eels (Report 2015, pp. 33–52, 79–85). Based on data that extend back to the 1950s, commercial landings of American eels were low in the 1960s, with about 1,000 tons landed; were high in the 1970s and 1980s, peaking in 1979 at about 3,000 tons of eels; and declined to about 750 tons in recent years (Cairns et al 2014, pp. 16, 59). The harvest trends may reflect changes in eel abundance, but it is possible that the large harvests in the 1970s and 1980s may have constituted overfishing of the stock. In the United States, the largest harvests are yellow eels in the Chesapeake Bay region, where about 250 tons of yellow eel are landed annually in the states of Maryland and Virginia. The largest eel fishery in Canadian waters has been the Quebec silver eel fishery with landings of 267 to 991 tons from 1920 to 1989, followed by a decline and closure of the fishery in 2013 (Cairns et al. 2014, pp 53–55). Landings in the Quebec and Chesapeake Bay fisheries have been reduced in the last two decades by license buybacks and quotas, respectively. American eel fisheries in northern and southern portions of the east coast are currently a fraction of the peak landings in the 1970s and 1980s. This historical period of high landings was due to domestic markets for yellow eels, as well as emerging markets for silver eels in Europe and glass eels to supply Asian aquaculture operations. The best available information from literature indicates that 1970s yellow eel harvest levels are unlikely to occur again due to the changes in eel markets. The value of landed eel has fluctuated widely depending on the price paid for glass eels that are used in aquaculture—in particular, high prices (e.g., $2,000 per pound) for glass eels in 2012 and 2013. High prices for glass eels have created poaching concerns in states that do not have legal glass eel fisheries (Bangor Daily News 2014, p. 2). However, harvest and sale tracking with swipe cards has been implemented to reduce glass eel poaching. Glass eels are harvested in the Dominican Republic and Haiti but the quantity is uncertain. The best available information indicates that existing harvest levels which may also include some level of poaching is not a threat to the American eel.

The ASMFC manages American eel fisheries in territorial seas and inland waters along the Atlantic coast from Maine to Florida. The current ASMFC management plan (Plan) was adopted in October 2014 to conserve and protect the American eel stock. The ASMFC considers the American eel population to be stable, but depleted, and therefore manages harvests with a goal of reducing mortality and increasing conservation of American eel stocks across all life stages. To conserve spawning eels, the ASMFC limits silver eel harvests to a few permits on the Delaware River. Glass eel harvests have increased in recent years due to the demand for seed stock to supply the aforementioned Asian aquaculture industry—the pressure from this market may continue to be volatile in response to changes in market prices. Market prices may increase as sources of other glass eels of other eel species worldwide decline. As of March 2015, coastwide regulations prohibit the harvest of glass eels except in Maine and in South Carolina, which hosts a small glass eel fishery. Although glass eel harvests in these two States may deplete eel abundance in adjacent rivers and streams, we expect the many other rivers, streams, and estuaries to contribute to the panmictic spawning stock. The Maine glass eel quota includes a requirement to implement a fishery-independent study of the life cycle from glass eel, through yellow eel, to mature silver eel. The Plan also includes triggers to implement state-specific yellow eel quotas. The goal of the ASMFC management plan is to protect the spawning stock of silver eels leaving continental waters.

Although the States began implementing the quotas specified in ASMFC's Addendum IV in October 2014, as described above, the previous year's monitoring of activities under Addendum III are in the process of being reported and reviewed. As part of that review, on August 6, 2015, ASMFC's Interstate Fisheries Management Program Policy Board found a state out of compliance for "not fully and effectively implementing and enforcing Addendum III to the Fishery Management Plan for American Eel" (ASMFC 2015, pp. 13, 15). The ASMFC has issued a notice of non-compliance and will be working with the state to become compliant. The best available information indicates that existing harvest levels, which may include some level of potential overharvest where Addendum III requirements are not being implemented, are not a threat to the American eel.

Limited harvests of eels occur in the Gulf States under the management of the Gulf States Marine Fisheries Commission (GSMFC) member states (however, the GSMFC neither has an American eel Fisheries Management Plan nor are they planning to prepare one in the immediate future). Eel harvests in the Caribbean have been reported by the United Nations Food and Agriculture Organization and comprise sporadic landings data for Mexico, the Dominican Republic, and Cuba, but details, such as the life stages being harvested, are unknown.

In Canada, all directed commercial harvests of American eel have been reduced or eliminated. In Ontario, harvests were eliminated in 2004. In Quebec and the maritime provinces, harvests have been significantly reduced. The majority of licenses are for traps or pots, which capture and hold the fish alive until the gears are fished, allowing for the selective release of animals back to the water. Glass eels are harvested in the maritime provinces of Canada and managed with individual quotas.

In addition to commercial harvests, recreational harvests also affect some individuals of the species. However, recreational harvests are estimated to be less than 10,000 eels per year, spread over the entire range of the American eel (ASMFC 2015; *http://www.asmfc.org/species/american-eel*; last accessed July 17, 2015). Also, based on our review of the best available scientific and commercial information, we did not find evidence that any significant numbers of American eel are taken for scientific or educational purposes.

Conservation Efforts to Reduce Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Throughout the species' North American range, commercial harvests of American eels have been further reduced since the 2007 12-month finding (72 FR 4967), and further measures recently have been implemented to further reduce the harvest of American eel. In the United States, the ASMFC's Addendum IV, which was adopted in October 2014, manages directed eel fisheries by quota. The ASMFC management plan limits the 2015 yellow eel fisheries to a total quota of 454 tons, and limits the 2015 Maine harvest of glass eels to a quota of 9,688 lbs. The ASMFC requires states with glass eel fisheries or desiring to establish one to implement comprehensive life cycle surveys to understand natural mortality of eels and the impacts of harvest of various life stages. Life cycle surveys would include but not be limited to collecting the following information: fisheries independent index of abundance, age of entry into the fishery/survey, biomass and mortality of glass and yellow eels, sex composition, age structure, prevalence of *Anguillicoloides crassus* (see Factor C below), and average length and weight of eels in the fishery/survey. These studies will provide valuable information for ongoing and future conservation of the American eel. In Canada, licenses in the Southern Gulf of St. Lawrence and Eastern New Brunswick weir fisheries have been reduced to 151 licenses (Chaput *et al*. 2014, p.19).

Summary of Factor B

All American eel harvests are of prespawning fish. Commercial harvests of American eel in U.S. waters peaked in the late 1970s and 1980s when large numbers of yellow eels were harvested, perhaps to the point of overfishing of the stock. However, commercial harvest variability is also affected by emerging markets (e.g., European markets for silver eels in the 1970s and current markets for glass eels in Asia), consumer demand for eels in these markets, the prices paid to commercial fishers, changes in fishing regulations, and alternative economic opportunities for commercial fishers. It is difficult to determine whether declining eel abundance or socioeconomic factors were a major contributor to declining harvest, but the best available information indicates that the high yellow eel harvests of the 1970s are unlikely to occur again. This decline of yellow eel harvest is in contrast to the harvests of American glass eels—the aquaculture industry demand for glass eels has shifted to American eel, which now supplies much of the stock for Asian aquaculture operations, as a result of the ban on exporting glass eels to Asia from Europe and the decline of Japanese eel stocks.

The American eel is a highly resilient species, with the ability to occupy a broad range of habitats within freshwater, as well as estuarine and marine waters. Despite historical habitat losses (see Factor A above), as well as some potential, unverifiable level of poaching, and levels of historical and current commercial and recreational removals, it remains a widely distributed fish species with a depleted but stable status. The legal harvest is being managed via harvest quotas, licenses, and reporting requirements intended to ensure the species' conservation. Despite a single instance of non-compliance with Addendum III, there is no information to suggest that the Addendum IV quotas are not being met. Therefore, we conclude based on the best scientific and commercial information available that overutilization for commercial, recreational, scientific, or educational purposes does not currently pose a threat to the American eel, nor is it likely to become a threat in the future. See Factor D below for additional information.

Factor C. Disease or Predation

The 2007 12-month finding (72 FR 4947) concluded that Factor C was not a threat to the American eel. New information regarding disease (Report 2015, pp. 58–65) and predation (Report 2015, pp. 89–90) is described in the Report and summarized in the following sections.

Disease

New information since 2007 indicates that the exotic parasite *Anguillicoloides crassus* has become well established in continental waters of the western North Atlantic since it was introduced in 1995. The distribution of the parasite continues to expand along the Atlantic coast, particularly northward into additional Canadian waters, including the Upper St. Lawrence River and Lake Ontario (Report 2015, p. 62). The recent introduction of *A. crassus* to eastern Nova Scotia is the single instance where ballast water transfer best explains the appearance of *A. crassus* in previously uninfected waters. In previously infected watersheds, parasitized eels, and possibly paratenic (intermediate) hosts, are expanding the parasite's range farther upstream. In addition, there is some evidence that mean *A. crassus* infection rates have increased in some watersheds (Report 2015, pp. 61–62), although the parasite does not typically kill infected eels. These trends mirror the progression of the *A. crassus* infestation about a decade earlier in Europe.

With regard to sublethal effects of *Anguillicoloides crassus*, some researchers, based on laboratory results, hypothesize that heavily infected European silver eels may have a damaged swimbladder that impairs buoyancy compensation during migration in the open ocean. There is still a significant level of uncertainty about the effect of *A. crassus* on the American eel during outmigration and spawning, which cannot easily be studied under natural conditions or inferred from studies that use artificial laboratory conditions. Telemetry studies of migrating American silver eels in the Gulf of St. Lawrence have documented high rates of apparent mortality (see Predation, below), but it is unlikely that these telemetered eels were infected with parasites since rates of infection are low among St. Lawrence eels (Report 2015, p. 62). In summary, despite the spread of *A. crassus* and increasing mean infection rates over time, there is no direct evidence to support a conclusion that the parasite causes significant American eel mortality. Nor is there direct evidence to support or refute the hypotheses that *A. crassus* impairs the silvering process, prevents American eels from completing their spawning migration to the Sargasso Sea, or impairs spawning.

The introduction and spread of two nonnative parasitic flatworms in the genus *Pseudodactylogyrus* have been similar to the introduction and spread of *Anguillicola crassus*. The parasitic flatworms *P. anguilla* and *P. bini* were introduced through the importation of infected aquaculture eels. The parasite subsequently infected wild

American eels. Although these flatworms cause localized gill tissue damage to infected eels and may produce serious epizootics in aquaculture settings, the best available information indicates they do not cause mortality in wild American eel.

Predation

Telemetry and dietary studies conducted since 2011 indicate that fish predation upon silver American eels may be significant. Acoustic and satellite telemetry have been used to study silver eels migrating from the St. Lawrence River through the Gulf of St. Lawrence and into the open ocean. Satellite telemetry indicated that six of eight eels were ingested by warm-gutted predators, as determined by a sudden increase in temperature and changes in swimming depth profiles that are consistent with the behavior of porbeagle shark (*Lamna nasus*). A 2-year acoustic telemetry study monitored the migration of 180 silver eels from fluvial and estuarine portions of the St. Lawrence River through the Gulf of St. Lawrence. Although 89 percent of tagged eels were detected at fluvial and estuarine detection arrays, only 4.0 percent were detected leaving the Gulf of St. Lawrence (Report 2015, pp. 89–90). The authors concluded that the low detection rate may be due to high mortality rate, possibly due to predation, although they could not rule out inadequate coverage of the telemetry receivers. The predation inferred from these studies may have been exacerbated by the hydrodynamic effects of the transmitter tag, which may have impaired the swimming ability of tagged silver eels and increased their oxygen consumption. Further study is needed to assess tag effects on swimming ability and to determine the magnitude of predation. Studies of European silver eels indicate that silver eels are predated by not only porbeagle sharks, but also common thresher sharks (*Alopias vulpinus*) and toothed whales. Dietary studies of Striped Bass also documented predation upon male silver eels seasonally off the mouth of Chesapeake Bay (Jim Price, Chesapeake Bay Ecological Foundation, personal communication and unpublished data).

Predation upon glass eels and elvers below dams by fish such as juvenile striped bass has been observed, and the survival rate of glass eels and elvers may be naturally low in many rivers. However, based on the best available scientific and commercial information, we conclude that natural predation is affecting individual American eels in their marine, freshwater, and estuarine habitats but this predation is not likely having a population-level effect on the species. In addition, our review of the best available information does not suggest natural levels of predation may be increasing.

Conservation Efforts to Reduce Disease or Predation

Based on our review of the best available information, we did not find any conservation efforts being implemented to directly address disease or predation.

Summary of Factor C

Over the last two decades, the nematode parasite *Anguillicoloides crassus* has been spread by various transmission routes including upstream movement of infected eels, the spread of paratenic hosts, and likely by transfers of ship ballast water. Although the distribution of *A. crassus* has expanded, and infection rates are increasing where the parasite is present, the best available information does not indicate that the parasite is causing significant mortality or impairing the American eel's migratory ability. Therefore, we conclude that disease is not a threat to the American eel, nor is it likely to become a threat in the future.

Ocean-migrating silver eels are known to be predated by thermoregulating sharks (e.g., porbeagle and thresher sharks) and toothed whales. Glass eels, elvers, and silver eels are predated by fishes such as striped bass. While natural predation on individuals occurs, the best available information does not indicate that predation is affecting the species as a whole. Therefore, we conclude that predation is not a threat to the American eel, nor will it likely become a threat in the future.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

The 2007 12-month finding (72 FR 4947) concluded that there were no inadequate regulatory mechanisms affecting the American eel. The 2010 petition asserted that there is inadequate regulation of: (1) harvest of American eel on the Atlantic seaboard under the Magnuson-Stevens Fisheries Conservation Act by the ASMFC; (2) hydroelectric power dams via implementation of legal authorities under the Federal Power Act on the part of the Service, National Marine Fisheries Service (NMFS), and FERC; and (3) disposition of ballast water, resulting in the spread of *Anguillicoloides crassus*, under the Clean Water Act (CWA) by the Environmental Protection Agency (EPA) (CESAR 2010, pp. 28–35). We conclude in this 12-month finding that Factors A, B, and C (discussed above) and Factor E (discussed below) are not threats to the species. Because there are no threats to the American eel, we conclude that those stressors affecting individual eels are either being adequately managed (e.g., harvest) or have no existing regulatory mechanisms (e.g., warming temperatures in the Sargasso Sea). However, we discuss below the existing regulatory mechanisms identified in the 2010 petition.

Harvest and Trade

New information since 2007 indicates that American eel recreational and commercial harvest occurs throughout most of the species' freshwater and estuarine range. Most harvest of American eel occurs along the Atlantic coasts of the United States and Canada and is managed by the ASMFC and Canadian federal and provincial governments, respectively. Harvest throughout the rest of the species' North American range is managed by the Great Lakes Fisheries Commission and state agencies. Other range countries such as Mexico, Dominican Republic, and Cuba report harvest information, but the best available data does not include harvest details or management practices in these areas.

In our 2007 12-month finding, we fully explained the regulatory mechanisms that directly and indirectly affect harvest of American eel (72 FR 4967, pp. 4983–4987, 4990). This explanation still provides the best overview of the ASMFC's American Eel Fisheries Management Plan process. Since 2007, the ASMFC adopted several revisions to the management plan, the most recent being Addendum IV in October 2014, which put further prohibitions and quotas in place across the east coast for specific life stages (see Factor B above).

Demand for American eel glass eels for use in Asian aquaculture markets has increased since export of European eel glass eels to Asia was banned and the Japanese eel stocks have declined. Eels are currently regulated in the United States under the ASMFC's 2014 management plan. In addition, the American eel is under consideration for submission of a U.S. proposal to include the species in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or Convention (R. Gnam, pers. comm., December 13, 2014). The Convention is an international treaty designed to regulate international trade in certain animal and plant species that are now, or potentially may become, threatened with extinction. Species are listed in one of three Appendices to CITES, each conferring a different level of regulation and requiring CITES permits or certificates. An Appendix II species is one "although currently not threatened with extinction, may become so without trade controls." The Wildlife Conservation Society suggested that the United States consider the American eel for Appendix II CITES listing. A recommendation will be formulated after consideration of public comments (see below for additional information on the CITES process). If the American eel were added as an Appendix II species, export and international trade of the species would be regulated via the CITES permit process if a Party's Management and Scientific Authorities determine that such trade is legal and does not threaten the species' survival in the wild (Service 2014).

On June 27, 2014, the Service published a Federal Register Notice (79 FR 36550) to solicit comments from the public on recommendations for proposals to amend the CITES Appendices at the next Conference of the CITES Parties (CoP17; September 24 to October 5, 2016).After evaluating the public comments and assessing species against CITES criteria, the Service will issue another Federal Register Notice that identifies species for which we are likely, unlikely, or undecided about submission of a proposal. In that Notice, the Service will solicit input from the public and other countries and initiate the range state consultation process. Proposals to be considered at the CoP17 must be submitted 150 days prior to the meeting; therefore, proposals should be submitted by April 2016 for the September 2016 meeting. Proposals are adopted if they receive a two-thirds majority of the votes of the Parties present and voting (R. Gnam, pers. comm., June 18, 2015). Given the international demand for American eels that drives some domestic harvest, regulation under CITES could complement ASMFC's domestic regulation of the species.

In 2006, Canada initiated a status review of the American eel and the species was designated as threatened in 2012 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). However, a COSEWIC designation does not automatically confer listing of a species under the Canadian Species at Risk Act (SARA) (Report 2015, p. 79), and the American eel is not currently listed under SARA. See our 2007 12-month finding (72 FR 4967, p. 4976) for additional explanation and limitation of the 2006 COSEWIC status review. Should the American eel become listed under SARA in the future, SARA makes it an offense to kill, harm, harass, capture, or take an individual of a listed species that is endangered or threatened; possess, collect, buy, sell, or trade an individual of a listed species that is extirpated, endangered, or threatened, or its part or derivative, or to damage or destroy the residence of one or more individuals of a listed endangered or threatened species or of a listed extirpated species if a recovery strategy has recommended its reintroduction. For many of the species listed under SARA, the prohibitions on harm to individuals and destruction of residences are limited to Federal lands (Species at Risk Public Registry 2012). While the American eel is not listed under SARA, the species was listed as endangered by the Province of Ontario in 2007, and that listing provides some habitat protection and prohibits direct take of the species (COSEWIC 2012, p. ix).

In 2014, the International Union for Conservation of Nature (IUCN) published an update of the organization’s Red List that included American eel as endangered (IUCN 2014, http://www.iucnredlist.org/details/full/191108/0; last accessed May 28, 2015). The IUCN is not a regulatory agency, and the Red List itself does not provide any regulatory protection for included species. The purpose of the Red List is to provide “information and analyses on the status, trends and threats to species in order to inform and catalyze action for biodiversity conservation” (IUCN 2015, *http://www.iucnredlist.org/about/overview*; last accessed May 28, 2015).

As discussed above under Factor B, we continue to acknowledge that sometimes large numbers of individual American eel are recreationally or commercially harvested for food, bait, or aquaculture but we conclude that harvest and trade are not a threat to the American eel. The species is highly resilient and remains a widely distributed fish species with a relatively stable population despite the levels of historical habitat loss and historical and current commercial and recreational harvest. That harvest is being managed and monitored via existing harvest quotas, licenses, and reporting requirements to ensure the species’ conservation, and therefore is not a threat under the ESA. Because the American eel is not managed under SARA, we cannot evaluate the adequacy of that law as an existing regulatory mechanism. Likewise, because the American eel is not yet managed under CITES, we cannot evaluate the adequacy of the Convention and its permitting structure as an existing regulatory mechanism. And lastly, the IUCN is not a regulatory agency nor is its Red List a regulatory mechanism; therefore, we do not evaluate it under Factor D.

Fish Passage

New information since 2007 indicates that some unknown quantity of silver eels migrate from estuaries or marine habitats and do not encounter dams. However, many large, fecund female silver eels emigrate from headwaters and encounter one or more dams while migrating. Hydroelectric turbines, particularly multiple turbines within a watershed or turbines on terminal dams, which may affect the entire silver eel run, can cause substantial silver eel mortality within those watersheds (see Factor E below).

However, turbines are present on a small portion (less than 5 percent—see Factor E below) of the dams in Atlantic and Gulf coast watersheds and are absent from most of the barriers encountered in the Mississippi River watershed.

In our 2007 12-month finding, we fully explained section 18 of the Federal Power Act (16 U.S.C. 791a et seq.) as the primary regulatory mechanism that specifically provided for fish passage prescriptions by the Secretary of the Interior (as exercised by the Service) and the Secretary of Commerce (as exercised by NMFS) for dams regulated by FERC, and also explained the roll of other state and Federal regulations that contribute to fish passage (72 FR 4967, p. 4990). We have no new information since our 2007 12-month finding that indicates these regulatory mechanisms are inadequate. However, we do have new information, since 2007, indicating some additional downstream passage facilities have been built specifically for silver eels and have had variable success. In addition, the nighttime shutdowns implemented at times that match the silver eel migration can and have successfully provided a safe alternative to turbine passage. As discussed below under Factor E, we continue to acknowledge that sometimes large numbers of individual American eel are injured or killed by hydroelectric facilities, but also continue to conclude that fish passage in general, and hydroelectric dams specifically, are not a threat to the American eel because there is no evidence of population-level effects to the American eel.

Disposition of Ballast Water

New information since 2007 indicates the parasitic nematode, *Anguillicoloides crassus*, continues to spread throughout the American eel's range (see Factor C above). In our 2007 12-month finding, we stated that the best available information indicated that, in addition to the role of aquaculture, the expulsion of ballast water may be providing a transport mechanism for the spread of *A. crassus* (72 FR 4967, pp. 4987–4988). However, new information since 2007 documents that the movement of infected animals (eels or paratenic hosts), aquaculture, and trap/transport activities are the primary mechanisms for the spread of *A. crassus* and that the parasite appears to have lower prevalence at the salinity levels typical of estuarine and marine habitats (Report, pp. 59–65). In addition, as explained in Factor C, *A. crassus* is not a threat to the American eel. The best available information indicates that the disposition of ballast water is not a primary mechanism for *A. crassus* dispersal. Therefore, we conclude that EPA's regulation of ballast water under the CWA as it relates to *A. crassus* dispersal is not inadequate.

Conservation Efforts to Increase Adequacy of Existing Regulations

We are unaware of any ongoing conservation efforts to increase the adequacy of existing regulatory mechanisms.

Summary of Factor D

As stated above, we conclude that Factors A, B, C, and E are not threats to the species. Therefore, based on the best available information, we conclude that existing regulatory mechanisms for any stressors affecting the American eel are adequate.

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

The 2007 12-month finding (72 FR 4947) concluded that Factor E was not a threat to the American eel.   New information regarding mortality from hydroelectric turbines (Report 2015, pp. 74–79), climate change (Report 2015, pp. 53–58), and contaminants (Report 2015, pp. 85-89) is described in the Report and summarized below.

Mortality from Turbine Passage

The 2007 American eel status review (72 FR 4967) noted that hydroelectric dams in the Atlantic and Gulf states constitute 4.5 percent (1,511 dams) of the estimated 33,663 dams found in these states. These hydroelectric dams are obstacles that may delay the downstream migration of silver eels that mature in riverine habitats, and hydroelectric turbines can cause mortality or injury (eels that mature and migrate from estuary or marine habitats downstream are not affected by hydroelectric dams). Silver eel maturation and migration also may be reversed if they encounter significant obstacles or undue delay in attempting to pass downstream. For those maturing eels that do pass through hydroelectric facilities, the rate of turbine mortality is lowest with large turbines—two large generating stations on the St. Lawrence River documented mortality rates of about 26 percent. On the other hand, smaller turbines, or turbines that rotate rapidly, may have mortality rates that approach 100 percent. Also, turbine mortality and injury disproportionately affects large fecund female eels; this is because the degree of mortality and injury increases with increasing eel size, and because large fecund female eels often migrate from headwater habitats located upstream of, and therefore must migrate downstream through, multiple hydroelectric dams. McCleave (2001b, p. 603) concluded that small increases in population density, or increases in female silver eel length, had greater positive effects on survival and realized fecundity than comparable increases in turbine survival rate. The effects of turbine injury, including delayed mortality and possible impaired reproduction and increased predation risk, are poorly understood in the American eel. The best scientific and commercial information available indicates that mortality from hydroelectric turbines can cause significant mortality to downstream-migrating silver eels. The installation of effective downstream passage measures (i.e., bypasses or night spillage) through the FERC relicensing process has reduced and continues to reduce, this mortality. The Service can require downstream eel passage measures when hydroelectric projects are relicensed (at 30 to 50 year intervals), or at any time if fish passage prescriptive authority was reserved under Section 18 of the Federal Power Act (16 USC § 791-828). Therefore, we conclude based on our review of the best available scientific and commercial information that turbine mortality is not having a population level effect on the species and thus is not a threat to the American eel, nor is it likely to be a threat in the future.

Effects of Climate Change

Changes in the abundance of American glass eels reaching continental waters are correlated with ocean temperatures and changes in the North Atlantic Oscillation (NAO) (Report 2015, pp. 53–58). Glass eel abundance in coastal waters is inversely correlated with Sargasso Sea water surface temperatures at the time of spawning. Juvenile eel abundance is inversely correlated with the NAO at the time of spawning and larval migration. Figure 24 in the Report (2015, p. 56) indicates this inverse correlation is cyclical and may be level now as it was in the mid-1940s. These correlations are also found for European eels, indicating that ocean environmental conditions affect the marine spawning and larval habitats of both species in a similar manner. Sampling of American and European eel larvae in the Sargasso Sea indicate that spawning locations vary from year to year, but American eel spawn further west than European eel with some overlap of the two species. The Intergovernmental Panel on Climate Change (IPCC) (2014, p. 8) notes that ocean warming accounts for more than 90 percent of accumulated climate change energy and that the resulting ocean warming is most pronounced in the upper 75 m (246 ft), habitats that are used by spawning and larval eels. American eel spawning success, larval survival, or both may be reduced by climate-induced warming of the North Atlantic Ocean if some combination of the following occur: (1) Water temperatures in Sargasso Sea spawning habitats increase, creating less habitat conditions suitable for larval survival; (2) Nutrient upwelling and primary productivity decrease due to increased thermal stratification, decreasing food availability for larval eels; or (3) Ocean currents change, affecting larval transport to suitable continental waters. However, while changes in the abundance of American glass eels reaching continental waters are correlated with ocean temperatures and changes in the NAO, the best available scientific and commercial information has not positively identified the specific processes by which these changing conditions would affect American eel abundance. North Atlantic Ocean temperatures may continue to rise as a result of climate change, but a great deal of uncertainty remains regarding changes in physical oceanographic processes and how, or to what extent, they will affect eel migration, aggregation for reproduction, and ultimately abundance. Based on our review of the best available scientific and commercial information, we conclude that the currently known effect of climate change is not a threat to the American eel nor likely to become a threat in the future.

Contaminants

Contaminants may affect early life stages of the American eel, but without specific information, we remain cautious in extrapolation of laboratory studies to rangewide population-level effects (e.g., reduced recruitment of glass eels which would be an indicator of decreased outmigration, egg, or leptocephali survival). A correlation between the contamination of the upper Saint Lawrence River/Lake Ontario watershed (SLR/LO) and the timing of the 1980s decline of American eel in the upper SLR/LO is not evident (Castonguay *et al*. 1994, pp. 482–483). Given the absence of evidence for population-level effects, we conclude that the best available information does not indicate that contaminants are a threat to the American eel at a population level.

Conservation Efforts to Reduce Other Natural or Manmade Factors Affecting Its Continued Existence

Some eels survive turbine passage and may complete their migration, even after multiple turbine passage events. Turbine passage survival rates are extremely variable, varying from 94.5 percent to as low as 0.0 percent. Downstream passage survival through multiple dams must be high (e.g., exceeding 67%) in order to achieve any net population benefit from providing access to upstream habitats (Sweka *et al*. 2014, p. 1548). Despite the losses from numerous hydroelectric dams throughout the range of the American eel, there is no evidence of a population-level effect from turbine mortality; rather, turbine passage mortality is responsible for decreases in abundance on a local or regional scale and can be compensated with dam removal, effective bypass facilities, or properly timed nighttime shutdowns. For example, 295 dams were removed in the United States between 2008 and 2012, many of which were within the range of American eel.

Broad-scale efforts to reduce greenhouse gas emissions may reduce potential threats to marine habitat by slowing the rate of sea surface temperature changes. But the extent to which such efforts will be implemented is uncertain.

Summary of Factor E

We conclude that mature silver eels passing downstream through operating hydroelectric plants can incur significant mortality. However, the FERC relicensing process, has reduced, and continues to reduce, turbine mortality through the installation of effective downstream passage measures (i.e., bypasses or night spillage). As stated above, based on our review of the best available information, we conclude that turbine mortality is not a threat to the species as a whole.

Changes in the abundance of American glass eels reaching continental waters are correlated with ocean temperatures and changes in the NAO. However, the best available scientific and commercial information available has not positively identified the specific processes that affect American eel abundance. Additionally, although North Atlantic Ocean temperatures may continue to rise as a result of climate change, there remains a great deal of uncertainty regarding changes in physical oceanographic processes and how, or to what extent, they will affect eel reproduction and migration. As stated above, we conclude, based on the best available information, that the currently known effect of climate change is not a threat to the American eel.

While contaminants may affect early life stages of the American eel, no correlation has been found between the contamination of the upper SLR/LO and the timing of the 1980s decline of American eel in the upper SLR/LO. Given the absence of evidence for population-level effects, we conclude that the best available information does not indicate that contaminants are a threat to the American eel at a population level, nor are they likely to become a threat in the future.

In summary, the best scientific and commercial information available indicates that there are no other natural or manmade factors that are a threat to the American eel's continued existence now or in the future.

Cumulative Effects from Factors A through E

As discussed above, there are no individual stressors that rise to the level of a threat to the American eel. Some stressors can have cumulative effects and result in increased mortality. For example, the Report discusses known cumulative and synergistic interactions of various contaminants (2015, p. 88) and known cumulative effects of increased predation and mortality at or below dams which block eel migration (2015, p. 90). While some individual American eels may be exposed to increased levels of mortality as a result of these contaminant or predation cumulative effects, we have no indication that the species is, or will be, significantly affected at a population level. Therefore, we conclude that there are no cumulative stressors that are a threat to the American eel now, or will become a threat in the future.

Finding

As required by the Act, we considered the five factors in assessing whether the American eel is endangered or threatened throughout all of its range. We examined the best scientific and commercial information available regarding the past, present, and future threats faced by the American eel. We reviewed the petition, information available in our files, other available published and unpublished information, and we consulted with recognized American eel experts, habitat experts, private sector experts, and other Federal, state, and tribal agencies.

Several lines of evidence indicate that the American eel population is not subject to threats that would imperil its continued existence. Despite historical habitat losses and a population reduction over the past century, American eels remain widely distributed throughout a large part of their historical range. Glass eels are recruited to North American rivers in large numbers. Elvers are also present in large numbers well inland on some east coast river systems—for example more than 820,000 eels passed through a new fishway at the Roanoke Rapids Dam, located 137 miles inland on the Roanoke River in 2013, the fourth year of operation (Report p. 70). American eels are plastic in their behavior and adaptability, inhabiting a wide range of freshwater, estuarine, and marine habitats over an exceptionally broad geographic range. Because of the species' panmixia, areas that have experienced depletion or extirpation may experience a "rescue effect" allowing for continued or renewed occupation of available areas. Trends in abundance over recent decades vary among locations and life stages, showing decreases in some areas, and increases or no trends in other areas. Limited records of glass eel recruitment do not show trends that would signal recent declines in annual reproductive success or the effect of new or increased stressors. Taken as a whole, a clear trend cannot be detected in specieswide abundance during recent decades, and while acknowledging that there have been large declines in abundance from historical times, the species currently appears to be stable. While some eel habitat has been permanently lost and access to freshwater habitats is impaired by dams that lack upstream fish passage, access to freshwater habitat has improved, and continues to improve, in other areas through new or improved eel ladders and removal of barriers. Despite the loss of some freshwater habitat, the American eel population appears to be stable based on young-of-the-year indices and estimates of spawner abundance. In addition, since 2007, newer information indicates that some American eel complete their life cycle in estuarine and marine waters.

Based on our review of the best available scientific and commercial information pertaining to the five factors, we find that the threats are not of sufficient imminence, intensity, or magnitude to indicate that the American eel is in danger of extinction (endangered), or likely to become endangered within the foreseeable future (threatened), throughout all of its range.

Significant Portion of the Range

Under the Act and our implementing regulations, a species may warrant listing if it is in danger of extinction or likely to become so throughout all or a significant portion of its range. The Act defines “endangered species” as any species which is “in danger of extinction throughout all or a significant portion of its range,” and “threatened species” as any species which is “likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” The term “species” includes “any subspecies of fish or wildlife or plants, and any distinct population segment [DPS] of any species of vertebrate fish or wildlife which interbreeds when mature.” We published a final policy interpreting the phrase “Significant Portion of its Range” (SPR) (79 FR 37578). The final policy states that (1) if a species is found to be endangered or threatened throughout a significant portion of its range, the entire species is listed as an endangered or a threatened species, respectively, and the Act’s protections apply to all individuals of the species wherever found; (2) a portion of the range of a species is “significant” if the species is not currently endangered or threatened throughout all of its range, but the portion’s contribution to the viability of the species is so important that, without the members in that portion, the species would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range; (3) the range of a species is considered to be the general geographical area within which that species can be found at the time the Service or NMFS makes any particular status determination; and (4) if a vertebrate species is endangered or threatened throughout an SPR, and the population in that significant portion is a valid DPS, we will list the DPS rather than the entire taxonomic species or subspecies. As stated above, we find the American eel does not warrant listing throughout its range. Therefore, we must consider whether there are any significant portions of the range of American eel.

The SPR policy is applied to all status determinations, including analyses for the purposes of making listing, delisting, and reclassification determinations. The procedure for analyzing whether any portion is an SPR is similar, regardless of the type of status determination we are making. The first step in our analysis of the status of a species is to determine its status throughout all of its range. If we determine that the species is in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range, we list the species as an endangered (or threatened) species and no SPR analysis will be required. If the species is neither in danger of extinction nor likely to become so throughout all of its range, we determine whether the species is in danger of extinction or likely to become so throughout a significant portion of its range. If it is, we list the species as an endangered or a threatened species, respectively; if it is not, we conclude that listing the species is not warranted.

When we conduct an SPR analysis, we first identify any portions of the species' range that warrant further consideration. The range of a species can theoretically be divided into portions in an infinite number of ways. However, there is no purpose to analyzing portions of the range that are not reasonably likely to be significant and endangered or threatened. To identify only those portions that warrant further consideration, we determine whether there is substantial information indicating that (1) the portions may be significant and (2) the species may be in danger of extinction in those portions or likely to become so within the foreseeable future. We emphasize that answering these questions in the affirmative is not a determination that the species is endangered or threatened throughout a significant portion of its range—rather, it is a step in determining whether a more detailed analysis of the issue is required. In practice, a key part of this analysis is whether the threats are geographically concentrated in some way. If the threats to the species are affecting it uniformly throughout its range, no portion is likely to warrant further consideration. Moreover, if any concentration of threats apply only to portions of the range that clearly do not meet the biologically based definition of "significant" (i.e., the loss of that portion clearly would not be expected to increase the vulnerability to extinction of the entire species), those portions will not warrant further consideration.

If we identify any portions that may be both (1) significant and (2) endangered or threatened, we engage in a more detailed analysis to determine whether these standards are indeed met. The identification of an SPR does not create a presumption, prejudgment, or other determination as to whether the species in that identified SPR is endangered or threatened. We must go through a separate analysis to determine whether the species is endangered or threatened in the SPR. To determine whether a species is endangered or threatened throughout an SPR, we will use the same standards and methodology that we use to determine if a species is an endangered or a threatened species throughout its range.

Depending on the biology of the species, its range, and the threats it faces, it may be more efficient to address the "significant" question first, or the status question first. Thus, if we determine that a portion of the range is not "significant," we do not need to determine whether the species is endangered or threatened there; if we determine that the species is not endangered or threatened in a portion of its range, we do not need to determine if that portion is "significant."

As stated above, there are no threats currently affecting the American eel throughout the species' range. There are several stressors that cause individual mortality, including recreational and commercial harvest (Factor B), predation (Factor C), and hydroelectric turbines (Factor E), but none that affect a portion of the species' range more than another. In addition, there are no portions of the species' range that are considered significant given the species' panmictic life history. Therefore, we find that no portion of the American eel's range warrants further consideration of possible endangered or threatened status under the Act.

References Cited

A complete list of references reviewed and cited for the American eel 12-month petition finding form is available at *http://www.fws.gov/northeast/newsroom/eels.html*.

Approval/Concurrence:

Approve: ______________________________ 20 August 2015

Acting Northeast Regional Director, Fish and Wildlife Service — Date

Concur: ______________________________ ______________

Director, Fish and Wildlife Service — Date

Do not concur: ______________________________ ______________

Director, Fish and Wildlife Service — Date

Director's Remarks:

American eel *(Anguilla rostrata)* 12-month Petition Finding Form